University of Hertfordshire

In association with the International Year of Astronomy 2009

Book of Abstracts

European Week of Astronomy and Space Science

20-23 April 2009

University of Hertfordshire, UK

Incorporating RAS NAM 2009
and EAS JENAM 2009

www.jenam2009.eu

The programme includes UK Solar Physics and MIST meetings, ESA and ESO plenaries, multiple parallel science sessions and symposia on

- **The next era in radio astronomy: the pathway to SKA**
- **The standard cosmological models - successes and challenges**
- **Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets**
- **The life cycle of dust**
- **Multi-wavelength high redshift surveys**
- **Three decades of gravitational lenses**
- **The IYA 2009 in Europe**

NRAO / AUI / NSF. Image courtesy of NRAO/AUI Photo: Matthew L. Abbondanzio

Book of Abstracts – Table of Contents

Welcome to the European Week of Astronomy & Space Science

I am pleased to welcome you to our de Havilland Campus. The University of Hertfordshire is delighted to be hosting the European Week of Astronomy & Space Science Meeting, incorporating the Royal Astronomical Society's National Astronomy Meeting and the European Astronomical Society's Joint European and National Astronomy Meeting. It is fifteen years since this Europe-wide meeting was last held in the UK and it is an honour to host this meeting during the International Year of Astronomy. We are pleased that the event has attracted over 1000 delegates.

Astronomers are very fortunate to be carrying out research that not only motivates them but captures the imagination of the public. Importantly, astronomy draws many young people into science. The four Public Lectures and a Schools Day with over 500 children attending, clearly demonstrates the widespread interest in astronomy and the commitment of astronomers to reach out to the community.

I know that there will be many new and exciting discoveries presented, and I wish you all a very successful meeting.

Professor Tim Wilson
Vice-Chancellor of the University of Hertfordshire

On behalf of the Royal Astronomical Society I welcome colleagues from astronomy, space science and planetary science throughout Europe to this special meeting incorporating the NAM and JENAM. The NAM has become a major event in the calendar of UK astronomy; this year it will reflect our important links through ESA and ESO with colleagues on the continent. A measure of its enhanced status is that our meeting, for the first time, will be opened by a government minister. If the present recession has taught us anything, it is that we need to base our economies on scientific knowledge.

Our subjects, in asking fundamental questions about the universe, not only have helped revolutionise the technologies on which modern societies depend, they excite the public imagination and encourage young people to equip themselves for careers in 'knowledge based' economies. I am sure we will have a memorable meeting!

Professor Andy Fabian
President, Royal Astronomical Society

It is a pleasure and honour for me to welcome you in the name of the European Astronomical Society to JENAM2009: "The European Week of Astronomy and Space Science". EAS is delighted to hold this meeting together with the Royal Astronomical Society, the oldest such society in the world.

As the title "The European Week of Astronomy and Space Science" already tells you, the meeting will present a broad overview of European activities on all levels and across wavelength bands from the highest energy regimes via optical and infrared to radio astronomy; from subjects such as our planetary system via stars and galaxies to the ultimate questions posed by cosmology.

I am particularly excited about the great response, with more than 1000 colleagues already registered. We have an exciting conference ahead of us and I very much hope that this meeting will serve to offer the opportunity to meet, discuss scientific problems, to make new contacts and refresh old ones. I should like to thank all British colleagues for the preparation of this meeting and thank the institutions and sponsors that supported this event. I wish you a scientifically successful meeting, and many stimulating conversations with your colleagues.

Professor Joachim Krautter
President, European Astronomical Society

How space, and a few stars, came to Hatfield

In November each year, graduands of the University of the Hertfordshire gather in the Cathedral and Abbey Church of St Alban to take their degrees. For physics and astronomy students, this is a particularly apt setting: seven hundred years ago the abbot of the Great Abbey was one of England's most remarkable medieval scientists – Richard of Wallingford. Richard was a Benedictine monk with a fascination for mechanical devices that could be used to calculate and represent celestial motions. Educated at Oxford, he had written the *Quadripartitum*, a major treatise on spherical geometry, and invented the *Albion*, a medieval astronomical supercomputer. The ingenious and intricate geometrical construction of the Albion facilitated the determination of parallax, planetary motions, conjunctions and eclipses, alongside the normal functions of an astrolabe and quadrant. Richard also designed one of Europe's earliest (and certainly most elaborate) mechanical clocks with its own suite of astronomical functions including gearings for solar and lunar motions and the variation in the tides. The clock was to be fabricated in iron and installed in the Abbey on the wall of the southern transept. Construction began whilst Richard was Abbot and Edward II is reported to have been shocked that making it was given precedence over the restoration of the fabric of the Abbey: Richard rejoined that whilst those that succeeded him would doubtless be capable of organising repairs, he alone knew how to design and make the clock – his father had been a blacksmith. It is unsurprising then that when Richard died of leprosy, work on the clock was suspended although reports suggest it was eventually finished in 1390, over fifty years after Richard's death. The original clock sadly no longer exists although a reconstruction can be found in Illinois.

Our story continues with another clock. It belonged to the Walker family who lived in Highgate in Victorian England. Unbeknown to the family, their son Charles, usually referred to simply as 'C.C.', had liberated the mechanism from the clock and adapted it to drive his small telescope – the removal was only revealed when the clock was sent to a jumble sale and the empty shell returned by its irate purchaser! He took some rather impressive full-frame images of the Moon, which were generously donated to the Centre for Astrophysics Research a few years ago. It says something for the speed of film emulsions in the late nineteenth century that a drive was required and the exposures were typically about a thousand times what might be required today. As a young man, C.C. became interested in aviation and wrote to Geoffrey de Havilland (right) asking if he might work for him, without salary at first, at least until he had proved his usefulness. De Havilland had built his own plane from scratch sponsored by his grandfather and designed a modified motorcycle engine to power it. These were the pioneering days of powered flight and, on its first successful flight, a colleague was required to lie on the ground as the plane attempted to gather lift to confirm it had indeed become airborne. Although he didn't start his own business immediately, this was the seed of the de Havilland Aircraft Company. C.C. must have impressed Geoffrey de Havilland because he was a founding director of the de Havilland Aircraft Company which moved its base to Hatfield in the early nineteen thirties. The fact that the company could expand in a time of depression was a testament to the enduring popularity of one of its best known designs – the DH Moth.

Around Hatfield, road and building names recall the golden age of aviation and allow us to forget for a moment the indignity of a vestigial hanger that currently houses a fitness centre. Outside the Comet Hotel, a short walk from the de Havilland campus, is a model of the DH aircraft, the twin-piston engine Comet Racer named 'Grosvenor House', which won the MacRobertson Trophy in 1934 – a speed race from London to Melbourne. It has the beautiful lines that characterize so many de Havilland aircraft. Indeed, these reflect the recurrent design philosophy of C.C. Walker that there was a potential economy in speed, and hence a value in what he rather nicely called 'aerodynamic purity'. Next time you have a seemingly impossible deadline to meet, you might like to reflect that ten months before the race took place, not even a plan existed of this remarkable aeroplane. In the event, it had a range of nearly five thousand kilometres at an average speed of 350 km/hr; it took 71 hours to make the trip, about three times the transit time of a jumbo jet. The wooden construction of the DH88 Racer was mirrored in the wartime development of the Mosquito, an equally remarkable aircraft that also lends its name to the collection of de Havilland memorabilia displayed in a nearby museum in London Colney, just outside St Albans.

Before moving into the jet age, a quick diversion is in order to gather evidence for Hatfield's strategic importance at the time. Eddie Chapman, a small-time crook who would be played by a louche Christopher Plummer in a film of his life, offered to blow up Hatfield airfield to prove his credibility as a spy. The fact the film is called *Triple Cross* will tell you that the airfield was never in serious danger. However Jasper Maskelyne, a London magician (who also invented the coin-operated toilet door) was called in to fake the aftermath of an explosion that might at least deceive aerial photography and enable Chapman to continue his double (or triple) bluff. The name might sound familiar – Jasper was a descendant of Neville Maskelyne, the fifth Astronomer Royal. In 1774, Neville Maskelyne undertook a determination of the mass and hence density of the Earth based on observing the deflection of a plumb bob by a large mountain, Schiehallion, in Scotland - he was apparently within 20% of the right answer.

Actually, the airfield would be blown up half a century later, with somewhat more advanced film trickery. Steven Spielberg and Tom Hanks came to Hatfield to shoot sequences of first *Saving Private Ryan* and later *Band of Brothers*. Production designers apparently cleaned out clothing stock from the town's charity shops and aeroplanes and smoke filled the sky during an unusually noisy summer vacation. University students worked on some of the models for these productions, as they have on many others in the thriving local film industry. The replica of Galileo's telescope that you will see on stage during the conference was made by an undergraduate, Tina Jane Moore, as part of her final year project on the Model Design programme.

Anyway, we move on from Agent Zig-Zag, as Chapman was known, to Spider Crab. Thankfully not a genetically modified superhero from a comic book too far, Spider Crab was the code name for another aircraft, the Vampire – although it's not altogether clear why something called a Vampire needed a code name. Powered by de Havilland's Goblin engine, it was the first jet to operate from an aircraft carrier. In the late nineteen forties, the great challenge to aeronautical design was breaking the sound barrier and the de Havilland DH108 became the first British jet aircraft to achieve Mach 1, albeit in a partially controlled dive. Just to show this speed lust has not deserted Hatfield, some University aerospace students have recently designed and built an impressive rocket sled for impact testing that also comfortably breaks the sound barrier on an eighty metre horizontal wire.

The quest for speed brings us to the Comet airliner built in Hatfield in 1949. The tragic early history of this aircraft should not overshadow the wonderful accomplishment of de Havilland in developing and building the world's first jet airliner - and thus making international observational astronomy possible! The metal fatigue problems that beset the first model not only allowed American competitors to catch up, but meant pioneering studies, from which all airlines ultimately benefited, were costly in every sense to the company.

Space entered the picture in the fifties with the development of missiles designed as part of the national nuclear deterrent. The test facilities became a distinctive local landmark as no effort was made to disguise the site which was clearly visible (and audible) from Manor Road. Fortunately, the Blue Streak missile discovered a happier role as the lowest stage in the European Space Launcher Programme, Europa, where it proved extremely reliable and, with its twin RZ.2 Rolls Royce engines, immensely powerful.

The University is a natural descendant of the de Havilland Aeronautical Technical College where the trademark first assignment for new trainees was to make their own tool box. Some of the early courses in the Technical College (and later Polytechnic) were designed for satellite groups working for the firm. In

1960, de Havilland was bought by Hawker Siddeley in a major restructuring of the British aircraft industry, and this in turn became part of nationalised British Aerospace in 1977. Although this closed in 1992, there is still local expertise e.g. in mathematics, where one of Hatfield's specialisms in the nineteen sixties was the optimisation of spacecraft trajectories. There are also close links, including a European postdoctoral training network, with EADS Astrium, based in nearby Stevenage and one of the generous sponsors of this meeting. A prototype Mars rover designed there will be stationed close to the conference on the closest surface we could find to a Martian dune which, rather fittingly, comes from Sandy!

Astronomy as a subject in its own right at the University was established by J.C.D. (Lou) Marsh. He was working as a lecturer in electrical engineering and decided to put up a trial course of lectures on general astronomy. When this met with an enthusiastic response, he suggested in 1967 that it be offered as a regular subject and an observatory be built to support the course. With backing from the Polytechnic Director Sir Norman Lindop and others in the senior management of the University, it was possible to offer the first courses in 1969.

The University Observatory is located at Bayfordbury, in a country estate about half an hour's drive from the main campus offering some respite from insidious town lighting. The Observatory was opened by Alan Hunter, then Deputy Head of the Royal Greenwich Observatory – the Isaac Newton Telescope (INT) was only a few years old then and working from the Sussex countryside. Bayfordbury is one of the UK's finest teaching observatories hosting eight domed telescopes with apertures up to 0.5 m. There are dedicated domes for spectroscopy and video astronomy and a 4.5 m radio dish. This will be supplemented shortly with two further receivers to add interferometry to the site's capabilities. An historically important observation of an occultation by Titan, in early efforts to study the thickness of its atmosphere, was made by Bob Forrest, who has managed the technical running of the Observatory for a quarter of a century. Chris Kitchin succeeded Lou Marsh as Director of the Observatory; you may know him best as the author of *Astrophysical Techniques (*now in its 4th edition). Chris and Iain Nicholson, another celebrated astronomical writer, developed astronomy as a major degree programme within the University. One of the highlights of recent times was the observation of a gamma ray burst optical afterglow – the first by a UK university observatory. A long-time friend of the Observatory, Sir Patrick Moore was surrounded by old and new friends when he opened the award-winning control building named in his honour in 2000.

Hatfield's early research reputation rests on the detection and modelling of polarised radiation in active galactic nuclei, star forming regions and planetary nebulae. Polarimeters were designed and constructed in-house, a programme initiated and driven by a then University physics lecturer, Jim Hough, who is now Director of Astronomy Research (in the now much expanded research centre) nearly forty years later. The first polarimeter was built here in the early nineteen seventies. It was a stand-alone instrument operating in the near-infrared that employed first a PbS and then an InSb detector. This was followed by a series of Hatfield polarimeters working in the optical and infrared, used on the UK Infrared Telescope (UKIRT) in Hawaii and the Anglo-Australian Telescope (AAT) in New South Wales. In the early nineties, the emphasis switched to the construction of polarimeters as additional facilities for observatory imagers and spectrometers including dual-beam polarimetry systems at the AAT and UKIRT and the polarimetry optics for the Japanese instruments, TRISPEC and SIRIUS. Latest in the line is PlanetPol, with polarization sensitivities of better than one part in a million. It was designed to find extrasolar planets by detecting the polarized signal of reflected light from a distant planetary atmosphere. One of the most provocative discoveries of the group was the serendipitous discovery of high degrees of circular polarization in the Orion star forming complex and the speculation that this could be linked to the molecular homochirality essential for life.

Nowadays the research interests of the Centre for Astrophysics Research also embrace high and low frequency radio, x-ray and gamma ray astronomy. The Centre currently has about sixty researchers working in wide-ranging galactic and extragalactic programmes. Astronomer and musician Brian May has endowed a studentship awarded each year to a student of outstanding promise studying toward a Research Masters degree within the Centre.

Any gazetteer for visitors to Hatfield would be incomplete without a mention of Hatfield House, the ancestral home of the Cecil family. If you arrived by train, you can't fail to have noticed the large bronze of Robert Arthur Talbot Gascoyne-Cecil, the 3rd Marquess of Salisbury and three times Prime Minister, atop the plinth outside the Main Gates. But rather than enter by these gates, we'll take a detour climbing the hill through Old Hatfield and so enter the House close to its Elizabethan dining hall. This small diversion means we can pop into *The Eight Bells*, an inn - amongst many others admittedly - where Dickens stayed; he used it as a setting for Bill Sykes' refuge in *Oliver Twist*. Hatfield's inns were also scoured by Colonel Forster in Jane Austen's *Pride and Prejudice*: he was searching for Lydia Bennett after her elopement with Wickham, but the reckless couple weren't to be found here.

Elizabeth I learnt of her accession to the throne in the grounds of Hatfield House in 1558 when she was twenty five. There is a striking Rainbow Portrait of the Queen in the House painted by Isaac Oliver around 1600. The first details that strike most people are eerie eyes and ears that cover the Queen's cloak. But there are subtle reminders of Richard of Wallingford's *Albion* here too. In a painting laced with symbolism, there is a tiny celestial sphere on her right arm and a crescent jewel to represent the lunar goddess Cynthia in her headdress. Elizabeth herself is the Sun described in the painting's motto – *non sine sole iris* (no rainbow without the Sun). She holds the rainbow in her right hand like a steering wheel as a symbol of peace in her realm. This is a nice cue to mention that one of the major research interests of the University is in light scattering. Analogue ice crystals have been constructed to produce light haloes in the laboratory and there is a new dedicated facility for the study of scattering by biological particles. This work and that of the quantum optics group rest daily on the observation that Thomas Young made on the interference of light waves – one of the most influential experiments in the history of physics. And so to one final tie with the past: in 1790, as a young man of seventeen, the polymath Young read and was inspired by Newton's *Opticks* in Youngsbury, a country house near Ware, just a few miles to the east of the University Observatory.

JLC - April 2009

Bibliography

A distillation of a vast amount of his personal research on Richard of Wallingford's life and science is contained in John North's *God's Clockmaker – Richard Wallingford and the Invention of Time* (Hambledon Continuum 2005). Contemporary reaction to Richard's clock can be found in G.H. Baillie's *Watches – Their History, Decoration and Mechanism* (reprinted by N.A.G. in 1979). Details of C.C. Walker's life were kindly passed on to me by Betty Ewens B.E.M. who worked for de Havilland and also organised the donation of Walker's surviving photographs from the estate of Mrs Riks. There is a nice centenary appreciation of 'C.C.' written by D.R. Newman and published in The Aeronautical Journal of the Royal Aeronautical Society in October 1978. The early trials and excitement of experimental powered flight are captured in Sir Geoffrey de Havilland's autobiography *Sky Fever* (reprinted by the Crowood Press Limited in 1999). A comprehensive history of DH aircraft is *A History of de Havilland* by C. Sharp and D.H. Martin (Airlife 1982). P.J. Birtles has also published much about de Havilland and the Mosquito in particular, but *Planemakers – de Havilland* (Jane's 1984) is a good general reference. Eddie Chapman's story has been told in more than one film but the biography by Ben Macintyre (*Agent ZigZag,* Bloomsbury Publishing 2007) gives far more background to Chapman's extraordinary life. A comprehensive and accessible review of what can be achieved with polarimetry is Jim Hough's "New opportunities for astronomical polarimetry" (*Journal of Quantitative Spectroscopy & Radiative Transfer* <u>106</u> (2007) 122). Further details of the Rainbow Portrait and indeed other art treasures in Hatfield House are contained in Auerbach and Adams' *Painting and Sculpture at Hatfield House* (Constable & Co. Limited 1971). I learnt about the Youngsbury connection from a recent biography of Thomas Young by Andrew Robinson, *'The Last Man Who Knew Everything'* (Oneworld 2007).

Plenary I: UK Solar Physics (UKSP) and Magnetosphere, Ionosphere and Solar Terrestrial (MIST)

Monday
9:50am

STEREO: From Sun to the Earth

R. Harrison (STFC Rutherford Appleton Laboratory)

The twin STEREO spacecraft are now located over 45 degrees either side of the Sun-Earth line. From these vantage points we are identifying and tracking Earth-directed solar ejecta using novel wide-angle telescope systems developed in the UK. Such heliospheric imaging is opening new fields of research into the nature of solar ejecta, their propagation through interplanetary space and their impacts on solar system bodies. However, the techniques are also providing new insights into such areas as cometary physics and the structure of the heliosphere. This talk aims to review the first two years of the mission.

Monday
10:10am

Electron Acceleration and Loss in the Radiation Belts

R. Horne (British Antarctic Survey)

The Earth's Van Allen radiation belts were discovered in 1958 by the first US satellite, Explorer I. Ever since their discovery it was thought that the outer electron belt was formed by electron entry into the Earth's magnetic field followed by diffusive transport towards the planet. However, data published in 2007 shows conclusively that diffusive transport is incompatible with observations. The data show that there must be another electron acceleration process operating inside the Earth's magnetic field. Here we review the observations that have overturned a theory lasting more than 40 years. We describe the theory of cyclotron resonant electron acceleration by whistler mode waves and explain why this has now become the leading theory for the formation of the outer radiation belt. We review some of the outstanding questions on acceleration and loss that still need to be answered, and discuss the application of the theory to Jupiter and Saturn. We pose the question as to whether cyclotron resonant electron acceleration could be part of a more general universal process in planetary radiation belts.

Monday
4:00pm

Kinematically Decoupled Galaxies

F. Combes (Observatoire de Paris)

Galaxy formation often involves violent scenarios, including either interacting and merging sub-systems, or the cannibalism of dwarfs. In addition, galaxies assemble their mass through slow accretion of gas from cosmic filaments. In both cases, the consequences can be counter-rotating components, in the plane of galaxies, or warps and polar rings in perpendicular directions. I will describe some recent work on kinematically decoupled systems, the clues that these peculiarities give us on galaxy formation, and the implication on star formation or fueling of active nuclei.

Plenary II: European Organisation for Astronomical Research in the Southern Hemisphere (ESO)

Tuesday
9:00am

ESO Present and Future

T. de Zeeuw (ESO)

The European Southern Observatory is an intergovernmental organization for astronomy, created in 1962 by Belgium, France, Germany, Sweden and The Netherlands, and today has 14 member states. Headquarters are located in Garching near Munich. ESO's mission is to enable scientific discoveries by constructing and operating powerful observational facilities that are beyond the capabilities of individual member states, and to organize collaborations in astronomy. ESO operates medium-sized optical telescopes on Cerro La Silla, the Very Large Telescope and Interferometer on Cerro Paranal, widely considered to be the most advanced optical/infrared observatory in the world, and the sub-millimeter observatory APEX on Llano Chajnantor, all located in Northern Chile. ESO represents Europe in a partnership with North America and East Asia that is constructing the Atacama Large Millimeter/sub-millimeter Array, to be completed in 2013. ESO is also designing the world's biggest eye on the sky, an Extremely Large Telescope with a 42m primary mirror and adaptive optics built-in, to be constructed in the next decade. The talk will summarize the current program, include some scientific highlights, and will outline the plan for the coming decade.

Tuesday
9:30am

Statistical Properties of the Rich Population of Super-Earths - Results of the Harps Survey

M. Mayor (Geneva University)

In the last six years, at la Silla Observatory, we have carried out a systematic survey to search for planetary systems. The extreme sensitivity of the HARPS spectrograph has led to the detection of an impressive population of low-mass planets on close-in orbits . Already several statistical properties are emerging. First comparisons will be made between observed distributions and predictions from models of planetary formation.

Tuesday
10:00am

Dynamics and Evolution of Star Forming Galaxies at z=1-3

L. Tacconi (MPE, Garching)

I will discuss progress on our understanding of massive galaxy formation through two major programs that address the kinematic properties of z~1.5-3 galaxies with spatially resolved spectroscopy. With the adaptive optics assisted, integral field spectrometer SINFONI on the ESO VLT we have studied more than 70 star forming galaxies and find compelling evidence for large, geometrically thick (turbulent), rotating disks in many of the objects we can spatially resolve. With the IRAM Plateau de Bure millimetre interferometer we derive the dynamical properties of ~20 submillimeter bright galaxies, and find strong evidence for compact, major mergers. We are also now directly measuring molecular gas fractions in both types of star forming high redshift galaxies. I will discuss the impact of these new observations on our understanding of galaxy evolution in the early Universe, and place them in the context of the future E-ELT and ALMA facilities.

Wednesday
9:00am

Space Science for Europe: ESA's Science Programme

D. Southwood (European Space Agency)

The space missions of the science programme of the European Space Agency have allowed the scientific community in Europe to excel in a number of fields as diverse as high-energy astrophysics, magnetospheric physics, solar physics and planetary atmospheres and geophysics. The program has scored a number of "firsts", such as the landing on the farthest body in the solar system (the Huygens probe on Titan) and the upcoming launch of the largest space telescope ever (Herschel). I will illustrate the broad portfolio of ongoing missions and of missions currently in the implementation phase, and then present the Cosmic Vision 2015-2025 programme, describing the mission concepts currently being studied as candidates for implementation in the 2017-2020 time frame. I will conclude with a selection of highlights of results from the planetary science missions from the programme.

Wednesday
9:50am

Scientific Highlights from ESA's Ongoing Astrophysics Missions

A. Parmar (European Space Agency)

There have been many remarkable discoveries made with ESA's high-energy astronomy missions since the launch of COS-B in 1975 which provided the first detailed views of the gamma-ray Universe. Using ESA's first X-ray astronomy mission, EXOSAT (1983-1986), scientists discovered quasi-periodic oscillations from low-mass X-ray binaries and X-ray pulsars - a field still providing new insights into accretion processes in X-ray binaries and AGN. Today's missions, Integral and XMM-Newton, have been used to make a host of new discoveries covering almost all fields of astronomy - from nearby comets to distant AGN. Whilst interest in these missions shows no sign of abating, astronomers are already planning the next-generation successor, IXO - the International X-ray Observatory, in collaboration with JAXA and NASA.

Wednesday
10:10am

Highlights from Solar-Terrestrial Missions

D. Mueller (European Space Agency)

Since the launch of Ulysses in 1990, a fleet of ESA and joint ESA/NASA spacecraft has revolutionized our understanding of the Sun, the heliosphere and the magnetosphere of our home planet. This talk will highlight key discoveries of the Ulysses, SOHO and Cluster missions and illustrate recent insight into solar-terrestrial relations.

Plenary IV: Square Kilometre Array (SKA), High-Energy Astrophysics, Asteroseismology

Thursday
9:00am

The Square Kilometre Array

J. Lazio (Naval Research Laboratory)

The Square Kilometre Array is intended to be the centimeter- and meter-wavelength telescope for the 21st century. Originally proposed as the "hydrogen telescope," the SKA Science Case has evolved to be much broader, with the SKA contributing significantly to the multi-wavelength, multi-messenger landscape of modern astronomy.

The 21-cm hyperfine transition of neutral hydrogen continues to play a significant role in the Key Science Projects envisioned for the SKA. The 21-cm emission from galaxies will be used both as a means of tracking galaxy evolution over a significant era in the Universe's history as well as a tracer of mass for cosmological studies. The 21-cm emission and absorption from the intergalactic medium itself at the time of the Epoch of Reionization will be traced to follow the evolution of this crucial phase of the Universe's history.

In addition, the SKA will - Probe fundamental aspects of the gravitational and strong nuclear forces by using neutron stars to study gravitational waves, theories of gravity, and neutron star structure; - Track the evolution of magnetism in the Universe via Faraday rotation studies in clusters of galaxies and the intergalactic medium as a whole; and - Search for life and its constituents in the form of organic molecules and protoplanetary disks.

A number of telescopes currently in operation and under construction, will provide crucial pathfinding developments, technically, algorithmically, and scientifically.

Thursday
9:30am

Highlights in Ground-Based Gamma-Ray Astronomy

W. Hofmann (Max Planck Institute for Nuclear Physics)

Instruments such as the HESS, MAGIC and VERITAS Cherenkov telescopes but also the MILAGRO shower detector have in last years generated spectacular advances in ground-based very high energy (VHE) gamma-ray astronomy. The number of sources is approaching 100, representing a variety of source types, both Galactic and extragalactic. Source morphologies are resolved, light curves of AGN are probed on minute time scales, and an increasing body of multiwavelength observations helps in the interpretation of data. The talk will aim at presenting the key issues and selected highlights.

Thursday
10:00am

Asteroseismology in the Era of the CoRoT Space Mission

C. Aerts (Leuven, Belgium)

After a general introduction into the modern research field of asteroseismology, we review the highlights achieved from multi-site ground-based campaigns dedicated to some very bright stars and to white dwarfs. We show how asteroseismology has the potential to improve stellar evolution models to a level that cannot be achieved by any other method so far. Subsequently, we discuss several results from the operational French-led European space mission CoRoT (Convection, Rotation, planetary Transits) for various types of stars and illustrate the immense advantage of having long-term uninterrupted data from space with a factor 100 better precision compared to data from the ground. Finally, we will highlight the next step in this research, to be expected from, e.g., the space missions Kepler (NASA) and PLATO (ESA), which have been designed for exoplanet hunting. PLATO will allow us to do asteroseismology of thousands of bright exoplanet host stars.

Monday
11:00am

A European Vision for Radio Astronomy: Pathway to the SKA

T. van der Hulst (Kapteyn Astronomical Institute)

The European SKA Consortium is a collaboration between 12 organisations/institutions from 7 European countries. Its goal is to coordinate the SKA activities in Europe and Europe's participation in the global SKA project and to promote the SKA project in Europe. I will briefly describe the activities of the Consortium and its view on the role of Europe in the SKA project.

Monday
11:15am

The Square Kilometre Array

R. Schilizzi (SKA Program Development Office)

The SKA will have a collecting area of up to one million square metres spread over at least 3000 km, providing a sensitivity 40 times higher than the Expanded VLA. In addition, the SKA will deliver an instantaneous field of view (FOV) of many square degrees, substantially larger than that of existing instruments, and potentially several large (200 sq. deg), independent fields-of-view for multiple simultaneous users. These capabilities are enabled by a much greater use of information and communications technology than in current telescope designs, and the result will be an extremely powerful survey telescope with the capability to follow up individual objects with high angular and time resolution. The SKA science impact will be widely felt in astro-particle physics and cosmology, fundamental physics, galactic and extragalactic astronomy, solar system science and astrobiology. Details of the SKA science will be covered in many talks during this meeting.

The design will involve parabolic dishes with innovative feeds at mid and high band frequencies, while at lower frequencies phased arrays are cost-effective and offer new operational capabilities. Data transport rates are likely to be in the range of 100 Giga-bits/sec to multiple Tera-bits/sec, with multiple Petaflop capacity required for the central processor. Much of the required technology is currently being developed in the course of specific design studies and the construction of several SKA Pathfinder instruments around the world.

In my presentation, I will describe the SKA, paying attention to the design activities around the world in more detail, siting issues, and the timeline.

Monday
11:30am

Widefield Techniques for the SKA using Aperture Arrays

A. van Ardenne (ASTRON), G.W. Kant, J.G. bij de Vaate , A.J. Faulkner, P. Alexander, P.N. Wilkinson

Mid 1990s early R&D and science activities were mounted to build the case for a telescope being an order of magnitude more sensitive, having wide field of view capabilities and over two decades of observing frequency coverage to mention a few [1,2,3]. The global radio-astronomy community is now engaged in system design and planning activities toward this Square Kilometre Array (SKA) [4]. Current SKA specifications require operation from 70 MHz to 25 GHz with two orders of magnitude higher sensitivity than existing telescopes. For the design to be optimal, this large frequency coverage, different antenna concepts are required. In the lower frequency range up to say, a few GHz, the case is strongest for phased array concepts using multi-beam techniques allowing wide field-of-view surveying and imaging observations. Sparse narrow band phased arrays are well known to radio astronomy, but these multi-octave sparse and dense arrays require new technology approaches, signal processing and calibration techniques. They can be successfully implemented as phased array feeds for dish reflectors, upgrading the efficiency of existing telescopes with large effective field-of-view, as well as for new telescopes. Another telescope architecture uses phased arrays without any additional reflectors. The phased array elements are small enough to see most of the sky intrinsically offering a large field of view. The development of low cost array antenna design and successful demonstrations, pave the way to cost effective large scale implementation for sparse (such as LOFAR [5] and other low frequency telescopes being build) and dense mode operation for higher frequencies[6] but below 1-1.5 GHz for the SKA. Telescopes of these types are called Aperture Arrays. This paper addresses these new capabilities and aims to provide insight in the status of enabling technologies that will unleash the potential of phased arrays for future growth of radio astronomy synthesis arrays.

Monday
11:45am

The Latest on Apertif

T. Oosterloo (Netherlands Institute for Radio Astronomy), Wim van Cappellen, Laurens Bakker, George Heald, Marc Verheijen

Focal plane arrays hold the promise to enlarge the field of view of radio telescopes by factor 10 to 100. Such an increase in field of view will enable many new avenues of astronomical research. I will summarise the science for focal plane arrays and will also present the latest result obtained with a prototype focal plane array mounted in one of the WSRT dishes

Monday
12:00pm

Science with the Australian Square Kilometre Array Pathfinder

S. Johnston (ATNF, CSIRO), Ilana Feain

The future of cm and m-wave astronomy lies with the Square Kilometre Array (SKA), a telescope under development by a consortium of 17 countries that will be 50 times more sensitive than any existing radio facility. Most of the key science for the SKA will be addressed through large-area imaging of the Universe at frequencies from a few hundred MHz to a few GHz. The Australian SKA Pathfinder is a technology demonstrator aimed in the mid-frequency range, and achieves instantaneous wide-area imaging through the development and deployment of phased-array feed systems on parabolic reflectors. The large field-of-view makes ASKAP an unprecedented synoptic telescope that will make substantial advances in SKA key science. ASKAP will be located at the Murchison Radio Observatory in inland Western Australia, one of the most radio-quiet locations on the Earth and one of two sites selected by the international community as a potential location for the SKA. In this talk, I will outline the ASKAP project and summarise its headline science goals as defined by the community at large.

Monday
12:15pm

The MeerKAT Telescope

J. Jonas (Rhodes University)

The MeerKAT telescope is a precursor for the SKA in that it will be located near the Karoo site proposed for the SKA by South Africa, and it will fulfil the role of technology and science pathfinder for Phase 1 and Phase 2 of the "mid-band" SKA. In particular, it will be a pathfinder for the single-pixel wideband-feed technology option for the mid-band SKA. Engineering prototype activities are currently underway, and the construction of the MeerKAT array will begin around 2010/2011. The reference specification for the array calls for eighty 12-metre antennas extending out to 10 km baselines. A large fraction of the aperture will be concentrated in a compact core supporting baselines of less than 700 m to provide high surface brightness sensitivity for extended emission structures. This compact core will also facilitate the detection and monitoring of transient radio sources. Although the goal specification for frequency coverage is 0.5-10 GHz the initial instrument will probably employ a feed covering 0.7-2.5 GHz (L- and S-band). This instantaneous frequency coverage will be dictated by the state of development of wideband feeds at the time of commissioning. Future expansion will extend the frequency coverage to the X-band. The goal specification for instantaneous bandwidth is 1 GHz. The L- and S-band science objectives for the MeerKAT include galaxy evolution, magnetic fields (in the Milky Way, other galaxies and clusters), the Galactic interstellar medium, the intergalactic medium (both continuum and HI emission), and radio transients (including pulsars). Reconfigurable digital backends will provide flexible data processing options for both imaging and time-domain observing modes.

Monday
2:00pm

The e-EVN: a Realtime VLBI Instrument

Z. Paragi (JIVE)

Electronic very long baseline interferometry (e-VLBI) is a technique that involves transfering huge amounts of data across continents within milliseconds. The e-EVN is now a fully operational real-time VLBI array, capable of producing results directly after observations have been completed. This instrument is thus a technological, but also a scientific pathfinder for a high resolution SKA. The e-EVN and its astronomical output will be introduced.

Monday
2:20pm

e-MERLIN

S. Garrington (MERLIN/University of Manchester)

e-MERLIN (http://www.merlin.ac.uk/e-merlin/) is a unique astronomical facility which will provide radio imaging, spectroscopy and polarimetry with 10-150 milliarcsecond resolution and microJansky sensitivity at centimetre wavelengths. The fundamental infrastructure of six radio telescopes distributed across England has been enhanced by the installation of a dedicated 210 Gb/s optical fibre network and new receivers. A summary of its capabilities and an update of the status of the project will be given.

Monday
2:30pm

Radio Emission from Super-Grains: Observing Planets Form

J. Greaves (University of St Andrews)

I will present 1cm data showing the presence of very large dust grains in the discs of young stars. Such particles are a key step on the road to forming planetary cores, and identifying which stars grow rocky bodies most successfully allows us to test fundamental theories. Our new eMERLIN programme PEBBLES (Planet Earth Building Blocks - a Legacy eMERLIN Survey) will image such planet formation in action on scales of only a few AU, in particular resolving for the first time the terrestrial and gas giant formation zones. I will discuss the science goals and also plans for the future, where extrasolar Earths could be imaged as they form, using future facilities such as SKA.

Monday
2:45pm

COBRaS - e-MERLIN Cyg OB2 Radio Survey

D. Fenech (University College London), R. Prinja (P.I.), J. Yates and others

The e-MERLIN Cyg OB2 Radio Survey (COBRaS) is designed to exploit e-MERLIN's enhanced capabilities to conduct uniquely probing, targeted deep-field mapping of the tremendously rich Cyg OB2 association in our Galaxy. The project aims to deliver the most detailed radio census for the most massive OB association in the northern hemisphere, offering direct comparison to not only massive clusters in general, but also young globular clusters and super star clusters.

Monday
3:00pm

Relativistic Jet Physics with e-MERLIN

R. Laing (ESO)

I will outline recent advances in our understanding of relativistic jets from modelling of very deep VLA observations in total intensity and linear polarization. We can now derive the geometry and the three-dimensional distributions of velocity, magnetic-field ordering and emissivity for jets in low-luminosity radio galaxies on kiloparsec scales. The next challenge for this method is to extend it to work on powerful jets and smaller spatial scales. This will be feasible with the next generation of synthesis arrays and is the subject of an accepted e-MERLIN Legacy Programme.

Monday
3:15pm

The E-MERGE Legacy Program

S. Chapman (Institute of Astronomy, University of Cambridge)

We will present the E-MERGE Legacy program for E-MERLIN, representing a deep survey of the GOODS-N field, and a deep survey through a massive lensing cluster. Both surveys are aimed at resolving the faint microJansky radio source population at high redshifts.

Monday
4:30pm

Polarization and Spectral Surveys with Aperture Arrays on the SKA

P. Alexander (University of Cambridge)

Aperture Arrays (AA) offer immense opportunities as a collector technology for the SKA. By making a direct measurement of the incoming wave front, they offer unprecedented flexibility in potential observing modes provided we can process the very high data rates and calibrate the system. The "headline" advantage is the ability to produce many simultaneous beams, to give very large instantaneous fields of view, and hence very high survey speeds. The flexibility of the re-configurable beam former also allows us to trade, at fixed data rate, bandwidth for field of view and have a field of view which varies not as wavelength squared, but as some other chosen function. In this talk I will discuss how this flexibility can be used to deliver the SKA key science with particular emphasis on spectral and polarization experiments. I will also discuss the challenges of calibrating the system and the processing requirements. A particular challenge is that the AA is electrically steered and therefore the imageplane calibration effects and polarization response are particularly important. However, this is counterbalanced by an ability to control, and know, the response of the system very accurately and to off-load a large part of the processing to the realtime digital electronics.

Monday
4:45pm

Synergies between SKA and ALMA

L. Testi (ESO)

ALMA and SKA will be the worldwide leading facilities at submillimeter and centimeter wavelengths in the coming decades. While there are different key science programs that will be addressed separately by these two facilities, there are a number of prominent science objectives of these two facilities that will only be fully achieved using a combined approach. In this talk I briefly summarize the main scientific synergies between the two facilities.

Monday
5:00pm

Synergies between SKA and ELT

R. Gilmozzi (European Southern Observatory)

E-ELT and SKA are the highest priority European ground based astronomical facilities identified by the Astronet initiative for the next decade. They will have powerful performances, and will tackle some of the most compelling science cases of modern astronomy. I will review the synergetic role of the two facilities, in fields ranging from planetary and protoplanetary systems, to the processes of galaxy assembly, to the exploration of the primeval dark ages, to the probing of the physical laws across the extent of the Universe.

Monday
5:15pm

At the Beginning was the Hydrogen: Simulations for The SKA

D. Obreschkow (Oxford)

Detailed studies of atomic and molecular hydrogen now possible in the local Universe with radio and millimeter telescopes will, over the coming decades, be extended to high redshifts as new facilities like the SKA or the ALMA come on line. In this talk we present a simulation of the cosmic evolution of cold hydrogen gas in about 30 million evolving galaxies, focusing on gas masses, gas disk sizes, and velocity profiles. Mock observing cones for the HI-emission line and several CO-emission lines extracted from this simulation potentially permit robust predictions for the SKA, the ALMA, and other future telescopes.

Monday
5:30pm

Simulating the Radio Sky on the Pathway to the SKA

F. Abdalla (UCL), the SKADS team

The SKA will be a very powerful tool in many areas of astronomy when it reaches its completion. I will describe the efforts that have been done in producing a set of simulations and tools that will allow us find the best path to designing an optimal telescope.

Monday
5:45pm

The Atlas3D Survey of HI in Early-Type Galaxies

P. Serra (ASTRON), Morganti, Oosterloo, Cappellari, Emsellem, Krajnoivic, McDermid, & the Atlas3D team

Atlas3D is an ambitious project that is putting together optical integral-field spectroscopy, optical imaging, CO single-dish and interferometric observations, and HI interferometry of a complete, volume-limited sample of ~260 early-type galaxies within 40 Mpc. I will present first results of our WSRT observations of ~100 field galaxies belonging to the Atlas3D sample. This is the largest, homogeneous set of deep interferometric HI data on early-type galaxies, and will allow to firmly establish on strong statistical ground the HI properties of these objects in the local Universe. I will discuss HI detection rate, HI properties and environment of this class of galaxies. I will also link this project to what will be possible in the future with the SKA and its pathfinders.

Tuesday
11:00am

LOFAR: Current Status, Scientific Programmes and Exploration for the SKA

R. Vermeulen (ASTRON)

The Low Frequency ARray (LOFAR), currently under construction by ASTRON in The Netherlands and in several European countries, will commence astronomical commissioning observing later in the year, and is on the way to full-scale operations next year. LOFAR breaks open astrophysical research in a new spectral window, through the revolutionary use of fully electronic steering of phased antennas without moving parts, and software processing of massive data streams. Large-area surveys will be possible on an unprecedented scale; likewise, studies of transient phenomena across the sky will be revolutionised. Probing the epoch of re-ionisation is another key application of LOFAR; cosmic magnetism, solar physics, cosmic ray physics, and many other branches of astrophysics will also benefit tremendously. I will review the current status and plans for LOFAR. I will discuss its major science and technical capabilities specifically in the light of preparations and pathfinder activities for the SKA, for which LOFAR, soon to be in operation, will provide invaluable experience in many areas.

Tuesday
11:15am

The LOFAR Epoch of Reionization Key Project

L. Koopmans (Kapteyn Astronomical Institute)

The Aims of the LOFAR Epoch-of-Reionization Key-Science Project are to detect, for the first time, the redshifted 21-cm neutral hydrogen emission from the first billion years of the Universe and to quantify its spatial power-spectrum as function of redshift. This would provide exciting new data on the infancy of the Universe, where the first stars, quasars and galaxies formed. I will present an overview and status-report the LOFAR EoR KSP.

Tuesday
11:33am

Deep Extragalactic Surveys with LOFAR

P. Best (IfA Edinburgh), Huub Rottgering and the LOFAR Surveys Key Science Project Team

One of LOFAR's 6 key science projects is to carry out very deep and wide extragalactic surveys. I will present the details of the proposed LOFAR extragalactic surveys, discuss the comparison between these surveys and other large radio surveys with pre-SKA next-generation radio telescopes, and describe some of the key scientific goals that have led to the proposed survey plans.

Tuesday
11:51am

Detecting High Energy Cosmic Rays with LOFAR

A. Horneffer (RU Nijmegen), The LOFAR CR KSP

High energy cosmic rays have been detected with energies up to some 10^20 eV. Almost a century after their initial discovery, origin, acceleration, and transport to the Earth of cosmic rays remain unsolved problems. To solve them large detectors or new detection methods are needed. LOFAR can detect cosmic particles by measuring radio pulses from particle cascades in the atmosphere (air showers) and by searching for radio pulses from similar cascades in the lunar regolith.

Triggering for both detection methods means detecting a radio pulse of some tens of nanoseconds width and discriminating real events from radio interference. Together this can only be done with a digital radio telescope, such as LOFAR.

The high sensitivity and excellent calibration will make LOFAR an unique tool to study the radio properties of single air showers and thus test and refine our theoretical understanding of the radio emission process. In addition LOFAR will be able to observe the moon with high sensitivity by forming several independent tied array beams to cover the moons surface. This will give it unprecedented sensitivity to cosmic rays or neutrinos at energies around 10^22 eV.

Eventually, the SKA will be able to fill the gap between current ground based experiments extending up to 10^20 eV and the forthcoming moon experiments starting round 10^22 eV.

Tuesday
12:09pm

Pulsars: From LOFAR to the SKA

B. Stappers (JBCA, University of Manchester), M. Kramer, J Hessels, J van Leeuwen, R. Smits

LOFAR is the first of the next generation telescopes to come online and provides an excellent opportunity to do unique pulsar science but also will teach us a lot about observing pulsars with the SKA. LOFAR will perform a search for pulsars of the entire Northern sky and will be more than double the number of sources known in the region. The extreme sensitivity will mean the entire local population will be found. The search techniques will be similar to those that will be needed with the SKA which will find tens of thousands of pulsars. I will discuss the science that can be achieved with LOFAR and also address the synergies with SKA pathfinders and the SKA itself.

Tuesday
2:00pm

Wide-field VLBI Imaging without Supercomputers

O. Wucknitz (AIfA Bonn)

VLBI offers the highest resolution of all observing techniques. At the same time, the field of view is intrinsically only limited by the primary beam of individual telescopes and thus not necessarily smaller than that of connected interferometers. Doing the exercise in practice, however, is still a major challenge. Correlations have to be done with high spectral and temporal resolution, which produces considerable data volumes. Mapping these large data sets for very many facets in the standard way becomes so prohibitively expensive that more efficient ways have to be found. In this contribution I discuss such an approach that increases the efficiency by orders of magnitude. This method has already been used to produce full primary-beam maps in a test case and is currently being tested and improved further. Very efficient imaging methods are not only required for current VLBI instrumentation but will also be essential to make long-baseline SKA imaging possible with realistic efforts.

Tuesday
2:15pm

Space and Planetary Science Frontier of SKA

L. Gurvits (Joint Institute for VLBI in Europe), L.I. Gurvits

The coming two decades will see a burst of space and planetary science missions ranging from cosmological and astrophysical telescopes positioned in the Sun-Earth L2 point to the planetary probes and missions to Mercury, Venus, Mars, outer planets and their satellites. In all these missions a multi-facet support from SKA would greatly enhance the mission scientific return. Although not among the SKA Key Science themes, the SKA-based research in the planetary science area will deliver high-impact results. For example, SKA-based tracking of planetary probes during their approach to and landing on the surface of planets will yield an extremely valuable "health-check" of the spacecraft and scientific measurements beyond ability of the present and prospective "standard" deep space tracking facilities. Such the experiments proved to be highly rewarding even with much less sensitive than SKA present day radio telescopes and their networks. VLBI tracking of planetary probes involving SKA will provide an unprecedented combination of sensitivity and angular resolution, bypassing any other methods of estimating state vectors of planetary probes. In addition, SKA will enable Direct-to-Earth (DtE) data delivery of the mission-critical information as a back-up to the nominal data transmission schemes with relaying the data via orbiters and fly-by spacecraft. Importantly, all the above SKA observations will exploit standard SKA instrumentation and impose very modest mission-specific operational requirements. Last but not least, the SKA involvement in space science and planetary missions brings in a large new community of SKA users - planetary scientists. In this presentation I will emphasise those scientific applications of SKA to the space and planetary science missions scheduled for in-situ operations in the 2020's, during the first decade of the SKA life.

Tuesday
2:30pm

Gravitational Lensing of the Cosmic 21 cm Radiation

R. Metcalf (Max Planck Institute for Astrophysics)

Low-frequency radio observations of neutral hydrogen during and before the epoch of cosmic reionization will provide hundreds of quasi-independent source planes, each of precisely known redshift. These planes can be used to reconstruct the projected mass distribution of foreground material. If the reionization epoch is at z $\tilde{<}$ 9 very large amounts of cosmological information will be accessible. With an SKA-like telescope the distribution of matter could actually be mapped with high fidelity. A wide-area survey of 21 cm lensing would provide very sensitive constraints on cosmological parameters like dark energy and on neutrino masses. By comparing these measurements with foreground galaxy lensing surveys the growth of structure could be measured at redshifts of 1 to 3 providing a probe of the universe's equation of state that could distinguish between competing models of dark energy. The method and the prospects for different telescope designs to measure gravitational lensing will be discussed.

Tuesday
2:45pm

What Ultra High-Resolution, High-Sensitivity Maser Observations tell us about the Physics of Stellar Winds

A. Richards (JBCA, Manchester), P Diamond, S Etoka, M Elitzur, J A Yates, I Bains

Molecular masers trace the kinematics of winds from evolved stars at sub-AU resolution. Only MERLIN has the resolution and sensitivity to test predictions of maser beaming theory. e-MERLIN will also resolve the stellar continuum and mass-loss process, constaining micro- and macroscopic physics.

Tuesday
3:00pm

Radio Pulsar Surveys and Neutron-Star Binary Discoveries

J. van Leeuwen (ASTRON)

Radio pulsars continue to provide unique opportunities for testing theories of gravity and probing states of matter otherwise inaccessible; as the rare end-points of binary star evolution, relativistic neutron-star binaries offer unique insights and powerful constraints on our physical understanding of the formation properties of compact objects; and in large samples pulsars allow detailed modeling of the Galactic neutron star population.

For these reasons, we have initiated several large-scale pulsar surveys that aim to discover pulsars in short-period relativistic or otherwise interesting orbits. I will discuss our recent discovery of three such systems and extrapolate to LOFAR and the SKA: The first discovery makes a significant contribution to the computed cosmic inspiral rate of compact binary systems and the gravitational wave background -- The second one is a 'Whodunit', where the culprit that must have spun up the pulsar to 465Hz appears unknown -- While the third one is the long-sought x-ray binary/radio pulsar evolutionary missing link.

Tuesday
3:15pm

SKA Polarised Sky Simulations

J. Geisbuesch (University of Cambridge), Paul Alexander

We present simulations of the extra-galactic polarized radio sky at SKA wavebands based on modeling radio source populations and intervening Faraday screens. Further, we discuss how measurements of linear polarization can be used to explore intrinsic source polarization properties and to study the magnetic field of galaxy clusters via Faraday rotation of the polarization plane of traversing radiation. Parts of this work have been included in the SKA reference science mission document. In this respect the potential of different survey strategies for constraining magnetic fields in different environments is investigated.

1-P01 Mapping Atomic Hydrogen with the Galactic Arecibo L-band Feed Array (GALFA)

K. Douglas (University of Exeter), Joshua Peek, Carl Heiles, Snezana Stanimirovic, Steven Gibson, Mary Putman, Jacco van Loon, Ayesha Begum

The GALFA-HI Project aims to image Galactic 21-cm HI spectral line for the entire Arecibo sky (about 12000 square degrees in the range -1.2 deg < delta < 38.0 deg). We focus on local gas over a velocity range of -700 km/s to +700 km/s, with resolutions of 0.2 km/s (spectral) and 3.4' (spatial). Science highlights will presented for HI observations of the Galactic Plane, the Galactic Disk-Halo interface, and Local Group galaxies.

1-P02 Measuring Transverse Velocities

N. Douglas (Kapteyn Institute)

The radial velocities of PNe are used, by instruments such as the Planetary Nebula Spectrograph (PNS), to probe the kinematics of early-type galaxies. The lack of two components of the velocity vector is a serious setback. In the near future the combination of VBLA and SKA might be able to redress this problem.

1-P03 Applying Bayesian Analysis to SKA Polarisation Data

J. Geisbuesch (University of Cambridge)

We discuss simulations of the polarized sky in the frequency range of the SKA mid-band. From our polarization simulations, which build on semi-empirical extra-galactic radio continuum simulations, empirically as well as numerically derived intrinsic source population polarization properties and radiation propagation from the emitting source along the line-of-sight to the observer, we obtain synthetic polarization observations assuming SKA telescope specifications as defined by the most recent reference design study. For the purpose of radiation transfer, we utilize a halo model approach to obtain the spatial distribution of the Faraday depth induced by galaxies, groups and clusters. Our modeling includes local halo physical as well as global cosmological aspects. By applying Bayesian analysis methods based on MCMC and nested sampling techniques on rotation measure data sets we investigate how well cosmic magnetic fields can be studied and their properties inferred from prospective polarization data. Furthermore, we make predictions about constraints that can be placed on the origin, amplification and evolution of large-scale magnetic fields.

1-P04 The Splatalogue Database for Astronomical Spectroscopy

A. Markwick (University of Manchester), A. J. Remijan (NRAO), the ALMA Working Group on Spectral Line Frequencies

The next generation of powerful radio and millimetre/submillimetre observatories (e.g. EVLA, ALMA, Herschel) will require extensive resources to identify spectral line transitions and create synthetic spectra for data analysis. We describe the compilation of the most complete spectral line database currently assembled for this purpose. Splatalogue is a comprehensive transition-resolved compilation of observed, measured and calculated spectral lines. In addition to the JPL and CDMS spectral line lists, almost 250000 new/updated lines from the Spectral Line Atlas of Interstellar Molecules (SLAIM) were included. Some 12000 lines were subsequently added to the Lovas/NIST Recommended Rest Frequencies of known astronomical transitions. Splatalogue also contains atomic and recombination lines. Although splatalogue has a web-based front end at www.splatalogue.net, it has two more useful access methods. First, the database is VO-compliant, queryable under the IVOA SLAP standard, and second, it is programmatically accessible through the Splatalogue API.

1-P05 On Possible Coincident Detections of Gravitational Waves and Radio Signals from Coalescing Binary Neutron Stars

V. Predoi (Cardiff University), Stephen Fairhurst

A number of theoretical models are analyzed from the point of view of practicality for a possible joint effort of detecting coincident gravitational waves and radio signals from compact binary objects. The radiation mechanisms,expected wavelengths, expected fluxes and possible extinction processes are explained using the simplest formalisms and order-of-magnitude calculations are performed. The conclusions will help orienting to new external triggered events in gravitational waves detection.

1-P06 FIRST - A Space-Borne Low-Frequency Radio Observatory Using Passive Formation Flying

D. Robinson (Psi-tran Ltd), J. Bergman, R. Blott, A. Forbes, D. Humphreys, and C.Stavrinidis

Space-borne low-frequency radio astronomy has been identified by ESA as a key science application for a pathfinder mission called FIRST (Formation-flying sub-Ionospheric Radio astronomy Science and Technology). Its objective is to demonstrate passive formation-flying and at the same time perform unique world class science with a very high serendipity factor, by opening a new frequency window to astronomy. Passive formation-flying is a novel space-flight concept, in which the satellites are allowed to drift so that no expensive and complex position control systems are required to maintain the spacecraft in redefined positions. Instead, precise knowledge of the orbits enables the continuous phase re-construction of a high-performance radio telescope aperture to be performed while the individual constellation satellites rotate and drift. The FIRST constellation consists of six daughter spacecraft with radio astronomy antennas, and a mother spacecraft for data processing and communications. The location of the constellation at the second Lagrange point (L2) allows for a stable, low-drift orbit that is sufficiently far away from Earth to avoid severe radio frequency interference (RFI). FIRST will provide low-frequency all-sky images with unprecedented sensitivity and angular resolution and can be used to image the low-frequency Sun and the evolution and propagation of coronal mass ejections (CME) at higher resolution than before. With suitable long integration times, FIRST may even glimpse the dark ages by means of high red-shift 21 cm line emissions. Larger future space observatories based on the enabling passive formation-flying technology, but consisting of several small satellite constellations, are being considered as the next step. These will have enhanced sensitivity and resolving power to address many fundamental science objectives in radio astronomy, such as direct observation of earth-like exo-planets, by detection of their burst planetary radio emissions, as well as comprehensive studies of the dark ages and the epoch of reionization.

1-P07 The Magnetic Field of the Nearby Starburst Galaxy NGC 253

V. Heesen (Volker Heesen), M. Krause, R. Beck, and R.-J. Dettmar

We present radio continuum polarimetry observations of the nearby edge-on galaxy NGC 253 which possesses a very bright radio halo. Using the vertical synchrotron emission profiles and the lifetimes of cosmic-ray electrons, we determined the cosmic-ray bulk speed as 300±30 km/s, indicating the presence of a galactic wind in this galaxy. The large-scale magnetic field was decomposed into a spiral magnetic field in the disk and a poloidal component in the halo. The poloidal component shows a prominent X-shaped magnetic field structure centered on the nucleus, similar to the magnetic field observed in other edge-on galaxies. Faraday rotation measures indicate that the poloidal field has an odd parity (antisymmetric). NGC 253 offers the possibility to compare the magnetic field structure with models of galactic dynamos and/or galactic wind flows.

(2) The standard cosmological models - successes and challenges

Monday
11:00am

CMB Constraints on Cosmology

A. Lewis (IoA)

I will overview constraints on cosmological parameters from the Cosmic Microwave Background Radiation. This will cover the latest measurements from the Wilkinson Microwave Anisotropy Probe (WMAP) and ground based experiments, as well as predicted constraints from the Planck satellite. I will discuss the role of polarisation measurements in improving the constraints, and degeneracies between different parameters. Synergy with other experiments will be highlighted.

Monday
11:25am

Experimental Particle Physics Constraints on Dark Matter

N. Spooner (University of Sheffield)

Great progress has been made in the drive to detect dark matter particles in the laboratory. I will present an overview of the situation and pass a critical eye over some recent claims that a real WIMP dark matter signal has been seen. In general the likelihood is that larger and more sophisticated experiments will be needed to determine a definitive identification. Liquid noble gases and cryogenic bolometers are one route but there is also the possibility of directional technology, a WIMP telescope that could perhaps tell us something about the galactic halo structure in dark matter.

Monday
11:50am

First Science Results from the ZEPLIN-III Direct Dark Matter Search

T. Sumner (Imperial College London)

ZEPLIN-III has just completed its first science run and has set new limits on the cross-section of SUSY neutralinos as cold dark matter candidates. Both spin-independent and spin-dependent limits will be presented. In both cases the limits are world competitive and for the spin-dependent limts they are world leading. Plans for the second run will be presented.

Monday
12:00pm

Measuring B-mode polarization with Clover

M. Jones (Oxford University), Clover collaboration

Clover is a UK experiment to measure the B-mode polarization of the CMB and detect the signature of primordial gravitational waves. I will report on the current status of the project and prospects.

Monday
2:00pm

Evidence for Dark Energy

A. Taylor (University of Edinburgh)

I will review the recent evidence for dark energy from a range of cosmological probes including supernovae, the cosmic microwave background and large scale structure. The constraints on the dark energy equation of state will be presented. I will emphasize the key quantities constrained by each probe and the resulting degeneracies. The potential systematics of each probe will also be reviewed.

Monday
2:25pm

Simulations of Quintessential Cold Dark Matter: Beyond the Cosmological Constant

E. Jennings (Institute for Computational Cosmology, Durham), C. M. Baugh, S. Pascoli, R. Angulo

We study the nonlinear growth of cosmic structure in different dark energy models, using ultra-large volume N-body simulations which can resolve haloes down to 9 x 10^12 /h Msun. We consider a variety of quintessential models of dark energy, and compare the growth of structure to that in a universe with a cosmological constant. The range of models we consider spans essentially the full range of behaviour expected in the different dark energy scenarios currently under discussion. We present predictions for the evolution of the matter power spectrum, the mass function and concentration of dark matter haloes and the amplitude of redshift-space distortions to the clustering pattern in the different dark energy models.

Monday
2:35pm

Searching for Evolution in the Spectra of Type Ia Supernovae

E. Walker (University of Oxford), The SNLS Collaboration

The Supernova Legacy Survey (SNLS) is an ambitious survey project to measure the redshifts and spectra of 450 Type Ia supernovae (SNe Ia) in order to measure the dark energy equation of state parameter w. This work is an evolutionary study looking at the differences between the high-z spectra measured as part of the SNLS and low-z objects from the literature with a long-term goal of measuring and calibrating out any differences between the two populations.

This study draws on techniques developed in two previous SNLS papers (Bronder et al. 2008 and Ellis et al. 2008) to measure the pseudo-equivalent widths (EW) of 3 spectral features - CaII H&K, SiII and MgII - in recent Gemini SNe Ia spectra. A low-redshift sample for comparison is drawn from the literature and using a resilient median to create a trend in EW with rest-frame phase.

We present the results from the evolutionary study and the first results from using spectral properties to improve the calibration for the cosmology.

Monday
2:45pm

Evidence Against an Accelerating Universe?

T. Shanks (Durham University), U. Sawangwit

A clear prediction of an accelerating Universe model is that there should be a correlation between the CMB and large-scale structure in the foreground galaxy distribution the acceleration means that the gravitational blueshifting of a CMB photon as it enters a galaxy supercluster is not completely cancelled by redshifting as it leaves. This Integrated Sachs-Wolfe (ISW) effect has previously been claimed to be detected in a variety of observations. Here we show that in a large new sample of ~800000 foreground z~0.68 luminous red galaxies, the ISW effect appears to be absent and the data appear to reject the accelerating Universe prediction. In addition, we show that many of the previous ISW detections may be subject to unknown systematic effects. If there is no ISW effect then the implications for the standard cosmological model are serious since no model that has dark energy and is compatible with General Relativity would be allowed.

Monday
2:55pm

Masses of Galaxies, Groups and Clusters via QSO Lensing.

U. Sawangwit (Department of Physics, Durham University), T. Shanks

The QSO lensing provides a powerful alternative to weak shear lensing analysis in terms of probing the masses of galaxies, galaxy groups and galaxy clusters. Previously, our group has detected the effect of galaxy and cluster lensing on faint background 2dF QSOs. We found that the results were inconsistent with the standard Lambda CDM model in the sense that the result implied a high Omega_m and/or strong anti-bias. Scranton et al. confirmed the observational results using photo-z QSO from the SDSS. However, they suggested that the lensing result was compatible with the standard Lambda CDM model. We now present the updated observational results where for the first time, we use bright SDSS QSO spectroscopic redshifts to show that the predicted positive correlation is detected at bright magnitudes, consistent with the lensing interpretation of the anticorrelation previously detected at faint end. We shall finally discuss possible routes to understand why Scranton et al. and ourselves came to such different conclusions from essentially the same QSO lensing data.

Monday
4:30pm

Cosmic Shear Results from the CFHTLS

H. Hoekstra (Leiden Observatory), CFHTLS collaboration

Intervening structures in the universe give rise to small distortions in the shapes of distant galaxies. By measuring this tiny coherent signal, we can study the mass distribution in the universe directly, without relying on baryonic tracers. This makes weak lensing by large-scale structure a powerful probe of cosmology. I will review the topic of cosmic shear and I will present results from the CFHT Legacy Survey. Finally I will discuss what will be required to significantly improve constraints on the properties of dark energy.

Monday
4:40pm

The Impact of Intrinsic Alignments on Cosmology from Weak Gravitational Lensing

D. Kirk (University College London), Sarah Bridle

(2) The standard cosmological models - successes and challenges

Weak Gravitational Lensing (WGL) is a powerful tool in modern cosmology, using cosmic shear to probe the growth of Large Scale Structure and the expansion history of the Universe. A number of systematic effects must be addressed if WGL is to reach it's full potential to constrain cosmological parameters. We study the effect of intrinsic correlations between galaxy ellipticities, an important WGL systematic. We model this Intrinsic Alignment (IA) using the recent Halo Model approach, as well as the more simplistic Linear and Nonlinear Alignment Models. We quantify the bias on measurements of the matter power spectrum normalisation if IAs are ignored. We show how effects of IAs continue to be important when WGL data is combined with other probes. We present parameter constraints from a joint analysis WGL data and galaxy survey data, including the effect on constraints of the neutrino mass.

Monday
4:50pm

Beyond Standard Models with 3D Cosmic Shear

T. Kitching (University of Edinburgh), Alan Heavens, Licia Verde, Alessandro Melchiorri, Paulo Serra

I will show that 3D cosmic shear, that using the information from every galaxy to directly reconstruct the three dimensional cosmic shear field. Has the potential to constrain physics beyond the standard models of both particle physics and gravity.

Monday
5:00pm

Locating the Baryon Acoustic Peak

F. Simpson (University of Edinburgh), John Peacock, Patrick Simon

Forthcoming photometric redshift surveys should provide an accurate probe of the acoustic peak in the two-point galaxy correlation function, in the form of angular clustering of galaxies within a given shell in redshift space. I will explore the form of the anticipated signal, quantifying the distortions that arise due to projection effects, and in particular the validity of applying the Limber approximation. The position of the acoustic peak within the angular correlation function is shown to relate to the angular diameter distance at the far side of the redshift bin. Thicker redhift bins therefore shift comoving features towards smaller angular scales. As a result, the value of the photometric redshift error acquires a greater significance, particularly at lower redshifts. In order to recover the dark energy equation of state to a level of 1 %, we find the total redshift dispersion must be determined to within ~0.001, which may prove challenging to achieve in practice.

Monday
5:10pm

What Do Galaxy Surveys Really Teach Us?

M. Swanson (University College London)

A key question as we push the current frontiers of cosmology is how much we can trust galaxy clustering measurements from galaxy surveys to teach us about the underlying cosmic matter distribution. I will address this important issue with SDSS measurements of galaxy bias that quantify its stochasticity and its dependence on scale, luminosity, and color and discuss how these effects might impact cosmology with future galaxy surveys.

Tuesday
11:00am

Theoretical Models of Dark Energy

E. Copeland (University of Nottingham)

(2) The standard cosmological models - successes and challenges

We briefly review some of the types of dark energy models that have been proposed involving either a cosmological constant, some form of fundamental (and as yet undiscovered) scalar field or modifications of gravity. In each case we will highlight the fine tuning required in order to satisfy cosmological and solar system constraints.

Tuesday
11:25am

Review on Modified Gravity

R. Durrer (Geneva University)

I shall give a brief overview of the 'most popular' theories of modified gravity (braneworlds, f(R), f(G), de-gravitation). I shall mainly stress basic theoretical requirements and observational tests of these ideas.

Tuesday
11:50am

Cosmological Parameters from Photometric Redshift Surveys

F. Abdalla (UCL), the DES-UK collaboration

In the next few years, most upcomming cosmological surveys in cosmology will be photometric redsfhit surveys planning to perform weak gravitational lensing, baryonic acoustic oscillations and cluster science with photometric redsfhits. The Dark Energy survey will be one of these surveys starting 2011. I will describe the status of this survey as well as the expectations of what it will achieve in terms of our cosmological understanding of the Universe.

Tuesday
12:00pm

The Case for European Involvement in LSST

B. Mann (University of Edinburgh)

LSST is the most ambitious of the next generation of optical sky surveys. During its anticipated ten years of operations it will survey a 20,000 sq deg region in u,g,r,i,z and y, visiting each field ~1000 times and yielding a coadded map to r~27.5. The LSST system has been designed to match science requirements from across a broad range of astrophysics, and one of its key science themes is probing dark energy and dark matter. LSST data products will have no formal proprietary period, but the LSST project lacks the funds to provide the computational infrastructure required to enable their analysis by astronomers from beyond the US and Chile. I shall make the case for European involvement in LSST, and will outline a year-long theme of events sponsored by the e-Science Institute in Edinburgh which can provide a forum for European astronomers to assess the relative scientific capabilities of the next generation of sky surveys and to address the computational issues which we must solve if we are to exploit fully their scientific potential.

Tuesday
2:00pm

Future Surveys

M. Colless (Anglo-Australian Observatory)

I will overview future cosmological surveys, focussing on those aimed at measuring the dark energy equation of state. This will cover spectroscopic and imaging surveys. I will also briefly overview the current status of some ongoing surveys including the WiggleZ survey.

(2) The standard cosmological models - successes and challenges

Tuesday
2:25pm

Dark Energy and Dark Matter from space

A. Refregier (CEA Saclay)

I will overview the status of planned satellite missions to measure the properties of dark energy and dark matter with high precision. In particular, I will describe the Euclid mission, which is designed provide an all sky imaging and spectroscopic survey.

2-P01

Photometric Redshift Estimation: Methods and Applications

M. Banerji (University College London), Filipe Abdalla, Ofer Lahav

The currently available methods for photometric redshift estimation are reviewed and a comparison of six of these methods on a sample of Luminous Red Galaxies from the 2SLAQ survey is presented. Results are then presented for the application of one of these methods, namely artificial neural networks on simulations for future ground and space-based dark energy missions.

2-P02

Acceleration of Charged Particles by Magnetic Collapse During Decoupling

E. Bennet (University of Glasgow), L F A Teodoro & D A Diver

This article concentrates on the non-equilibrium evolution of magnetic field structures at the onset of recombination, when the charged particle current densities decay as neutrals are formed. We consider the effect that a decaying magnetic flux has on the acceleration of particles via the transient induced electric field. Since the residual charged-particle number density is small as a result of decoupling, we will consider the magnetic and electric fields essentially to be imposed, neglecting the feedback from any minority accelerated population. We find that the electromagnetic treatment of this phase transition can produce energetic electrons scattered throughout the Universe. Such particles could have a significant effect on cosmic evolution in several ways: (i) their presence could influence the overall physics of the recombination era; and (ii) a population of energetic particles might lend a Coulomb contribution to localized gravitational collapse. This is confirmed by a numerical simulation in which a magnetic domain is modelled as a uniform field region produced by a thin surrounding current sheet. The imposed decay of the current sheet simulates the formation of neutrals characteristic of the decoupling era, and the induced electric field accompanying the magnetic collapse is able to accelerate ambient stationary electrons (that is, electrons not participating in the current sheet) to energies of a few keV.

2-P03

Bayesian Component Separation and CMB

C. Dickinson (U. of Manchester), Hans-Kristian Eriksen, Anthony Banday, Kryzszstof Gorski, Charles Lawrence, Ian O'Dwyer, Greg Huey, Ben Wandelt

A well-tested and validated Gibbs sampling code, that performs component separation and CMB power spectrum estimation, was applied to the WMAP 5-yr data. Using a simple model consisting of CMB, noise, monopoles and dipoles, a 'per pixel' low-frequency power-law (fitting for both amplitude and spectral index), and a thermal dust template with fixed spectral index, we found that the low-l (l < 50) CMB power spectrum is in good agreement with the published WMAP5 results. Residual monopoles and dipoles were found to be small (~< 3 mu K) to negligible in the 5-yr data. We comprehensively tested the assumptions that were made about the foregrounds (e.g. dust spectral index, power-law spectral index prior), and found that the CMB power spectrum was insensitive to these assumptions. The map of low frequency spectral indices indicates a steeper spectrum on average (beta=-2.97±0.21$) relative to those found at low (~GHz) frequencies.

2-P04 Cosmology with the Shear-Peak Statistic

J. Dietrich (ESO), J. Hartlap

Weak gravitational lensing has initially been hailed as a method for constructing purely mass selected samples. It has become increasingly clear in recent years that weak-lensing cluster catalogs are in fact shear-selected, not mass-selected. As such they are neither complete nor pure catalogs, complicating their application to cosmology.

Here we investigate the potential of the shear-peak statistic to provide cosmological constraints. Instead of concentrating only on shear peaks caused by collapsed halos we also consider mass peaks caused by projections of the large-scale structure as carrier of cosmological information. We populate the Omega_m-sigma_8 plane with N-body simulations through which we perform ray-tracing and simulate observations with a tomographic peak finder. Such simulations can be tuned to closely match parameters of real surveys and can be made to include a variety of observational effects like e.g., masking of areas affected by bright stars.

We find that the shear-peak statistic gives constraints on Omega_m and sigma_8 competitive with 2 point cosmic-shear tomography. We discuss the potential of the shear-peak statistic to break the Omega_m-sigma_8 degeneracy of cosmic and to constrain other cosmological parameters.

2-P05 Constraints on Sudden Future Singularity Models from Cosmological Data

H. Ghodsi (University of Glasgow), Dr M Hendry

One of the most notable challenges facing cosmologists today is the nature of the mysterious dark energy introduced in the standard model of cosmology to account for the current accelerating expansion of the universe as established by the observation of high redshift Type Ia supernovae. In this regard, many other non-standard cosmologies have been proposed which would eliminate the need to include any form of dark energy. One such model is the Sudden Future Singularity model in which no equation of state linking the energy density and pressure in the universe is assumed to hold. In this model it is possible to have a sudden rise in the pressure occurring in the near future while the energy density would remain unaffected. This forecasted singular behaviour of the pressure in these models mimics the accelerating expansion observed today as required. In this contribution we compare Sudden Future Singularity models with current data from high redshift supernovae, baryon acoustic oscillations and the CMBR. We explore the limits placed on the SFS parameters by these current data and discuss the viability of SFS models as an alternative to the standard concordance cosmology.

2-P06 C-BASS: Outline, Status and Timeline

O. King (University of Oxford), The C-BASS collaboration

The C-Band All Sky Survey is a project which aims to produce maps of total intensity and linear polarisation over the whole sky at 5 GHz with unprecedented sensitivity and low systematics. These measurements of the polarised Galactic foreground are necessary for the accurate characterisation of the CMB B-mode. I will outline the project's goals, the current status of the project, and a timeline going forward.

2-P07 No More Nuisance Parameters

T. Kitching (University of Edinburgh), Adam Amara, Filipe Abdalla, Benjamin Joachimi, Alexandre Refregier

When confronted by a systematic cosmologists routinely parameterise their lack of knowledge with a function and estimate the values of the extra parameters from the data. This method is necessarily dependent on the choice of parameterisation.

I will present a method that allows the robust estimation of cosmological systematic uncertainties in a model and parameter independent way. By using such a method we will be able to calculate robust systematic constraints in addition to our statistical errors.

2-P08 Dark Energy and Quantum Gravitation, from Neutrino Oscillations

M. Laloum (CNRS / IN2P3 / LPNHE Paris)

We argue that the present classical formalism of neutrino oscillations is just approximate (cf. PDG 2006), thus requiring various second-order corrections : internal kinetic dispersion from internal mass dispersion ; curing Lorentz invariance violation between different MASS EIGENSTATES, in transitions of the kind m1 => m2, through energy shifts (m2^2-m1^2)/(2p) , made salient in phase factors ; so, necessary transfers of quadri-momentum with any medium, even "vacuum" ; so, evidence of ethereal "DARK ENERGY" of purely weak essence, within "vacuum" oscillations ; actual violation of some deeply rooted principles of "quantum mechanics" (corpuscular elementarity, orthogonality of eigenstates amplitudes, Wigner's rules of super-selection, Heisenberg's relations of uncertainty) ; strict non-hermiticity of the Hamiltonian operator, involving FINITE PROPER LIFETIMES ; neutrino mass matrices duly of the "CKM" type, as for quarks ; "UBIQUITY" concept and existence of "PROBABILITY WAVES", instead of matter waves, giving serious credibility to the paradoxical lemma of intense radiation from the vicinity of so-called "black holes" and "pulsars" (so, faking genuine "white wells"). Spontaneous individual birth of zero-mass neutrinos (not by pairs, from Lorentz invariance !), might explain the paradoxical excess of "dark energy" over "dark mass", overwhelming at cosmological scales. Opposition is thus made between coherent radiation endowed with gravitational effects, and incoherent radiation with zero gravitational power, in fundamental lemma for QUANTUM GRAVITATION.

2-P09 Optimal Binning of the Primordial Power Spectrum

P. Paykari (Imperial College London), Andrew H. Jaffe

The primordial power spectrum describes the initial perturbations in the Universe which eventually grew into the large-scale structure we observe today, and thereby provides an indirect probe of inflation or other structure-formation mechanisms. In this paper we will investigate the best scales the primordial power spectrum can be probed, in accordance with the knowledge about other cosmological parameters such as Omega_b, Omega_c, Omega_Lambda, h and tau. The aim is to find the most informative way of measuring the primordial power spectrum at different length scales, using different types of surveys and the information they provide for the desired cosmological parameters. We will find the optimal binning of the primordial power spectrum for this purpose, by making use of the Fisher matrix formalism. We will then find a statistically orthogonal basis for a set of cosmological parameters, mentioned above, and a set of bins of the primordial power spectrum to investigate the correlation between the two sets. For this purpose we make use of principal component analysis and Hermitian square root of the Fisher matrix. The surveys used in this project are Planck and SDSS (BRG), but the formalism can easily be extended to any windowed measurements of the perturbation spectrum.

2-P10 The Statistics of the Sunyaev-Zel'dovich Effect

M. Peel (Jodrell Bank Centre for Astrophysics), Richard Battye, Scott Kay

Using large numbers of simulations of the microwave sky, comprising the Cosmic Microwave Background, the Sunyaev-Zel'dovich effect and foreground point sources, we investigate the statistics of the power spectrum at microwave frequencies between spherical multipoles of 1000 and 10000. We compare the statistics to analytic calculations, and look at the effects of map size and large clusters on the statistics, as well as the implications for the possible detection of a high-multipole excess.

2-P11 The XMM Cluster Survey and Cosmology

M. Sahlén, Pedro Viana, Andrew Liddle, Kathy Romer

The XMM Cluster Survey (XCS) is an ongoing effort to detect X-ray galaxy clusters from XMM archival data and utilize those to constrain cosmology. The currently completed survey area is 132 sq. deg., with a final projected area of 500 sq. deg. We present the current status of the XMM Cluster Survey (XCS) for cosmology, and forecast the constraints on the values of sigma_8 and Omega_m, and cluster scaling relation parameters which we expect to obtain from the complete survey. We perform a Monte Carlo Markov Chain analysis of the evolution of the number density of galaxy clusters that takes into account a detailed simulated selection function, temperature measurement errors, and photometric redshifts. It is the most detailed cluster survey treatment to date. We expect to measure Omega_m to ± 0.03 and sigma_8 to ± 0.05. We do not expect measurement errors or imperfect knowledge of their distribution to degrade constraints significantly. Scaling-relation systematics can easily lead to cosmological constraints 2sigma or more away from the fiducial model. We comment on required improvements for our final and future cluster analyses.

2-P12 Probing the Large-Scale Scale Galaxy Density and Peculiar Velocity Field with Type Ia Supernovae

B. Senevirathne (University of Glasgow), Dr M Hendry

The galaxy density and peculiar velocity field can be a powerful probe of the distribution of dark matter in the Local Supercluster. Comparing observed radial peculiar velocities with those predicted from the galaxy density field reconstructed from all-sky redshift surveys can place useful constraints on models of galaxy biasing and the dimensionless matter density.

In this contribution we describe current work at Glasgow comparing the peculiar velocity field derived from the smoothed PSCz density field with the observed peculiar velocities inferred from local type Ia supernovae. We describe the constraints on the linear bias parameter, beta, obtained from these data and discuss future prospects for constraining galaxy biasing models using the next generation of galaxy peculiar velocity surveys.

2-P13 Cosmological Results from Five Years of 30 GHz CMB Intensity Measurements with the Cosmic Background Imager

A. Taylor (University of Oxford), CBI Collaboration

We present final results on the angular power spectrum of total intensity anisotropies in the CMB from the CBI. Our analysis includes all primordial anisotropy data collected between January 2000 and April 2005, and benefits significantly from an improved maximum likelihood analysis pipeline. It also includes results from a 30 GHz foreground survey conducted with the Green Bank Telescope (GBT) which places significant constraints on the possible contamination due to foreground point sources. We improve on previous CBI results by about a factor of two in the damping tail. These data confirm, at ~3-sigma, the existence of an excess of power over intrinsic CMB anisotropy on small angular scales (l > 1800).

2-P14 The First Galaxy Formation Model Including the TP-AGB Stellar Phase

C. Tonini (ICG Portsmouth)

A well-known problem of the hierarchical galaxy formation is to match the colours and luminosities of 'very red passive' galaxies at high-redshift. We show that a substantial part of this failure was caused by an incorrect treatment of stellar evolution in the semi-analytic models and simulations. We present the first semi-analytic model of hierarchical galaxy formation in which stellar population with the very red stellar phase of Asymptotic Giant Branch are included. The new simulated galaxies display a substantially different mass vs luminosity relation and colour-magnitude relation along the cosmic time, with the synthetic galaxies being now much more luminous and much redder at the same mass. The comparison with observations radically modifies the belief that the hierarchical model fails to assembly enough mass at high redshift. In particular we are able to match for the first time the very red passive galaxy population discovered in the Hubble Deep Field and a substantial fraction of high-redshift starbursts without any ad-hoc assumption.

2-P15 How Flat Can You Get? A Model Comparison Perspective on the Curvature of the Universe

M. Vardanyan (Oxford University, Astrophysics), Trotta, Roberto & Silk, Joe

The question of determining the spatial geometry of the Universe is of greater relevance than ever, as precision cosmology promises to verify inflationary predictions about the curvature of the Universe. We revisit the question of what can be learnt about the spatial geometry of the Universe from the perspective of a three-way Bayesian model comparison. We show that, given current data, the probability that the Universe is spatially infinite lies between 67 % and 98 %, depending on the choice of priors. For the strongest prior choice, we find odds of order 50:1 (200:1) in favour of a flat Universe when compared with a closed (open) model. We also report a robust, prior-independent lower limit to the number of Hubble spheres in the Universe, N_U > 5 (at 99 % confidence). We forecast the accuracy with which future CMB and BAO observations will be able to constrain curvature, finding that a cosmic variance limited CMB experiment together with an SKA-like BAO observation will constrain curvature with a precision of about sigma ~ 4.5x10^{-4}. We demonstrate that the risk of 'model confusion' (i.e., wrongly favouring a flat Universe in the presence of curvature) is much larger than might be assumed from parameter errors forecasts for future probes. We argue that a 5-sigma detection threshold guarantees a confusion- and ambiguity-free model selection. Together with inflationary arguments, this implies that the geometry of the Universe is not knowable if the value of the curvature parameter is below |Omega_curvature| ~ 10^{-4}, a bound one order of magnitude larger than the size of curvature perturbations, ~ 10^{-5}.

2-P16 A Geometrical Method for Extracting the Equation of State of Dark Energy from SN, LSS, and CMB Data

H. Ziaeepour (MSSL-UCL)

All the present estimations of parameter w in the equation of state dark energy are consistent with w ~ -1, i.e. very close to a cosmological constant. Nonetheless even a slight deviation from this value has a great impact on the candidate models. The outcome of multi-parameter fitting methods suffers from the degeneracy between the large number of cosmological parameters. Moreover, the uncertainty of measurements can smear the real value of parameters which must be indirectly extracted from data. As the value of w is close to a critical point for models, such inaccuracies can lead to very wrong conclusions. Here we present a method based on geometrical properties of the density variation with redshift. It is less sensitive to uncertainties of other cosmological parameters than fitting methods and can be applied to supernova and large scale structure data in which the density variation is directly measured. We also discuss the possibility of the extension of this concept to cosmologically integrated data such as Cosmic Microwave Background (CMB) anisotropy.

2-P17 Future Surveys

M. Colless (Anglo-Australian Observatory), The WiggleZ Team

I will overview future cosmological surveys, focussing on those aimed at measuring the dark energy equation of state. This will cover spectroscopic and imaging surveys. I will also briefly overview the current status of some ongoing surveys including the WiggleZ survey.

(3) Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets

Monday
11:00am

Model Atmospheres fo Brown Dwarfs and Extrasolar Giant Planets

F. Allard (CRAL), Derek Homeier, Bernd Freytag

The atmospheres of Brown Dwarfs (BDs) and Extrasolar Giant Planets (EGPs) are the site of molecular opacities and cloud formation, and control their cooling rate, radius and brightness evolution. Brown dwarfs evolve from stellar-like properties (magnetic activity, spots, flares, mass loss) to planet-like properties (electron degeneracy of the interior, cloud formation, dynamical molecular transport) while retaining, due to their fully convective interior, larger rotational velocities (>= 30 km/s i.e. P < 4 hrs versus 11 hrs for Jupiter). Model atmospheres treating all this complexity are therefore essential to understand the evolution properties, and to interpret the observations of these objects. In this paper, we review the efforts over the past decade in modeling brown dwarf atmospheres

Monday
11:30am

The PHOENIX BT-Settl Models of Brown Dwarf and Gas Giant Planet Atmospheres

D. Homeier (Institut für Astrophysik Göttingen), France Allard, Bernd Freytag

The detection and study of substellar objects in the past 14 years has prompted renewed interest in extending classical stellar atmosphere modelling towards cooler effective temperatures, with the most recent discoveries of ultracool brown dwarfs leading close to the regime of planetary atmosphere and climate models. As cooler atmospheric temperatures are encountered the formation of molecules and condensation, sedimentation of condensates and chemical non-equilibrium leading to vertical abundance stratification have to be treated in such models. This talk gives a report on the status of the PHOENIX series of theoretical stellar and planetary atmospheres. While the pure gas-phase based NextGen models (Allard & Hauschildt 1995, Allard et al. 1997, Hauschildt et al. 1999) have allowed an understanding of the various populations of Very Low Mass Stars (VLMs), the AMES-Dusty models (Allard et al. 2001) based on equilibrium chemistry have reproduced the near-IR photometric properties of M and L-type brown dwarfs, and played a key role in the determination of the mass of brown dwarfs and Planetary Mass Objects (PMOs) in the field and in young stellar clusters. These models are succeeded by the BT-Settl grid of models based on the most recent water line list of Barber & Tennyson (2006, BT2) and a quasi-stationary equilibrium treatment of dust formation and sedimentation balanced by vertical mixing. The complexity of the dust microphysics under these conditions has triggered the development of a variety of modelling approaches as reviewed by Helling et al. (2008). Our present model atmosphere grid for VLMs, BDs, PMOs, and EGPs, includes a cloud model and dynamical molecular transport based on vertical mixing characteristics from 2D Radiative Hydrodynamical (RHD) simulations. These simulations provide a consistent velocity field and diffusion efficiencies for the convectively unstable and overshoot regions to predict both condensate distribution and departures from gas phase chemical equilibrium.

Monday
11:50am

An Ammonia Line List for Modelling Brown Dwarfs and Exoplanet Atmospheres

B. Barber (UCL)

(3) Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets

The IR spectra of brown dwarfs and exoplanets are characterized by deep absorption features due to the presence of water, methane and ammonia in their atmospheres, and the variation in transmitted intensity with wavelength is capable of revealing information about the composition and temperature of these atmospheres. However, this requires accurate knowledge of the contribution that each molecular species makes to the opacity as a function of temperature, that is to say, 'line lists' are required. Our BT2 computed line list for water, which was published in 2006, is widely used for atmospheric modelling and spectroscopic applications and we are now in the process of computing a line list for ammonia, which will find application at temperatures of up to 1,500 K. This talk will provide a brief introduction to computed molecular line lists before focusing on the ammonia project.

Monday
12:10pm

Mid Infrared Variability in Binary Brown Dwarfs

M. Sterzik (E.S.O.), K. Geissler, E. Pantin

We present spatially resolved mid-IR photometry of nearby binary brown dwarfs obtained with VISIR at the VLT. In particular, we have monitored eps Indi B and HD130948 in several narrow-band MIR filters. The derived fluxes generally agree with predictions of recent atmospheric models of ultra-cool brown dwarfs. We discuss the signatures of variability in the 10.5 mum band that may become a sensitive probe to constrain non-equilibrium chemistry in the atmosphere of cool brown dwarfs.

Monday
2:00pm

Cool Benchmarks Down to the Water Cloud Regime

B. Burningham (University of Hertfordshire), The Cool Dwarf Science Working Group

I will review recent progress that has been made in the identification of brown dwarfs in systems for which fiducial constraints such as metallicity and age may be obtained, highlighting the recent discovery in the UKIDSS Large Area Survey of a T8.5+M4 dwarf wide binary system that is probing the sub-600K Teff regime.

Such "benchmark" systems will prove crucial for constraining the physics of the ever cooler objects that will be identified in the new era of wide-field infrared surveys, such as VISTA and WISE. I will discuss the future prospects for using such systems to constrain models of substellar atmospheres in the water cloud regime.

Monday
2:20pm

Testing Substellar Models with Dynamical Mass Measurements

T. Dupuy (IfA/Hawaii), Michael C. Liu (IfA/Hawaii), Michael J. Ireland (U. Sydney)

(3) Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets

Mass is the fundamental parameter that governs the life-history of stars and brown dwarfs. Until recently, however, mass determinations were available for only a few relatively warm (> 2000 K) brown dwarfs. Thus, substellar theoretical models have remained largely unconstrained by observations, even though they are widely used to interpret the properties of brown dwarfs and planetary-mass objects. We have been monitoring the orbits of ~25 brown dwarf binaries using Keck laser guide star adaptive optics (LGS AO) and have already doubled the number of mass measurements for brown dwarfs. Keck LGS AO routinely achieves sub-milliarcsecond astrometry, which enables precise mass determinations (3-10\%) for these brown dwarfs with individual masses of 30-60 MJup. These binaries now encompasses the lowest mass, coolest objects with dynamical masses, having effective temperatures of 1000-1800 K (i.e., mid-L to mid-T spectral types). Dynamical mass measurements of brown dwarfs enable strong empirical tests of substellar theoretical models, and our first results have revealed some surprising discrepancies. By monitoring brown dwarf binaries in triple systems with young stellar companions of known age, we have found that evolutionary models may underpredict the luminosities of brown dwarfs by a factor of ~2-3. Such a systematic error in theoretical models would have wide-ranging implications, for example, leading to a systematic overestimate of the masses of brown dwarfs and planetary mass objects of known age and luminosity. We have also for the first time determined the masses of brown dwarfs undergoing the removal of their dust clouds (the L/T transition). This poorly understood, complex phase of substellar evolution also has implications for the cloudy atmospheres of warm extrasolar planets recently found by direct imaging.

Monday
2:40pm

Substellar Companions to White Dwarfs in UKIDSS

P. Steele (University of Leicester), M.R. Burleigh, J. Farihi, M.A. Barstow, R.F. Jameson, P.D. Dobbie

We present a near-infrared spectroscopic search for substellar companions to white dwarfs in UKIDSS. We cross-correlate the SDSS DR4 and McCook & Sion catlogues of white dwarfs with the UKIDSS DR4 database producing 906 and 133 matches respectively. Blackbody models are then fitted to optical photometry to identify those with near-infrared excesses consistent with the presence of an unresolved substellar companion. Data is presented from Gemini follow-up spectroscopy confirming a brown dwarf companion to the white dwarf PHL5038.

Monday
3:00pm

Masses and Radii of Brown Dwarfs in Interacting Binaries

S. Littlefair (University of Sheffield), Vik Dhillon, Tom Marsh, Boris Gaensicke, John Southworth, Isabelle Baraffe, Chris Copperwheat

There is growing evidence that the low-mass stellar models are missing some important physics. Observations of low mass stars in eclipsing binaries show that these stars are larger than expected by 10-20 %. However, we do not know if the same effects influence the structure of smaller objects, like brown dwarfs. There is very little observational data to assess this question, largely due to a lack of brown dwarfs in eclipsing binaries, where mass and radius determinations are possible.

The eclipses of some cataclysmic variables contains sufficient information to derive the mass and radius of the donor star, given minimal assumptions about the system. This allows a donor star mass and radius to be derived, even if the donor is too faint to detect directly. We use this technique to measure masses and radii for a small number of substellar donor stars in CVs. The donor stars are larger than predicted by stellar models, by some 10-15 %. We discuss the implications, including the relevance of donors in interacting binaries to field brown dwarfs.

Monday
3:15pm

Low-Mass Object in Moving Groups

M. Galvez-Ortiz (University of Hertfordshire), J. R. A. Clarke, D. Pinfield, S. L. Folkes, J. S. Jenkins, B. Burningham, A. C. Day-Jones,

We present here the study of part of a 133 target sample of low-mass objects previously selected via photometric and astrometric criteria, as possible members to five young moving groups (MG): Local Association (Pleiades moving group, 20 - 150 Myr), Ursa Mayor group (Sirius supercluster, 300 Myr), Hyades supercluster (600 Myr), IC 2391 supercluster (35 Myr) and Castor moving group (200 Myr). The aim of the work is to further asses or dismiss their membership by using different kinematic and spectroscopic criteria. The confirmed members will provide a new and substantial population of age and metallicity benchmark ultra cool dwarfs (UCDs), an valuable set to test atmosphere and evolutionary UCDs models at age < 1Gyr and a suitable targets for AO imaging searches for sub-stellar companions/exo-planets.

Monday
4:30pm

ESO AO Instrumentation for BD and Exoplanet Research

M. Kasper (ESO)

The talk will provide an overview on existing and future VLT instrumentation using adaptive optics and their relevance to brown dwarf and exoplanet research. It will further provide an introduction to the exoplanet imaging camera and spectrograph (EPICS) for the EELT which is currently in a phase-A study.

Monday
5:00pm

UKIRT Planet Finder

H. Jones (University of Hertfordshire), Barnes J., Longmore A., Rayner J., Ramsey L., Pinfield D., Collier-Cameron A., Doyle G., Marsch, T., Pollacco D., Tinetti G., Viti, S.

Over 300 extra-solar planets have been discovered to date using a variety of techniques. The majority have been discovered at optical wavelengths from the Doppler shift of F, G and K stars induced by orbiting planets. We have constructed models simulating likely planets around M dwarfs and demonstrated the ability to recover their radial velocity signals in the infrared. We have conducted experiments in the infrared with a brass-board instrument to explore real-world issues. We are thus confident that a stabilised radial velocity spectrometer suitable for UKIRT with a single-shot 1 and 1.7 microns coverage at a resolution of around 70 k can achieve an instrumental radial velocity error of 0.5 m/s. This enables the efficient measurement of radial velocities for M, L and T spectral classes.

Monday
5:15pm

The OmegaCAM Transit Survey - Revised Survey Strategy and Early Results

J. Koppenhoefer (MPE, Garching), I.A.G. Snellen, R.P. Saglia, J.M. Alcala

The OmegaCAM Transit Survey (OmegaTranS) is going to start in early 2010 using the new VLT Survey Telescope (VST) at Paranal Observatory. We present results obtained in a pre-OmegaTranS campaign with ESO/WFI including a very promising planet candidate orbiting a late K-dwarf. Further we give an overview of the survey strategy which has been optimized towards detecting and characterizing two of the presently most interesting planetary populations: low-mass planets around M-dwarfs and Jupiter-sized planets in open clusters.

Monday
5:30pm

High Contrast Observations with EPICS (ExoPlanet Imaging Camera and Spectrograph)

G. Salter (Oxford Astrophysics), Niranjan Thatte, Matthias Tecza, Fraser Clarke, Markus Kasper, Cristophe Verinaud

Instruments are now being built to obtain direct images and spectra of extrasolar planets. This mean achieving contrasts of >10^6 at separations of few tenths of an arcsecond. All new instruments are incorporating an Integral Field Spectrograph due to their unique ability to both detect and characterise in a single observation thus obviating the need for expensive follow-ups. With the SPHERE instrument nearly ready for the VLT and promising to deliver contrasts enabling us to detect Super Jupiters, investigations have already begun into the possibilities for high contrast imaging instruments for the next generation of telescopes. A design study for EPICS on the E-ELT is already underway and is hoping to reach exo-Earths which means contrasts approaching 10^-10. Promising research is being done into using an IFS and a method called spectral deconvolution to eliminate quasi-static speckles by using their chromatic behaviour to surpass the speckle noise limit to achieve the required contrasts. The general concept of the instrument will be presented as well as its goals in terms of contrast and its main science cases. The spectral deconvolution method will also be described.

Monday
5:45pm

Measuring the Frequency and Composition of Extrasolar Minor Planets

J. Farihi (University of Leicester)

Asteroids are ancient planetesimals, the building blocks of terrestrial planets. In the Solar System, we indirectly measure the composition of asteroids by studying meteorites. Evidence is now strong that warm dust disks resulting from the tidal disruption of minor planets exist at between 1 % and 3 % of all white dwarfs with cooling ages less than around 0.5 Gyr, providing a ready explanation for their externally-polluted, metal-enriched atmospheres. These discoveries provide information that at present can be acquired no other way: the frequency and bulk chemical composition of minor planet systems around other stars. I will present work to date using this novel approach to the spectroscopic study of extrasolar, terrestrial planetary debris. Currently, there appear to be at least very basic similarities between the composition of Solar System asteroids and extrasolar asteroids. For heavily polluted stars, we anticipate that, eventually, a combination of optical and ultraviolet spectroscopy will enable the measurement of the relative abundances of two dozen or more heavy elements representing the bulk chemical composition of extrasolar minor planets.

Tuesday
11:00am

Direct Imaging of Multiple Planets Orbiting HR 8799

J. Patience (University of Exeter), C. Marois, B. Macintosh, T. Barman, B. Zuckerman, I. Song, D. Lafreniere, R. Doyon

(3) Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets

With high-contrast adaptive optics imaging on the Keck and Gemini telescopes, a multiple planet system has been imaged around the dusty, A-type star HR 8799. The projected separations range from 24 AU to 68 AU, and the masses are estimated to be 5 to 13 times the mass of Jupiter. The HR 8799 planetary system and prospects for future searches with the Gemini Planet Imager will be discussed.

Tuesday
11:20am

Homogeneous Comparison of Planet Candidates Imaged Directly

R. Neuhaeuser (AIU Univ. Jena), Tobias Schmidt (Univ. Jena) and Andreas Seifahrt (Univ. Goettingen)

Between April 2005 and November 2008, 12 planet candidates detected by direct imaging have been published. The first few planet candidates were found around very young stars; most recently, planets were found around stars with debris disks. For companions imaged directly, i.e. in wide long orbits, it is difficult to constrain the mass well. Hence, it remains often unclear whether the companion is a planet or a brown dwarf. This may also depend on the exact definition of planet, in particular its upper mass limit. We will present new Sinfoni spectra of some objects and comparison with Drift-Phoenix model atmospheres. Then, we will compare all detected objects and determine their mass ranges in a homogeneous way. Based on that we will discuss their formation and nature.

Tuesday
11:45am

Transiting Planets: from Hot Jupiters to Super-Earths

E. Simpson (Queen's University Belfast), Don Pollacco

The discovery of over 50 hot Jupiters via the transit method has enabled us to study these curious and enigmatic planets in unprecedented detail, from internal structure to atmospheric properties. Both ground and space based projects continue to push the boundaries of detectability towards lower masses and longer orbital periods, increasing our understanding of a variety of different systems and environments. Sophisticated techniques and instrumentation are being brought to bear on the demanding task of planet detection and characterisation, however we are still faced with many challenges. In this review talk, I will summarise the current status of transit surveys as well as some of the important discoveries which have been made, and take a look to future missions and the drive towards Earth-like planets in the habitable zone.

Tuesday
12:10pm

Detection of a Transit by the Eccentric-Orbit Planetary Companion to HD 80606

S. Fossey (UCL), Ingo Waldmann, David Kipping

We report one of the first detections of a transit egress by the ~3.9-Jupiter-mass planet HD 80606b, an object in a highly-eccentric orbit (e~0.93) about its parent star of approximately solar type. Observations were made using the facilities of the University of London Observatory. The astrophysical reality of the signal of variability in HD 80606 is confirmed by observation with two independent telescope systems, and checks against several reference stars in the field. Differential photometry with respect to the nearby comparison star HD 80607 provides a precise light curve. We model the light curve with a full eccentric-orbit model to obtain a planet/star-radius ratio of 0.1057 +/- 0.0018, corresponding to a planet radius of 1.029 R_J for a solar-radius parent star; and a precise orbital inclination of 89.285 +/- 0.023 degrees, giving a total transit duration of 12.1 +/- 0.4 hours. The planet hence joins HD 17156b in a class of highly eccentric transiting planets, in which HD 80606b has both the longest period and most eccentric orbit. The recently reported discovery of a secondary eclipse of HD 80606b by the Spitzer Space Observatory permits a combined analysis with the mid-time of primary transit in which the orbital parameters of the system can be tightly constrained. We note the exciting new opportunities opened up by the transit detection for follow-up study of this fascinating exoplanet system.

Tuesday
2:00pm

Transiting exoplanets from the WASP-South Survey

C. Hellier (Keele University), The WASP consortium

The WASP-South survey has so far found 12 transiting exoplanets around stars of V = 9--13, making it the most successful transit search in the South. I will review the current state of WASP-South and present details of the new discoveries, including several planets with unprecedented parameters that extend the envelope of known systems.

Tuesday
2:20pm

The Spitzer/HARPS Search for Nearby Transiting Rocky Planets

M. Gillon (University of Liege), D. Deming, B.-O. Demory, C. Lovis, M. Mayor, F. Pepe, D. Queloz, S. Seager, S. Udry

The few transiting giant planets known to transit a host star bright enough to allow a detailed multi-wavelength follow-up have opened a new field of astronomy: exoplanetology. Extending this select group by detecting the few terrestrial planets that must transit nearby stars will permit the characterization of rocky worlds outside our solar system. Among the few transit surveys able to detect rocky planets, none target stars bright enough to permit such a thorough characterization in the near-future. On the other hand, the HARPS radial velocities survey has already detected dozens of 'Super-Earths' in the solar vicinity. Knowing their presence and their orbit, the search for their transit is certainly the most efficient way to open the era of terrestrial exoplanetology. Among the existing facilities, we will show that the Spitzer Space Telescope is the most suited for this task. We will present in our talk our Spitzer/HARPS program and its first results.

Tuesday
2:40pm

Groundbased Observations of Hot-Jupiter Atmospheres

I. Snellen (Leiden Observatory), Ernst de Mooij, Simon Albrecht

I will discuss our recent results on groundbased transmission spectroscopy of sodium in HD209458b and our K-band detection of the secondary eclipse of TrES-3b.

Tuesday
3:00pm

New Observations and Modelling of the Exoplanets HD 189733b and HD 209458b

G. Tinetti (UCL)

In the past decade, more than 300 planets orbiting other stars (extrasolar planets) have been discovered. For a growing sample of giant extrasolar planets orbiting very close to their parent star (hot-Jupiters), we can already probe their atmospheric constituents using transit techniques. With the primary transit method, we can indirectly observe the thin atmospheric ring surrounding the optically thick disk of the planet -the limb- while the planet is transiting in front of its parent star. With the secondary transit method, we can collect photons emitted or reflected by the planet. Here we will present new most recent observations of the Hot-Jupiters HD 189733b and HD 209458b, including primary and secondary transit photometry and spectroscopy measurements with Hubble, Spitzer and ground-base telescopes. These new results combined with the existing ones, show that a complex chemistry is present in Hot-Jupiters' atmospheres, including -a part from hydrogen and water- a variety of carbon and nitrogen-bearing molecules. More comprehensive photochemical models are required to explain these exotic environments.

Tuesday
3:15pm

Evidence for a Lost Population of Close-in Exoplanets

P. Wheatley (University of Warwick), Tim Davis, University of Oxford

We investigate the evaporation history of known transiting exoplanets in order to consider the origin of observed correlations between mass, surface gravity and orbital period. We show that the survival of the known planets at their current separations is consistent with a simple model of evaporation, but that many of the same planets would not have survived closer to their host stars. These putative closer-in systems represent a lost population that could account for the observed correlations. We conclude that the relation underlying the correlations noted by Mazeh et al. (2005) and Southworth et al. (2007) is most likely a linear cut-off in the M^2/R^3 vs a^-2 plane, and we show that the distribution of exoplanets in this plane is in close agreement with the evaporation model.

3-P01

Pan-Planets: A Massive Search for Hot Jupiters

C. Afonso (Max Planck Institute for Astronomy), Th. Henning

The Pan-Planets pro ject is a search for transiting extra-solar Jupiter-like planets with the 1.8m Pan-STARRS telescope and its wide field camera of 7 square degrees. Three transit surveys campaigns will be performed, with the first two over the course of the Pan-STARRS mission, and the third at the end of the mission. Each transit survey campaign is to be scheduled for 120 hours per year, covering 5 to 7 adjacent fields, i.e. 35 to 49 square degrees per campaign with a time sampling of 5 min. per field. It is expected to reach relative photometric accuracies of 0.5 -1 % down to V=16.5 mag, with the goal of finding more than 100 Very Hot to Hot Jupiters. The primary scientific aim of Pan-Planets is to derive the frequency of Very Hot to Hot Jupiters with stellar type using a homogeneous sample, and add to a better understanding of the radius-mass diagram. Finally, the findings of Pan-Planets will serve as an input for planet population synthesis models for semi-major axis < 0.05, currently being developed at MPIA.

3-P02 Improving the Parameters of CoRoT Planets with Transit Reconstruction in the Presence of Stellar Activity

A. Alapini (University of Exeter), Suzanne Aigrain

An accurate characterisation of exoplanets is important to constrain planet formation and evolution models. This is difficult to achieve in the case of planets around active stars, as most of the current 'pre-detection' stellar variability filters, which are needed to allow the detection of the transits, alter the transit signal. We discuss how the transit signal is affected by the stellar variability filtering process in the case of the widely used 'pre-detection' nonlinear iterative filter (NIF). We then present a new, 'post-detection' iterative reconstruction filter (IRF) which filters out the stellar variability while minimising the effect on the transit signal. Using simulated light curves from the CoRoT Blind Test 2, we show that the IRF leads to a significant improvement in the estimate of the planet parameters compared to the NIF. We apply the IRF to the planets discovered by CoRoT in an attempt to a) refine the planet parameters and b) search for secondary eclipses.

3-P03 Brown Dwarfs in Praesepe

D. Baker (University of Leicester), Richard Jameson

We present the results of a photometric and proper motion search for low mass members of the Praesepe star cluster. Using data made available from the Two Micron All Sky Survey (2MASS), The Sloan Digital Sky Survey (SDSS) and The UKIRT Infrared Deep Sky Survey (UKIDSS). We identify 91 "Bright" high probability members ($p>0.6$) from the cross-correlation between 2MASS and UKIDSS and 3 "Faint" low probability objects from the cross-correlation between SDSS and UKIDSS. Further to this, the data allowed an investigation into the cluster's luminosity and associated mass function, which we subsequently fitted with a single power law with an index alpha equal to 1.57.

3-P04 Exoplanet Detection and Characterisation from High Resolution Spectroscopy

J. Barnes (Hertfordshire), T. Barman, H.R.A. Jones, C.J. Leigh, B. Barber, A. Collier Cameron

Space based broadband infrared observations of close orbiting extrasolar giant planets at transit and secondary eclipse have proved a successful means of determining atmospheric spectral energy distributions and molecular composition. I will discuss near infrared, ground based, high resolution spectroscopic efforts to detect and characterise the molecular composition of these objects. Studies of a number of systems indicate that species such as H_2O and carbon bearing molecules which are present in current models and confirmed observationally at low resolution do not match observations at high resolution.

3-P05 A Search for Southern Ultracool Dwarfs in Young Moving Groups

J. Clarke (University of Hertfordshire), M. C. Galvez (1), D. J. Pinfield (1), H. R. A. Jones (1), B. Burningham (1), R. S. Pokorny (2), N. R. Deacon (3), A. C. Day-Jones (4), J. S. Jenkins (4) ((1) University of Hertfordshire; (2) National Astronomical Observatories / Yunnan Observatory, the Chinese Academy of Sciences; (3) Radboud University Nijmegen; (4) Universidad de Chile)

We have constructed a 800 strong Red Object catalogue by cross referencing optical and infrared catalogues with an extensive proper motion catalogue compiled for red objects in the southern sky to obtain proper motions. We applied astrometric and photometric constraints to the catalogue in order to select ultracool dwarf moving group candidates. 133 objects were found to be candidates of a moving group.

From this candidate list we present initial results for seven of the brighter candidates. Using spectroscopy we have obtained reliable spectral types and space motions, and by association with moving groups we can infer an age and composition. The further study of the remainder of our candidates will provide a large sample of young brown dwarfs and confirmed members will provide benchmark ultracool dwarfs. These will make suitable targets for AO planet searches.

3-P06 Searching for widely separated ultracool companions to white dwarfs in SDSS and UKIDSS.

A. Day-Jones (Universidad de Chile), D.J. Pinfield (U of Hertfordshire), M.T. Ruiz (U de Chile), R. Napiwotzki (U of Hertfordshire), B. Burningham (U of Hertfordshire), J.S. Jenkins (U de Chile), J. Gallardo (U de Chile), H.R.A. Jones (U of Hertfordshire), Z. Zhang (U of Hertfordshire) and M. Radizcz (U de Chile).

Whilst white dwarf + ultracool dwarf binary systems are rare, they are likely to be benchmark systems, where the age of the system can be well defined from the white dwarf age, using robust evolutionary models. In this way, by association an ultracool dwarf companion will have an independently determined age, that is not reliant on models of ultracool dwarfs, that can suffer from unreliability, stemming from some poorly understood atmospheric physics of such cool atmospheres. The ability to aid the calibration of such models relies on the discovery of objects from systems such as these, where their properties can de independently determined. With the help of deep, large optical and NIR surveys, such as SDSS and UKIDSS a new hunting ground has been provided, where many more systems of this type should be found. We present our current findings from our search for widely separated white dwarf + ultracool dwarf systems from the UKIDSS (DR4) and SDSS (DR7).

3-P07 The Current Population of Benchmark Brown Dwarfs

A. Day-Jones (Universidad de Chile), D.J. Pinfield (U of Hertfordshire), M.T. Ruiz (U de Chile), B. Burningham (U of Hertfordshire), J.S. Jenkins (U de Chile), H.R.A. Jones (U of Hertfordshire), J. Gallardo (U de Chile), M.C .Gálvez-Ortiz (U of Hertfordshire) and J.R.A. Clarke (U of Hertfordshire)

Since the discovery of the first brown dwarfs (Tiede 1; Rebolo et al. 1995, Gliese 229B; Nakajima et al. 1995) the complement of brown dwarfs now stands at ~700. Yet our understanding of these cool objects is still lacking, and models are struggling to accurately reproduce the variety of photometric and spectral properties observed. What is needed is a method of calibrating the models, which can be provided by brown dwarfs whose properties (e.g. age, mass) can be independently determined without reference to the models. Such benchmarks are not common however, and the level of accuracy on those constraints is not always high. We present the current status of the population of age benchmark brown dwarfs and compare them to the latest model predictions.

3-P08 Physical Parameters of M Dwarfs from High Resolution Spectra

C. del Burgo Díaz (Dublin Institute for Advanced Studies), E. L.Martin, R. Deshpande, P. Hauschildt

We determine the radial velocity, rotational broadening, effective temperature and surface gravity of a sample of M dwarfs from the comparison of high-resolution near-infrared spectra and synthetic models. We also estimate their mass and age from state-of-art models.

3-P09 Identifying Ultra-Cool Dwarfs at Low Galactic Latitudes: A Preliminary Southern Catalogue

S. Folkes (University of Hertfordshire), D. J. Pinfield, H. R. A. Jones, J. R. A. Clarke and M. C. Galvez

We present the results of a search for Ultra-Cool Dwarfs (UCDs) in the crowded regions of the southern Galactic plane. We have identified 247 UCD candidates resulting from a cross-correlation of the 2MASS and SuperCOSMOS surveys from 3236 square degrees (220deg < l < 360deg and 0deg < l < 30deg, for |b| < 15deg). Sixteen of the candidates are spectroscopically confirmed as UCDs with spectral types from M7V to L9, one of which being the unusual blue L dwarf 2MASS J11263991-5003550. Our selection method allows UCDs from ~M7V to the L-T transition to be selected down to a 2MASS limiting magnitude of K_s=14.5mag (for SNR >= 10). This method does not require candidates to have optical detections for inclusion in our preliminary catalogue. We give details of an optimal set of photometric optical/near-IR, and reduced proper motion selection criteria we have defined. These, together with additional photometric constraints and a novel `overcrowding' criteria provide effective removal of contaminants. We identify a number of potential benchmark objects, for which constraints on their physical properties may be inferred indirectly from future observations: three are possible companions to nearby Hipparcos stars, while 23 show possible kinematic membership of known moving groups. Confirmed young moving group members would make ideal targets for AO imaging searches, to discover faint sub-stellar and possibly planetary mass companions. Estimates of spatial completeness in the preliminary catalogue are made, as well as areal completeness for which a correction at the 75 per cent level is applied. We derive a preliminary space density of 0.013+-0.005 UCDs per parsec cubed, similar to previous values measured at higher Galactic latitudes (|b| > 15deg) in the field population.

3-P10 Planetary Debris Discs Around White Dwarfs

B. Gaensicke (University of Warwick), T.R. Marsh, D. Koester, T. Kinnear, J. Southworth

While the number of known exo-planets is growing at a weekly rate, little is known about the survival of planetary systems during the late phase of stellar evolution. Throughout the last years, more than a dozen white dwarfs harbouring hydrogen and helium-depleted debris discs have been identified that are interpreted as signatures of the tidal disruption of rocky asteroids. While the initial hallmark of these planetary debris discs was the detection of an infrared excess we have identified five white dwarfs that exhibit double-peaked emission lines from gaseous metal-rich circumstellar discs. These emission lines hold a substantial diagnostic potential for exploring the geometric, dynamical, and thermal structure of the debris discs. I will review the observational data available so far, and discuss our progress in modelling these debris discs.

3-P11 A Search for Earth-Sized Exoplanets Using RISE - A New Fast Camera for the LT.

N. Gibson (Queen's University, Belfast), Don Pollacco, Yogesh Joshi, Susana Barros, Ian Skillen, Marie Hrudkova

High precision transit photometry of extra-solar planets allows us to measure the central transit times of these systems very accurately (~10s). This could reveal the presence of a third body through transit timing variations (TTV) by measuring any perturbations on the transiting planets orbital period. This is even sensitive to Earth-sized planets when orbiting in low-order mean-motion resonance. A new fast camera, RISE, was mounted on the Liverpool Telescope early last year, primarily to obtain high-time resolution transits for TTV observations. I will present nine light curves of TRES-3 - some of the first results from RISE. I will discuss techniques to model the light curves and accurately determine the central transit times in an effort to detect a TTV signal, and also techniques to model 3-body systems in order to place upper mass limits on a hypothetical second planet.

3-P12 Polarisation of brown dwarfs

B. Goldman (MPIA), J.Pitann, M. R. Zapatero Osorio, C. A. L. Bailer-Jones, V. J. S. Béjar, J. A. Caballero, and Th. Henning

Ultra-cool dwarfs of the L spectral type (Teff=1400 to 2200K) are known to have dusty atmospheres. Asymmetries of the dwarf surface may arise from rotationally-induced flattening and from an heterogeneous dust-cloud coverage. This may result in non-zero linear polarisation through dust scattering.

We aim to study the heterogeneity of ultra-cool dwarfs' atmospheres and the grain-size effects on the polarisation degree in a sample of nine late M, L and early T dwarfs.

We obtained linear polarimetric imaging measurements using FORS1 at the Very Large Telescope, in Paranal, in the Bessel I filter, and for a subset in the Bessel R and the Gunn z filters.

We measure a polarisation degree of (0.31±0.06) % for LHS102BC. We fail to detect linear polarisation in the rest of our sample, with upper-limits on the polarisation degree of each object of 0.09 % to 0.76 % (95 % of confidence level), depending on the targets and the bands. For those targets we do not find evidence of large-scale cloud structure in our data. For three brown dwarfs, our observations indicate polarisation degrees different (at the 3-sigma level) than previously reported, giving hints of possible variations.

Our results decrease the fraction of ultra-cool dwarfs with detected linear polarisation to (23+10-6) % (1-sigma errors). From the whole sample of well-measured objects with errors smaller than 0.1 %, the fraction of ultra-cool dwarfs with polarisation degree larger than 0.3 % is smaller than 16 % (95 % confidence level).

3-P13 Galactic Research with SAFARI: A far-IR Imaging-Spectrometer for SPICA

Javier R. Goicoechea (CAB-CSIC, Madrid, Spain), Kate Isaak (U. Cardiff, UK), Bruce Swinyard (RAL, UK) on behalf of the SAFARI consortium.

(3) Understanding substellar populations and atmospheres: from brown dwarfs to exo-planets

The far-IR spectral window plays host to a wide range of spectroscopic diagnostics with which to follow the processes that transform gas and dust into stars and planets at wavelengths completely blocked by the Earth's atmosphere but that play a critical diagnostic in a number of key areas of galactic research.

These include some of the key atomic (e.g., oxygen) and molecular (e.g., water) cooling lines, the dust thermal emission, the water ice features as well as many other key chemical tracers. The proposed Japanese-led IR space telescope SPICA, with its 3.5m cooled mirror will be the next step in sensitivity after Herschel. SPICA has been selected to go to the next stage of the ESA's Cosmic Vision 2015-2025 process.

This contribution summarizes the design concept behind SAFARI: an imaging far-IR spectrometer covering the 35-210um waveband that is one of a suite of instruments for SPICA; it also highlights some of the science questions that it will be possible to address with SAFARI (and that will not be answered by Herschel due to sensitivity/wavelength coverage limitations): e.g., providing a comprehensive inventory of stars with circumstellar disks for future planet imaging facilities, resolving the (water ice) "snow line" in nearby planet forming disks, accessing the main gas coolants and grain compounds in protoplanetary disks and comparing them with the hundreds of spectra of distant (tras-Neptunian) objects that will be possible to acquire in our own Solar System, as well as potential searches of far-IR signatures in transiting exoplanets (water?). With its high sensitivity and large field-of-view, SAFARI will provide a superior way to obtain fully sampled spectro-images and full SEDs of very faint and/or very extended regions in a key wavelength domain not accessible to JWST or ALMA.

3-P14 On SAFARI, Local and Beyond

K. Isaak (Cardiff University), Javi Goicoechea, Bruce Swinyard on behalf of the SAFARI consortium

We present the design and science case for SAFARI, a FIR imaging spectrometer for the proposed JAXA-led Japanese-ESA mission, SPICA. SPICA is one of a number of missions that have been selected to go to the next stage of the ESA Cosmic Vision proposal. With its cooled, 3.5m mirror, SPICA will provided unprecendented sensitivity in the FIR. SAFARI is an imaging spectrometer with both spectral and photometric capabilities that cover the 35 - 210um waveband. We illustrate the uniqueness of SAFARI through the key science that will be addressed with the instrument, in fields as diverse as planet formation and galaxy evolution.

3-P15 SPICA - the SPace Infrared Mission for Cosmology and Astrophysics

K. Isaak (Cardiff University), Takao Nakagawa on behalf of the SPICA consortium

We present the mission concept, design and a brief description of the focal plane instrument suite for SPICA - a proposed next generation infrared satellite for cosmology and astrophysics and a candidate mission for the ESA Cosmic Vision. A Japanese-led, joint JAXA-ESA mission, SPICA will have a single-element, high surface accuracy 3.5m mirror, cooled to ~ 4.5K. The combination of large collecting area, low self-emission and diffraction-limited performance over a core wavelength range of 5 - 210um, will provide the basis for a sensitive and versatile suite of focal plane instruments. These include: a large-format MIR camera and spectrometer, a high contrast (10^-6) MIR coronograph with photometric and spectroscopic capability, a FIR imaging spectrometer and camera, and a high sensitivity, low-resolution FIR/submm grating spectrometer.

3-P16 First Results from the CHEPS: Exoplanets and the Discovery of an Eccentric Brown Dwarf in the Desert

J. Jenkins (Universidad de Chile), H.R.A. Jones, K. Gozdziewski, C. Migaszewski, J.R. Barnes, M.I. Jones, P. Rojo, D.J. Pinfield, A.C. Day-Jones, S. Hoyer

We report the discovery of a brown dwarf on an eccentric orbit and with a semimajor axis that places it in the brown dwarf desert region around the star HD191760. The star has a spectral type of G3IV/V and a metallicity ([Fe/H]) of 0.29 dex. HD191760 adds to the small number of metal-rich stars with brown dwarf companions. After employing a bisector span correction to the observed radial-velocities, we find the brown dwarf (HD191760b) has an orbital period of 505.57+/-0.40 days and semimajor axis of 1.35+/-0.01 AU, placing it firmly in the brown dwarf desert. The eccentricity of HD191760b is found to be 0.64+/-0.01, meaning it reaches as close as 0.47 AU from the host star. Dynamical simulations indicate that no inner planets could reside at separations beyond ~0.17 AU due to the disastrous gravity imposed by HD191760b. In addition to these first results we also refine the orbits found for the exoplanets around the stars HD48265, HD143361 and HD154672. All 1-planet solutions are in agreement with those previously published by the Magellan Planet Search, albeit with lower rms scatter.

3-P17 Rotation velocities for M-dwarfs

J. Jenkins (Universidad de Chile), H.R.A. Jones, L.W. Ramsey, Y. Pavlenko, J. Gallardo, J.R. Barnes, D.J. Pinfield

We present spectroscopic rotation velocities (v sin i) for 56 M dwarf stars using high resolution HET HRS red spectroscopy. In addition we have also determined photometric effective temperatures, masses and metallicities ([Fe/H]) for some stars observed here and in the literature where we could acquire accurate parallax measurements and relevant photometry. We have increased the number of known v sin is for mid M stars by around 60\% and can confirm a weakly increasing rotation velocity with decreasing effective temperature. Our sample of v sin is peak at low velocities (~3 km/s) with a secondary pile up of higher velocity stars. When all literature velocities for M dwarfs are included there are 215 with v sin i < 10 km/s. In addition we also search the spectra for any significant Halpha emission or absorption. 43\% were found to exhibit such emission and probably represent young, active objects with high levels of radial-velocity noise. We acquired two epochs of spectra for the star GJ1253 spread by almost one month and the Halpha profile changed from showing no clear signs of emission, to exhibiting a clear emission peak. Four stars in our sample appear to be low-mass binaries (GJ1080, GJ3129, Gl802 and LHS3080), with both GJ3129 and Gl802 exhibiting double Halpha emission features. The tables presented here will aid any future M star planet search target selection to extract stars that will exhibit low radial-velocity jitter.

3-P18 The lithium abundance of stars with planets

J. Jenkins (Universidad de Chile), J. Gallardo, A. Escala

Controversial conclusions about lithium (Li) depletion in stars with planets as an indicator of the existence of exoplanetary systems have been arrived at by several authors. In this poster we attempt to shed some light on these disagreements using the database of the Anglo-Australian Planet Search survey. We compare chromospheric activity, metallicity and, specifically, we focus our study on the rotational velocities in stars with and without planetary companions and their Li abundance. Our conclusions suggest that stars harbouring planets are more Li depleted and slower rotators than stars without planetary companions, in agreement with the previous results claimed by Gonzalez (2008). This result will help constrain and optimize future extrasolar planet search surveys.

3-P19 An Exoplanet Mass Function from the Anglo-Australian Planet Search

H. Jones (University of Hertfordshire), O'Toole, S., Tinney, C., Butler, R.P., Bailey, J.

We report on a 48 night run with the Anglo-Australian Telescope. On this run we targeted 24 bright, nearby and intrinsically stable Sun-like stars selected from the Anglo-Australian Planet Search's main sample. we have Monte-Carlo simulated the data from this run on a star-by-star basis to produce robust detection constraints. These simulations demonstrate clear differences in the exoplanet detectability functions from star to star due to differences in sampling, data quality and intrinsic stellar stability. They reinforce the importance of star-by-star simulation when interpreting the data from Doppler planet searches. The two low-mass planets we discover in our 24 star sample indicate that the exoplanet minimum mass function at low masses is likely to be a flat, a=-1 (for dN/dM = M^a) and that ~17 +/- 12 % of stars host planets with orbital periods of less than 16 days and minimum masses greater than 3 Earth masses.

3-P20 Transit Timing Effects due to an Exomoon

D. Kipping (David Kipping)

As the number of known extrasolar planets continues to grow, the question as to whether such bodies harbour satellites has become one of increasing interest. A profound motivation is the search for rocky, habitable bodies which may support life. Observations and simulations suggest the Solar System could be a unique environment, and so perhaps life on an exomoon is more feasible than life on an exoplanet.

Direct detection of an exomoon is beyond the capabilities of current instruments, but the motion of a transiting exoplanet could offer a short-cut. In this work, we consider the wobble of an exoplanet due to an orbiting moon and conclude that a transiting planet will exhibit two measureable effects: i) mid-transit time variation (TTV) ii) transit duration variation (TDV). We evaluate the magnitude of these observables and demonstrate that current telescopes can detect an Earth-like moon around a Neptune-like planet.

3-P21 Photometrical Observations of Transiting Planets TrES-2 and TrES-3

V. Krushevska (MAO NAS of Ukraine), Yu. Kuznyetsova, M. Andreev, A. Vid'machenko

More than three hundred planets orbiting other stars are known up today. Among all these discovered extrasolar planets the most interesting ones are the transiting planets because from the light curves of their parent stars we can get planet radius. In this work we present the results of CCD-photometry data processing of two such transiting planets: the massive hot Jupiter TrES-2 and one of the closest to host star exoplanets TrES-3. The photometrical observations of TrES-2 and TrES-3 were obtained in 1-meter telescope of Crimean Astrophysical Observatory and in Zeiss-600 of Terskol Branch of INASAN RAS.

3-P22 Comparative Spectroscopic Research of Atmospheres of Giant Planets

Y. Kuznyetsova (Main Astronomical Observatory of NAS of Ukraine), Vid'machenko A.

High-resolution spectral observations for atmospheres of giant planets Jupiter, Saturn, Uranus, Neptune and some stars with exo-planets in visible range are presented. The observations were carried out with the help of 2-meter telescope of Terskol Observatory and 6-meter telescope of Special Astrophysical Observatory (both Northern Caucasus, Russia). Obtained spectra were analyzed taking into account Raman light scattering by hydrogen molecules in atmospheres of giant planets. Quantitative estimation of Raman light scattering contribution for spectra of atmospheres of giant planets Jupiter, Saturn, Uranus and Neptune was done. The attempt of detecting of Raman light scattering in spectra of stars with exo-planets was undertaken. Comparative research of contributed levels of Raman light scattering in spectra of these planets was carried out. Variations of Raman light scattering levels over the time were analyzed for each giant planet separately.

3-P23 Self-Gravitating Discs with Radiative Transfer: Their Role in Giant Planet Formation

F. Meru (University of Exeter), Matthew Bate

We present new results on the fragmentation, spiral structure strength and angular momentum transport in self-gravitating accretion discs. The early evolution of massive self-gravitating discs has been considered using cooling parameters to describe the thermodynamics (e.g. Lodato & Rice 2004) and using grid-based radiative transfer calculations (e.g. Cai et al. 2008; Boss 2004). We present results from simulations using a Smoothed Particle Hydrodynamics code with radiative transfer to follow the evolution of such discs in order to simulate more realistically the physical processes of energy transfer that may occur in such massive discs, with particular focus on whether regions of these discs are able to cool sufficiently enough to fragment and form giant planets. Future observations using Subaru, Keck, VLT, Gemini, ALMA and other telescopes will not only observe extra-solar planets but also young discs undergoing planet formation, perhaps detecting the presence and strengths of spiral structures in massive discs as predicted by theory. With this in mind, the need to model these discs as realistically as possible is important in order to marry the theories of giant planet formation and disc evolution with observations.

3-P24 Mid-Infrared Variability of Protostars in IC 1396A

M. Morales-Calderon (LAEX-CAB/INTA-CSIC), J.R. Stauffer, B. Whitney & D. Barrado

We present the results of photometric monitoring program of the IC1396A dark globule in order to study the mid-IR (3.6 - 8mu) variability of the heavily embedded Young Stellar Objects (YSOs) present in that area. We obtained light curves covering a 14 day timespan with a twice daily cadence for 69 YSOs, and continuous light curves with approximately 12 second cadence over 7 hours for 38 YSOs. About half of the YSOs showed detectable variability, with amplitudes from 0.05 mag to 0.2 mag. Eighteen of the YSOs showed quasi-sinusoidal light curve shapes with apparent periods from 5-12 days and light curve amplitudes approximately independent of wavelength over the IRAC bandpasses. The apparently periodic light curves are best explained by YSO models where a high latitude photospheric spot periodically heats the inner wall of the circumstellar disk. The other YSOs in our sample show a range of light curve shapes, some of which are probably due to varying accretion rate or disk shadowing events. We believe that these kind od studies open a new window into the physics of star and early planet formation.

3-P25 Detection of Astrophysical False Positives in the Pan-Planets Photometric Data

N. Nikolov (MPIA), Cristina Afonso, Thomas Henning

The Pan-Planets project is dedicated to photometric search of transiting extra-solar Jupiter-like planets with the 1.8m PanSTARRS telescope and its wide field detector of 7 square degrees, at the Lure Observatory in Haleakala, Maui Hawaii. The experience of previous transit surveys demonstrates that the number of events that mimic the signal of a transiting planet (astrophysical false positives) significantly out-number the true transiting planets. We have implemented a pipeline that classifies our detections according to three criteria - out-of-transit ellipsoidal variation (Drake 2005), -parameter diagnostic (Tingley & Sackett 2005) and the derived stellar and planetary parameters from a fit of the light curve. The selection is made further based on additional external information if available, such as proper motion, colors, spectral types, blend-topology, and variable stars catalogs. Furthermore, we present some preliminary results from the testing of our tools on the publicly available OGLE light curves and simulated Pan-Planets planetary transits.

3-P26 Orbital Motion in Gravitational Microlenses

M. Penny (University of Manchester), Shude Mao

A standard planetary microlensing lightcurve allows just two parameters of the lensing system to be measured: the mass ratio of the planet to its host, and the projected separation of the components in units of the Einstein radius. However, other exotic effects can provide more information about the lensing system. Orbital motion in the lens is one such effect, which if detected, can allow the system mass and planetary orbit to be determined. We attempt to quantify the probability of detecting lens orbital motion in binary microlensing events using Monte Carlo simulations. We also define an easily calculable quantity, the orbital measure, to describe the probability and inform the computationally expensive modeling process.

3-P27 About the Criterion of the Stability of Extra-Solar Planetary Orbits Near to Circular Ones

E. Plavalova (Comenius University of Bratislava, Slovakia), Solovaya N.

We investigate the near circular motion of extra-solar planets in a binary stellar system. The task is computed in the Jacobi's coordinate system. The intermediate orbits were obtained by approximated solution of differential equations of motion which were transformed by the Zeipel's method. These orbits are non-keplerian ellipses. We offer the criterion of the stability for the near circular orbits. We should like to show it at the example of a real extra-solar planet.

3-P28 High-Precision Transiting Planet Properties through Extreme Telescope Defocussing

J. Southworth (University of Warwick), The MiNDSTEp Consortium

The best way to constrain the formation and evolution of planetary systems is through measuring the properties of transiting extrasolar planets. The difficulty is that the depth and duration of transits are typically similar to the timescales and sizes of the many systematic effects which affect astronomical photometry. One way round this is extreme telescope defocussing: spreading a PSF over thousands of pixels allow a large number of photons to be detected, makes flat-fielding errors and seeing changes negligible, and improves the observational efficiency as the CCD is read out less often. We present light curves of the transiting planetary systems WASP-4 and WASP-5, taking with the Danish 1.5m telescope at ESO La Silla. The PSFs cover approximately 2000 pixels, and the light curves have noise levels as low as only 0.50 mmag per point. From these observations we measure the physical properties of the WASP-4b and WASP-5b to accuracies of a few percent in mass and radius.

3-P29 Brown Dwarf Formation by Disc Fragmentation

A. Whitworth (Cardiff University), Dimitri Stamatellos

I will present SPH simulations of the fragmentation of protostellar accretion discs around low- and intermediate-mass stars, and show that this mechanism is a promising way to form brown dwarfs and planetary-mass objects. Most of the brown dwarfs formed in this way are liberated into the field by mutual interactions and/or the tides of passing stars. They are usually attended by small discs (sufficient to sustain accretion and outflows like the ones observed). They match the multiplicity statistics of brow dwarf systems extremely well. And they provide a way to form binary systems with low mass-ratios (a result which other formation mechanisms find hard to match).

Tuesday
4:00pm

The Technology of Laboratory Astrophysics

I. Lyon (University of Manchester)

Interstellar grains, which are condensates from giant stars, were first isolated from primitive meteorites over 20 years ago. Their analysis in the laboratory led to a new field of study which may be described as "laboratory astrophysics" in which real solid samples from extreme astrophysical environments may be used to "ground-truth" astronomical observations and theoretical modelling of interstellar dust formation. The grains range from nanometer to micrometer in diameter and as they contain between 10^3-10^12 atoms in total, the analysis of their elemental and isotopic composition is extremely challenging. This presentation will focus upon how the grains are separated from their meteorite hosts and are analysed by a variety of analytical techniques, principally secondary ion mass spectrometry. Emphasis will be placed upon new analytical developments in "laboratory astrophysics" that have led to the study of the nucleosynthetic sources of material that went to make up our solar system and how the grains may be used as probes of conditions in the interstellar medium.

Tuesday
4:15pm

In-Situ Measurements of Interstellar Dust in the Solar System

H. Krueger (Max-Planck-Institut fuer Sonnensystemforschung), Markus Landgraf, Nicolas Altobelli, Eberhard Gruen

In the early 1990s, the in-situ dust detector on board the Ulysses spacecraft identified interstellar dust penetrating deep into the solar system. Between 1992 and 2007 Ulysses monitored the interstellar dust stream at high ecliptic latitudes between 3 and 5 AU. Interstellar impactors were also measured with the dust detectors on board Cassini, Galileo and Helios, covering a heliocentric distance range between 0.3 and 3 AU in the ecliptic plane. The interstellar dust stream in the inner solar system is altered by the solar radiation pressure force, gravitational focussing and interaction of charged grains with the time varying interplanetary magnetic field. The grains act as tracers of the physical conditions in the local interstellar medium surrounding our solar system. Our dust measurements imply the existence of a population of 'big' interstellar grains (up to 10^-13 kg) and a gas-to-dust-mass ratio which is a factor of 1.5 -- 2 larger than the one derived from astronomical observations, indicating a concentration of interstellar dust in the very local interstellar medium. Until 2004, the interstellar dust flow direction measured by Ulysses was close to the mean apex of the Sun's motion, while in 2005, the data showed an approximately 30 degree shift of particles larger than 10^-16 kg (i.e. > 0.2 micron). We give an overview of our in-situ dust measurements in interplanetary space and present our most recent results.

Tuesday
4:30pm

Extreme Deuterium-Rich Organic Matter Revealed by Antarctic Ultra-Carbonaceous Micrometeorites from CONCORDIA Collection

J. Duprat (CSNSM-CNRS-Univ Paris XI), E. Dobrica, C. Engrand, J. Aleon, M. Gounelle, H. Leroux, Y. Marrocchi, A. Meibom, S. Mostefaoui, J.-N. Rouzaud and F. Robert

In January 2006, we collected unaltered micrometeorites from central Antarctic snow in the vicinity of the permanent French-Italian station located at Dome CONCORDIA (Dome C). MMs from this study were extracted from ultra-clean snow from a trench at depths corresponding to a fall on Earth between 1955 and 1970. Among the particles that exhibit a fluffy fine-grained texture with no evidence of heating during atmospheric entry, we identified ultracarbonaceous Antarctic micrometeorites (UCAMMs) with exceptionally high carbon content in form of organic matter (OM) representing from 60\% up to 80\% of the particle's volume. The presence of both Fe-sulphides and carbonates in UCAMMs indicate that they experienced little to no modifications upon atmospheric entry and during their terrestrial residence at low temperature (-80 C < T < -25 C) in the surface snow of Dome C. We performed isotopic imaging of UCAMMs using secondary ion mass spectrometry (NanoSIMS50 at LEME-MNHN Paris). D/H maps revealed large deuterium excesses up to 30 times the terrestrial ocean value (D/H ratios up to 4.5 x 10^-3). These extreme D/H are associated with carbon rich areas. By contrast with previous observations in insoluble organic matter from meteorites and stratospheric interplanetary dust particles where the high D/H ratios are confined to sub-micron hotspots, the bulk D/H ratio of OM in UCAMMs is controlled by the D-rich regions that extend over remarkably large areas (hundreds of square-microns). The UCAMMs are probably giant cometary particles, possibly related to the CHON particles detected in comet Halley. Because in UCAMMs both primitive organic compounds and their associated mineral phases can be directly studied in-situ, these objects provide a unique opportunity to probe the early history of the coldest regions of the nascent solar system.

Tuesday
4:45pm

Ultra-Primitive Interplanetary Dust Particles from the Comet 26P/Grigg-Skjellerup Dust Stream Collection

H. Busemann (University of Manchester), A. N. Nguyen, G. D. Cody, P. Hoppe, A. L. D. Kilcoyne, R. M. Stroud, T. J. Zega, L. R. Nittler

Cometary material and pristine interplanetary dust particles (IDPs) best resemble the dust from which our solar system was built, because they remained largely unaltered since accretion in the outer protoplanetary disk. IDPs might supply more primitive assemblages available for laboratory analysis than comet 81P/Wild 2 Stardust but their individual provenances are typically unknown. We speculate that some IDPs collected by NASA in April 2003 may be associated with comet 26P/Grigg-Skjellerup, because their particularly pristine character coincides with the collection period that has been predicted to show an enhanced flux of particles from this comet. Some IDPs from this collection contain the most primitive assembly of interstellar matter found to date in any extraterrestrial material, including an usually high abundance of presolar grains and isotopically highly anomalous and disordered organic matter, as well as fine-grained carbonates and an amphibole that potentially imply formation in a nebular rather than planetary environment. Two IDPs may contain assemblages of molecular cloud material at percent level, which is supported by the presence of four rare presolar silicate grains, possibly of supernovae origin, within one IDP, and the close association of a supernova olivine with an interstellar carbonaceous nano-globule. Our study, together with Deep Impact observations of comet 9P/Tempel 1 and 81P/Wild 2 Stardust analyses, reveals compositional variations and similarities among three Jupiter-family comets, indicating that carbonates and primitive organic matter were widespread in the comet-forming regions of the outer protoplanetary disk. Not all comets contain as much inner solar system material as has been inferred for comet 81P/Wild 2. The anomalous hydrogen and nitrogen isotopic compositions and the carbon Raman characteristics of the organic matter in IDPs and primitive meteorites are remarkably similar. This implies that the same mixture of molecular cloud dust has been transported inward into the meteorite-forming regions of the solar system.

Tuesday
5:00pm

The Fine Detail of Comet Wild 2: TEM And Synchrotron Characterisation

J. Bridges (University of Leicester), H.C. Changela

Comet Wild 2 samples from the Stardust Mission are improving our understanding of the nature of short period comets and their similarities to asteroids and interplanetary dust particles (IDPs). The micron to nanometre size of the grains captured in aerogel require TEM and synchrotron analyses to determine the composition, oxidation state and textures of the cometary grains. Through preparation of TEM sections with a Focused Ion Beam-SEM technique and our analyses at the Diamond synchrotron, we have identified a variety of Fe-bearing oxides and sulphides, some of which have an affinity to carbonaceous chondrites. For instance, XANES and EXAFS spectroscopy at Diamond revealed the variation of oxidation of the Fe-bearing phases, with both Fe-Ni metal and oxides in the same samples. In this way we are showing the similarities and distinctions between the chondrite meteorite groups in our collections and Comet Wild 2.

Tuesday
5:10pm

First Detections of Interstellar Ethyl Formate and N-Propyl Cyanide: Dust-Grain Chemistry Strikes Again

R. Garrod (Cornell University), A. Belloche, H. S. P. Mueller, K. M. Menten, C. Comito & P. Schilke

We report the first interstellar detections of ethyl formate and n-propyl cyanide, in the Galactic center star-forming region Sgr B2N. These two molecules represent the next stage of complexity to be observed in two classes of organic interstellar molecule: esters and alkyl cyanides. A complete spectral survey was conducted using the IRAM 30 m telescope, in the 3 mm and 1.3 mm atmospheric windows, with additional lines at 2 mm. The XCLASS package was used to model the emission of all known molecules, allowing the subtraction of their spectra to reveal underlying weaker lines. All expected emission lines of ethyl formate and n-propyl cyanide were detected, or were blended with other lines: there were no missing lines.

Here we present gas-grain chemical models of Sgr B2N, in which the formation/destruction of the newly-detected molecules is incorporated into a large chemical network. Grain/ice-surface processes are found to be capable of forming them in sufficient abundance, and at appropriate (rotational) temperatures. Abundances and temperatures of other molecules are used to constrain the models. A number of plausible formation mechanisms are tested for the two molecules. It is found that only a formation mechanism in which complex molecules are constructed on the grains from pre-existing functional groups is capable of reproducing the observed abundance ratios between n-propyl, ethyl, and methyl cyanide, and between ethyl and methyl formate. These functional groups derive from granular ices formed on the grains during earlier stages of evolution.

The combined observational detection and chemical modeling of these new molecules further illustrates the importance of dust-grain surfaces to the chemistry of highly complex organic molecules in star-forming regions, and points to the presence of similarly complex molecules from other molecular families. It also brings us tantalizingly close to the detection of pre-biotic and biotic molecules in interstellar space.

Tuesday
5:20pm

PAHs as carriers of DIBs and AIBs

P. Sarre (The University of Nottingham), Alessandra Candian, Mark Hammonds, Amit Pathak

We report progress towards identification of specific classes of polycyclic aromatic hydrocarbon (PAH) carriers of diffuse interstellar bands (DIBs) and aromatic infrared bands (AIBs), both of which are closely associated with interstellar dust. TD-DFT calculations of electronic transitions of protonated stable PAH molecules show that, unlike most neutral PAHs which generally absorb strongly in the UV or near-UV, the corresponding protonated forms of PAH molecules have absorptions in the visible spectral region and are therefore a strong class of candidate DIB carriers. We describe also DFT calculations of IR transitions of PAHs which yield new insight on assignment of the 11.0 and 11.2 micron emission bands.

Wednesday
11:00am

The Cosmic Journey of Dust

A. Tielens (Leiden Observatory)

Ground-based, air-borne and space-based infrared spectra of a wide variety of objects show prominent absorption and emission features due to dust grains characteristic of a wide range of materials, including both amorphous and highly crystalline silicate, oxide and carbonaceous compounds. Analysis of stardust isolated from Solar system meteorites have revealed a similarly highly diverse interstellar and circumstellar grain inventory. This diversity reflects the wide range of stellar sources injecting solids into the interstellar medium each with its own physical characteristics such as density, temperature and elemental composition. Once injected into the interstellar medium, dust is highly processed during its sojourn from its birthsite (stellar outflows and explosions) to its incorporation into protoplanetary systems. Of particular importance is processing in the interstellar medium by cosmic rays and by strong shocks driven by supernova explosions. The former leads to amorphization. The latter leads to rapid destruction due to sputtering by impacting gas ions due to grain-grain collisions. Further processing occurs in the planet-forming disk around Young Stellar Objects either through high temperature chemistry in the inner nebula or by temporal events such as shock waves or lightning throughout the nebula. The effects of all these processes are recorded in the grains viewed in protoplanetary systems and recovered from meteorites and comets. I will review this cosmic journey of interstellar dust and describe the inventory of interstellar dust, its characteristics and relevant processes.

Wednesday
11:45am

Observational constraints on dust production

J. van Loon (Keele University)

Dust grains are produced predominantly in the outflows of cool evolved stars, and in the ejecta of supernovae. Difficulties in predicting the amounts and nature of the grains from ab initio calculations are met by difficulties in obtaining such information from measurements in situ. I will describe how recent observations with the Spitzer Space Telescope have advanced our understanding of dust production in cool giant stars in globular clusters and Local Group dwarf galaxies, in particular with regard to the thermo- and hydrodynamical conditions in the condensation and grain growth zone. I will also present new constraints on dust production and destruction in the winds of supernova progenitors and in the shocked ejecta within supernova remnants, in the Small and Large Magellanic Clouds.

Wednesday
12:00pm

Cassini CAPS-ELS Observations of Enceladus's Plume

G. Jones (MSSL, University College London), C. S. Arridge, A. J. Coates, S. Kanani, D. Young, and the Cassini CAPS team

The Electron Spectrometer, ELS, of the Cassini Plasma Spectrometer, CAPS, was oriented for the direct sampling of material inside Enceladus's plume during two of the three close encounters with this moon in 2008, on March 12, and October 9. We present ELS observations obtained during these two encounters, approaching to within 52 and 25 km of the moon's surface, respectively. Several unanticipated features were observed within the plume; we present our interpretations of these features, comparing them with other instruments' observations of the plume and its surface sources.

Wednesday
12:10pm

Trajectories of Charged Icy Dust Grains in the Plume of Enceladus: Modelling and Cassini CAPS Observations

C. Arridge (MSSL / UCL), G.H. Jones, C.T. Russell, Y.D. Jia, C. Paty, A.J. Coates, S.J. Kanani, F.J. Crary and D.T. Young

The plume ejected from the south pole of Enceladus is produced through active cryovolcanic processes and contain both gaseous and dusty components. The Cassini-Huygens mission has confirmed that these plumes are a major source of gas and dust for Saturn's magnetosphere. On two separate encounters with Enceladus on 12 March and 09 October 2008 (E3/E5) the sensors of the Cassini Plasma Spectrometer (CAPS) were oriented such that they directly sampled the plume material. Particles were measured by the electron and ion sensors on CAPS and entered the instrument at almost the ram velocity of the spacecraft through the plume, thus facilitating a measurement of the mass of the particles (Jones et al., submitted). In this study we examine the motion of the detected grains ice grains and solve the equation of motion for grains emerging from discrete vents on Enceladus. We take into account the gravitational fields from Saturn and Enceladus, the background magnetospheric field, and the motional electric field introduced by the azimuthal convection of Saturn's magnetospheric plasma and its stagnation in the vicinity of the plume. We show that the stagnation of the flow near the plume is important in preventing the dispersion of the plume in the immediate vicinity of Enceladus. We also present preliminary results of a Monte Carlo model of the plume resulting from a number of discrete vents and compare these results with CAPS observations.

Wednesday
12:20pm

Experimental and Theoretical Research on the Dust Cloud around Europa and its Application to the Design of a New Hybrid Dust Detector for an Orbiter

K. Miljkovic (The Open University), Nigel J Mason, John C Zarnecki

Space in the vicinity of atmosphereless bodies in the solar system bodies is often populated by dust originating from the surface. Fragments of the surface are ejected mostly due to hypervelocity meteoroid impacts. It is also possible that material from sub-surface layers may be vented through cracks in the ice (as detected near Enceladus).

The understanding of Europa's dust cloud (and dust clouds of this sort in general) is done by mimicking micrometeoroid impact into simulated Europan regolith/ice using the light gas gun at the Open University. The research is complemented with impact modelling using the finite element hydrocode, ANSYS Autodyn 3D. The results are implemented in IDL in order to calculate the approximate dust cloud population (size and spatial density) of the surface fragments at different altitudes. It is, therefore, investigated whether orbit-based detection and analysis of material ejected from the surface may provide an alternative method for sampling material without landing.

In the case of Europa, relative impact speeds from these dust sources onto an in-orbit detector would, typically, be about 2 km/s. This impact speed is generally too low for complete vapourisation of the impactor/target, hence analysis of the impact plasma generated via time-of-flight through charged grids (as used on the Cassini CDA instrument) will only be partially successful. Our current work is aimed at the development of a new hybrid dust detector for any Europa orbiter.

Wednesday
2:00pm

Stardust in the Laboratory

E. Zinner (Washington University)

In the past, almost all information about stars has come to us in the form of electromagnetic radiation. In the last twenty years, a new source of information on nucleosynthesis and stellar evolution has become available in the form of preserved stardust found in primitive meteorites. These µm- and sub-µm-sized so-called presolar grains are recognized as stardust by their isotopic compositions, which are completely different from those of the solar system. Whereas most of the material from many different stellar sources that went into the making of the Solar System was thoroughly mixed, obliterating any information about its origin, these grains preserve the isotopic compositions of their stellar sources. They condensed in outflows from late-type stars and in SN ejecta and were included in meteorites, from which they can be isolated and studied for their isotopic compositions in the laboratory. Thus these grains constitute a link between us and our stellar ancestors. They provide new information on stellar evolution, nucleosynthesis, mixing processes in asymptotic giant branch (AGB) stars and supernovae, and galactic chemical evolution. Of the eight nuclear processes proposed by Burbidge et al. to build all the elements heavier than He, signatures of all except the r- and the x-process have been detected in presolar dust grains. Red giants, AGB stars, Type II supernovae, and possibly novae have been identified as stellar sources of the grains. Stardust phases identified so far include silicates, oxides such as corundum, spinel, and hibonite, diamond, graphite, silicon carbide, silicon nitride, titanium carbide, and Fe-Ni metal.

Wednesday
2:45pm

Crystallization of Silicates in Stellar Winds

C. Kemper (University of Manchester)

The presence of silicate dust in crystalline form is often seen as evidence for thermal processing, and requires heating of the grains to temperatures above the glass temperature, roughly 1000 K. At these temperatures, crystallization occurs virtually instantaneously. Once cooled off, the grains remain crystalline, and amorphization only occurs by external events, such as cosmic ray hits.

Although absent in the general interstellar medium, due to the cosmic ray fluence, crystalline silicates are commonly seen in the dense stellar winds of high-mass-loss rate Asymptotic Giant Branch stars. The crystalline fraction is observed to be around 10\%, which is surprising given the fast annealing of grains heated above the glass temperature. Indeed, in a simple radiative transfer model, Kozasa & Sogawa (1999, ApJ 516, L33) predict that either all or none of the grains are annealed, depending on the density of the wind.

In this talk, I will give an overview of the observational evidence showing the relation between wind density and crystalline fraction. I will also explore theoretical models that are available to explain a partially crystalline dust composition.

Wednesday
3:00pm

Looking Inside Presolar Silicon Carbide Grains

T. Henkel (University of Manchester), Ashley King, Julia Tizard, Ian Lyon

Presolar SiC grains are typically micrometre sized, which allows the study of individual grains. Furthermore, the wide variety of elements incorporated into the grains permits detailed studies of their stellar sources. Since their original discovery, the grains have been separated from primitive meteorites using acid extraction, which dissolves the surrounding material leaving behind acid-resistant presolar grains such as diamond, graphite and silicon carbide.

However, studies over the last few years have shown that the outer layers of the SiC grains are affected by the acids up to some tens of nanometres deep, mainly by the loss of AlN, a major constituent of the grains. Additionally, any kind of non acid-resistant coating would easily be stripped from the grain and lost. We therefore developed a gentle extraction method using only pure water in a freeze-thaw process and size and density separation to keep the grains as pristine as possible.

Analyses of these gently extracted grains, and comparison with acid-extracted grains, showed some fundamental differences. Both types of grain show elevated abundances for several elements (Li, B, Na, Mg, Al, K), in some grains, in a layer down to some hundred nanometres below the acid-affected outer rim. We have attributed this to implantation via shockwaves during the grain's traverse through the interstellar medium before it was incorporated into the solar system. Additionally, some gently extracted grains show significant elevations in Mg and Ca abundances which might be attributed to some outer layer/coating of the grains. It remains an open question as to whether these elevated Mg and Ca abundances are connected to MgS layers which are observed astronomically on SiC grains and further study is necessary.

Wednesday
3:10pm

TOFSIMS Analysis of Gently Separated Presolar Graphite

A. King (University of Manchester), T. Henkel, S. Chapman, D. Rost and I. Lyon

All presolar graphite grains analyzed to date were extracted from their host meteorite using acid dissolution techniques. However, recent evidence has suggested that the use of harsh acids may significantly alter the outer surface of presolar grains extracted in this way. We have previously described a technique for "gently separating" presolar SiC (i.e. without the use of acids) from meteorites, and have now adapted this procedure in order to isolate presolar graphite. This provides us with pristine samples with which to study stellar environments.

For the gentle separation of graphite we crushed ~116mg of Murchison matrix-material. This was broken down to grain sizes of <20 microns (most presolar graphite grains are typically 1-10 microns in diameter) using freeze-thaw cycles, whereby the sample was alternately dipped between liquid nitrogen and hot water (~45°C). The grains were first separated into four size fractions using a fixed angle centrifuge. Each size separation was then further separated according to density, selecting for graphite between 1.6-2.2gcm-3. An electron microscope was used to locate candidate grains in each fraction.

So far the isotopic compositions of 2 gently separated graphite grains have been analysed using Time-of-Flight Secondary Ion Mass Spectrometry (TOFSIMS). 12C/13C ratios of 28±15 and 18±5 (1 sigma) suggest that these grains likely originate from AGB stars. Previous studies have shown that presolar graphite grains with large 12C/13C anomalies in acid separations are predominantly spherical in shape. In contrast our grains are irregular. The high spatial resolution of TOFSIMS allows the distribution of trace elements within individual grains and sub-grains to be observed. Depth-profiles of trace element abundances for both grains show no significant variation to a depth of hundreds of nanometres below the grain surface.

Wednesday
3:20pm

Investigating Presolar Silicate and Oxide Grains in Primitive Solar System Materials: A NanoSIMS Study

J. Leitner (Max Planck Institute for Chemistry), P. Hoppe, J. Zipfel

CR chondrites belong to the most primitive chondrite groups. Recent investigations revealed high abundances of presolar silicate and oxide dust grains that formed in the outflows of evolved stars or in the ejecta of stellar explosions in individual meteorites of this group. During earlier analyses of meteorites of this class, almost no presolar silicates and oxides were found. Promising areas of fine-grained matrix material were identified on a thin section of the CR2 chondrite NWA 852 and subsequently analyzed by NanoSIMS. 16O, 17O, 18O, 28Si, as well as 27Al16O ion images were acquired in multi-collection mode. Presolar grains are identified in situ by their O-isotopic composition, and detection of 28Si and 27Al16O allows to distinguish between silicates and Al-rich oxides. About 15000 μm^2 of fine-grained matrix were investigated. 23 presolar silicate and 8 oxide grains were identified so far, representing silicate and oxide abundances of 98 ppm and 70 ppm, respectively. 23 grains belong to O isotope group 1, stemming from low-mass AGB-stars, and 8 belong to group 4, possibly originating from the ejecta of Type II supernovae. High silicate/oxide ratios are considered as characteristics for low degrees of alteration. Oxide grains are more resistant to parent body processes than silicates, so low silicate/oxide ratios are expected for more processed material. NWA 852 has by far the lowest silicate/oxide ratio from all materials with high presolar grain abundances. Either, NWA 852 was subject to more severe parent body alteration than other CR chondrites, and its initial presolar silicate abundance was significantly higher, possibly even exceededing observations for primitive IDPs. Or, the difference is due to heterogeneities in the early solar nebula, which have occured on such small scales that they are observable in matrices of different meteorites of the same class and parent body.

Wednesday
4:00pm

IR Spectroscopy of Dust: a View from the Laboratory Bench

M. Grady (The Open University), Andreas Morlok3. 1PSSRI, The Open University, Milton Keynes, MK7 6AA; 2Dept. Mineralogy, Natural History Museum, London, SW7 5BD 3CRPG-CNRS, Nancy, France. (m.m.grady@open.ac.uk)

The ubiquity of dust (interstellar, circumstellar, interplanetary, cometary and asteroidal) is an indication of its importance in the astrophysical environment. Dust is one of the building blocks from which planets, stars and galaxies are constructed, and understanding its evolution from molecular clouds, through protoplanetary disks to planets is one of the challenges of contemporary astronomy. Information about the nature of dust gives insight into the early stages of Solar System formation, and that of other planetary systems. Planetary scientists use laboratory-based instrumentation to study extraterrestrial dust. Astronomers observe dust by telescope, as interstellar molecules and circumstellar dust grains. To follow the evolution of dust from stellar production and processing to its final destination, a common set of measured compositional parameters must be available. One tool that is used to relate astronomical data to laboratory-based studies is that of IR spectroscopy. Astronomers use ground- and space-based instrumentation to observe dust in situ. Infrared (IR) spectroscopy and spectropolarimetry give the composition, structure, grain size and opacity of the dust. Interpretation of dust spectra frequently assumes that any silicates present are forsteritic olivine and enstatite pyroxene, despite the fact that pure end-member silicates are rarely present in meteorites or IDPs. Laboratory-based IR spectroscopy of extraterrestrial materials focuses on IDPs and meteorites. IR spectra from minerals separated from meteorites maybe better suited as material for comparison with IR spectra from astronomical sources than terrestrial or artificial minerals. Examination of meteorites in thin section reveals a variety of mineralogies and mineral chemistries. It is likely that interstellar and circumstellar dust also shows an equivalent variety of compositions.

Wednesday
4:20pm

Origin of Dust and Gas in the Local Group Galaxies

M. Matsuura (UCL), G.C. Sloan, A.A. Zijlstra, M.J. Barlow

We report on two studies related to the dust evolution of nearby galaxies. First, we have measured the dust and gas budget of an entire galaxy, with the Spitzer Space Telescope (SST). As a test case we used the Large Magellanic Cloud (LMC), which is relatively close (50 kpc) and where individual stars are well resolved. The SST's sensitivity is good enough to detect the dust excess from asymptotic giant (AGB) stars. For gas budgets, supernovae (SNe) are slightly more important gas source compared to AGB stars. On the other hand, AGB stars are an important dust source and the contribution of SNe to dust production remains uncertain. However, it appears that the dust input from AGB stars and possibly SNe is insufficient to account for the dust mass present in the interstellar medium (ISM) of the LMC. Second, we report on the detections of dust in low-metallicity galaxies in the Local Group, so as to test dust formation at low metallicity. We detected amorphous and SiC dust grains from AGB stars in low-metallicity galaxies. It appears that the dust grain composition is strongly affected by what elements are synthesised in AGB stars, rather than from the elements included in the stars themselves at the time of their formation. This could provide a clue on the dust formation in high-z galaxies, which are assumed to have such low-metallicity.

Wednesday
4:30pm

Molecules and Dust in the Early Universe: the Supernova Connection

I. Cherchneff (Basel University), Eli Dwek

We present new results on molecule and dust formation in the ejecta of Pop. III supernovae. A chemical kinetic approach is used to describe the synthesis of molecules and the nucleation of small solid clusters. All relevant chemical processes are included as well as non-thermal processes such as destruction of molecules by Compton electrons and dissociation by ultraviolet radiation. The chemistry is applied to the ejecta of massive pair-instabilty (PISN) and low-mass core-collapse (CCSN) supernovae of zero-metallicity progenitors. Fully-microscopically mixed and unmixed ejecta are considered. We show that molecule formation is effective in all ejecta. In particular, for unmixed ejecta, a 170 Msun PISN forms 37 Msun of molecules in its ejecta whereas the molecular phase amounts to 1.2 Msun for a 20 Msun CCSN. The dominant species surviving dust nucleation in both cases are O2, SiS and CO. At high redshift, massive PISNe therefore eject 46\% of their progenitor mass in the form of molecules to the local, pristine gas. As to dust, we derive upper limits for the solid phase of ~ 9 Msun and 0.3 Msun for a 170 Msun PISN and a 20 Msun CCSN, respectively. We find that PISNe form essentially carbon and silica dust precursors whilst CCSN forms carbon, forsterite, iron sulphide and periclase precursors. Our upper limits are always lower than dust masses derived in existing studies indicating that the formation of molecules is a 'bottleneck' to dust condensation in supernova ejecta.

Wednesday
4:40pm

Galaxy Zoo: Inclination Dependent Dust Attenuation in Visually Classified Spirals

K. Masters (ICG, Univ. Portsmouth), Robert Nichol and GZ Team

We use data from the Galaxy Zoo project (www.galaxyzoo.org) to define a sample of visually classified spirals. We study trends of their colours in the SDSS bands (ugriz), and Balmer decrement (from the "SDSS fibre) with axial ratio (or inclination). We find that the total extinction from face-on to edge-on is on average at least 0.9 mag in u-band (0.8 mag in g, 0.7 mag in g and 0.6 mag in i) while the Balmer decrement indicates an average of 0.3 mags of extinction between Halpha and Hbeta in face-on galaxies, increasing to 0.6 mags at edge-on. The observed trends are compared to the spiral galaxy attenuation models of Tuffs et al. (2004, A&A 419, 821) which are based on a Milky Way like extinction law. We split the sample into "bulgy" and "disky" spirals using the SDSS parameter frac_deV (which describes the fraction of the light fit by a de Vaucouleur profile) to allow a better comparison with the Tuffs et al. model in which the total attenuation depends on bulge-disk ratio as well as central opacity. We find that the model reproduces the observed trends surprisingly well, considering the number of fixed geometrical parameters (eg. the relative size of the stellar and dust disks, bulge shape, etc.). However looking in detail, the models appear to over-predict the amount of u-band attenuation in edge-on galaxies while under-predicting that in gri-bands for any reasonable choice of central opacity and bulge-disk ratio. This could point to an inadequacy of the Milky Way extinction law when applied to external galaxies, but more likely indicates that a wider range of model geometries need to be allowed for.

Wednesday
4:50pm

The Dust Shell around SN2008S

R. Wesson (University College London), M Barlow, B Ercolano, J Andrews, J Gallagher, B Sugerman, G Clayton, M. Otsuka, D Welch, M. Meixner

SN 2008S erupted in early 2008 in the grand design spiral galaxy NGC 6946. Its progenitor was detected in Spitzer images taken over the four years prior to the explosion, but was not detected in deep optical images, suggesting a self-obscured object with a mass of about 10 Msun. We serendipitously observed SN 2008S with the Spitzer Space Telescope several days after its outburst, and also obtained Spitzer and Gemini infrared and optical observations five months later. Radiative transfer modelling indicates that at least 7e-4 Msun of dust was produced by the progenitor of SN 2008S in its self-obscured phase, and that although dust evaporation by the flash removed most of the obscuring dust column, only a small fraction of the total mass of circumstellar dust was destroyed by the outburst. If objects like this are common, as has recently been suggested, they may contribute significantly to the dust budget of galaxies.

Wednesday
5:00pm

Dusty Discs around Evolved Stellar Objects

F. Lykou (Jodrell Bank Centre for Astrophysics), A. Zijlstra, O. Chesneau, E. Lagadec

Mass-loss outflows are important in the late stages of stellar evolution. We have observed such outflows using high-angular resolution techniques, and we have found dusty discs and torii around the cores of evolved stellar objects. The dusty structures may have been instrumental for the shaping of the gaseous ejecta of those objects into bipolar/multipolar nebulae. The sample consists of three different stages of late-type evolution objects, namely a post-AGB star (Mz3), a planetary nebula (M2-9) and a very-late-thermal-pulse object (V4334 Sgr), that allows us to compare and assess the contribution of those dusty structures in the shaping of the mass-loss throughout the final stages of stellar evolution. For each of the three cases, we have detected a disc/torus around the central ionising source in the mid-infrared with VLTI. The first two objects contain discs composed of silicate dust, while the latter contains a torus of carbonaceous material. Their intrinsic geometric and physical properties have been determined with the use of radiative transfer modelling.

Wednesday
5:10pm

Debris Discs Around the Oldest Stars in the Galaxy

C. Sheehan (University of St Andrews)

Debris discs are the signatures of other solar systems, consisting of dust of a short lifetime that is continually replenished by the collisional grinding of unseen planetesimals. Spitzer's MIPS instrument was used to carry out a survey of galactic thick disc stars, stars of great age and very low metallicity. These stars represent the first stars formed in the Galaxy, and investigation revealed a low number of debris detections. Implications for very old planetary systems will be discussed.

Wednesday
5:20pm

Dust from AGB Stars and its Survival in the ISM

S. Zhukovska (Max Planck Institute of Astrophysics), Hans-Peter Gail

The interstellar dust mixture is determined by the balance between dust injection from stars and efficient processing of dust grains in the ISM. AGB stars are known to be the most efficient dust factories. Using a chemical evolution model of the Milky Way combined with a dust model we analyse quantitatively the contribution of AGB stars as a function of mass and metallicity. We discuss strong variations in the dust mixture from AGB stars with metallicity in the Galactic disk. We also present our recent results on the input of stardust into the Solar System, a special case that can be studied by means of meteorites in the laboratory.

Thursday
11:00am

An Update on SCUBA-2

W. Holland (UK ATC)

SCUBA-2 is a 10,000 pixel submillimetre camera currently undergoing commissioning on the James Clerk Maxwell telescope. In the autumn of 2009 a number of legacy surveys will begin including studies of giant molecular clouds in our galaxy, debris disks, the galactic plane and high red-shift galaxies. I will present an update on the project including first light images and the plan for updating the instrument with science-grade arrays.

Thursday
11:15am

Studying large-Scale Galactic Star Formation using the Sub-mm

T. Moore (LJMU - Astrophysics Research Institute)

Observations of the continuum emission from cool dust in dense, star-forming cores is an essential tool in the study of large-scale star-formation processes. The key observables in this study are the efficiency with which molecular clouds create dense, star-forming structures, which limits the star-formation efficiency, and the mass spectrum of these structures, in which may lie the origin of the stellar IMF. Mapping the sub-mm continuum on the scales of Giant Molecular Clouds allows us to look for variations in these quantities related to the environment in the molecular gas and to feedback and triggering processes. This talk will outline the results of one such large-scale study and will look forward to the forthcoming JCMT Plane Survey (JPS), a Galaxy-scale dust continuum survey with SCUBA-2.

Thursday
11:30am

Observational Constraints on Interstellar Grain Alignment

B. Andersson (USRA), S.B. Potter, V. Piirola

We will discuss three sets of recent observations, aimed at constraining the mechanism causing interstellar dust grains to become aligned with the magnetic field. These observations form part of a comprehensive program studying grain alignment physics using the wavelength of maximum polarization in the optical/near infrared as the primary tracer. This method has the advantage of being insensitive to line-of-sight turbulence and independent of grain temperature.

In a recent survey of six near-by molecular clouds we showed that the alignment is anti-correlated with the extinction, supporting modern grain alignment theory. We have now confirmed this result with an expanded observation sample in the Taurus complex. We are following up these observations with a survey of sightlines, in the Chamaeleon cloud, directly, radiatively, affected by a bright and hot, exposed YSO. Finally, we are probing the possible effects of molecular hydrogen formation on the grain alignment by a combination of high sensitivity H_2 imaging of the fluorescence and spectropolarimetry over the IC 63 PDR/reflection nebula.

Thursday
11:40am

Cassiopeia A: Dust Factory Revealed via Submillimeter Polarimetry

L. Dunne (University of Nottingham), R. Ivison, S. Maddox, H. Gomez, L. Rudnick, T. DeLaney, B. Matthews, C. Crowe, S. Eales, S. Dye

The huge quantities of dust found in some high redshift galaxies and quasars are difficult to explain without a very rapid mechanism for dust production. Type-II supernovae are an obvious candidate for the source of this dust but evidence for significant dust formation in local SNae is scant and controversial. In particular, submillimetre observations which appeared to show a large mass of cold dust in Cas A were later questioned due to the presence of molecular clouds along the line of sight. Here, we present new polarimetry data which shows conclusively that a significant fraction of the sub-mm dust emission does arise from within Cas A. The properties of this dust are quite unusual compared to that in the general ISM. The role of supernovae as dust factories is investigated.

Thursday
11:50am

The Role of Supernovae in the Interstellar Dust Budget

H. Gomez (Cardiff University), L Dunne, R Ivison, S Eales

Are supernovae an important source of dust? The question remains unresolved. Chemical evolution models suggest a rapid source of dust is required to explain dusty galaxies in the early Universe. Our ground-based submillimetre observations, sensitive to cold dust, imply 1-2 orders of magnitude more dust in Kepler's remnant compared to previous infra-red studies. Here, we discuss some of the ideas proposed as an alternative explanation of the submm emission observed in Kepler's remnant, including exotic grains and contamination from foreground molecular clouds. Accounting for clouds along the light of sight, we revise the total dust mass associated with Kepler's remnant to 0.2-0.6 solar masses; depending on the assumed absorption properties of supernova dust. We look forward to future observations with the Herschel Space Observatory.

Thursday
12:00pm

Anomalous Radio Emissivity of Dust

R. Davis (JBCA, University of Manchester), C.Dickinson, R. D. Davies, C. Tibbs

Anomalous dust emission is discussed in our Galaxy with respect to its possible influence on measurements of the Cosmic microwave background (CMB). The talk discusses particular objects and the more diffuse emission coming from extended regions. We start by discussing the best example of the Perseus Molecular cloud initially studied with the COSMOSOMAS telescope in Tenerife. Then moving on to the dark cloud LDN1622 studied with CBI in Chile. Diffuse emission using COSMOSOMAS, WMAP, and DIRBE is discussed. To show that all is not simple the two examples are discussed where it is not clear what exactly is going on ie the Helix nebula and LPH 96. 3C396, a supernova remnant, has been studied with the VSA in Tenerife and shows evidence for anomalous dust. RCW 175 has been studied with VSA and CBI and is another excellent example. 15 fields were selected from WMAP and the anomalous emission associated with dust is clearly detected in most of the 15 fields studied. Fields that are only weakly contaminated by synchrotron, free-free and CMB were studied. We find the anomalous emissivity varies by a factor of two from region to region. Attempts are then made to study how the emission may depend on environment.

Thursday
12:10pm

Spitzer Analysis of the Perseus Cloud: Constraining the Anomalous Microwave Emission

C. Tibbs (Jodrell Bank Centre for Astrophysics), Roberta Paladini, Nicolas Flagey, Sachindev Shenoy, Kieran Cleary, Alberto Noriega-Crespo, Clive Dickinson, Yacine Ali-Haïmoud, Chris Hirata, Simon Casassus, Sean Carey, Richard Davis, Rod Davies and Bob Watson

Anomalous microwave emission is known to exist in the Perseus Molecular Cloud. One of the most promising candidates for this anomalous emission is electric dipole radiation from rapidly rotating very small dust grains - "spinning dust". A detailed analysis of photometric and spectroscopic data from the Spitzer Space Telescope has been performed, and combining these data with a dust emission model (DUSTEM) allow us to place constraints on the dust properties of this anomalous emission.

Thursday
12:20pm

Dust Input from AGB Stars in Local Group Galaxies

E. Lagadec (Jodrell Bank Centre for Astrophysics)

We have carried out a Spitzer survey of AGB stars in the satellite galaxies to the Milky Way. The stars cover a metallicity range down to 1/25th of the solar metallicity. The results show that at sub-solar metallicity, AGB mass-loss is strongly dominated by carbon stars. The mass return from oxygen-rich stars is strongly suppressed at low metallicity. Carbon stars show little dependence of the mass-loss rates on metallicity. I will also present some results about the detection of carbon-rich dust around an AGB star with primitive abundances. This raises the possibility that carbon stars contributed carbonaceous dust in the early universe.

4-P01

Excitation of Dust Lower-Hybrid Waves, their Modulational Instability

Z. Ehsan (Imperial college London), N. L. Tsintsadze

A theoretical model is presented for the excitation of ultra-low frequency dust-lower hybrid mode (DLH) oscillating by employing the decay of a relatively high frequency dust-modified lower-hybrid (DMLH) wave into a relatively lower frequency DMLH and DLH based on 3-wave resonant interaction. A coupled nonlinear Schrodinger (NLS) equation for the DMLH wave and Zakharov equation for the DLH wave are derived. The nonlinear contribution in the NLS equation comes from the DLH density fluctuations. Modulational instabilities of DMLH waves are investigated and its growth rates are studied. Additionally, one-dimensional nonlinear localized structures of bright solitons and nonlinear nonlocal structures like cusp solitons are obtained. It is shown that, when the phase velocity resonates with the dust sound speed, the nonlocal nonlinearity leads to the generation of cusp solitons.

4-P02

Near Infrared Integral Field Spectroscopy of a Post-Asymptotic Giant Branch Star

K. Forde (University of Hertfordshire), Tim Gledhill and Michael Smith

There is no agreement on the mechanisms that shape Planetary Nebulae (PNe). As these objects are the main contributors to dust in the local universe it is important to understand the processes ongoing in these stars. To understand these mechanisms better we study their progenitors, a short-lived (10^2 --> 10^5 yrs) population of objects that occupy the Asymptotic Giant Branch (AGB) to Planetary Nebula (PN) transition stage of evolution - post-AGB stars or Proto-Planetary Nebulae (PPN). We present preliminary results of an Integral Field Spectroscopy (IFS) study of the post-AGB star IRAS 16594-4656. We have obtained VLT/SINFONI K-band data of IRAS 16594-4656 in order to analyse its H_2 emission spectrum over the full area of the extended nebula. IRAS 16594-4656 displays all the characteristics of a post-AGB star; a typical double-peaked Spectral Energy Distribution (SED), B7 type central star (not hot enough to ionise the surrounding gas), multi-polar structure, and shock excited emission. Previous studies of the object have focused on morphology, structure, excitation mechanisms, and polarimetry. We use various line-ratio diagnostics coupled with detailed shock excitation modelling to investigate the outflow structure and kinematics using hydrodynamic code. We present line maps for all major S & Q lines and the brackett gamma line in the K-band spectrum. We use certain line-ratio maps as a diagnostic to investigate the processes at work in the molecular cloud around IRAS~16594-4656. A comparison with HST/WFPC2 broadband (F606W) images showing the dust surrounding IRAS~16594-4656 shows that the H_2 emission traces the dust for the most part.

4-P03 UK CAN: UK Cosmochemical Analysis Network

M. Grady (The Open University), G. Benedix-Bland2, P. Bland4, R. Burgess3, I. Franchi1, I. Gilmour1, J. Gilmour3, I. Lyon3, S. Russell2 and I. Wright1.
1PSSRI, The Open University, Milton Keynes, MK7 6AA; 2Dept. Mineralogy, Natural History Museum, London, SW7 5BD 3Dept. Earth Sciences, University of Manchester, Manchester; 4Dept. Earth Sciences, Imperial College London.
E-mail: m.m.grady@open.ac.uk

Return of material from comet Wild II by the Stardust mission brought into focus one issue: a limited amount of suitable material available for analysis. An answer to this problem is to form consortia of investigators with complementary expertise to analyse the same sub-samples to gain the maximum information from the minimum of material. In the UK, we have used our consortium to bid for funds to purchase and develop a new generation of instrumentation. Our consortium is the UK CAN: the UK Cosmochemical Analysis Network, a network for development and application of new analytical technologies for the laboratory analysis of extraterrestrial material. The three centres that form the UK CAN are at the Open University (Milton Keynes), the University of Manchester and in London, a group based at the Natural History Museum and Imperial College. The three centres have complementary skills and instrumentation. The NHM-IC specialises in elemental and structural imaging; the Open University uses an ion microprobe (NanoSIMS) and gas source mass spectrometry for high precision isotopic and molecular analyses, and the University of Manchester uses resonance and secondary ion mass spectrometry to determine isotopic and elemental compositions at high spatial resolution. UK CAN forms a combination that is greater than the sum of its parts. UK CAN instrumentation is available for use by other members of the planetary science community, and will also form a training and teaching network for students and PDRAs. See http://www.open.ac.uk/ukcan for more information.

4-P04 Surveying the Agents of Galaxy Evolution: The Life Cycle of Dust in the Magellanic Clouds

C. Kemper (University of Manchester), Margaret Meixner, Karl Gordon & the Mega-SAGE team

Due to their proximity the Magellanic Clouds provide excellent circumstances to obtain a global view of the life cycle of dust in galaxies. The Mega-SAGE team has used the Spitzer Space Telescope to survey both Clouds in the mid-infrared, leaving a publicly available legacy. Full photometric maps have been obtained in all IRAC and MIPS bands, ranging from 3.6 to 160 micron, and we have sampled a range of environments for a spectroscopic survey using the low resolution IRS (5--38 micron) and the MIPS SED modes (52--97 micron). A further photometric follow-up with Herschel (HERITAGE) is approved.

Here we present a showcase of results from the project so far, highlighting dust production by evolved stars, the properties of dust in the interstellar medium and the dusty envelopes of young stellar objects in the clouds.

4-P05 Chemistry in Dark Clouds at Low Metallicity

N. Kunawicz (Jodrell Bank Centre for Astrophysics), A. J. Markwick-Kemper and P. M. Woods

A time-dependent model of a dark cloud was constructed, in an attempt to model these clouds in low metallicity environments such as external galaxies. The models were calculated with varying initial elemental abundances of carbon, oxygen, nitrogen, sulphur and iron. These abundances were taken from observations of HII regions in the LMC and SMC [1]. The results were used to identify potential metallicity tracer species in dark clouds.

[1] Garnett(1999) IAU Symposium 190..266G

4-P06 BLASTing for Dust - A Resolved View of Dust in Nearby Galaxies with BLAST

M. Smith (Cardiff University), BLAST Team

IRAS, ISO and Spitzer surveys have greatly increased our understanding of dust in the universe, however it is estimated 90\% of dust is too cold to radiate in the IRAS bands and any dust colder than 15 K will not radiate significantly in the Spitzer bands. Understanding of dust is critical as it has varied affects ranging from obscuring star formation to to providing sites where hydrogen can be converted from atomic to molecular form. BLAST (Balloon-borne Large Aperture Sub-millimeter Telescope) provides high resolution images of a set of six nearby galaxies in the range of 250 to 500 micrometers. This unique data set allows detailed investigation of the distribution and temperatures of cold dust which has previously not been observable. Combining these results with gas maps allows us to quantitatively see how the dust and gas vary with respect to each other in different regions and environments within a galaxy. This poster presents preliminary results of dust to gas ratios in a sample of nearby BLAST galaxies. With the advent of Herschel and the SPIRE instrument this work can be expanded to look at much larger samples and the effects of galactic environment on dust.

4-P07 A Point Source Classification Scheme using Mid-Infrared Spectra

P. Woods (Jodrell Bank Centre for Astrophysics), E. Lagadec, C. Kemper, J. Oliveira, K. Volk and the SAGE-Spec team

We have produced a simple but robust classification scheme for point-source targets using mid-infrared spectra. This region of the spectrum is often dominated by dust features, and we utilise these and other spectral features, the overall shape of the spectrum and related information, such as bolometric luminosity and variability, to classify point sources. This scheme has been applied to Spitzer data from the SAGE-Spec project (Kemper et al. 2009) and here we present examples and extend its application to ISO SWS spectra. This scheme will also have an application to data from IRAS, Spitzer, AKARI and the forthcoming MIRI instrument on the JWST.

4-P08 The Dust Condensation Sequence at Low Metallicty

P. Woods (Jodrell Bank Centre for Astrophysics), C. Kemper, A. Speck, M. Marengo and the SAGE-Spec team

Observations of carbon stars in the Magellanic Clouds (Speck et al. 2009, Leisenring et al. 2008, Lagadec et al. 2007) have produced differing opinions on the condensation sequence of carbon-rich dust, and in particular the order of formation of important condensates such as TiC, SiC and graphitic carbon. We present initial results in modelling the dust condensation sequence in such regions of low metallicty using a molecular equilibrium model, and compare our results to observations of the LMC taken as part of the SAGE-Spec project with the Spitzer Space Telescope.

Tuesday
4:00pm

Galaxies in the First Few Gyrs

M. Lehnert (GEPI, Observatoire de Paris)

I will review what is known about galaxies above redshifts of 4-5. This review will focus on the physical properties of these distant galaxies as gleaned from multiwavelength observations, especially results from the limited spectroscopy that is available.

Tuesday
4:20pm

Intense Starbursts at z~5: First Stellar Mass Assembly in the Progenitors of Present- Day Spheroids

A. Verma (University of Oxford), Matt Lehnert, Natascha Foerster Schreiber, Laura Douglas, Malcolm Bremer

We describe a comprehensive multiwavelength program to study high redshift galaxies selected from deep optical imaging surveys complemented by infrared data and follow-up spectroscopy. Using the Lyman-break technique we have identified a robust sample of z~5 UV luminous star-forming galaxies for which we present a complete statistical study of their physical properties derived from their rest-frame UV-to-visible SEDs. The characteristic properties of this sample differ from LBGs at z~3 of comparable luminosity in that they are a factor of ten less massive (~few ×10^9 solar masses) and the majority (~70\%) are considerably younger (<100 Myr). We estimate the contribution of this young population to the global star formation rate and stellar mass density of the universe at z~5. The constraint derived for the latter is affected by their young ages and short duty cycles which imply z~5 LBG samples may be highly incomplete. Their high unobscured star formation rate intensities (~100s solar masses per year per square kpc), suggest these galaxies drive outflows and winds that enrich the intra- and inter-galactic media with metals. We do not find any strong differences between their properties (mass, SFR, age or dust) and the presence of Lyman alpha suggesting that local conditions (neutral gas fraction, winds, geometry) more likely influence the emergence and strength of Lyman alpha emission. The general picture that emerges from our study is that z~5 LBGs are in-formation and are accumulating their first significant stellar mass. They have properties consistent with being the progenitors of the densest stellar systems in the local Universe - the centres of old bulges and early type galaxies.

Tuesday
4:30pm

Spectroscopy of 70 LBGs at z>4.7

L. Douglas (Observatoire de Paris), Malcolm Bremer, Matt Lehnert, Elizabeth Stanway

I will present the results from a spectroscopic survey which resulted in the confirmation of 70 Lyman break galaxies at redshifts greater than 4.7 over 10 separate fields. From a large colour selected sample, 20 spectroscopic masks were observed for a total of 100 hours on FORS2 at the VLT resulting in the identification of Lyman-alpha emitting and continuum break only galaxies. I will discuss the colours of these galaxies, comparing the two populations, and the equivalent width distribution of Lyman-alpha. Two of the ten survey fields exhibit spikes in their individual redshift distributions, a factor of 6 above the number of galaxies expected within a 0.1 redshift bin. Different interpretations of such structures will be proposed, speculating on the final location of these small and young high redshift galaxies, e.g. nearby massive galaxies. I will also comment on the fraction of galaxies identified as part of multiple systems through complementary HST imaging.

Tuesday
4:40pm

Constraints on Star Forming Galaxies at z>6.5 from HAWKI Y-Band Imaging of GOODS-South

S. Hickey (University of Hertfordshire), Andrew Bunker, Matt Jarvis, Kuenley Chiu

We present the results of our search for high redshift Lyman-break galaxies over the GOODS-South field. We use ACS HST data in B, V, i' & z', VLT ISAAC J and Ks, Spitzer 3.6, 4.5, 5.8 and 8.0 micron data in conjunction with the new HAWK-I Y-band science verification data to search for dropout galxies in the 6<z<9 redshift range. Candidates were selected on the basis of a colour cut of (Y-J)AB>0.75 and (z'-Y)AB>1.0 for Y and z' drops respectively. We find no robust Y-drops (z~9) brighter than J(AB)<26.4. In our search for z'-band dropouts (z~6.5-7.5), we identify two previously-known Galactic T-dwarf stellar contaminants with these colours, and two likely supernovae seen in the Y-band data. We also identify 2 galaxies with z'-drop colours and bright Spitzer/IRAC fluxes which are likely z>6.5 galaxies.The implications if all or none of our candidates are real on the Ultra-Violet luminosity functions at z>6.5 are explored. We find our number of z'-drop candidates to be inconsistent with the expected number of z' drops in a simple no-evolution scenario from the z=3 Lyman-break galaxy luminosity function but we are marginally consistent with the observed luminosity function at z approx. 6 (if all our candidates are real). However, it is possible that one or both of our z'-drop candidates are not z>6.5 galaxies, which would demand evolution of the luminosity function at early epochs, in the sense that the number density of UV-luminous star-forming galaxies at z>7 is less than at z=3-6.

Tuesday
4:50pm

The clustering properties of high-redshift galaxies and AGNs

C. Porciani (Argelander Institute for Astronomy, Bonn Universit)

Thanks to the advent of deep redshift surveys it has been possible to extend studies of galaxy clustering and galaxy environment beyond the local universe. We review recent progress in the field emphasizing both observational and theoretical aspects.

Tuesday
5:10pm

The Clustering Properties of Distant Red Galaxies from the UKIDSS Deep Extragalactic Survey

G. Parish (University of Hertfordshire)

We present the number count and spatial distributions of distant red galaxies (DRGs) selected from the Data Release 3 of the UKIDSS Deep Extragalactic Survey. The DRGs are selected using the colour selection of J-K>2.3 over an area of 11 sq degs to a depth of K < 20.0. Using a redshift distribution from the UKIDSS Ultra Deep Survey we present the correlation length of the DXS sample. This is the largest area over which this type of analysis has been carried out and enables us to quantify the effects of cosmic variance using the four independent DXS fields.

Tuesday
5:20pm

Obscured Star Formation as a Function of the Environment in the COSMOS Field

C. Feruglio (CEA -Saclay)

The leading factor driving star-formation in massive galaxies is still a matter of debate: is it environment or mass? Galaxy interactions, and in general galaxy environment, are expected to play a role in triggering both star-formation and AGN activity in the standard Lambda CDM framework. On the other hand, recent results might suggest that mass is the main parameter governing galaxy evolution. We have undertaken a study aiming at disentangling the mass and environment parameters, using an infrared selected sample to avoid any bias due to obscuration. We take advantage of the deep multiwavelegth photometric coverage and of the unprecedented quality of the photometric redshifts in the Cosmic Evolution Survey (COSMOS), to select a large sample of luminous infrared galaxies (LIRG) detected at 24 micron in the Spitzer-COSMOS survey, and characterize their environment in terms of galaxy surface density. We will discuss the properties of LIRGs as a function of the galaxy density up to z~1.2, comparing with a sample of optically-selected galaxies, and with the predictions from the Millennium Simulation. We find an overall increase of LIRG fraction with increasing redshift as expected from the evolution of the co-moving star-formation rate density. Having eliminated the mass as a parameter in our samples, we find variations of the LIRG fraction as a function of redshift and environment, showing that environment does actually play a role in galaxy evolution. We find that the decrease of the LIRG fraction in high density environments is in place by z~1, together with the color-density relation. At z=1-1.2 we find a flatter trend of LIRG fraction with density, suggesting that the reversal of the SFR-density relation may occur at z>1.

Wednesday
11:00am

The History of Mass Assembly: Results and Open Questions

A. Fontana (INAF-OAR)

In the most recent years, spectacular results have been obtained in tracing the history of galaxy mass assembly over most of the life of the Universe. I will review the present status of our knowledge, with an amphasis on open questions and problems that are still awaiting a solution.

Wednesday
11:30am

A Major Spectroscopic Campaign Targeting K-Band Selected Galaxies in the UKIDSS Ultra-Deep Survey

H. Pearce (Institute for Astronomy, University of Edinurgh), R. McLure, M. Cirasuolo, O. Almaini

The UKIDSS Ultra-deep survey (UDS) is currently the deepest, wide-area, near-IR imaging survey in existence. The combination of deep near-IR data with optical imaging from Subaru and deep IRAC+MIPS imaging from Spitzer makes the UDS an ideal laboratory for studying the high-redshift evolution of massive galaxies. At present, the UDS data-set is being greatly enhanced by the addition of a large VIMOS+FORS2 spectroscopic follow-up campaign on the VLT, designed to provide redshifts for >4000 K-band selected galaxies at z>1. Here we present the first results from the on-going FORS2 spectroscopy campaign which has already provided robust spectroscopic redshifts for more than 300 massive galaxies (K_AB<23) in the redshift interval 1<z<2. Crucially, the combination of the new spectroscopic information with the excellent multi-wavelength data available in the UDS has allowed us to derive much improved stellar mass measurements for the FORS2 sample. Using this new information we present an initial demonstration of the potential to trace the influence of downsizing in massive galaxy evolution by studying the properties of composite spectra as a function of stellar mass, starformation rate and size.

Wednesday
11:40am

Size Evolution of Early-Type Galaxies

A. van der Wel (MPIA)

Several studies have revealed the presence of high-redshift (z~2) galaxies that are much like present-day early-type galaxies: they are compact, their star-formation rates are low, and they have evolved stellar populations. The main difference between these objects and equally massive local counterparts is that their sizes are 3-5 times smaller. The need to understand how these galaxies evolved between z~2 and the present goes beyond the need to satisfy our curiosity regarding the fate of these intriguing objects: their evolution must be intimately related to galaxy assembly over cosmic time in general. First I will summarize the observational evidence for strong size evolution of early-type galaxies. Then I will present a simple, empirically motivated model that combines the continuous emergence of galaxies with early-type characteristics and subsequent gas-poor merging. The model predictions match both the observed evolution in the volume-averaged number of early-type galaxies and their evolution in size.

Wednesday
11:50am

Exploring the Formation of Massive Galaxies in GOODS

I. Ferreras (MSSL/UCL), T. Lisker, A. Pasquali, S. Kaviraj, S. Khochfar, S. Malhotra, J. Rhoads, R. Windhorst

Massive early-type galaxies constitute one of the best probes to test models of galaxy formation. I will present recent and ongoing work focussing on a sample of moderate redshift (z<1.5) early-type galaxies from the GOODS North and South fields. We explore in detail the evolution in density, size, stellar mass and intrinsic colour distribution. These observations pose strong constraints on recent models of galaxy formation. I will also present recent work exploring z<0.1 massive early-types from SDSS by looking at their stellar populations via model-independent statistical techniques.

Wednesday
12:00pm

The Star Formation History of Early-Type Galaxies over the Last 8 Billion Years

S. Kaviraj (MSSL and Oxford), Sukyoung Yi (Yonsei University), Kevin Schawinski (Yale), Eric Gawiser (Rutgers), Ignacio Ferreras (MSSL), Joseph Silk (Oxford), Richard Ellis (Caltch/Oxford), GALEX Science Team and MUSYC collaboration

I review our current understanding of the star formation histories of early-type galaxies, in the context of recent observational studies of their rest-frame ultraviolet (UV) properties. By combining restframe UV to NIR data of the high-redshift Universe from deep optical surveys (MUSYC/ COMBO-17/GEMS/COSMOS), with GALEX (UV) and SDSS (optical) photometry in the nearby Universe, we are able to put unprecedented constraints on the formation and evolution of these galaxies over the last 8-10 billion years. In agreement with previous (optical) studies, the results indicate that the bulk of the stellar mass in early-types forms at high redshift (z > 1), possibly over short timescales (< 1 Gyr). Nevertheless, early-types of all luminosities form stars over the lifetime of the Universe, with most luminous (-23 < M(V) < -21) systems forming up to 10 - 15 % of their stellar mass after z = 1 (with a scatter to higher values), while their less luminous (M(V) > -21) counterparts form up to 30 - 60 % of their mass in the same redshift range. The intensity of the recent star formation activity and the UV colour distribution is consistent with what might be expected from minor mergers (mass ratios < 1:3) in a standard LCDM cosmology. This is strongly supported by HST images of early-types around z ~ 0.5 which show a remarkable correspondence between the presence of morphological disturbances and UV excess. Based on these results, the role of minor merging in shaping the (late-epoch) evolution of the massive galaxy population is discussed.

Wednesday
12:10pm

The Nature and Clustering of Star-Forming Galaxies at z=0.84

D. Sobral (Institute for Astronomy), P. N. Best, J. E. Geach, Ian Smail, J. Kurk, M. Cirasuolo, M. Casali, R. J. Ivison, K. Coppin, G. B. Dalton

New results from a large survey of H-alpha emission-line galaxies at z=0.84 using WFCAM/UKIRT and a custom narrow-band filter in the J band will be presented as part of the HiZELS survey. Reaching an effective flux limit of 1e-16 erg/s/cm^2 in a comoving volume of 1.8e5 Mpc^3, this represents the largest and deepest survey of its kind ever done at z~1. There are 1517 potential line emitters detected across 1.4 sq.deg of the COSMOS and UKIDSS UDS fields, of which 743 are selected as H-alpha emitters. These are used to calculate the H-alpha luminosity function, which is well-fitted by a Schechter function. The integrated star formation rate density (SFRD) at z=0.845 is 0.15±0.01 M_sun/yr/Mpc^3. The results robustly confirm a strong evolution of SFRD from the present day out to z~1 and then flattening to z~2, using a single star-formation indicator. Out to z~1, both the characteristic luminosity and space density of the H-alpha emitters increase significantly; at higher redshifts, L* continues to increase, but phi* decreases. The z=0.84 H-alpha emitters are mostly disk galaxies (82±3 %), while 28±4 % of the sample show signs of merger activity and contribute ~20 % to the total SFRD. Irregulars and mergers dominate the H-alpha luminosity function above L*, while disks are dominant at fainter luminosities. These results demonstrate that it is the evolution of 'normal' disk galaxies that drives the strong increase in the SFRD from the current epoch to z~1, although the continued strong evolution of L* beyond z=1 suggests an increasing importance of merger activity at higher redshifts. These star-forming galaxies are also significantly clustered, presenting a real-space correlation length r_0=3.5±0.5 Mpc/h, with the most luminous ones (mostly irregulars) being clearly more clustered r_0~6 Mpc/h than fainter galaxies (disks), which present r_0~2 Mpc/h.

Wednesday
12:20pm

The GOODS NICMOS Survey: Early Results

C. Conselice (Nottingham), Amanda Bauer, Asa Bluck, Fernando Buitrago, Ruth Grützbauch, and the GOODS NICMOS Survey Team

The GOODS NICMOS Survey is a large Hubble Space Telescope programme to obtain deep H-band and J-band imaging over the GOODS-North and South fields. The total exposure time is 180 orbits within the F160W filter (H-band) in fields surrounding massive galaxies with log M > 11 at 2 < z < 3. This survey covers 1/3 of a GOODS field, and reaches a depth of H = 26.5 AB. In this talk I will review the latest results from this survey, including examination of the mass assembly rates, merger rates, sizes, and black hole growth for massive galaxies at z < 3. Science results I will present include the first measurement of the merger and pair fraction, and quantified size evolution history for massive galaxies at z < 3, as well as how black holes in massive galaxies grown with time, as well as future activities measuring the star formation rates evolution in these galaxies.

Wednesday
2:00pm

Obscured Star Formation Review

I. Smail (ICC, Durham)

I will review results on obscured star formation at high redshifts.

Wednesday
2:30pm

The Far Infrared History of the Universe from the Balloon- Borne Large- Aperture Submillimeter Telescope: BLAST

E. Pascale (Cardiff University, Physics), The Blast Collaboration

The energy emitted by the galaxies in the Universe makes up the most dominant form of energy, second only to the black body radiation left over from the Big Bang. About half of this starlight is emitted at the time of galaxy formation and it is reprocessed by dust into the rest-frame far-infrared. This radiation contributes to the Cosmic Infrared Background (CIB) which extends up to the submillimetric part of the spectrum, due to the cosmological redshift. Advances in understanding the star formation history in the Universe has been recently achieved with the results of the Balloon-borne Large Aperture Submillimeter Telescope (BLAST), a sub-orbital experiment designed to image the sky with unprecedented angular coverage in three spectral bands, from 250 to 500um, near the peak of the CIB. Here we report the first deep BLAST images showing that the CIB is resolved by mid-infrared selected sources located at a redshift <~ 2. With a negligible AGN contribution < 7 %, the CIB is mostly composed by starbust galaxies. The BLAST spectral coverage allows the first direct measurement of the far-infrared luminosity and star formation history of the Universe and to track its evolution with redshift. We find that star formation is dominated by optically-obscured dusty galaxies, with optical star formation contributing a 1/3 of the total, which link to the ultra-luminous galaxies detected with SCUBA and MAMBO at higher redshifts.

Wednesday
2:40pm

The AzTEC mm-Wave Survey of the SHADES Fields

A. Mortier (Institute for Astronomy, University of Edinburgh), The SHADES/AzTEC consortium

The AzTEC/SHADES survey using the AzTEC camera on the JCMT is the largest, deep extragalactic millimetre-wavelength survey undertaken to date. These observations of the SHADES fields at 1.1mm are giving us a new insight into the extreme star formation rates in massive star-forming galaxies at high redshifts. Combining maps, sources and 1.1mm number counts with the wealth of existing co-spatial multiwavelength data we discuss the history of dust-enshrouded star formation in massive galaxies and the implications for galaxy formation and evolution models.

Wednesday
2:50pm

The High-Redshift (z>4) Tail of Submillimeter Galaxies

K. Coppin (Durham), The LESS Collaboration

We have discovered the highest redshift submm-selected galaxy (SMG) currently known at z=4.76 in a new 870-um survey undertaken in the Extended Chandra Deep Field South (ECDFS) with the Large Apex BOlometer CAmera (LABOCA) on the Atacama Pathfinder EXperiment (APEX) telescope in Chile. The bolometric emission of this SMG is dominated by a starburst (SFR~1000 Msun/yr), although we also identify a moderate luminosity AGN in this system since it shows a mix of starburst and obscured AGN signatures. The redshift distribution of SMGs peaks around z~2.2, although a tail of SMGs is beginning to emerge at z>4 through recent confirmation of three other SMGs lying at z=4-4.5. This high redshift tail could pose a serious challenge to current hierarchical models which predict a z>4 SMG surface density about an order of magnitude less than would be implied if all massive high-redshift galaxies form through a submm-luminous phase.

Wednesday
3:00pm

Investigating the Far-IR/Radio Correlation of Star Forming Galaxies to z=3

N. Seymour (MSSL/UCL), M. Huynh, T. Dwelly, M. Symeonidis, A. Hopkins, I.M. McHardy, M. Page & G. Reike

We have studied the Spitzer far-infrared (far-IR) properties of sub-mJy radio sources from the 13^H XMM-Newton/Chandra Deep Field in order to examine the infrared/radio correlation by redshift and galaxy type: Active Galactic Nucleus (AGN) or Star Forming Galaxy (SFG). We directly detect 70um counterparts (at >3sigma significance) for 22.5\% (92/408) of the radio sources. For the sources detected at 70um we find that the mean and scatter of the flux density ratio, q70, are similar to previous results in the literature. The AGN have a lower mean q70 than the SFGs. For the non-detected radio sources we perform stacking analysis by redshift and galaxy type. At all redshifts we obtain a stacked detection for the 70um non-detected SFGs which have mean flux densities only just below the 70um detection limit. For the AGN individually undetected at 70um, we obtain a stacked detection only for our highest redshift bin (1<z<5) where we may be sampling hot dust associated with the AGN at rest-frame 12-35um. The combined observed mean value of q70 for the SFGs decreases gradually with redshift to 0.7dex below the local value by z~3. This trend is consistent with the values of q70 expected from simply redshifting templates of local starburst galaxies, i.e. the far-IR/radio correlation broadly holds to z~3. However, there is a suggestion of a lower mean value of q70 at z~1 compared to these template tracks, implying that some high redshift (Ultra) Luminous IR Galaxies may have different SEDs to their local counterparts. We find our results are not significantly affected by the prior use of 24um/radio flux density ratio cuts to discriminate between SFG and AGN.

Wednesday
3:10pm

Deep Multi-Frequency Radio Imaging in the Lockman Hole using the GMRT and VLA: The Nature of the sub-mJy Radio Population

E. Ibar (UK ATC), R.J. Ivison; A.D. Biggs; D.V. Lal; P.N. Best; D.A. Green

In the run up to routine observations with the upcoming generation of radio facilities, the nature of sub-mJy radio population has been hotly debated. In this talk, I describe multi-frequency data designed to probe the emission mechanism that dominates in these faint radio sources. Our analysis is based on observations of the Lockman Hole using the Giant Metre-wave Radio Telescope (GMRT) -- the deepest 610-MHz imaging yet reported -- together with 1.4-GHz imaging from the Very Large Array (VLA), well matched in resolution and sensitivity to the GMRT data (sigma_610MHz ~ 15 uJy/beam, sigma_1.4GHz ~ 6 uJy/beam, FWHM ~ 5 arcsec). The GMRT and VLA data are cross-matched to obtain the radio spectral indices for the faint radio emitters. Statistical analyses show no clear evolution for the median spectral index, alpha(1.4GHz, 610MHz) (where S_nu ~ nu^alpha), which is found to be approximately -0.6 to -0.7 based on an almost unbiased 10-sigma criterion, down to a flux level of S_1.4GHz > 100 uJy. The fraction of inverted spectrum sources, alpha(1.4GHz, 610MHz) > 0, is less than 10 per cent. The results suggest that the most prevalent emission mechanism in the sub-mJy regime is optically-thin synchrotron, ruling out a dominant flat spectrum or ultra-steep spectrum radio population. The spectral index distribution has a significant scatter, Delta(alpha) ~ 0.4 - 0.5, suggesting a mixture of different populations at all flux levels. This is supported by spectroscopic classifications of radio sources with hard X-ray emission, which has allowed us to estimate that the fraction of radio-quiet (type 1 and 2) AGN at S_1.4GHz < 300 uJy is 13--30 per cent, in agreement with a dominant star-forming galaxy population in the sub-mJy regime.

Wednesday
3:20pm

High Resolution CO and Radio Studies of High-z ULIRGs: Calibrating the z=2 Star Formation Laws

S. Chapman (Institute of Astronomy, University of Cambridge)

We present new high resolution CO and radio observations of z~2 ULIRGs selected through radio, submillimetre and infrared properties. We use these spatially resolved maps to better calibrate the z=2 star formation density thresholds, and in turn study the implied range of gas properties for lower luminosity galaxies at these redshifts.

Wednesday
4:00pm

Testing the AGN-Starburst Connection with Deep Multi- Wavelength Surveys

D. Alexander (Durham University)

Deep multi-wavelength surveys over the past decade have identified galaxies and AGN out to z~5-6. I will review results exploring the intimate connection between star formation and AGN activity, focused mainly on the deepest multi-wavelength surveys in the GOODS fields.

Wednesday
4:30pm

Constraints on the Micro-Jy Radio Source Population from the VLA-CDFS Survey

P. Padovani (ESO), V. Mainieri, P. Tozzi, K. Kellermann, E. Fomalont, N. Miller, P. Rosati, P. Shaver

We present a detailed analysis of the ~ 260 sources from our deep (flux density limity of 42 microJy) Chandra Deep Field South (CDFS) 1.4 and 5 GHz VLA survey. The radio population is studied by using a wealth of multiwavelength information in the radio, optical, and X-ray bands. The availability of redshifts for ~ 80 % of the sources in our complete sample allow us to derive reliable luminosity estimates for the majority of the objects. Contrary to some previous results, we find that star-forming galaxies make up only about 50 % of sub-milliJansky radio sources, with the remaining sources being active galactic nuclei (AGN). The AGN include low luminosity radio galaxies and a significant radio-quiet component. A preliminary analysis suggests significant evolution of the star-forming population, but no evolution for the radio-loud AGN population.

Wednesday
4:40pm

Radio Observations of Complete Hard X-Ray AGN Samples

F. La Franca (Universita` Roma Tre), G. Melini, F. Fiore

We have studied the AGN radio emission properties from a compilation of complete hard X-ray selected samples, all observed in the radio (1.4 GHz) band. A total of about 2000 AGN have been used up to redshift 4. For a complete sub-sample of about 200 X-ray bright AGN it was possible to reach a ~90 % level of radio detections and therefore, for the first time, it was possible to derive the complete probability distribution function of the ratio of the radio to intrinsic X-ray luminosity.

The dependence from luminosity and redshift of the probability distribution of the LR/LX ratio has been studied. The implications on the AGN radio mode feedback are discussed.

Wednesday
4:50pm

Results from an Ultra-Deep Chandra Observation of the z=3.09 SSA22

B. Lehmer (Durham University), The Chandra Deep Protocluster Survey Team

It is now widely accepted that the growth of galaxies and their central supermassive black holes (SMBHs) are linked. Observations and CDM theories of large scale structures indicate that galaxy growth is accelerated in high-density environments, and the highest density structures underwent their most vigorous star formation at z > 2--3. To study the corresponding growth of SMBHs in such high-density environments, we have conducted an ultra-deep ~400 ks Chandra survey covering the SSA22 protocluster at z=3.09: the Chandra Deep Protocluster Survey. The protocluster itself contains a factor of ~6 overdensity in galaxies (i.e., LBGs and LAEs) and is predicted to collapse into a z=0 cluster resembling a rich local cluster (e.g., Coma). I will report on the current status of the Chandra Deep Protocluster Survey and will highlight two recent investigations that make use of the new Chandra data. These investigations include (1) a study of the growth of galaxies and SMBHs in the z=3.09 protocluster environment compares with z~3 sources found in lower-density environments where we find that the fraction of galaxies hosting AGN activity is enhanced compared to the field, and (2) a comprehensive exploration of the role of AGN and star-formation activity in producing extended (>30 kpc) Lyman-alpha emitting blobs (LABs).

Wednesday
5:00pm

Ongoing Nuclear Activity and Star Formation in z>1 AGN in the CDFS

F. Fiore (INAF-OAR), M. Brusa

The co-evolution of host galaxies and the active black holes which reside in their centre is one of the most investigated topic in modern high-redshift multiwavelength surveys. Here we present a study on the host galaxies properties of obscured Active Galactic Nuclei (AGN) deteted in the CDFS 1Ms observation and for which deep K-band observations obtained with ISAAC@VLT are available. The aim of this study is to characterize the host galaxies properties of obscured AGN in terms of their stellar masses, star fo rmation rates, and specific star formation rates. To this purpose we: 1) refined the X-ray/optical association of 179 1 Ms sources in the MUSIC area, using a three-bands (optical, K, and IRAC) catalog for the counte rparts search; 2) recomputed photometric redshifts making use also of the IRAC+MIPS data points and a large number of SED templates; 3) studied the observed frame optical to near infrared to mid-infrared colors and 4) derived the rest frame properties from SED fitting. We found that the host of obscured AGN at z>1 are associated with luminous, massive, red galaxies with significant star formation rates episodes still ongoing in about 50 % of the sample. The fraction of AGN inmass selected samples at different redshifts, once the selection effects are taken into account, is similar to what is observed in the local Universe, suggesting a change in the duty cycle of AGN activity from redshift z~2 to z~0.

Wednesday
5:10pm

X-Ray Selected Type-2 QSOs: a Laboratory to Study Ongoing Star Formation and Black Hole Accretion

V. Mainieri (ESO)

Although the fraction of obscured AGN is found to decrease with luminosity from several studies, a non-negligible population of obscured QSOs is still required by the X-ray background synthesis models. We present a large sample (121 objects) of X-ray selected Type-2 QSOs from the XMM-COSMOS survey (2 sq. degs). Type-2 QSOs are luminous AGN whose central engines are obscured by large amounts of gas and dust. The selection criteria we have used is based on high X-ray luminosity (L(X)>10^44 erg/s) and heavy obscuration (N_H>10^22 cm-2). These two physical quantities have been derived from a detailed X-ray spectral analysis (see Mainieri et al., 2007, ApJS, 172, 368) of the ~1800 X-ray point-like sources in this survey. Few (~5 %) of the Type-2 QSOs are best fitted with a pure reflection model, typical of Compton-thick sources. We have optical spectra for ~30 % of the sample and for the remaining sources we have derived accurate photometric redshifts. The redshift range covered is wide, 0.3<z<3.9 (95 % at z>0.8). Our X-ray selected sample of Type-2 QSOs is complementary to the SDSS optically selected one (Zakamska et al. 2003) in terms of redshift range covered and of host galaxy colors.

We will use this large high-z sample of quasars and the wide multi-wavelength data available in COSMOS to correlate the general properties of the host galaxies with the ongoing accretion in their nuclei. Using a sophisticated morphological classification of the host galaxies based on five non-parametric diagnostics (asymmetry, concentration, Gini coefficient, M20, ellipticity) we found that ~10 % of the Type-2 QSOs are in elliptical galaxies, ~55 % in disk galaxies and ~35 % in irregular galaxies. The majority of the irregular hosts can be described as undergoing merger activity or show tidal debris. We derived stellar masses from the stellar population synthesis model that represents the best fit of the observed photometry (from 0.3 to 4.5 micron) and star formation rates from the [OII] or H_alpha line fluxes. The majority (75 %) of QSO-2 host galaxies have stellar masses above log(Mstar)~ 10.5 MSun and have ongoing star formation (<SFR>~100 MSun/yr). The value of 10.5 MSun is similar to the characteristic mass for obscured AGN (Kauffmann et al. 2003) and radio-loud AGN (Best et al. 2005) in the SDSS. It is also consistent with the more general result that the fraction of galaxies hosting AGN increases with the stellar mass.

Wednesday
5:20pm

Results from the Deepest Ever Far-Infrared Survey of AGNs

J. Mullaney (Durham University), D. M. Alexander, M. Huyn, A. Goulding, D. Frayer

Recent X-ray and infrared (IR) surveys have proven to be highly efficient means of finding AGN, especially those obscured in the optical wavebands by dense clouds of dust and gas. Here I report on our results derived from the deepest ever far-IR (Spitzer 70um) observations of X-ray selected AGNs out to a redshift of z~3.5. I will show that the average mid to far-IR spectral energy distribution (SED) of AGNs has remained virtually unchanged out to (at least) z=2. Despite this, the average IR-to-Xray luminosity ratio increases by a factor of ~6 in typical (Lx=10^(42-43) ergs/s) AGN between z=0.5 and 2, providing the first strong evidence of increased dust covering factors at high redshifts. I show that the 70/24um flux ratio can discriminate between starburst and AGN dominated systems out to z~1.5 and find that X-ray luminous AGNs have more AGN-dominated IR SEDs. To distinguish between AGN and starburst dominated systems at higher redshifts requires longer wavelength data, which will be provided in the near future by deep Herschel and SCUBA2 observations.

Thursday
11:00am

Outstanding Issues in Galaxy Formation

S. White (MPI for Astrophysics)

We now have a standard (if implausible) model for the origin and evolution of structure. Within this paradigm the parameters which specify the contents of the Universe and the initial conditions for structure formation are well determined. Despite this, there are many aspects of the formation of galaxies which we are still very far from understanding. Why was galaxy formation so inefficient? Where are most of the baryons today? Most of the heavy elements? What sets the characteristic masses and sizes of galaxies? Why are most stars part of thin galaxy disks? What is the role of mergers in determining the morphology and activity of galaxies? Why are the properties of supermassive black holes so closely linked to those of their host galaxies? Are there any "first galaxies" left today? I will review these and other questions that will dominate galaxy studies for the next decade.

Thursday
11:30am

VIDEO and SERVs: a Deep and Wide Near-Infrared View of the Universe

M. Jarvis (University of Hertfordshire)

The VISTA Deep Extragalactic Observations (VIDEO) survey and Spitzer Extragalactic Representative Volume Survey (SERVS) will begin this year. Combined, they will provide and unprecedented view of the high-redshift Universe from the 0.8-4.5 microns providing us with the opportunity to monitor the formation and evolution of galaxies and AGN from the Dark Ages through to the present day as a function of environmental density. I will provide an overview of the main science goals of these groundbreaking surveys and provide an update on the synergies with other future multi-wavelengths surveys.

Thursday
11:40am

The Herschel ATLAS and other Herschel Surveys

S. Eales (Cardiff), The Herschel ATLAS team

The Herschel ATLAS is the largest Herschel Open-Time key project, consisting of a survey of 550 square degrees in five far-IR and submm bands - an area of sky four times larger than all the other Herschel surveys combined. The ATLAS has six major science programmes: (i) a survey of dust and dust-obscured star formation in the nearby universe; (ii) high-resolution imaging of the sources in the Planck point-source catalogue; (iii) a search for gravitational lenses; (iv) AGN; (iv) the evolution of the clustering of dusty galaxies; (vi) a survey of prestellar cores and protostars at high galactic latitudes. I will describe the details of the science programme, the plans for the production of legacy data products, and also how the ATLAS fits in with the rest of the Herschel programme.

Thursday
11:50am

The Herschel Multi-Tiered Extragalactic Survey (HerMES)

S. Oliver (University of Sussex), The HerMES Consortium

It is now well known from observations of the extragalactic cosmic background light than about half of the photons emitted by star-formation over the course of the history of the Universe are absorbed by dust and remitted at far-infrared wavelengths. This obscured star-formation challenges models of galaxy evolution.

ESA's Herschel mission is due to be launched on April 16th 2009, the week before JENAM. Herschel will study this emission from 70 to 600 micron, the peak of this cosmic infrared background.

HerMES aims to characterize the bolometric emission from obscured galaxies and map this star-formation history both temporally and spatially. HerMES will map over 70 square degrees including many famous deep extragalactic survey fields. It will detect over 100 thousand such galaxies (q.v. a few 100 sub-mm galaxies from ground based telescopes today). HerMES is the largest project being conducted by Herschel occupying 900 hours or ~5 % of the mission. It will provide an invaluable legacy for studies of galaxy evolution at all wavelengths.

I will provide a brief justification and summary of HerMES and place the survey in context of existing and future multi-wavelength surveys and (depending on the rest of the program) other surveys from Herschel.

Thursday
12:00pm

Beyond Herschel on SAFARI - a FIR Imaging Spectrometer and Photometer for SPICA

K. Isaak (Cardiff University), on behalf of the SAFARI consortium

The infrared waveband plays host to a tool box full of spectroscopoic and photometric diagnostics which probe the very wide range of physical conditions found across different astronomical environments. The past 25 years have marked a golden age in space-based infrared astronomy, with the IRAS, ISO, AKARI and Spitzer satellites advancing fields from planetary science to starformation, and galaxy formation through to galaxy evolution. Much is expected from the far-infrared/submillimetre instrument suite on the soon-to-be launched Herschel, and the NIR/MIR capabilities of JWST.

The successes of past missions have raised many key questions in galaxy evolution that can only be addressed in the IR/MIR/FIR, yet that are "just" beyond the capabilities of Herschel and the JWST.

In this talk I will introduce SAFARI, the FIR instrument on the proposed JAXA-led Japanese-ESA mission, SPICA. SPICA is one of a number of missions that have been selected to go to the next stage of the ESA Cosmic Vision proposal. With its cooled, 3.5m mirror, SPICA will provide unrivalled sensitivity in the FIR, a waveband that is central to unravelling galaxy evolution. SAFARI is the proposed imaging spectrometer for SPICA, with both spectral and photometric capabilities that cover the 35 - 210um waveband. I will illustrate how the unique capabilities of SAFARI can be used to address key questions in extragalactic astrophysics, and will illustrate the synergies between JWST-SAFARI-ALMA.

Thursday
12:10pm

Predictions for Cosmological Surveys with Herschel Based on Galaxy Formation in CDM

C. Lacey (ICC, Durham University), Carlton Baugh, Carlos Frenk, Cesario Almeida

Cosmological surveys with Herschel promise to revolutionize our understanding of the history of dust-obscured star formation in the universe. To set the scene for this, I will present up-to-date predictions for what Herschel is expected to see, based on our current theoretical understanding of galaxy formation in CDM and of the reprocessing of starlight by dust in galaxies. The predictions are calculated by combining the semi-analytical model GALFORM with the dust radiative transfer code GRASIL. The output includes the complete far-UV to radio SED of each model galaxy. A version of this model has already been shown to be successful in reproducing the number counts and redshifts of galaxies in the sub-mm (Baugh etal 2005) and also galaxy evolution in the IR observed by Spitzer (Lacey etal 2008). I will review the background to the model, including successes at other wavelengths and for the properties of present-day galaxies. I will then show predictions for Herschel including number counts, redshift distributions and luminosity function evolution in the far-IR. I will also present predictions for the fluxes of Herschel sources at other wavelengths, and discuss the predicted physical properties of these sources (star formation rates, stellar masses etc). Finally, I will show some results on building mock catalogues for Herschel surveys based on the Millennium N-body simulation, with particular reference to the Herschel ATLAS survey, and discuss the clustering of Herschel sources and what this can tell us about the relation between star formation and structure in the dark matter.

5-P01

A Wide-Area Search for Extreme Lyman-Alpha Emitters

D. Bonfield (University of Hertfordshire), Bruce E. Woodgate, Don J. Lindler, Carol A. Grady, Donald G. York, Stuart L. Mufson, Brian Baptista, Charles L. Joseph

Previous surveys for Lyman-alpha emitting galaxies (LAEs) have made deep narrow-band observations, usually of fairly small fields, and have thus probed rather small volumes. These small volume surveys find a handful of objects with Lyman-alpha equivalent widths in excess of 500 A in the rest frame. For a star-forming galaxy, such a high equivalent width is greater than one expects from a simple model based on case-B recombination. While a number of mechanisms are proposed to explain this discrepancy, including an almost total absence of old stars, an excess of very massive stars, or extinction of UV light by a clumpy interstellar medium, the very small number of example systems means the question remains open.

Interestingly, the high equivalent width also means that the galaxies' broadband photometry is significantly augmented in the band containing the Lyman-alpha line. On this basis, we are conducting a broad-band search for LAEs, using deep optical imaging from the Sloan Digital Sky Survey (SDSS) stripe 82 coadd and the Canada-France-Hawaii Telescope Legacy Survey (CFHTLS). The large areas of these surveys and the broadband nature of our selection method will allow us to search a volume of ~2 Gpc, several thousand times larger than previous narrow-band surveys.

Here, we will present the details of our search, and results from pilot spectroscopy of a small number of candidates.

5-P02 AGN activity in HS1700: A Protocluster at z=2.3

J. Digby-North (Imperial College)

We present the results of a 200ks Chandra observation of the HS1700+641 field protocluster at z=2.3. We detect ~160 point sources in the field and find that ~30 are associated with BX/BM/MD galaxies (selected at z~1.7-2.7 by their rest-frame UV colours). This field has extensive supporting observations at various wavelengths; these include Lya and Ha narrow-band imaging, Spitzer IRAC and MIPS (24um) data, near-infrared data (to K(AB)=24) and 4 x 5 orbit HST/ACS (I band) pointings. Initial results suggest that there is not a significant enhancement of AGN in the z=2.3 protocluster, as found in the z=3.09 protocluster in the SSA22 field.

5-P03 Evolution and Descendants of Sub-mm Galaxies in the Lambda-CDM Model

J. Gonzalez (Durham University), Cedric Lacey, Carlos Frenk and Carlton Baugh

We present a study of the predicted evolution and descendants of submillimetre galaxies (SMGs) in the Lambda Cold Dark Matter cosmology. We use the Baugh et al (2005) semi-analytical model which matches the observed SMGs number counts and their redshift distribution by using a top-heavy IMF for bursts triggered by galaxy mergers. We build galaxy merger trees and follow the evolution and properties of SMGs. For SMGs selected with flux brighter than 5.0 mJy we find that: The duration of the sub-mm phase is shorter than 0.1 Gyr in most cases. All galaxies at the present day with stellar masses bigger than 5x10^(11) h^(-1)M_sol are predicted to be descendants of SMGs. The median stellar mass of their descendants is 10^(11) M_sol (but covering a wide range from 10^(10) to 10^(12) M_sol). More than 70 % of the submillimetre galaxies end up as bulge dominated galaxies at the present day. We find that the stellar mass produced in the submillimetre phase contribute only about 15 % of the total present-day stellar mass in these systems.

5-P04 Dust Properties of Active Galactic Nuclei

E. Hatziminaoglou (ESO), Jacopo Fritz et al.

tbd

5-P05 Extending PLE Galaxy Evolution Models to Spitzer and Sub-mm Wavelengths

M. Hill (Durham University), Tom Shanks

Pure luminosity evolution (PLE) models where galaxies brighten at high z simply due to increased SFR are known to provide a surprisingly good fit to galaxy counts and colours from U to K and to z~4. Here we show that these models also give good fits to galaxy counts, colours and z distributions in the Spitzer IRAC bands from 3.6-8 microns. We argue that this success provides a firm base for searching for high z galaxies and show resulting candidates for z~7 galaxies. At 24 microns and beyond these simple models fail by a factor of 10 even at bright magnitudes. We modify the models by incorporating dust emission seds for some galaxies on local IR observations and this immediately improves their fit to FIR galaxy counts and colours. However, at 850 microns these models again fail and we then need a significant contribution from obscured AGN to fit the sub-millimetre data.

5-P06 Ultra Deep 15 Micron AKARI Observations of Abell 2218

R. Hopwood (The Open University), Stephen Serjeant, Mattia Negrello, Eiichi Egami, Myungshin Im, Jean-Paul Kneib, Jongwan Ko, Ian Smail

We present photometry, photometric redshifts, extragalactic galaxy number counts and band-merged catalogue for AKARI ultra deep 15 micron mapping of the gravitational lensing galaxy cluster Abell 2218, which is the deepest image taken by any facility at this wavelength. A necessary step towards gaining a full understand of galaxy formation and evolution over the age of the Universe is to fully resolve the cosmic infrared background (CIRB), which represents the dust-shrouded cosmic star formation history. Observing through Abell 2218 gives magnifications of up to a factor of 10, thus allowing the sampling of a more representative spread of high redshift galaxies, which comprise the bulk of the CIRB. Compared to CIRB predictions from source count models, our data resolves the CIRB beyond the 80\% that blank field AKARI surveys aim to achieve. 19 pointed observations were taken by the MIR-L channel of AKARI's IRC. A final combined image with an area of 122.3 square arcminutes and effective integration time of 8460 seconds was achieved. The 5 sigma sensitivity limit is estimated at 15.6 micro Jy and the image is 50\% complete down to 31 micro Jy and 80\% complete down to 39 micro Jy. Our 5 sigma source catalogue contains 565 sources, giving 39 beams per source, which shows the image is confusion limited. Our 15 micron number counts show strong evolution, in line with previously published counts, and are consistent with galaxy evolution models that incorporate downsizing in star formation.

5-P07 GALEV Evolutionary Synthesis Models: The Ideal Tool to Model High-Redshift Galaxies

R. Kotulla (University of Hertfordshire), Uta Fritze, Peter Weilbacher & Peter Anders

GALEV evolutionary synthesis models describe the evolution of stellar populations in general, of star clusters as well as of galaxies, both in terms of resolved stellar populations and of integrated light properties over cosmological timescales of > 13 Gyr from the onset of star formation shortly after the Big Bang until today.

For galaxies, GALEV includes a simultaneous treatment of the chemical evolution of the gas and the spectral evolution of the stellar content, allowing for what we call a chemically consistent treatment: We use input physics (stellar evolutionary tracks, stellar yields and model atmospheres) for a large range of metallicities and consistently account for the increasing initial abundances of successive stellar generations.

I will review the latest version of our models that are now interactively available at http://www.galev.org and show how this web-interface can be beneficial for users throughout the wider community. A detailed comparison with galaxies in the local and high-redshift universe will be given as evidence of the fact that our models are able to describe a wide range of observed properties.

5-P08 Photometric Redshifts from Chemically Consistent Templates

R. Kotulla (University of Hertfordshire), Ralf Kotulla

Multi-band imaging allows us to reach the numerous - but faint - population of "normal" galaxies out to high redshifts - far beyond the reach of spectroscopic surveys.

I will present a new and innovative approach to the study of this galaxy population. GAZELLE is a photometric redshift code tailored to work with our GALEV evolutionary synthesis models. The most significant difference to previous photo-z codes is that its templates include the full evolution of our GALEV models. GALEV models in turn include not only the photometric and spectroscopic evolution, but also the chemical evolution of galaxies in a chemically consistent way, i.e. they fully account for the increasing initial abundances of successive stellar generations. I will show that neglecting this chemical evolution leads to a significant bias in the derived photometric redshifts and hence galaxy properties.

This combination allows us to derive not only redshifts, but also physical parameters such as stellar and gaseous masses, star formation rates and metallicities in a consistent way, opening the door to a more detailed physical understanding of normal galaxies in the distant universe.

5-P09 The X-Ray Properties of Submm-Selected Galaxies

E. Laird (Imperial College London), Kirpal Nandra, Alexandra Pope, Douglas Scott

We present an analysis of the X-ray properties of 35 robust 850 micron-selected submm galaxies (SMGs) in the HDF-N region. Almost half of the 16 (45 %) SMGs detected in the 2-Ms Chandra data have measured X-ray luminosities consistent with those expected based on the FIR or radio-derived star formation rate, and hence with the X-rays coming solely from star formation. A dominant AGN contribution to the X-ray emission is required in 40 % of the detections (20 % of all SMGs), while in a couple of sources it is unclear whether stellar processes or accretion dominate in the X-ray. We deduce that the AGN fraction in SMGs based on X-ray observations is 20-25 %, which is at the lower limit of previous estimates. Spectral analysis shows that SMGs are generally not heavily obscured in the X-ray, but most of the AGN SMGs show absorption with N_H > 10^22 cm^-2. The bolometric luminosity appears to be dominated by the AGN in only 3 cases and in ~80 % of the SMGs, the X-ray spectrum effectively rules out an AGN contribution that dominates the bolometric emission, even if the AGN is Compton thick. This suggests that in most SMGs intense star formation accounts for both the FIR and X-ray emission. We argue that, rather than having an especially high AGN fraction or duty cycle, SMGs have a high X-ray detection rate at very faint fluxes partly because of their high star formation rates and, in relatively rare cases, because the submm emission is from an AGN.

5-P10 Planning and Exploiting High-z Galaxy Surveys using SED-Fitting

J. Pforr (ICG, Portsmouth), C. Maraston et al.

Galaxy surveys at various redshifts are a fundamental tool to constrain galaxy formation and evolution. In a very popular approach, the physical properties of galaxies such as ages, stellar masses, star formation rates, etc. are derived by fitting galaxy spectro-photometric data with stellar population models. However, even considering an optimal stellar evolution the derived galaxy properties depend on other assumptions such as the wavelength range used in the fitting and the choice of templates (e.g. metallicity, star-formation history). Knowing the effect of these parameters on the final result would help considerably to plan a successfull survey. We present the results of such a project in which we make use of mock galaxies from semi-analytic models for which the input properties are known. We provide the optimal setup in terms of wavelength coverage and choice of template that allows one to recover galaxy properties as a function of redshift and galaxy type. These results are crucial for successful planning and exploiting high redshift surveys.

5-P11 Is there a Redshift Cutoff for Submillimetre Galaxies?

G. Raymond (Cardiff University), S. A. Eales, S. Dye, R. Carlberg and M. Sullivan

We present new optical and infrared photometry for a statistically complete sample of seven 1.1 mm selected sources with accurate Submillimetre Array coordinates. We estimate photometric redshifts for four of the seven sources. Of the other three sources two are undetected at optical wavelengths down to the limits of very deep Subaru and Canada-France-Hawaii Telescope images (~27 mag AB, i band) and the photometry of the remaining source is corrupted by a bright nearby galaxy. The sources with the highest redshifts are at higher redshifts than all but one of the ~200 sources taken from the largest recent 850 um surveys, which may indicate that 1.1 mm surveys are more efficient at finding sources at very high redshifts than 850 um surveys.

We investigate the evolution of the number density with redshift of our sample using a banded V_e/V_a analysis and find no evidence for a redshift cutoff, although the number of sources is very small. We also perform the same analysis on a statistically complete sample of 38 galaxies selected at 850 um from the GOODS-N field and find evidence for a drop-off in the number density beyond z~1 and 2 for hot and cold dust dominated SMGs respectively, confirming the earlier conclusion of Wall, Pope & Scott (2008). We also find strong evidence for the existence of two differently evolving sub-populations separated in luminosity, with a higher relative density of the high luminosity galaxies at higher redshifts.

Wall, J.V., Pope, A., Scott, D., 2008, MNRAS, 383, 435

5-P12 The Effectiveness of Mid IR / Far IR Blind, Wide Area, Spectral Surveys in Breaking the Confusion Limit

G. Raymond (Cardiff University), Kate Isaak, Dave Clements, Adam Rykala and Chris Pearson

Source confusion determines the useful depth to which to take large-area extragalactic surveys. 3D imaging spectrometers with positional as well as spectral information, however, can potentially provide a means by which to use strong emission lines to break the traditional confusion limit.

SAFARI is a FIR imaging Fourier Transform Spectrometer concept for the proposed JAXA-led SPICA (Space Infrared Telescope for Astronomy and Astrophysics) mission. With a 3.5 m diameter mirror, SPICA will be subjected to the same confusion limit as Herschel. The primary mirror will, however, be cooled to 4 K and so will offer a great leap in sensitivity over Herschel.

In this poster we present the results of our investigation into the effectiveness of mid/far infrared, blind, wide area surveys in breaking the confusion limit. We generate an artificial sky representative of 40 SAFARI footprints for bright-end and burst-mode galaxy evolution models (Pearson 2005; Pearson et al. 2007). Using a fully automated redshift determination method we find we can retrieve accurate redshifts for 40 and 54\% of sources with continuum fluxes as much as an order of magnitude below the confusion limit for the bright-end and burst-mode evolution models respectively. This suggests that deep, blind spectral line surveys with SAFARI will be able to break the traditional photometric confusion limit, allowing us to resolve a great number of previously inaccessible galaxies, and so potentially to differentiate between different galaxy evolution models.

Person, C., P., 2005, MNRAS, 358, 1417 Pearson, C., P., Jeong, W.-S., Lee, H.M., Nakagawa, T., 2007, Advances in Space Research, 40, 605

5-P13 Spectroscopic Extragalactic Mid-Infrared Surveys: from ISO to Spitzer, Herschel and Beyond

D. Rigopoulou (Univ. of Oxford)

The mid-infrared part of a galaxy's spectrum hosts a number of features and fine-structure lines related directly to the underlying energy source. While with previous space mid-infrared missions (ISO) such studies were confined to a handful of nearby objects, the Spitzer Space Telescope allowed us, for the first time, to push the frontiers to higher redshifts. I will present recent Spitzer results on mid-infrared observations of high-redshift galaxies and discuss how these findings influence our understanding of galaxy evolution. I will summarize future missions, expectations and plans.

5-P14 The Link Between SCUBA, Spitzer and Herschel: Cold Galaxies at z<1

M. Symeonidis (MSSL/UCL), Page M., Seymour N., Dwelly T., Coppin K., McHardy I., Rieke G.H.

We identify a new population of Luminous and Ultraluminous InfraRed Galaxies (LIRGs and ULIRGs) at moderate redshifts, whose far-infrared properties are divergent from analogous sources in the local Universe. Our analysis is based on Spitzer MIPS and IRAC data of L_IR >1010 L_solar, 70micron-selected objects in the 0.2<z<1.5 redshift range and supported by a comparison with the IRAS Bright Galaxy Sample. A large fraction of the objects in our sample are described by Spectral Energy Distributions (SEDs) which peak at longer wavelengths than local sources of equivalent total infrared luminosity. This difference implies a noticeable change in the dust and/or star-forming properties from z~0 to the high redshift Universe, tending towards lower dust temperatures, indicative of strong evolution in the cold dust, `cirrus', component. We show that these galaxies are potentially the missing link between the well-studied local IR-luminous sources, Spitzer mid-IR populations and SCUBA sources --- the z<1 counterparts of the z>1 SubMillimetre Galaxies (SMGs) discovered in blank-field submillimetre surveys. The Herschel Space Telescope is well placed to fully characterise the nature of such cold IR-luminous sources, as its coverage extends over a major part of the far-IR/submm SED for a wide redshift range.

5-P15 Star Formation and Environment: Recent Results from the SWIRE survey

M. Thomson (University of Sussex), Seb Oliver, Mark Frost

Surveys with Spitzer provide an excellent way to study how galaxy star-formation and environment are related. We show some recent results from the Spitzer Wide area InfraRed Extragalactic (SWIRE) survey which study this link from local to large-scale environments. Firstly, we explore the obscured specific star-formation (star-formation per unit stellar mass) measured at the peak of the CIRB (70 and 160 micron) as a function of redshift (from 0<z<2) and as a function of the host galaxy stellar mass and compare this with recent models of galaxy evolution including AGN feedback. Secondly, we find 28, 5 and 7 (5 sigma significance) candidate proto-clusters at redshifts of 0.9, 1.4 and 2.5 selected using the 1.6um spectral bump feature, using simulations to demonstrate that these overdensities could not occur by chance coincidence. These objects are some of the most over-dense regions of the SWIRE survey and allow us to probe the relationship between galaxy star-formation rate (SFR) and environment at cluster scales. Finally, on the largest scales, we show results from Frost et al 2009 (in prep) which utilizes the photometric redshift catalogue of Rowan-Robinson et al 2008 to investigate the clustering of SWIRE galaxies over 10 sq deg and out to z~1.5. We measure the clustering as a function of stellar mass and SFR for early and late-type galaxies, finding that the clustering strength increases with stellar mass and SFR at all redshifts and decreases slightly, for galaxies of a given mass, as we move to higher redshifts. We also measure the clustering of dark matter haloes from the Millennium Simulation with masses ranging from 10^10.5<Msun<10^14, which we compare to our galaxy clustering to ascertain the typical mass haloes our galaxies reside in over the redshift range probed.

5-P16 A 1.1mm Survey for ULIRGs in the Field of the Galaxy Cluster MS0451-03

J. Wardlow (Durham University), on behalf of the JCMT/AzTEC MS 0451-03 survey team

We have undertaken a deep 1.1-mm survey with the AzTEC camera on the JCMT to search for luminous, but rare, obscured star-burst galaxies in the z=0.54 galaxy cluster MS0451.6-0305. In total 38 ultra-luminous infrared galaxies (ULIRGs) are detected with S/N > 3.5 in 0.10 deg^2, of which 18 are identified using radio, mid-infrared, X-ray and Smithsonian Millimeter Array data. Colour selection and photometric redshifts based on optical and near-infrared spectral energy distributions for the 13 of these galaxies identifies one potential cluster ULIRG from the background population. This possible MS0451 ULIRG has a flux of 5.3±-1.0 mJy at 1.1mm, corresponding to a star formation rate of ~300Mo/yr - which exceeds the integrated SFR in the rest of the cluster population (200Mo/yr, from the 24-um survey of Geach et al. 2006). We also examine the rest-frame mid- to far-infrared emission of a large sample of spectroscopically-confirmed cluster members and find similar levels of mid-/far-infrared emission to the field - suggesting that the cluster environment has not preferentially restricted obscured star-formation in member galaxies.

Tuesday
4:00pm

Gravitational Lensing - the First Discoveries

B. Carswell (Institute of Astronomy)

The theoretical developments and events leading up to the accidental discovery and announcement of the first known lensed quasar, 0957+561, are described. There followed an explosion in research in the area, both observationally and theoretically. More lensed quasars were found quite quickly, and lensed galaxies found as apparent giant arcs. Lensing in its various forms - strong, weak and micro - has since become a significant tool in astronomy.

Tuesday
4:30pm

More than Three Decades of Lensing Theory

P. Saha (University of Zurich)

Gravitational lenses lived in theorists' dreams long before they were actually discovered in the sky. While many have contributed to lensing theory as we have it today, the insights of Sjur Refsdal from 1964 onwards are especially prophetic. This talk will review the development of theory so far and speculate about where it might go in the future, with special attention to Refsdal's work.

Tuesday
5:00pm

The magnification Theorem

O. Wucknitz (AIfA Bonn)

In this presentation I discuss the magnification theorem according to which any realistic mass distribution will always produce at least one image with a magnification above unity. To avoid the paradox that total flux would not be conserved, this theorem can only be valid if the un-lensed situation used for comparison is defined in such a way that the area over which the flux is distributed is different from the lensed situation. In an alternative scenario with unchanged total area, the magnification theorem does not hold anymore. This picture has the advantage that the magnification can be derived directly from the deflection angle, which is not strictly true in the standard scenario. As an interesting implication, the Poisson equation has to be modified to account for the fact that field lines cannot escape the compact celestial sphere.

Tuesday
5:15pm

Nine Decades of Gravitational Lenses

R. Massey (Royal Observatory Edinburgh)

The first observation of gravitational lensing was made in May 1919, to prove Einstein's theory of general relativity. Sir Arthur Eddington and the Royal Astronomical Society launched an historic expedition to image a total solar eclipse from the equatorial African island of Principe. The observed deflection of light from stars in the Hyades cluster behind the sun, consistent with GR, was one of the most important scientific results of the 20th century.

I will discuss the history behind the expedition, and some of the adventures Eddington had en route. I will then describe an International Year of Astronomy expedition back to Principe, to celebrate the 90th anniversary of the original solar eclipse. More information is available from http://www.1919eclipse.org

Wednesday
11:00am

Microlensing: Planets, Dark Stars, Stellar Magnifying Glasses

A. Gould (IAP, OSU)

Microlensing began as a probe of dark-matter "lenses", but has now expanded to become a generalized technique to study both lenses and sources. Microlensing has so far detected 14 planets, and will become the most powerful planet-discovery method, with the broadest sensitivity of any method as functions of planet mass, star mass, planet-star separation, and Galactic environment. It is the best method to study "dark stars" like black holes, neutron stars, and old brown dwarfs. It is also being used as a powerful "magnifying glass" to obtain spectra of otherwise unobservable sources and to study stellar surfaces on nano-arcsecond scales. I review microlensing's 2 decades of successes and show how 100-fold improvements are possible in the near future.

Wednesday
11:30am

Microlensing Planet Hunt with EUCLID

J. Beaulieu (Institut d'Astrophysique de Paris)

Microlensing planet hunt is a unique method to probe efficiently for frozen Super Earth orbiting the most common stars of our galaxy. It is nicely complementing the parameter space probed by very high accuracy radial velocity measurements and future space based detections of low mass transiting planets. In the near-term (over the next 5 years) we advocate a strategy of automated follow-up with existing and upgraded telescopes which will significantly increase the current planet detection efficiency. In the medium term, the next step is an international network of wide-field 2m class telescopes to discover Earth-mass and free-floating exo-planets such as the KMT developped in Korea (PI Han). In the longer term, we strongly advocate a space microlensing telescope which, when combined with Kepler, will provide a complete census of planets down to Earth mass at almost all separations. Such a survey could be undertaken as a science programme on Euclid, a dark energy probe with a wide-field imager which has been proposed to ESA's Cosmic Vision Programme. I will put a special emphasis on the synergy between Cosmic shear and microlensing technical requirements.

Wednesday
11:45am

Extragalactic Microlensing: Quasars, Caustics & Dark Matter

J. Wambsganss (Heidelberg University)

Extragalactic microlensing was predicted right after the discovery of the first gravitationally lensed double quasar Q0957+561 by Sjur Refsdal and Kyongae Chang, exactly three decades ago. First detected in 1989, microlensing of quasars has developed into a versatile tool in extragalactic research. Its resolution power down to the microarcsecond scale makes microlensing very useful for studying the size and luminosity profile of accretion disks in quasars. The photometric signature of microlensing allows to determine properties of compact objects and smoothly distributed dark matter along the line-of-sight. This talk reviews the current achievements of extragalactic microlensing as well as it future potential.

Wednesday
12:15pm

Microlensing as a Tool to Probe the Quasar Structure

D. Sluse (ARI (Uni. Heidelberg)), A. Eigenbrod, F. Courbin, G. Meylan, A. Agol, T. Anguita, R. Schmidt, J. Wambsganss

Quasar micro-lensing is a promising tool to study the size and geometry of the inner regions of quasars. Indeed, the Einstein radii of stars and/or substructures in lensing galaxies of multiply imaged quasars have projected angular sizes of typically 10^(-2) pc. Consequently, both the continuum emission and the broad line emitting region of lensed quasars can be micro-lensed. Observationally, the most efficient micro-lensing studies of lensed quasars need spectroscopic data obtained on a regular basis. We will present the spectro-photometric monitoring of the Einstein Cross= Q2237+0305 carried out at the VLT and show the micro-lensed induced deformation of the quasar spectrum. We will explain how the comparison of numerical simulations with chromatic variations observed in the UV/optical continuum allow to constrain the energy profile of the quasar's accretion disk. We will finally briefly discuss the effect of micro-lensing on the broad emission lines and the implication these data have on the size of the regions emitting these lines.

Wednesday
2:00pm

Strong Gravitational Lensing by Galaxies

L. Koopmans (Kapteyn Astronomical Institute)

Strong gravitational lensing has become a standard tool during the last three decades to study the structure, formation and evolution of galaxies. I will review the current status field of strong gravitational lensing by galaxies and its most important applications.

Wednesday
2:30pm

COSMOS 5921+0638: a New Strong Gravitational Lensing System

T. Anguita (ARI Heidelberg University), C. Faure, J-P. Kneib, J. Wambsganss, C. Knobel and A. Koekemoer

Recently, about 70 new strong lens candidates have been discovered in the COSMOS field. We present follow-up observations and an in-depth study of one of these systems: COSMOS 5921+0638, which shows quadruply lensed images and a perfect Einstein ring (with a 0.71" radius). Using the available (COSMOS survey + follow-up) ground and space-based observations, we analyze the nature of the system, including its photometric, spectroscopic and physical properties. We have also performed an environmental study and both analytical and grid-based mass modeling. Our analysis shows that the source is a high redshift galaxy hosting a low luminosity AGN and the lens is an elliptical galaxy at a redshift z=0.55. Through the lens modeling, we have additionally estimated the mass and mass-to-light ratio of the lensing galaxy. Finally, we discuss the cause of observed flux anomalies between the lensed AGN images.

Wednesday
2:45pm

Integral- Field Spectroscopy of SLACS Lenses

O. Czoske (Kapteyn Institute, Groningen), L. V. E. Koopmans, M. Barnabe

Gravitational lensing has become an important method for deriving detailed information on the mass distribution in galaxies, in particular in combination with other types of observation, like galaxy kinematics. In an ESO Large Program, we have obtained integral-field spectroscopy for early-type lens galaxies from the SLACS sample of gravitational lens systems. Here, we present the kinematic fields of the full sample of 17 systems. A fully self-consistent analysis of galaxy structure, simultaneously modelling both the gravitational lens configuration as well as the kinematic maps, is in progress. We present our results on the six systems that have been fully analysed so far.

Wednesday
3:00pm

First Detection of Water in the Distant Universe

J. McKean (ASTRON), C. M. V. Impellizzeri. P. Castangia, A. L. Roy, C. Henkel, A. Brunthaler, O. Wucknitz

Astrophysical water masers (the microwave equivalent of a laser; rest-frame 22.23508 GHz) are found in clouds of dense gas that surround the super-massive black hole at the centre of most galaxies. Being within a few parsecs of the central engine, water masers give valuable information about the mass of the black hole and jet-outflows, and can even be used to determine a very accurate distance to the AGN host galaxy. However, water masers are quite rare locally ($z < 0.06$), and searches to higher redshifts are difficult due to the limited sensitivity of current radio telescopes. I will present the results of a survey for powerful water masers from 6 gravitationally lensed quasars with the Effelesberg radio telescope and the EVLA. Using the magnification provided by the foreground gravitational lens, water emission has been found in one quasar at redshift 2.64, a time when the Universe was only 1/5 the age it is today. The quasar, MG 0414+0534, is by far the most distant object water has been found in and the detection implies that water masers may be much more abundant in the past than first thought. Furthermore, our detection demonstrates the detectability of distant (unlensed) water masers with the next generation of radio arrays, for example, the SKA.

Wednesday
3:15pm

Gravitational Lensing: Surveys and Studies with New Instruments

N. Jackson (University of Manchester, Jodrell Bank)

New instruments and surveys with greatly increased sensitivity at many wavelength ranges will shortly allow the detection and detailed study of many gravitational lenses. I describe programmes including a large e-MERLIN legacy survey to probe galaxy potentials at high redshift, and discovery of new lenses using existing surveys such as UKIDSS, and new instruments.

Wednesday
4:00pm

Luminous Satellite Galaxies in Gravitational Lenses

S. Bryan (Sarah Bryan), Prof. Shude Mao & Dr Scott Kay

Substructures, expected in cold dark matter haloes, have been proposed to explain the anomalous fux ratios in gravitational lenses. About 50 per cent of lenses in the Cosmic Lens All-Sky Survey (CLASS) appear to have luminous satellites within about 5 h^-1 kpc of the main lensing galaxies, which are usually at redshift z ~ 0.2 - 1. We have used the Millennium Simulation combined with galaxy catalogues from semi-analytical techniques to study the predicted frequency of such satellites in simulated haloes. The fraction of haloes that host bright satellites within the (projected) central regions is similar for red and blue hosts and is found to increase as a function of host halo mass and redshift. Specifically, at z = 1, about 11 per cent of galaxy-sized haloes (with masses between 10^12 and 10^13 h^-1 solar masses) host bright satellite galaxies within a projected radius of 5 h^-1 kpc. This fraction increases to about 17 per cent (25 per cent) if we consider bright (all) satellites of only group-sized haloes (with masses between 10^13 and 10^14 h^-1 solar masses). These results are lower than the fraction (~ 50 per cent) of CLASS lensing galaxies observed to host luminous satellites. At z = 0, only ~3 per cent of galaxy-sized haloes host bright satellite galaxies. The fraction rises to ~6 per cent (10 per cent) if we consider bright (all) satellites of only group-sized haloes at z= 0. However, most of the satellites found in the inner regions are 'orphan' galaxies where the dark matter haloes have been completely stripped. Thus, the results crucially depend on the true survival rate of these 'orphan' galaxies. We have also considered the effects of numerical resolution and different cosmologies on our results.

Wednesday
4:15pm

Effects of Substructure on Gravitational Lensing: Results from Aquarius Simulations

D. Xu (Jodrell Bank Observatory, University of Manchester), Shude Mao, Jie Wang, V. Springel, Liang Gao, S.D.M. White, Carlos S. Frenk, Guoliang Li, Julio F. Navarro

In the hierarchical structure formation model with cold dark matter(CDM), large structures form via merger and accretion of smaller structures; the dense cores of smaller structures often survive as subhaloes (substructure) within the main halo. High resolution numerical simulations predict orders of magnitude more subhaloes in a Milky-Way type halo than the observed luminous satellite population. Gravitational lensing is a way to probe the abundance of these subhaloes. We use six galaxy-sized haloes from the collisionless Aquarius simulations performed in the concordance LCDM universe to study the effects of substructure on lensing. Subhaloes with masses larger than 10^5 h^(-1) M_sun are well resolved, at least two orders of magnitudes lower than those used in previous lensing studies. We incorporate a baryonic component modelled as a Hernquist profile and account for the response of the dark matter via adiabatic contraction. We focus on the "anomalous" flux ratio problem, in particular the violation of the cusp-caustic relation due to substructures. Detailed result will be reported.

Wednesday
4:30pm

Weak Gravitational Lensing: Recent & Future Progress

A. Taylor (University of Edinburgh)

Weak Gravitational Lensing is in a state of rapid development. In this talk I will discuss the basics of WL, review the status of current surveys for 2-D and 3-D Lensing and discuss the implications for Dark Matter and Cosmology. I will look ahead to the next-generation of surveys and beyond, and the possibility of probing Dark Energy and non-Einstein gravity and the potential problems which must be faced to get there.

Wednesday
5:00pm

A Halo Model for Intrinsic Alignments

S. Bridle (University College London), Michael Schneider

Correlations between intrinsic ellipticities of galaxies and between galaxy ellipticities and the surrounding dark matter are potentially dominant systematic errors when constraining dark energy properties from weak gravitational lensing surveys. In the absence of perfectly known galaxy redshifts some modeling of the galaxy intrinsic alignments is required to extract the lensing signal to sufficient accuracy. We present a new model based on the placement of galaxies into dark matter halos. We construct a constrained parameterization of the intrinsic alignment correlations that can be used when marginalizing over this systematic error to obtain dark energy constraints.

Wednesday
5:15pm

Weak Lensing Studies of Galaxy Clusters

H. Hoekstra (Leiden Observatory), A. Mahdavi, C. Bildfell and A. Babul

Weak gravitational lensing provides a unique way to study the mass distribution in clusters of galaxies without having to make assumptions about their dynamical state. Comparison of the results with other proxies for the mass can provide important insights into the physical properties of these important systems. Not only provides this a key piece of information for the use of clusters as probes of cosmology, it also provides ways to learn more about the physical processes that determine their observable properties. I will present results from the Canadian Cluster Comparison Project, which is one of the largest surveys of clusters at intermediate redshifts.

Thursday
11:00am

Cluster Lensing

J. Kneib (CNRS-LAM)

I will review the recent advances in clusters lensing, covering: strong and weak lensing mass modeling, comparison of cluster lensing mass to X-ray properties, cosmological constraints and the use of cluster as cosmic telescope.

Thursday
11:30am

LoCuSS: New Cluster Weak-Lensing Results from Subaru

G. Smith (University of Birmingham), Nobuhiro Okabe, Masahiro Takada, Chris Haines, and Dan Marrone, on behalf of the LoCuSS collaboration

The Local Cluster Substructure Survey (LoCuSS) is a multi-wavelength survey of ~100 massive galaxy clusters at z~0.2 with science goals spanning the calibration of cosmological mass-observable scaling relations through to the evolution of galaxies in clusters. In this talk I will present new results, concentrating on the weak lensing analysis of Subaru/Suprime-Cam observations of the first batch of 30 clusters. For example, we fit NFW universal density profiles to the weak shear signals, and construct a concentration-mass relation. This empirical relation has a normalization ~2x higher than is predicted from numerical simulations; the best-fit slope of the relation is alpha=-0.4±0.2, i.e. we detect the predicted anti-correlation of mass and concentration at 2sigma significance. When the clusters are stacked we obtain a clear detection of curvature in the mean shear profile and thus reject singular isothermal sphere mass models at 6 and 14 sigma in low and high mass bins respectively. This sample of 30 clusters currently forms the basis for both our scaling relation and galaxy evolution studies. I will therefore also present (i) preliminary mass-Ysz scaling relation results obtained in partnership with the SZA collaboration, and (ii) early results from our panoramic Spitzer and GALEX observations of the cluster galaxy populations. Time permitting I'll close with a summary of future plans, including expansion of our Subaru sample towards the goal of 100 clusters.

Thursday
11:45am

LoCuSS: Weak Lensing Analysis of 21 Galaxy Clusters at z=0.15-0.3

V. Hamilton-Morris (University of Birmingham), G. P. Smith, E.Egami, T. Targett, C. Haines, A. Sanderson...

The Local Cluster Substructure Survey (LoCuSS) is a multi-wavelength survey of 100 X-ray luminous galaxy clusters at 0.15<z<0.3, spanning X-ray to radio wavelengths. One of the main science goals is to measure the substructure of the Dark Matter distribution within clusters and to correlate cluster substructure with residuals on cluster mass-observable scaling relations. I will present a detailed structural analysis of 21 clusters using our HST/ACS SNAPSHOT data. Substructures found in the "non-parametric" lensing mass maps are compared with K-band luminosity maps, and Chandra X-ray flux maps. These three independent probes are in close agreement, including both structures detected within the ACS fields of view, and (in a sub-set of clusters) structures located outside the observed ACS fields. In contrast to all previous structural analyses of cluster samples that we are aware of, we then use Bayesian methods to obtain statistically robust conclusions on the complexity of the cluster mass distributions. Specifically, the new MCMC capability in Lenstool (Jullo et al., 2007) is used to calculate the bayesian evidence as a function of model complexity. These calculations form the basis for a new determination of the distribution of cluster substructure fractions that is compared with theoretical predictions, following Smith & Taylor (2008).

Thursday
12:00pm

Weak Lensing Observation of Potentially X-ray Underluminous Galaxy Clusters

J. Dietrich (ESO), A. Biviano, P. Popesso, Y.-Y. Zhang, M. Lombardi, H. Böhringer

Optically selected clusters of galaxies display a relation between their optical mass estimates and their X-ray luminosities Lx with a large scatter. A substantial fraction of optically selected clusters have Lx estimates or upper limits significantly below the values expected from the Lx-mass relation established for X-ray selected clusters, i.e., these clusters are X-ray underluminous for their mass.

Here we aim to confirm or falsify the X-ray underluminous nature of two clusters, Abell 315 and Abell 1456, with weak gravitational lensing as a third and independent measure of the clusters' masses.

After accounting for projections of large-scale structure and halo triaxiality we find that A 315 is significantly X-ray underluminous for its mass. We re-evaluate earlier kinematic and X-ray analyses of these two clusters and discuss the nature of the X-ray underluminous cluster A~315 and why A~1456 was probably erroneously identified as X-ray underluminous. Our results on A~315 give further support to the observation that the Lx-mass relation of optically selected clusters has a large asymmetric scatter extending to low X-ray luminosities.

6-P01 Constraining Accretion Discs in Anomalous Lensed Quasars

N. Bate (University of Melbourne), David Floyd, Rachel Webster, Stuart Wyithe

Observations of gravitational microlensing offer a unique probe of quasar emission region structure on sub-arcsecond scales. In this talk I will present the results of a new technique to constrain quasar accretion disc size as a function of wavelength, using single-epoch multi-band imaging of lensed quasars displaying a flux ratio anomaly. We have analysed new and archival optical and near-IR data of MG 0414+0534 and SDSS 0924+0219, obtained with the 6.5-metre Magellan telescopes and the Hubble Space Telescope. In MG 0414+0534, the continuum emission region is found to be statistically consistent with alpha-prescription thin accretion disc models (including the standard Shakura-Sunyaev disc). In SDSS 0924+0219, however, these models are ruled out with a high degree of confidence.

6-P02 GREAT08

S. Bridle (University College London), The GREAT08 Team

We present the GREAT08 Challenge to computer scientists. (The GREAT08 Challenge deadline is 30th April).

6-P03 Searching for Gravitational Lenses in the Southern Hemisphere - an Update

R. Chhetri (UNSW), Ron Ekers, Roberto Ricci

The Australia Telescope 20 GHz (AT20G) Survey provided us with the opportunity to search for gravitational lenses in the southern hemisphere at the high frequency of 20 GHz. The AT20G is a blind survey of all declinations of the southern hemisphere with sensitivity level of 50 mJy. Being a complete survey, any identification of gravitational lenses using this survey will strengthen the constraining of cosmological parameters through lensing statistics. I will provide an overview and an update on the high resolution follow up of candidates using the Australia Telescope Compact Array.

6-P04 The Angstrom Project: Status Update

M. Darnley (ARI - LJMU Liverpool), Kerins E., (2), Newsam A.M. (1). (1) Liverpool John Moores University, (2) University of Manchester

The Angstrom Project in undertaking an optical survey of stellar micro lensing events across the bulge region of the Andromeda Galaxy (M31) using a distributed network of 2m class telescopes. The Angstrom Project Alert System (APAS) has been developed to identify candidate micro lensing and transient events in real-time, using data from the fully robotic Liverpool and Faulkes North telescopes. Here we briefly describe the Angstrom data reduction pipeline and the APAS. We present a few example light curves obtained during the APAS commissioning phase that clearly demonstrate its real-time capability to identify micro lensing candidates as well as other transient sources.

6-P05 Optimising Tomographic Weak Lensing Analysis for the CFHTLS

E. Grocutt (IfA, University of Edinburgh), Alan Heavens, Catherine Heymans

Weak gravitational lensing allows us to measure the dark matter and dark energy components of the Universe, but observations are currently contaminated by other effects which mimic the appearance of lensing. Most notably the observed lensing signal contains contributions from "intrinsic galaxy alignments" due to galaxy formation mechanisms and "shear-shape correlations" between galaxies at different redshifts. Tomographic information of the weak lensing signal in different redshift bins enables us to extract these systematic effects and improve cosmological parameter estimates. In this poster we present the results of our current work that uses 3D ray-tracing simulations to optimise our joint lensing and systematics analysis. This work is in preparation for the tomographic lensing analysis of the now-complete 172 square degree CFHT Legacy Survey.

6-P06 Stellar Population Synthesis for Gravitational Lenses

D. Leier (University of Zurich), Ignacio Ferreras, Prasenjit Saha

Comparing baryonic mass estimates from Stellar Population Synthesis and total mass measurements via surface mass density reconstruction for lens galaxies opens a window to probe the dark matter content of early-type galaxies. With the photometric data for as many band passes as possible one can assemble pixel by pixel a generic galaxy with the same properties as the observed one in consideration of the most likely distribution of colours among the stars, assuming an initial mass function, a metallicity distribution and special chemical abundances for the lens galaxy to be synthesized. The pixel map out of the synthesis in combination with the reconstructed pixellated density mass map reveals a detailed view on the mass-to-light distribution within early-type galaxies. For a future analysis a sample of 20 lens galaxies from the CfA Arizona Space Telescope LEnsing Survey (CASTLES) can be used to study the interdependency between dark and luminous matter, such as which radius the dark halo becomes dominant over the stellar mass and how sharp this transition is.

6-P07 Optical Monitoring and Time Delay Determination in the Gravitationally Lensed Quasar UM673

V. Oknyanskij (Sternberg Astronomical Institute), E. Kotelova, B. Artamonov, W.-P. Chen

We present the results of a monitoring campaign of the lensed quasar UM673 with the 1.5-m telescope of the Maidanak Observatory and with the 1.3-m SMARTS telescope during the 2003-2008 observational period. The detected brightness variations in the A and B quasar components allow us to estimate the time delay between brightness variations of quasar components. From cross-correlation analysis we find that the brightness variations in component B follow the brightness variations in component A by about 145 days. We also explore the possibility of measuring the wavelength-dependent time delay between the brightness variations in the V and R bands. We find that the brightness variation in the R band may follow the brightness variation in the V band by about 13 days. We show that combination of the multiband data corrected for the wavelength-dependent time delay can help to improve the time delay analysis of the quasar A and B light curves.

6-P08 Results of Optical Monitoring of 5 SDSS Double QSOs with the Nordic Optical Telescope

D. Paraficz (DARK Cosmology Centre), Jens Hjorth, Ardis Eliasdottir

We present optical R-band light curves of five SDSS double QSOs obtained from monitoring at the Nordic Optical Telescope (NOT) between September 2005 and September 2007. We also present analytical and pixelated modeling of the observed systems. For SDSS J1206+4332, we measured the time delay to be 116 days, which, for a Singular Isothermal Ellipsoid model, corresponds to a Hubble constant of 73 km/s/Mpc. Simultaneous pixeleted modeling of five other systems for which a time delay has now been previously measured at the NOT leads to 61.5 km/s/Mpc. Finally, by comparing lightcurves of the two images of each system, suitably shifted by the predicted or observed time-delays, we found no evidence for microlensing variability over the course of the monitoring period.

6-P09 Orbital motion in Gravitational Microlenses

M. Penny (University of Manchester), Shude Mao

A standard planetary microlensing lightcurve allows just two parameters of the lensing system to be measured: the mass ratio of the planet to its host, and the projected separation of the components in units of the Einstein radius. However, other exotic effects can provide more information about the lensing system. Orbital motion in the lens is one such effect, which if detected, can allow the system mass and planetary orbit to be determined. We attempt to quantify the probability of detecting lens orbital motion in binary microlensing events using Monte Carlo simulations. We also define an easily calculable quantity, the orbital measure, to describe the probability and inform the computationally expensive modeling process.

6-P10 Reducing Data with THELI Pipeline

A. Roozrokh (Sharif University of Technology)

In astronomy, raw images from CCD detectors are not immediately usable for scientific exploitation but are instead contaminated by several instrumental effects. Generally speaking, data reduction is the transformation of raw data into a more applicable form. Thus, this involves: - Removal of instrumental signatures, like dark current and field curvature. - Masking of unwanted signals, like cosmic rays, stellar halos and satellite tracks. - Photometric and Astrometric Calibration. - Coaddition of individual frames.

In this poster we describe one of the methods available to automatically reduce large amount of data. We also present our own work with Abell 226 Optical Images.

6-P11 The Effect of Gravitational Distortion of Spacetime on Pulsar Timing

S. Sakai (University of Glasgow), Dr M Hendry and Dr G Woan

The aim of this research is to determine the impact of gravitational lensing on pulsar timing, and its implications for the detection of gravitational waves. Gravitational lensing occurs when a massive body passes close to the line-of-sight between the Earth and a source. From General Relativity, this causes space-time distortions which result in an extra path length that the light must travel, and subsequently a delay in the time of arrival. This research will look at the rate of change of (gravitational) Shapiro time delay, and determines whether this rate can be determined for globular clusters such as 47 Tucanae.

6-P12 Lensing by the Supermassive Black Hole in the Galactic Centre

M. Sereno (Univversity of Zürich)

The supermassive black hole in the Galactic center offers an unique laboratory for testing general relativity in new regimes. Here, we discuss observational prospects and technological requirements to observe gravitational lensing events toward it, either multiple images of background sources or microlensing light curves. Successful observations would provide invaluable information on the properties of the black hole and the matter distribution in the Galactic center. We put particular emphasis on the effects of lens spin and relative motion.

6-P13 Multi-Wavelength Analyses of Strong Lensing Clusters: AC 114

M. Sereno (Univversity of Zürich), Ph. Jetzer and M. Lubini

Strong lensing analyses can provide detailed mass maps of the inner regions even in dynamically active galaxy clusters. We discuss a parametric method for strong lensing investigations in which the mass model accounts for: i) cluster-sized dark matter halos; ii) galaxies (whose stellar mass can be obtained from optical analyses) and iii) the main baryonic component, the intracluster medium, modelled according to X-ray observations. This gives an unbiased look at each matter component and allows a study of the dynamical status of the cluster. The method has been applied to AC 114, an irregular X-ray cluster whose dark matter distribution turns out to be in remarkable agreement with predictions form numerical simulations.

6-P14 Constraints on neutrino masses from CFHTLS cosmic shear

I. Tereno (AIfA Bonn), I. Tereno, C. Schimd, J. P. Uzan, M. Kilbinger, F.H. Vincent, L. Fu

We use weak lensing measurements from the latest release of the Canada-France-Hawaii Telescope Legacy Survey to probe suppression of cosmic shear correlations and consequently constrain neutrino masses. We obtain broad constraints which are greatly improved when we combine them with WMAP-5 cosmic microwave background anisotropy data, baryonic acoustic oscillations from SDSS and 2dFGRS and supernovae data from SNLS and Gold-set. The combined constraints on the sum of neutrino masses at 95\% confidence level are an upper bound of 0.54 eV and a lower bound of 0.03 eV. The preference for massive neutrinos vanishes when we include shear-measurement systematics in the analysis.

6-P15 A 21st Century Perspective on The First Gravitational Lens System

A. Ullán (CAB (CSIC-INTA)), L.J. Goicoechea, V.N. Shalyapin, R. Gil-Merino et al.

We present a current perspective on the two major components of the first gravitational lens system, i.e., the lensed quasar and the main lensing galaxy. We found intrinsic variability, what let us study the origin of the fluctuations in the source quasar.

6-P16 Fundamental Limits to Galaxy Shear Estimation

L. Voigt (UCL), Sarah Bridle

Gravitational lensing promises to provide the most powerful tool in astronomy for constraining the nature of dark energy. The images of distant galaxies are distorted by intervening mass; measuring these distortions enables us to map out the distribution of large-scale structure in the universe and thus constrain cosmological parameters. Accurate measurement of galaxy shear is crucial. In particular biases must be reduced below the small statistical uncertainties that will be obtained in future galaxy surveys. I will show there is a fundamental limit to the accuracy achievable by model-fitting techniques adopting elliptical isophotes and discuss the impact of these results on shape measurement methods.

6-P17 VLA Observations of the Brightest Lyman Break Galaxy

F. Volino (AIfA (Bonn)), Olaf Wucknitz; Mike Garrett

The z=2.73 lensed source J002240.91+143110.4 is the brightest Lyman Break Galaxy doscovered so far. Thanks to the magnification provided by gravitational lensing we were able to carry out a detailed study of the radio properties of this source. In my poster I will present results from VLA observations.

6-P18 The Easy Route to Moving Lenses

O. Wucknitz (AIfA Bonn)

Even though they are currently not of overwhelming astrophysical relevance, the effects of motion of a gravitational lens have been discussed in a number of publications. In spite of this, there still seems to be some confusion even about the first-order effects of radial motion of a lens. This contribution tries to clarify the situation by explaining that the scenarios discussed by different authors are in fact not equivalent, so that conflicting results have to be expected. The effects of purely radial motion can be described most easily via their influence on the angular size distances.

Tuesday
2:00pm

Coordinating Globally the International Year of Astronomy 2009

P. Russo (IAU & ESO - ePOD), Lars Lindberg Christensen (ESO - ePOD & IAU) and Mariana Barrosa (IAU & ESO - ePOD)

IYA2009 is a global collaboration between almost 140 nations and more than 50 international organisations sharing the same vision. Besides the common vision, goals, branding and identity, IAU established a global framework supported by eleven cornerstones programmes, task groups and special projects. Those support the different IYA2009 stakeholder to organize events, activities under a common umbrella. During this talk we will examine the ups and downs of coordinating such global project and present an overview of the principal achievements so far of the year.

Tuesday
2:20pm

"100 Hours of Astronomy" and "Around the World in 80 Telescopes"

D. Pierce-Price (ESO), Mike Simmons

"100 Hours of Astronomy", an IYA2009 global cornerstone project, took place from 2-5 April 2009. The project invited professional and amateur astronomers, educators, planetaria, science centres and more to arrange events around the world during this 4-day period. During the events, people from around the globe shared the experience of observing the sky. For many, it was their first glimpse of the wonders of the heavens through a telescope. For others, it was the perfect opportunity to impart their knowledge and excitement, helping unveil the cosmos to fresh and eager eyes.

A major component of "100 Hours" was "Around the World in 80 Telescopes", a live 24-hour observatory webcast from some of the largest and most advanced telescopes on and off the planet, coordinated from ESO headquarters in Garching. It was scheduled from 3 April 09:00 UT to 4 April 09:00 UT, with astronomers at professional observatories around the world giving an insider's view of these cutting-edge scientific facilities.

We will discuss the "100 Hours" project, and in particular the research observatory webcast, giving background information, early results, and lessons learned for future events.

Tuesday
2:40pm

The IYA2009 cornerstone 'She is an Astronomer' project and website

H. Walker (Rutherford Appleton Laboratory), The She is an Astronomer Task Group

Gender equality and empowering women is one of the United Nations millenium development goals. The aim of the IYA2009 cornerstone project, She is an Astronomer, is to provide information to female professional and amateur astronomers, students, and those interested in the gender equality problem in science. An objective of the project is to build and maintain an easy-to-handle forum and database, where people can get information about the subject, ask questions and find answers. The website is the main tool to address the aims and objectives of this IYA2009 Cornerstone. This talk formally marks the launch of the website (www.sheisanastronomer.org) and it will highlight the projects identified by the Task Group. The main areas where information is being gathered are (1) profiles of living and historic female astronomers, a largely invisible part of the astronomy community in the past (2) resources available to women astronomers (3) events taking place during the year (4) an area for national ambassadors of She is an Astronomer to populate with information (5) a forum where issues and topics can be disucussed. As IYA2009 progresses the website will grow, and at the end of the IYA2009 the website and the information gathered in it will be retained and maintained as a legacy from IYA2009.

Tuesday
3:00pm

Portal to the Universe

L. Christensen (ESO), Lars Holm Nielsen (ESO), Pamela Gay (Southern Illinois University Edwardsville)

One of the greatest difficulties in astronomy is staying current. On any given day, half a dozen or more press releases may announce the latest discoveries of the professional astronomy community, while blogs and forums are alive with the latest sky events and news that hasn't yet made it to peer reviewed publications. To help bring all this content together, the Portal to the Universe has been released as a central aggregator of astronomy online content, including press releases, blogs, podcasts, image feeds and widgets.

Wednesday
11:00am

IYA in the UK

I. Robson (UK ATC)

I will give an overview of the IYA activities in the UK highlighting those specific projects that have a UK-flavour and are supportive of the Cornerstone Projects.

Wednesday
11:20am

IYA-2009 Activities in Armenia

A. Mickaelian (Byurakan Astrophysical Observatory (BAO))

The Armenian program of the IYA-2009 relates to an increase of activity of the professional, amateur, popular astronomy and astronomical education. Beside the IYA-2009 main projects, a number of other activities are planned. A webpage has been created at http://www.aras.am/IYA_2009.htm and the program is given with regular updates of the news and events. An Armenian Astronomical Council will be created to coordinate all astronomical activities, which have in fact been developed randomly, including the professional institutions (Byurakan Astrophysical Observatory (BAO), Yerevan State University (YSU), etc.), school astronomy and Olympiads, amateur astronomers, publishers, etc. Series of seminars "Astronomy and other fields of science" for various students in Byurakan during the whole year, an Astronomical Summer School for the YSU students in Byurakan for students of the YSU Department of Physics, the Armenian Astronomical Society (ArAS) annual meeting with an emphasis on the IYA-2009 will be organized. Publication of a DVD "Encyclopaedia of the Armenian astronomy" is planned, as well as a lot of other materials (booklets, sky maps, calendars, postcards, etc.). The school program includes visits to schools by professional astronomers for popular lectures and visits of pupils in Byurakan. There is a large mass media program too, including a meeting of professional astronomers and journalists in Byurakan.

Wednesday
11:40am

Science Outreach in Benin (West Africa) for the IYA 2009

A. Alapini (University of Exeter), Didier Pelat (Observatoire de Paris), Pascal Galais (CEA), Oscar Kiche (Astronomy Club Orion-Benin), Calixte Alapini (ONG-Acetrose), Romain Alapini (ONG-Acetrose)

Through the mixing of culture, the mixing of ages and the international transfer of knowledge in astronomy, the IYA 2009 is an exceptional opportunity to broaden minds and trigger interest in science among the young generations across the globe.

Since a first outreach mission in Benin for the total solar eclipse of 2006, we have been involved in a collaborative effort aiming at raising awareness of science through astronomy among children in urban and rural areas of Benin. For the IYA, we go a step further. 14 of us are returning to Benin, we will meet 6 local organisers and will visit schools and universities across the country aiming to reach more than a thousand of Benin's citizens. We will man science activities for children and teachers, observing sessions for all ages, and we will give conferences at the universities.

We wish to share with the broader community our experience on science outreach in a developing country. We present our activities in Benin for the IYA 2009, starting by describing how this collaboration began, how it is developing and the benefits and difficulties we encounter in this project.

Wednesday
12:00pm

Society of Astronomers of Serbia, Astronomical Society "Rudjer Boskovic" and IYA 2009

A. Kovacevic (Faculty of Mathematics University of Belgrade), M. S. Dimitrijevic

We will present Society of Astronomers of Serbia and the oldest society of professional and amateur astronomers in Serbia, Astronomical Society "Rudjer Boskovic", founded in 1934. We will review briefly their history and activities with particular attention to the activities, plans and programs for the IYA 2009.

Wednesday
2:00pm

Galileo Teacher Training Programme

R. Doran (Global Hands-on Universe/ NUCLIO), Rosa Doran

The Galileo Teacher Training Programme is a cornerstone for IYA2009. It intends to build a global network of educators, trained on the use of Hands-on Activites for Science Teaching. Modern resources such as robotic telescopes and astronomical software will be part of all training sessions. Global activities, in partnership with other cornerstones will also be promoted. Global Hands-on Universe Association promoters will ensure the continuation of GTTP. A legacy of IYA that intends to endure beyond 2009.

Wednesday
2:20pm

A Global Citizen of the Skies

D. Brown (CELS Nottingham Trent University), Natasha Neale

Global citizenship plays an important role in today's schools. This incorporates students developing an understanding of their place in the community and environment, but also developing tolerance, understanding, and being able to put themselves in the position of someone else. Many subjects taught in schools have already incorporated such ideas. Science and physics have also followed suit. However, when dealing with astronomy - a topic so seemingly far removed from society - it becomes difficult to imagine any links with global citizenship.

At Nottingham Trent University observatory we have developed an activity ideal to transport the idea of global citizenship and deal with common astronomical misconceptions. This interactive activity is based around stars and constellations. It incorporates role playing in the inspiring environment of an astronomical observatory. It has been tested with students aged 8 to 25 years of age over several months.

Stellar constellations with their myths and history pose an ideal opportunity to explore global citizenship in an unexpected way. Roleplaying members of different cultures and developing constellations and legends around them, allows students not only to place themselves in someone else's situation, but also to compare their different reactions or created constellations when faced with a common situation or stellar pattern. This idea is extended to analyse the change in constellation culture, not only across different cultures but throughout time. Constellations also offer the opportunity to examine the politics involved when creating new constellations.

In this presentation we will outline the details of this activity and how it deals with common astronomical misconceptions. We will demonstrate how easy it is to implement into astronomy taught at secondary schools and also introduce a planetarium facility used to enrich this activity and further the learning experience. Initial results showing the impact the activity had on the students will also be presented

Wednesday
2:35pm

The Impact of Archaeoastronomy on the Global Citizen

T. Sherwood (The Meden School), Tina Sherwood

The impact of Acheaoastronomy on a Modern Global Citizen

Jan-April 2009: Pre-Summer School activity: four Y7 Gifted and Talented students discover Archaeoastronomy for the first time

April 2009: Deliver their findings to the general public in Open Dome event at Nottingham Trent University and to scientific community at JENAM 2009, where students will be able to experience a scientific audience and environment and will be able to present their results and claim ownership of them. It is hoped that this experience will provide some valuable feedback which will further summer school preparation and motivate other schools to consider how the subject of archeaoastronomy may be combined with global citizenship. Working with Dr Dan Brown (CELs) NTU

August 2009: Summer School details

Introduction - Using Stonehenge and stone-age burials as examples

Investigation - Alignments and construction methods Fieldwork - Exploring stone circles in the northern Peak District (including environment)

Analysis - Estimating duration of construction and possible alignments

Presentation - Visualising and presenting the results

August- : Continuing work and possible collaboration with school and archaeoastronomy specialists in Germany.

Wednesday
2:50pm

AIA 2009 in Romania : Education and Outreach

M. Stavinschi (Astronomical Institute of the Romanian Academy), Catalin Mosoia

IYA2009 is a world-wide celebration of astronomy, which concludes in Romania the Triennium: IHY(2007), National Year of Astronomy, when we celebrated the centenary of the Bucharest Observatory (2008), IYA (2009). Its purpose is education and outreach, to make the general public aware of the beauty and value of astronomy. One of the IAU Cornerstone Projects, 'She is an astronomer', is directed towards young women, who will be encouraged to wear a special astronomical "martisor", a traditional symbol of spring, to publicize this activity. Furthermore, the International Year of Astronomy could be one of the first steps in establishing astronomy as one of the main driving forces in scientific awareness, thanks to the extensive education and outreach activities.

Wednesday
3:10pm

IYA 2009 in Slovakia and European Project Aurora Polaris.

D. Chochol (Astronomical Institute SAS, Tatranská Lomnica), Haley, P. (The Share Initiative, Hereford, UK)

The activities of the professional and amateur astronomical institutions in Slovakia in public outreach are presented. The projects granted by the Slovak Research and Development Agency (APVV) provide necessary funds for our goals in regards of IYA2009. They are mainly devoted to astronomical education of students in primary and secondary schools. Professional astronomers prepare the educational resources and give astronomical lectures at schools directly, or organize workshops for teachers of schools from Slovakia. The older learners in Slovakia are engaged in IYA 2009 through the Grundtvig learning partnership of four European countries. The project Aurora Polaris is coodinated by the SHARE Initiative (UK). Partners include the Astronomical Institute of the Slovak Academy of Sciences at Tatranská Lomnica (Slovakia), University of Athens (Greece) and Olsztyn Planetarium and Astronomical Observatory (Poland). Associate partners include national astronomical societies, universities and universities of the third age. Educational resources are developed by each country with the active participation of older learners.

Wednesday
4:00pm

Cutting It Fine: the Making of "The Starry Messenger"

R. Priddey (University of Hertfordshire), Ozgur Gorgun, Samantha Hickey, Alice Williamson

"The Starry Messenger" is a film drama to celebrate the International Year of Astronomy, made by astrophysicists at the University of Hertfordshire. Funded by a Science in Society Small Award from STFC, it will be distributed to over 1000 schools nationwide; not only as a teaching aid, but, more importantly, as a means of inspiring teenagers to take an interest in physics, astronomy and maths at a higher level. The film will receive its official premiere during EWASS, and in this accompanying talk we shall discuss its motivation, its scientific and historical themes and its role as an education and outreach project. We shall share our experience of the film-making process, from script to screen, and humiliate ourselves by showing some embarrassing outtakes.

Wednesday
4:15pm

Cosmos & Culture: Astronomy at the Science Museum

A. Boyle (The Science Museum)

In July 2009 the Science Museum will launch Cosmos & Culture, a temporary exhibition showcasing our world-class astronomy collection and new contemporary acquisitions. The exhibition will use a new multimedia format to enable visitors to engage with astronomical technology and personal stories of astronomers.

Wednesday
4:30pm

The ALMA Planetarium Show

H. Boffin (ESO), Douglas Pierce-Price (ESO) and Agnès Acker (Université de Strasbourg)

As part of a wide range of education and public outreach activities for the International Year of Astronomy 2009, the European Southern Observatory (ESO) has collaborated with the Association of French-speaking Planetariums (APLF) and other partners in Europe to produce a new planetarium show, 30 minutes in length, and centred on the global ground-based astronomical Atacama Large Millimeter/submillimeter Array (ALMA) project, arguably the largest astronomical venture in existence.

The emphasis of the new planetarium show is the incomparable scientific endeavour that the ALMA project represents. Edited by world experts Mirage3D, the show includes unique animations and footage, leading the viewer from the first observations by Galileo, 400 years ago, to the world of modern astronomy, moving from the optical wavelength domain to explore the millimetre-wave view of the Universe, and leaving light-polluted cities for unique settings in some of the highest and driest places on Earth. A young woman astronomer guides the public throughout the story.

In this talk, we will provide the audience with an overview on this amazing outreach product and show how this planetarium show integrates beautifully in a whole set of activities for an astronomy organisation and why it is an indispensable tool in reaching large audiences hardly reachable by other means.

Wednesday
4:45pm

The Scottish Solar System

M. Hendry (University of Glasgow), no co authors

The "Scottish Solar System" project, set up by Glasgow University astronomers in partnership with Glasgow Science Centre, aims to help coordinate astronomy events for schools and the public across Scotland throughout IYA2009, beginning with Spring Moonwatch week - March 28th to April 6th 2009.

Scotland has a rich tradition of public engagement in astronomy, with public "star parties" regularly organised by amateur astronomy societies across the country. Many of these societies have organised public events for Spring Moonwatch week. Remarkably, the locations of these events fit very well to a scale model of the Solar System. Thus, with Glasgow Science Centre as the Sun, IYA2009 events will take place at 'planets', 'moons' and 'asteroids' all across Scotland - from Shetland to Stranraer.

In this presentation I will describe the range of events already planned for our "Scottish Solar System", including astronomy "sleepovers", public observing, lectures, exhibitions, concerts and ceilidhs. I will also highlight the parallel series of "Science Fair" astronomy projects for primary schools which Glasgow University is coordinating with six Scottish Education Authorities and the Scottish Network for Able Pupils. Finally I will describe our project website (www.scottishsolarsystem.org.uk) which will host a range of outreach resources for schools and the public as a longer-term legacy of IYA2009.

Wednesday
5:00pm

Engaging the Public with Astronomy at the Royal Observatory, Greenwich: IYA and beyond

M. Kukula (Royal Observatory Greenwich), Rob Edwards, Dr Claire Bretherton

The Royal Observatory, Greenwich is one of the best-known historic & scientific sites in the world and, after a major refurbishment in 2007, it now boasts a state-of-the-art planetarium - currently the only one in London - as well as interactive galleries highlighting a range of contemporary astrophysics, cosmology and planetary science.

With 1.3 million visitors during 2008 the ROG has a tremendous opportunity to engage a large and very diverse audience with both the history of astronomy and the latest discoveries in space. To take advantage of this we are providing a broad programme for the International Year of Astronomy in 2009 with the intention of expanding our audience for science-based public events and increasing the fraction of casual visitors to the site who go on to engage with astronomy in more depth.

This talk will give an overview of the ROG's public programme during IYA, including exhibitions, talks, family events, observing sessions, new planetarium shows and innovative partnerships with arts organisations. It is also a call to the research community in the UK to think of innovative ways in which the ROG can help to promote contemporary astronomy research to the public.

Thursday
11:00am

Making Universe Awareness Happen

C. Ödman (Universe Awareness - Leiden Observatory)

This contribution will provide information on how to join the Universe Awareness (UNAWE) cornerstone project of the IYA2009.

The vision of UNAWE is to use the inspirational aspects of the Universe, astronomy and space to broaden young children's minds, stimulate world citizenship and tolerance, excite their curiosity in the sciences and demonstrate the power of rational thought. The programme is aimed at young children in underprivileged environments around the world.

Each of our partners takes the vision of UNAWE and adapts it to its own environment and circumstances to stimulate local engagement and ownership of the programme. Coupled with the international network of UNAWE, this results in a very diverse and dynamic programme in over 20 countries already.

We suggest some implementation models and invite astronomers and others to join the global UNAWE community.

Thursday
11:25am

IYA 2009 Education and Science Communication Networks

S. Trifourki (STEM Centre Greater Manchester), Catalin Mosoia

Over the course of 2009 two new networks are aimed to be formed to remain a legacy long after the year ends. The Science Newspaper and Astrokit share a common aim to facilitate a network of science educators and communicators and in late 2008 began a collaboration in producing information to encourage scientists and educators worldwide to share common information through the networks' platforms with the global community. The Science Newspaper and Astrokit aim to build on existing networks and strengthen ties between members by reporting on events, building a database of IYA 2009 related activities and acting as a virtual repository for education and communication materials. The educational materials produced by the Global Cornerstone Projects are currently being compiled into the Astrokit website in an accessible format with key specifications and guides into how these materials can be used in formal and informal education across Europe and internationally. The Science Newspaper also aims to facilitate the practise of science communication and outreach through workshops covering IYA 2009 subjects, providing a section of the newspaper dedicated to children to encourage them to become young science investigators, podcasting on astronomy related themes, and setting up children's school radio stations. Scientists, researchers and the amateur community are also encouraged to contribute to the content.

Thursday
11:45am

ESF Surveys for 'She is an Astronomer'

H. Walker (Rutherford Appleton Laboratory), Thibaut Lery, the ESF team, the She is an Astronomer Task Group

As part of the IYA2009 cornerstone project 'She is an Astronomer', the European Science Foundation will be conducting surveys of women in astronomy. Objective data and statistics are a vital part of the project, to help astronomers understand the issues and challenges. The ESF plans are discussed.

Thursday
12:05pm

The Spanish Survey for 'She is an Astronomer'

H. Walker (Rutherford Appleton Laboratory), Montserrat Villar, the Spanish Team, the She is an Astronomer Task Group

As part of the IYA2009 cornerstone project 'She is an Astronomer' Montserrat Villar, Spain's IYA2009 Single Point of Contact, is organising the first statistically complete study of professional women in Spain. It is a vital element of the cornerstone project that objective statistics are available, so this project is very important. The aims and challenges of the project will be discussed.

7-P01 The ESO Gigapixel Project - Showing the Sky as You Have Never Seen it Before

H. Boffin (ESO), Olivier Hainaut, Lars Lindberg Christensen (ESO)

The human view of the night sky, just gazing up, is perhaps the most poetic one and also the closest to everyone's experience. On the other end of the scale, astronomers today use more and more powerful telescopes to scrutinise celestial objects with extreme levels of detail. But how do these connect?

In the framework of the IYA2009, ESO has devised a whole range of activities. The Gigapixel project is one of these and aims at seamlessly bringing together the naked eye night sky with the very detailed view from a world-class research telescope.

In this project, ESO will progressively release three images taken from the ESO observatories, each from 400 to 800 million pixels in size. They will show the beauty of the sky and allow viewers to better understand the process that links their personal experience with professional astronomy. They will also provide unique publicity for the need to preserve our dark skies.

The first image is at the naked eye stage and will provide a new unique picture of the Milky Way, obtained from the ESO Paranal and La Silla sites. The second intermediate stage is an image of a smaller area of the sky, using a hobby telescope, also taken from the dark skies of Paranal. Finally, the third stage, professional astronomy, is obtained with the world-class Wide Field Imager (WFI) on the 2.2-metre telescope at La Silla.

The images will be made available through the web and will also be used in various exhibitions. For example, with these images, we will be able to allow users to zoom-in from the wide-field, degree large pixels, to the sub-arcsecond pixels of the WFI image. This will provide an invaluable experience in the field of astronomy.

7-P02 Unveiling the Cool Universe with Herschel

H. Gomez (Cardiff University), P Hargrave, M Griffin and the HOGPOG team

The Herschel Space Observatory is ESA's fourth cornerstone mission and will be the most sensitive and largest far-infrared telescope ever put into space. It will be the first space observatory to observe from the far-infrared to the submillimetre waveband, unveiling the mysterious, hidden cool Universe to us for the first time. Some of the key science areas are star formation, the formation of galaxies and determining where all the cosmic dust polluting our galaxies comes from. Given the huge public interest in large space missions such as Hubble and Spitzer, Herschel is an ideal opportunity to excite the UK public during IYA 2009. Here we present some of the education projects by the Herschel Outreach Group.

7-P03 IYA 2009 in Greece

T. Katsiyannis (National Observatory of Athens), C Goudis

As the Greeks hold proudly an astronomical tradition dating back thousands of years, the general public maintains a great interest in the latest scientific discoveries related to the cosmos. The IYA 2009 is an excellent opportunity to renew excitement about astronomy, illustrate its relevance to today's modern life and attract young people to science and technology. This will be done through a stimulating series of events that will promote new national and international telescope projects, exciting astronomical research and fascinating technological advantages.

The purpose of this presentation is to present the year's co-ordinated activities of the Greek National Node including talks, astronomical themed nights, multi-media presentations, etc.

7-P04 International Year of Astronomy in France, Some Highlights

A. Levasseur-Regourd (UPMC Univ Paris6/LATMOS), AMA09 steering Committee

Almost four months after the opening of the International Year of Astronomy in Paris, we present some highlights amongst the numerous projects that have been successfully developed for the Année Mondiale de l'Astronomie (AMA09), including special efforts towards disabled people, animations in schools and universities, exhibitions in museums, and the 100 hours of astronomy. Since observing is a key to the discovery of the wonders of the Universe, professional and amateur astronomers have worked together to organize huge Sun and star parties. Both in large cities and far away from them, they have offered in more than 30 locations scattered all over the country the possibility of day and night observations with radio-telescopes and small telescopes, together with numerous activities related to astronomy. Other star parties are anticipated to take place, especially in late July for the anniversary of the first Moonwalk and in late October, during the Galilean nights where emphasis will be given to the observation of the Galilean satellites.

7-P05 Communicating Astronomy with the Public Journal - a free peer-reviewed journal for astronomy communicators

P. Russo (IAU & ESO - ePOD), Lars Lindberg Christensen (ESO - ePOD & IAU) on behalf of the CAPj working group and editorial team.

Public communication of astronomy provides an important link between the astronomical community and society, giving visibility to scientific success stories and supporting education. For astronomers, disseminating new information to a wider audience is increasingly important. This is the main task of public astronomy communication: bringing astronomy to society. As the astronomy outreach community expands globally, it becomes necessary to establish a community of science communication experts.

Communicating Astronomy with the Public Journal (CAPjournal) is a forum where professionals can share and present their expertise and know-how. CAPjournal is a free peer-reviewed journal for astronomy communicators, online and in print. CAPjournal serves as the main channel to share best practices and innovations as well as research results and findings. In the framework of the International Year of Astronomy 2009, CAPjournal is an important platform to communicate with communicators around the world.

Public communication of astronomy is a burgeoning field of science communication and with the assistance of the astronomy outreach community,

CAPjournal is at the forefront of developments.

7-P06 Astronomy's Prime Observatories as UNESCO World Heritage Sites?

M. Smith (CTIO, Chile)

A description is given of a contribution from astronomy to the UNESCO/IAU "Starlight Reserve" initiative being made through simple photography at several of the world's key professional observatories. These include the European Southern Observatory in Chile and the European Northern Observatory on La Palma. This is in support of the wider context of protection of the natural nighttime environment for future generations.

7-P07 | The IYA in Poland

E. Wnuk (Adam Mickiewicz University, Poznan)

An organization, different projects from local and regional to international, and past, current and future activities in Poland in the frame of the International Year of Astronomy 2009 will be presented.

7-P08 | Capture the Cosmos

Clair McSweeney (Blackrock Castle Observatory), Niall Smith (BCO),
Carolina Ödman (UNAWE, Leiden Observatory)

Capture the Cosmos is a Cork City Council Arts Office & Community & Enterprise Project for the Cork St. Patrick's Festival in partnership with Cork Printmakers and Blackrock Castle Observatory and forms a key part of Cork' celebration of International Year of Astronomy 2009. This collaboration has made it possible for children from four schools across Cork City - Scoil na Croise Naofa, Mahon, Scoil Padre Pio, Churchfield, St. Mary's on the Hill N.S., Knocknaheeny and North Presentation Primary School, Blackpool - to explore the world of astronomy and express their new learning, creatively, through artist- led printmaking workshops.

Participating children visited Blackrock Castle Observatory where the fascinating expanse of the cosmos was brought to their fingertips. The cosmos also came to their schools in the form of a traveling planetarium, the Star Dome. Each school took part in four printmaking workshops in drawing, drypoint and mono-screenprint, facilitated by Cork Printmakers. The children were guided to explore their new knowledge of the universe, and at the same time develop their own creative skills.

The exhibition Capture the Cosmos brings together work donated from each participating child. Money raised from the sale of this work will enable the purchase of a telescope and production of materials which will benefit five primary schools (Olarash, Mlimani, Enguiki, Arkatan and Lashaine) from the Arusha region within the Monduli District in Tanzania, one of the largest regions inhabited by the Maasai tribe. This project will enable the Tanzanian school children to acquire basic knowledge about the sky and the universe and will allow them to consider careers in science. The motivation behind this project is an awareness of the lack of scientific culture among the population and the urgent need for skilled scientists in the country. The project is managed by UNAWE (Universe Awareness of Young Children).

7-P09 | Tales of the Stars: A Children's Book Exploring Mythologies and Science

Rosa M. Ros (Technical University of Catalonia),
Carolina Ödman (UNAWE - Leiden Observatory)

"Cuentos de Estrellas", (Tales of the Stars) is the first children's book produced by UNAWE. It contains 13 astronomical legends originating from North Africa to South America, blending cultures and interpretations of the night sky. Each story is beautifully illustrated and accompanied by a scientific explanation of the astronomical object featured in the story. From variable stars to cosmology, legends from the past and present reveal the intimate relationship between the people of the Earth and the sky. The idea behind the book was to exploit the commonality of the Spanish language found in a number of countries and cultures around the world. Children from those communities share a common cultural heritage and enrich it with their own cultural particularities. It was also important that the authors should come from different Spanish-speaking countries: Honduras, Colombia, Mexico, Brazil, Italy, El Salvador, Tunisia and Spain. The book includes tales from the Andean plateau, from the Amazon basin, from the traditions of the Inca peoples, the Mexicas, the Cubeos, Mayas and Aztecs, from the Arabic legends, from Christian tradition and Greek and Roman mythology. Thanks to a special IYA2009 grant from the European Astronomical Society this book has now been translated into English and is made available to the English-speaking community worldwide. It has also been translated into Catalan and Arabic. We have not managed to include every culture and all the stories so there is plenty of room for more books.

7-P10 The Multicultural Sky

C. Ödman (Universe Awareness - Leiden Observatory), Cecilia Scorza (Heidelberg), Natalie Fischer (Astronomieschule), Carolina Odman (UNAWE, Leiden Observatory)

In all cultures of the world children are exposed to myths and stories about the sun, the moon and the constellations from early ages. Through these stories children experience a deep connection with their own cultural roots and at the same time develop a broad view of the world by hearing stories from other cultural environments. The broader this view is at a young age, the more open and confident they grow in their attitudes towards life and other human beings. We present the results of astronomy activities carried out during the last three years in Germany as part of the UNAWE-Germany programme. Specifically in 12 Kindergarten of two inner cities attended by 85 % immigrant children and in which up to 11 different languages are spoken. The programme has turned into an important ingredient for intercultural education.

7-P11 The RAS UNAWE Earthball Project

C. Ödman (Universe Awareness - Leiden Observatory), Mark Bailey (Armagh), Pete Edwards (Durham), Stewart Eyres (UClan), Miruna Popescu (Armagh), Ian Robson (ROE)

As part of IYA2009 activities, the RAS awarded a consortium of British universities and research institutions a grant to carry out a Universe Awareness action. A programme of activities will be distributed using as a starting point an inflatable ball printed with satellite images of the Earth. The Earthball is a resource that has proved hugely successful in previous UNAWE activities around the world. Children and teachers are unanimous about its appeal and educational value. Its size is suitable for young children to comprehend astronomical scales.

We present some of the activities that we have written for the Earthball. They will be adapted to the UK curriculum and improved on based on feedback from primary schools in which the action will be carried out.

7-P12 UNAWE - Explora el Universo : a Resource Website for Spanish-Speaking Children from 4 to 10

Rosa M. Ros (Technical University of Catalonia),
Carolina Ödman (UNAWE - Leiden Observatory)

Many children around the planet share Spanish as a common language. In the framework of UNAWE, we thought it was a good idea to collect the educational resources from all Spanish-speaking partners in UNAWE. The authors of the resources are teachers and astronomers form Spanish speaking countries. At present 38 people from 12 countries (Brazil, Chile, Colombia, Honduras, Italia, Mexico, Panama, Portugal, El Salvador, Spain and Venezuela) contribute content but we invite all teachers from Spanish speaking countries to join our community. A group of Portuguese teachers are translating our materials into Portuguese, another major international language. In the future we plan to have the website in both languages. The website is divided in different sections: activities, short stories & poems, animations, articles, legends & tales, games, simulations and videos. Activities are divided in several subsections: instruments, models, observation, solar system, Earth-Moon system and the universe. As of March 2009, 107 different activities are online. We show a few examples here. A children's book about astronomical mythologies is one of the outcomes of this effort and is presented in another poster.

Monday
2:00pm

Negative Ions at Titan and Enceladus: Recent Results

A. Coates (MSSL-UCL), A.Wellbrock, G.R.Lewis, G.H.Jones, D.T.Young, F.Crary, J.H.Waite Jr, R.E.Johnson, T.Cassidy, T.W.Hill

Heavy (up to 10,000 amu) negative ions in Titan's ionosphere were one of the tantalising new results from the Cassini mission as they indicate for the first time the existence of heavy hydrocarbons and nitriles in this primitive Earth-like atmosphere. These ions were suggested (Coates et al, 2007, Waite et al, 2007) as precursors of aerosols in Titan's atmosphere and may precipitate to the surface as tholins (c.f. Sagan et al, 1993). Also negative ions, mainly water clusters in this case, were seen during Cassini's close flybys of Enceladus in 2008. Recently we have re-analysed the negative ion population at both objects. We present improved statistics on the variation of the Titan negative ions with altitude and latitude for all relevant encounters so far, and we examine the implications for the negative ion formation process. In addition we present mass spectra from Enceladus showing water clusters and possible additional species.

Monday
2:15pm

The Saturnian Ring Current as Revealed through Plasma, Energetic Particle and Magnetic Field Measurements

S. Kellett (University of Leicester), C.S. Arridge, E.J. Bunce, A.J. Coates, S.W.H. Cowley, M.K. Dougherty, D.C. Hamilton, S.M. Krimigis, N. Krupp, D.G. Mitchell, E.C. Roelof, and N. Sergis

Saturn's ring current flows eastward in the equatorial plasma and distorts the planetary field, thus influencing the configuration of the magnetosphere. Its origins and physical characteristics have been investigated using combined data from the MAG, MIMI, and CAPS instruments onboard Cassini. First, magnetic field data from high latitude orbits have been used to determine the thickness of the current layer in the dayside and nightside magnetosphere. Second, the combined data have been employed on equatorial orbits to address each term of the radial force balance equation, and to determine how each contribution to the current varies with radial distance. Results from these studies will be presented.

Monday
2:30pm

Search for a Cushion Region at Saturn

D. Went (Imperial College London), Michele Dougherty, Nick Achilleos

In this study we use data from the magnetometer instrument onboard the Cassini-Huygens spacecraft to search for evidence of a magnetically turbulent, dipolar region between the dayside magnetodisc and magnetopause which may be analogous to the cushion region seen at Jupiter. To do this we adopt a well accepted set of criteria for magnetodisc formation (Arridge et al. 2008) and survey a range of Cassini orbits from 2004-2007 for signs of these criteria breaking down in the region just inside the magnetopause in a way suggestive of field dipolarization. The cushion region at Jupiter is well developed at local times ranging from the dawn meridian (0600) to at least mid afternoon (1600) and is characterized by high levels of magnetic turbulence, predominately southward magnetic fields and a vanishing of the 10h periodicity (seen in the middle magnetosphere) which results from the planets tilted magnetic dipole. Although current theories suggest a strong link between the cushion region and the dayside plasma return flows associated with the Vasyliunas cycle, a full theoretical understanding of this region is still currently unavailable. An investigation of this outer magnetospheric region at Saturn (where similar plasma processes are thought to be operating) is highly important to develop a full understanding of this region and the physical magnetohydrodynamic processes responsible for its formation. Initial results from Cassini suggest that Saturn's cushion region, if present at all, is significantly smaller than that of Jupiter's raising interesting questions as to why this may be the case given the known similarities between other parameters of the systems.

Monday
2:45pm

Electron Optical Study of the Venus Express ASPERA-4 Electron Spectrometer (ELS) Top-Hat Electrostatic Analyser

G. Collinson (Mullard Space Science Laboratory), D. O. Kataria, Andrew J. Coates, Sharon M. E. Tsang, Christopher S. Arridge, Gethyn R. Lewis, Rudy A. Frahm, J. David Winningham, Stas Barabash

The performance of the Venus Express (VEX) ASPERA-4 Electron Spectrometer (ELS) is different from the nominal response shown by the ASPERA-3 ELS aboard Mars Express due to machining tolerance. Up to now, the precise mechanism for this was unknown and, therefore, the results of the experimental calibration could not be supported with a theoretical understanding of the fundamental instrument science behind the device. In this study we show that the difference is due to a mis-alignment of the inner hemisphere and a widening of the entrance aperture of the instrument. The response of the VEX ELS can be approximated by a combination of a vertical offset of the inner hemisphere of approximately 0.6mm and a lateral offset of less than 0.125mm, combined with an aperture that is approximately 0.54mm wider than nominal. The resulting k-factor, geometric factor, energy resolution and peak elevation are in good agreement with those observed experimentally. Therefore, we now have a good agreement between both laboratory calibration data and computer simulation, giving a firm foundation for future scientific data analysis.

Monday
3:00pm

A Preliminary Review of Ionospheric Photoelectrons at Venus

S. Tsang (Mullard Space Science Laboratory, UCL), A.J. Coates, G.H. Jones, R.A. Frahm, J.D. Winningham, A. Fedorov, S. Barabash, R.Lundin

Venus does not have an intrinsic magnetic field, as was shown by Pioneer Venus [Slavin et al., 1980]. Instead, the solar wind interaction with the planet's upper atmosphere creates an induced magnetosphere. This interaction causes the solar wind's magnetic field lines to drape around the planet, dragging through the ionosphere where they continue on to form a magnetotail [Luhmann & Cravens, 1991]. The solar HeII 30.4nm line ionises the atmosphere, which leads to the production of ionospheric photoelectrons. These photoelectrons are recognisable by their characteristic spectral shape in the electron energy spectrum [Mantas & Hanson, 1979] and have been seen at Venus in the ionosphere [Coates et al., 2008] and in the induced magnetotail for the first time [Tsang et al., submitted] using the electron spectrometer (ELS). ELS is part of the ASPERA-4 instrument, onboard the Venus Express spacecraft. Its energy resolution of ~7 % enables the ionospheric photoelectrons to be observed for the first time at Venus [Barabash et al., 2007]. Photoelectrons have previously been seen at Earth [Coates et al., 1985], Mars [Frahm et al., 2006a,b] and Titan. At Titan, they have been linked to ambipolar diffusion [Coates et al., 2007].

We present the further analysis on the first observations of photoelectrons in the tail of Venus. In addition we present preliminary work on a statistical review of the occurrence of photoelectrons in the tail.

Monday
3:15pm

Ionospheric Photoelectrons as Tracers of Magnetic Field Lines in Titan's Plasma Environment

A. Wellbrock, A.J. Coates, I. Sillanpää, G.H. Jones, G.R. Lewis, C.S. Arridge, A.D. Aylward, F. J. Crary, D.T. Young

Discrete photoelectron peaks near 24eV can be seen in the electron energy spectrum observed by the ELS (ELectron Spectrometer) part of the Cassini Plasma Spectrometer (CAPS) in Titan's ionosphere. These photoelectrons are generated as a result of the strong HeII (30.4nm) solar line ionising N2 (Galand et al, 2006). They are generally observed in the dayside ionosphere because this is where neutral N2 particles are present and can be reached by solar radiation. Coates et al (2007) discussed observations of photoelectrons in Titan's distant tail during the T9 encounter. This study describes other observations of photoelectron peaks at larger distances from Titan, where they are unlikely to have originated due to lower N2 densities at large distances. These photoelectrons may have travelled to the observation sites by means of a magnetic connection from lower altitudes in the dayside ionosphere where they could have been produced. This idea is strongly supported by results of the HYB model (Sillanpää, 2008). We therefore suggest that photoelectron peak observations can improve our understanding of Titan's complex plasma environment by using them as tracers of magnetic field lines.

Tuesday
2:00pm

Non-Stationarity of a Collisionless Quasi-Perpendicular Shock: Consequences for Particle Acceleration

C. Mazelle (CESR / Univ. Toulouse - CNRS), B. Lembège

Among several mechanisms issued from simulation and theoretical studies proposed to account for the nonstationarity of quasi-perpendicular supercritical shocks, one process - the so-called self-reformation - driven by the accumulation of reflected ions at a foot distance from the ramp has been intensively analyzed with simulations. Present results based on experimental CLUSTER mission clearly evidence signatures of this self-reformation process for the terrestrial bow shock. The study based on magnetic field measurements includes two parts: (i) a detailed analysis of two typical shock crossings for almost perpendicular shock directions where the risk of pollution by other nonstationarity mechanisms is minimal. A special attention is drawn on non appropriate treatment of data which could lead to wrong interpretation. One key signature of this self-reformation is that the ramp width can reach a very narrow value covering a few electron inertial lengths only; (ii) a statistical analysis based evidences the signatures of this nonstationarity versus different plasma conditions and shock regimes. Present results are compared with previous works and implications for particle accelaeration are driven.

Tuesday
2:20pm

Electron Acceleration at Quasi-perpendicular Shocks

D. Burgess (Astronomy Unit, QMUL), J. Woodcock

Enhanced electron fluxes are observed upstream and downstream of the Earth's bow shock. Energetic electron enhancements are also seen at interplanetary shocks, and electron acceleration at shocks is believed to be responsible for some types of solar radio burst. Electron acceleration at quasi-perpendicular shocks is studied using a combination of test particle and self-consistent plasma simulations. It is found that self-consistently generated turbulence in the shock layer is sufficient to scatter electrons and modify the standard picture of fast Fermi acceleration. The presence of the necessary turbulence depends on the shock Mach number. The scattering from the turbulence results in enhanced energization over a broader range of shock normal angle, and fluxes downstream comparable to those upstream. The implications of these results for electron acceleration at interplanetary shocks will be discussed.

Tuesday
2:40pm

Using CLUSTER II to Investigate the Dissipation/Dispersion Range of Solar Wind Turbulence

K. Kiyani (Khurom Kiyani), Sandra Chapman and Yuri Khotyainstev

In-situ observations of fluctuations in the solar wind typically show an "inertial range" of MHD turbulence, and at higher frequencies, a cross-over to spatial temporal scales where kinetic effects become important. In-situ monitors such as WIND and ACE have provided observations over ~1 decade of this dissipation/dispersion range which have motivated theoretical studies that in turn predict scaling in this region.

We will present some early results from very high-frequency magnetic field data from the four Cluster II spacecrafts in intervals where the spacecrafts were in quasi-stationary ambient solar wind and where the instruments were operating in burst mode. The magnetic field data are from the search coil data from the Cluster STAFF experiment (~450 Hz) and magnetometer measurements from the Cluster FGM experiment (~67Hz). These data sets provide observations of this dissipation/dispersion range over more ~ two decades, allowing a more precise determination of scaling exponents.

Theories centred around the dispersion of MHD waves and their associated damping and particle heating have been proposed to account for this scaling range. Since the spacecraft data shows a clean break from the scaling in the inertial range, followed by a different power-law spanning over approximately two decades, these theories centre around predictions of the spectral slope and the associated scaling exponents.

Motivated by the need to distinguish these theoretical predictions, we perform a robust statistical analysis focusing on power spectra, PDFs of magnetic fluctuations and higher-order statistics to quantify the scaling of fluctuations as we pass though the crossover from inertial range to near-dissipation range phenomenology.

Tuesday
2:55pm

Radio Wave Heating of the Plasma in the Polar Mesosphere: Diagnosis using Cross-Modulation

A. Senior (Lancaster University), M. T. Rietveld and M. J. Kosch

Powerful high-frequency radio waves can heat the free electrons in the mesosphere (the ionospheric D-region). This technique has found an important application in the study of dust particles in the mesosphere which are responsible for the phenomenon of Polar Mesospheric Summer Echoes (PMSE) in ionospheric radar data. The response of the echo strength to this heating provides information on the size and charge of the dust particles. At present, the electron temperature enhancement due to radio wave heating has to be estimated from model calculations because it is difficult to measure by techniques such as incoherent scatter radar, which can measure the electron density. The temperature enhancement raises the electron collision frequency and alters the absorption of other radio waves passing through the heated plasma. Measuring this absorption change is the basis of the long-established cross-modulation technique. The technique has been applied to diagnose the electron heating due to the EISCAT HF facility near Tromso, Norway. The experiment is described and the results are compared to model calculations. Limitations of the technique are discussed and some ideas for future improvements are suggested.

Tuesday
3:10pm

Resonant Absorption with 2D Variation of Field Line Eigenfrequencies

A. Russell (University of St Andrews), Andrew Wright

Resonant absorption is robust when field line eigenfrequencies vary in two dimensions across the background magnetic field. We show this for cold, linear, ideal MHD in a hydromagnetic box using a time independent analytic solution and time dependent computer simulations. Simulations show that energy is deposited from a monochromatic fast wave as a phasemixing Alfven wave where the local field line eigenfrequency matches the frequency of the driver, as one would expect from the 1D case. We relate the velocity perturbation of the Alfven wave to gradients of the field aligned magnetic field perturbation and the nature of the fast wave is shown to be captured in the energy density of the Alfven wave.

Tuesday
4:00pm

Constraining Substorm onset with Space- and Ground-Based Observations

A. Walsh (MSSL-UCL), I. J. Rae, I. R. Mann, A. N. Fazakerley, K. R. Murphy, M. Volwerk

Any solution to the substorm onset problem will involve the combination of observations from multiple space- and ground-based sources. Here we present observations at and around a substorm onset on 1st October 2005 from Cluster, Double Star, IMAGE & Geosynchronous Satelites and ground-based magnetometers & riometers from the CARISMA and NORSTAR arrays. The observations reveal a complex substorm preceded by several auroral activations at different latitudes and local times, the locations of which are constrained through the analysis of both ground- and space-based data. The near-Earth onset instability and the formation of the substorm current wedge were potentially observed in-situ by Double Star TC-2. As the substorm developed, higher latitude geomagnetic bays, larger than the auroral zone bays detected around onset, were observed. These bays are linked to the onset of reconnection of open magnetic flux through magnetotail data taken by the Cluster spacecraft.

This event provides a good example of the need for synoptic measurements taken throughout the entire magnetosphere-ionosphere system when studying the complexities of the substorm process.

Tuesday
4:15pm

Splitting Arcs and Sharp Boundaries in the ASK Imager

M. Ashrafi (Southampton University), Betty Lanchester, Nickolay Ivchenko, Dirk Lummerzheim

The ASK (Auroral Kinetic and Structure) instrument is a narrow field of view auroral imager providing high spatial and temporal resolution images of aurora in three different spectral bands. On 14th and 15th December 2006 ASK images show several splitting arc filaments and small scale structures with sharp boundaries. The observed characteristics of these structures and modelling of ASK emissions show that these optical features are very limited in height and produced by high energy electrons of a very distinct energy range. The change of electron energy within 200 meters of some of these filaments are similar to the sharp transitions in the precipitating electron energies observed by the electron spectrometer on-board the Freja satellite (Boehm et.al., 1995). However, some of the characteristics of splitting arcs are compatible with the features of the dispersing Alfvén waves.

Tuesday
4:30pm

Effects of Current System Scale Size and Location on the Curlometer

C. Forsyth (UCL Mullard Space Science Lab.), M. Lester, C. J. Owen

Using infinitely long current tubes, we investigate the response of the curlometer for range of scale sizes and positions of the current system relative to the tetrahedron. It is shown that, for these current systems, the percentage of the true current estimated by the curlometer is dependant on the position of the current system and the relative scale size of the tetrahedron. The curlometer under-estimates the true current at all the scale sizes examined, although for small scale sizes, this effect is much greater. Also, the angle between the true current and the current calculated by the curlometer significantly increases with decreasing scale size. We also show that for perfectly measured magnetic field and spacecraft separations, |div(B)/curl(B)| is much smaller than the values typically observed by Cluster, indicating that measurement uncertainties have a far greater effect on the validity of the curlometer measurements than the assumption of linear magnetic field gradients for the current systems examined. These effects must be taken into account when comparing data from the various Cluster tetrahedron scale sizes and possible future multi-tetrahedra missions.

Tuesday
4:45pm

Combined Electric and Magnetic Field Measurements in the Medium and Extremely Low Frequency Bands

T. Whitley (University of Bath), Dr Martin Fullekrug

The testing, evaluation and measurement campaign carried out using newly developed Metronix Geophysical data loggers. Recordings were made in the extremely low frequency band using horizontal magnetic coils in combination with medium frequency measurements in the vertical electric field at a remote site. Sferics and other electromagnetic events (as well as wind) were identified and compared in both sets of results with a high timing accuracy and provide the foundation for a global study using a network of data loggers in the near future.

Tuesday
5:00pm

The Eigenfrequency and Eigenfrequency Variation of the IAR Observed by Multiple Observatories

K. Yuan (University of Leicester), Terry Robinson, Darren Wright, Tero Raita

On 9 November 2002 there was an IAR event was observed by multiple search coil magnetometers. The magnetometers are located in Finalnd at Kilpisjarvi, Sodankyla, Rovaniemi, Oulu and Nurmijarvi, respectively. A double running average smoothing and a sinusoidal curve fitting were used on the spectral data of the event to find the eigenfrequencies of the IAR. According to the analysis, the eigenfrequencies and eigenfrequency rates of change were found to differ between the different stations. Possible reasons for these differences are outlined.

Tuesday
5:15pm

The Effect of a Purely Growing Mode in Analyses of Incoherent Scatter Spectra

H. Vickers (UNIVERSITY OF LEICESTER), T. Robinson

Spectral features such as those caused by the purely growing mode, can often be strongly enhanced in incoherent scatter spectra during the first few milliseconds of artificial ionospheric heating experiments carried out using the EISCAT high power facility at Tromsø. These features, often referred to as the 'overshoot' effect, are often indicators of a turbulent, non-Maxwellian plasma and the analysis of these spectra using the GUISDAP software leads to a poor estimation of the electron temperature during RF heating experiments. In this study, two approaches are presented in which the derivation of a more reliable estimate is attempted. In this first approach, Epstein functions are fitted to the height profile of the electron temperature change by extrapolating data points above and below the heater interaction altitude, where the electron temperature is deemed inaccurate. In the second method, a correction is made to the incoherent scatter spectra by subtracting a Gaussian function from the centre of the spectrum which represents the removal of the purely growing mode feature. The modified spectrum is then analysed using the GUISDAP software and compared to the standard analysis estimate. It is found that the errors in these new estimates are strongly proportional to the amplitude of the purely growing mode, but the large scale, bulk temperatures that evolve on longer timescales and which play an important role in governing thermal conduction processes, can be taken as reliable in the case when the temperatures have been inferred from spectra during the interval of heating which follows the initial overshoot.

Thursday
11:02am

Using the Heliosphere as an Astrophysical Laboratory

M. Hapgood (STFC Rutherford Appleton Laboratory)

The solar system is an excellent natural laboratory for studying the physical processes underlying many astrophysical phenomena. We can observe solar system phenomena in much higher resolution than those in more distant regions. We can also combine data from a wider range of techniques including in-situ measurements and short-range remote sensing from spacecraft as well as the usual astronomical approach of remote sensing from the Earth or a near-Earth spacecraft. The quality of data on solar system phenomena allows us to explore the complex physical processes that underly many of these phenomena. This presentation will apply these ideas in the context of heliophysics and outline how knowledge gained in the solar system can be used to constraint our understanding of phenomena in other astrospheres and coupling with exo-planets. The talk will emphasise the importance of plasma physics as a crucial element in understanding heliospheric and astrospheric phenomena.

Thursday
11:32am

Stellar Wind Interaction with Close-in Extrasolar Planets

E. Johansson (Institute for Theoretical Physics, TU Braunschweig), Uwe Motschmann

The discovery of close-in exoplanets, orbiting at distances much smaller than any major body in the solar system, has opened up for the possibility of new types of planet-stellar wind interaction previously unseen in the solar system. Examples include subsonic stellar wind interaction and magnetized exoplanets being induced to emit radio, possibly detectable from Earth. It is also expected that the atmospheres of close-in extrasolar planets frequently undergo hydrodynamic expansion and produce strong ionospheres due to intensive photoionization, while at the same time being exposed to a strong stellar wind. We have used a hybrid code, treating electrons as a massless, charge-neutralizing, adiabatic fluid and ions as macroparticles, to study the influence of a strongly expanding ionosphere on the stellar wind interaction for an unmagnetized close-in extrasolar terrestrial planet. We report on our attempts to apply this code to close-in extrasolar planets and results therefrom.

Thursday
11:51am

Solar Wind Interactions Seen with the STEREO Heliospheric Imagers

C. Davis (Rutherford Appleton Laboratory)

The NASA STEREO mission has now spent two and a half years studying the Sun and the solar wind from vantage points far away from the Sun-Earth line. The UK-built Heliospheric Imagers are wide-field cameras mounted on the side of each spacecraft in order to detect Earth-directed features in the solar wind. In addition to observing Earth-impacting solar mass ejections, the Heliospheric Imagers have witnessed the interaction of the solar wind with Venus, Mercury, several comets and some spacecraft. While giving a vivid picture of the hazards posed by the solar wind throughout the heliosphere, such observations also allow us to infer how stellar winds will interact with planetary bodies in solar-systems other than our own.

Thursday
12:10pm

Evolution of Large Scale Solar Wind Structures from the Sun to 1 AU from Remote Sensing and in-situ Observations

R. Forsyth (Imperial College London), A Rouillard, N Savani, J A Davies, M J Owens

Observations of both CME (coronal mass ejection) transients and other structures in the solar wind from the Heliospheric Imagers on STEREO, combined with in-situ observations of the solar wind from the fleet of spacecraft now available in the inner heliosphere and at 1 AU, provide an excellent resource for studying the evolution of these features with distance from the Sun. In this talk we present a number of examples from ongoing work illustrating the physics which can be learned from such studies. Examples include: establishing the relationship between optical signatures of CMEs and the structure of magnetic clouds observed in-situ; quantifying the expansion of coronal mass ejections with distance from the Sun; testing models of the expansion and distortion of CMEs propagating in a structured solar wind; and the evolution of the heliospheric current sheet structure with distance from the Sun.

A5-P01 Establishing the Outer Scale of Ionospheric Turbulence.

G. Abel (British Antarctic Survey), M. Parkinson and M. P. Freeman

The existence of large-scale (global) convection in the polar ionosphere has been recognised and measured for many years. Typically a 2-cell convection pattern is established under southward IMF conditions and a 4-cell convection pattern is established under northward IMF conditions. Recent work has shown that the small- and meso-scale (<1000 km) variability in the ionospheric plasma flow is consistent with multi-fractal turbulence. Existing studies of this turbulence have used a single SuperDARN radar to measure this variability and have suggested that the velocity variability on scales > 1000 km is dominated by the global convection structure. Unfortunately, measurements on scales >1000 km are scarce in the existing studies raising the question as to whether the breakdown of turbulent structure at this scale is indeed due to the domination of the global convection or rather simply a result of poor statistics. In this study we use measurements from the (almost) opposing meridional beams of the Halley and Tiger SuperDARN radars to probe scales >1000 km.

A5-P02 Saturn's Oscillating Magnetic Field

D. Andrews (University of Leicester), S. W. H. Cowley and G. Provan

Saturn's internally generated magnetic field is known to be highly symmetric about the rotational axis of the planet. Despite this, planetary-period oscillations are observed ubiquitously throughout the planet's dynamic magnetosphere, with no immediately obvious mechanism for their generation. We present some preliminary results of on-going analysis of the ~10.8h planetary-period oscillations observed in magnetic field data obtained with the Cassini spacecraft, currently orbiting the planet. Through analysis of data from the first ~3 years of the mission at Saturn we create a 'map' of the magnetic field oscillations, and show them to exhibit considerable structure both in azimuth and radial distance from the planet. We suggest that this rotating component of the planet's magnetic field can be produced by the action of a rotating partial ring current and associated field- aligned closure currents, and that this mechanism is also consistent with observations of other rotating phenomena at Saturn.

A5-P03 An Experimental and Theoretical Study of the Wide Band Non-Thermal Continuum Radiation Generation

C. Arridge (MSSL / UCL), S. Grimald and O. Santolik

Non-thermal continuum (NTC) radiation is, with auroral kilometric radiation, one of the two electromagnetic emissions generated within the Earth's magnetosphere and radiated into space. It is generally believed that NTC is emitted at the plasmapause density gradient, close to the magnetic equator, and with a narrow-band spectral signature. We present a specific type of NTC event, which appears as wide bands in the spectrograms recorded by the CLUSTER spacecraft. Similar events were infrequently observed by the WHISPER wave instrument. This NTC comes from several sources located in the plasmapause density gradient, at medium magnetic latitude and where fpe = nfce. It may have a different mechanism of generation than the "classical" NTC. In this presentation, we present an analysis that indicates that the wave is emitted by a group of sources, and that these waves mix close to the source region. The observed polarization is consistent with propagation in the left hand mode but measurements in the source region indicate that parallel propagating waves cannot be directly generated by a non-relativistic process from the observed electron populations.

A5-P04 First results about the position of the kronian ring current: an experimental and theoretical study

C. Arridge (MSSL / UCL), S. Grimald, A. Rochel, A. J.Coates, I. Dandouras

In the Earth magnetosphere, a ring current can be observed in the dipolar region, between 2 and 9 RE. In the inner magnetosphere, the low energy particles (ions and electrons) corotate. Due to the gradient and the curvature of the field lines, the dipolar magnetic field influences the movement of the particles. Gradient and curvature are responsible of the existence of drift velocities perpendicular to the magnetic field lines. Above limit energy, the total drift velocity will be higher than the corotation velocity. The electrons and the ions rotate in opposite directions then. This explains the existence of the ring current. The same phenomenon can exist in the kronian magnetosphere. Even if it exists evidence of the existence of a ring current in the magnetosphere of Saturn, its position and its composition is not defined. Using a model which calculates the drift and corotation velocities, we can determine the minimum energy from which the ring current appears. In this paper, we will use the CAPS and MIMI data on board the Cassini spacecraft and compare the energies observed with the result obtained with the model in order to localise the ring current.

A5-P05 Cluster Observations of ULF Waves Stimulated by SPEAR

S. Badman (University of Leicester), D.M. Wright, T.K. Yeoman, L.B.N. Clausen. R.C. Fear, A.N. Fazakerley, E.A. Lucek

SPEAR (Space Exploration by Active Radar) is an ionospheric heating facility situated on Svalbard which is capable of exciting ULF waves on local magnetic field lines. Similar heating experiments carried out by the EISCAT heating facility at Tromsø generated a wave which was detected by the FAST spacecraft as it flew over the Tromsø site (Robinson et al., 2000). Field-guided ULF waves can interact with the ionospheric Alfvén resonator (IAR) and produce parallel electric fields, which then accelerate electrons both up and down the field line. Detection and study of these waves thus provides information on the properties of the IAR and auroral acceleration processes. We examine an interval from 1 February 2006 when SPEAR was transmitting a 1 Hz modulation signal with a 10 min on-off cycle. Ground magnetometer data indicated that SPEAR successfully modulated currents in the ionosphere at 1 Hz and also enhanced a field line resonance with a 10 min period. During this interval the Cluster spacecraft passed over the heater site. Signatures of the SPEAR-enhanced field line resonance were present in the magnetic field data measured by Cluster-2. Periodic enhancements in field-aligned electron fluxes at energies of tens of eV were also detected at the spacecraft. We suggest that these electrons were accelerated at the upper IAR boundary by parallel electric fields resulting from the artificial 1 Hz modulation.

A5-P06 3D Reconstructions of the Inner Heliosphere and their Comparison with Interplanetary Spacecraft

M. Bisi (University of California, San Diego), Bernard V. Jackson, P. Paul Hick, Andrew Buffington, and John M. Clover; Center for Astrophysics and Space Sciences, University of California, San Diego, 9500 Gilman Drive #0424, La Jolla, CA 92093-0424, USA

We have developed a real-time three-dimensional (3D) tomographic reconstruction technique on the web (at http://ips.ucsd.edu/index_ss.html) which uses interplanetary scintillation (IPS) data from the Solar-Terrestrial Environment Laboratory (STELab) in Japan. This technique has two forms: co-rotating; and time-dependant. Results have been available since 1996. The tomography has more recently been applied to multiple sources of IPS data from around the World as well as to Thomson-scattered white-light observations from the Solar Mass Ejection Imager (SMEI) in Earth orbit. Both types of observations provide wide-angle sky coverage (near-all sky with SMEI at a much higher resolution than that of IPS) and thus are a good data source for reconstructing the inner heliosphere. This technique is used to determine solar wind pressure ("ram" pressure) at Mars. Results are compared with ram pressure observations derived from Mars Global Surveyor magnetometer data for the years 1999 through 2004. In addition, we compare events of interest with in-situ solar wind measurements from interplanetary spacecraft such as Wind, ACE, and STEREO. The events considered here include the 28 May 2003 CME sequence (and mass determination), and the ICMEs responsible for a series of geomagnetic storms in early November 2004. In addition, the Whole Heliosphere Interval (WHI) is summarised.

A5-P07 A Superposed Epoch Analysis of the Open Magnetic Flux and Solar Wind Conditions Around the Time of Substorm Onset

P. Boakes

Boakes et al. (2009) showed that the probability of seeing a substorm particle injection signature at geosynchronous orbit is dependent on the amount of open magnetic flux content of the magnetosphere at the time of substorm onset. We investigate this further by carrying out a superposed epoch analysis of the open magnetic flux, auroral boundaries, maximum nightside auroral intensity, solar wind conditions and magnetic indices around the time of substorm onset for over 300 substorms. We categorise the onsets in several different ways. Firstly by the presence or otherwise of a particle injection, secondly by the value of open magnetic flux at onset, thirdly by the auroral oval width and lastly by the difference in magnetic latitude between the open/closed field line boundary and the latitude of the auroral onset arc. We discuss these results in the context of the expanding/contracting polar cap paradigm.

A5-P08 ULF Wave Propagation- Observations and Modelling

J. Borderick (University of Leicester), T.K. Yeoman

A quantitative study of ~20 observations of the ionospheric signatures of magnetospheric Ultra Low Frequency (ULF) waves by a high-latitude (geographic: 69.60 N 19.20 E) high-frequency Doppler sounder has been undertaken. The signatures, which are correlated with pulsations in the IMAGE ground magnetometer data, exhibit periods in the range 100-600s and have azimuthal wave numbers in the range 1-12. They are interpreted as local field line resonances having large azimuthal scale sizes. The relative phases and amplitudes of the signatures in the Doppler and ground magnetometer data are compared with a numerical model for the generation of Doppler signatures from incident ULF waves. A 1 dimensional model of wave propagation from the magnetosphere, through the ionosphere to the ground with an oblique magnetic field is employed. HF signals that propagate via the ionosphere exhibit Doppler shifts due to a number of processes that give rise to a time dependent phase path. Here, the effect of the modelled incident wave field on such an HF radio path is calculated, and compared to observations. The relative importance of Doppler shifts resulting from the vertical component of an E X B bulk motion of the local plasma due to an incident Alfvén wave and changes in the local plasma density caused by the propagation of a compressional fast mode wave are compared for the database of events under study.

A5-P09 Exploring the Large-Scale Structure of the Solar Wind: Recent Advances from Combined Radio Scintillation and White-Light Imager Results

A. Breen (Aberystwyth University), Gareth Dorrian, Richard Fallows and Huw Morgan (Aberystwyth University), Mario Bisi (University of California), Jackie Davies (STFC Rutherford-Appleton Laboratory), Alexis Roulliard (Southampton University)

Over the last 3 years significant advances have been made in our ability to relate highly-detailed observations of small regions of the solar wind (from long-baseline radio scintillation measurements) to the overall structure of coronal mass ejections, stream interaction regions, small-scale transients or other dynamic features of the solar wind. A key factor in this has been the high-quality imagery produced by the HI instruments on STEREO, which form a perfect complement to the well-established technique of very long-baseline radio scintillation. In this poster we outline the approach used and present sample results including observations of CME cannibalisation, small-scale transients in the solar wind in the vicinity of a comet and a solar wind transient entrained within a CIR.

A5-P10 An Automated Method for Detection, Classification and Removal of Spacecraft Generated Magnetic Disturbances from Venus Express Magnetometer Data

A. Dimmock (University of Sheffield), S.A.Pope, M.A.Balikhin, T.L.Zhang

Magnetic field measurements are vital to the observation of solar wind interaction with celestial bodies within our solar system. Venus has no significant intrinsic magnetic field, which presents an interesting interaction between the solar wind and the upper atmosphere. Venus Express is the first spacecraft in over 25 years since the NASA Pioneer Venus Orbiter dedicated to detailed Venusian atmospheric Studies.

Venus Express is a descendant of the previously successful Mars Express mission launched in 2003. Mars Express did not carry any instrumentation capable of taking magnetic field measurements. When the main bus from Mars Express was adopted for Venus Express this lead to a magnetically unclean spacecraft.

We present an automated method based on modern engineering techniques such as Fuzzy Logic and Pattern Recognition for the removal of spacecraft generated magnetic fields. The resulting data is of comparable quality to that collected by magnetically clean spacecraft. Although the software and models developed are specific to Venus Express, most significantly the concepts and techniques developed, can be used to clean data collected from future magnetically unclean spacecraft.

Analysis of the cleaned data has resulted in the identification of a new type of collisionless shock, where giant vortices on a terminator downstream of the shock enable the loss of heavy ions from the ionosphere.

A5-P11 A New Form of Saturn's Magnetopause using a Dynamic Pressure Balance Model, Based on in-situ, Multi-Instrument Cassini Measurements

S. Kanani (Mullard Space Science Laboratory), C.S. Arridge, G.H. Jones, A.N. Fazakerley, H.J. McAndrews, N.Sergis, S.M.Krimigis, M.K. Dougherty, A.J. Coates, D.T. Young, K.C. Hansen

The shape and location of planetary magnetopauses can be determined by balancing the solar wind dynamic pressure with the magnetic and thermal pressures found inside the magnetopause. Previous studies have found the kronian magnetosphere to be rigid (like that of Earth) and compressible (like that of Jupiter) in terms of its dynamics. In this paper we expand on previous work and present a new model of Saturn's magnetopause. Using a Newtonian form of the pressure balance equation, we estimate the solar wind dynamic pressure at each magnetopause crossing by the Cassini spacecraft. We build upon previous findings by including an improved estimate for the solar wind thermal pressure, and include low energy particle pressures from the Cassini plasma spectrometer (CAPS) and high energy particle pressures from the Cassini magnetospheric imaging instrument (MIMI). Our improved model has a size-pressure dependence described by a power law DP-1/5.0±0.8 . This exponent is consistent with that derived from numerical MHD simulations.

A5-P12 High Azimuthal Wave-Number Pulsations in the Magnetosphere

A. Kavanagh (Lancaster University)

Data from the Advanced Rio-Imaging Experiment in Scandinavia (ARIES) are used to examine electron precipitation structures that exhibit the signature of pulsations with high azimuthal wave-numbers (m). We suggest a mechanism by which low-m cavity waves, stimulated by the solar-wind, resonate with a drifting proton population; these undergo drift-bounce resonance at high-m which in turn modulates the growth of VLF waves. These scatter electrons into the bounce-loss cone causing the observed precipitation signatures.

A5-P13 Substorm-Generated Chorus Waves in Outer Radiation Belt Precipitate >30keV Electrons

M. Lam (British Antarctic Survey), N. P. Meredith, R. B. Horne, S. A. Glauert, J. Green, H.Vickers

Energetic electrons are deposited into the atmosphere from Earth's radiation belts, resulting in the production of odd nitrogen (NOx) and odd hydrogen (HOx). During polar night these species are transported to low altitudes, where they can destroy ozone, affecting the radiation balance of the atmosphere. The percentage variability in the flux of energetic electrons (keV-MeV) trapped in the Earth's radiation belt is many times that of the total solar irradiance. The variability in flux is correlated with, for instance, the solar wind velocity and the phase of the solar cycle. Therefore the loss of these electrons to Earth's atmosphere provides a possibly significant link between solar variability and changes in Earth's climate. To determine the global distribution of the precipitating flux, we have built a statistical model binned in AE, MLT and L shell of >30 keV precipitating electrons from the MEPED instrument onboard the POES low-altitude satellites NOAA-15,16,17 and 18. We show that the precipitating flux increases with geomagnetic activity suggesting that the flux is related to substorm activity and/or enhanced convection. The precipitating fluxes maximise during active conditions where they are primarily seen outside of the plasmapause on the dawnside. The global distribution of the precipitating flux of >30 keV electrons is well-correlated with the global distribution of lower-band chorus waves as observed by the PWE instrument on board the CRRES satellite. In addition, the electron precipitation occurs where the pitch angle diffusion coefficient due to resonant interaction between electrons and whistler-mode chorus waves is high, as calculated using the PADIE code. Our results suggest that lower-band chorus is principally responsible for scattering ~30keV electrons from the Earth's radiation belts into the atmosphere.

A5-P14 The Magnetosphere- Stellar Wind Interaction as a Function of Stellar Age

J.-M. Grießmeier, H. Lammer, M. Khodachenko, A. Stadelmann, U. Motschmann.

Close-in extrasolar planets are exposed to both dense stellar winds and frequent collisions with stellar coronal mass ejections. This is especially im- portant for weakly magnetised planets, for which the atmosphere is not well shielded against the stellar wind and against energetic particles such as galac- tic cosmic rays. Recent studies show that the stellar wind conditions around young stars are very different from those encountered in the present solar sys- tem. In particular, the solar wind velocity and density can be much higher. Such enhanced stellar wind parameters lead to small planetary magnetos- pheres, and thus to reduced magnetospheric shielding. For such planets, we discuss implications of the weak magnetospheric protection for nonthermal atmospheric loss and for the cosmic ray flux to the planetary atmosphere as a function of the host star's age.

A5-P15 The Mass Loss Limit for Close-in Exoplanets: What Can we Learn from Transit Observations?

H. Lammer (Austrian Academy of Sciences, IWF), P. Odert , M. Leitzinger, M. L. Khodachenko, M. Panchenko , Yu. N. Kulikov, T. L. Zhang , H. I. M. Lichtenegger, G. Micela, A. Hanslmeier

We studied the possible thermal and non-thermal atmospheric mass loss of 49 known transiting exoplanets around F, G, K, and M-type stars over evolutionary time scales. For stellar wind induced mass loss studies we estimate the position of the pressure balance boundary between Coronal Mass Ejection (CME) and stellar wind ram pressures and the planetary ionosphere pressure for non- or weakly magnetized gas giants at close orbits. We found that most of the transiting low density gas giants at orbital locations of less than 0.025 AU, like CoRoT-Exo-1 b lost about 5-7\% of their initial mass. All other transiting exoplanets in our sample experience negligible thermal mass loss (less than 2\%) during their life time. We show that the ionospheric pressure can balance the colliding dense stellar wind and average CME plasma flows at distances which are above the visual radius of "Hot Jupiters", resulting in mass losses less than 2\% during evolutionary time scales. However, the ram pressure of fast CMEs cannot be balanced by the ionospheric plasma pressure at orbital distances between 0.02-0.1 AU. Therefore, collisions between hot gas giants and fast CMEs result in large atmospheric mass loss, which may influence the mass evolution of gas giants with masses less than that of Jupiter. Finally we discuss the orbital distance where exosolar gas and ice giants will lose their hydrogen envelopes so that their cores may remain.

A5-P16 Long-Wavelength Study of AD Leonis

M. Leitzinger (University of Graz, Institute of Physics, IGAM), P. Odert, A. Hanslmeier, A.A. Konovalenko, M. Vanko, M.L. Khodachenko, H. Lammer, H.O. Rucker

Coordinated stellar decametric and optical observations have been performed during 11 nights in February 2007. The active M dwarf AD Leonis was monitored for more than 60 hours using digital back-end facilities (DSP, Robin) on World's largest decameter array, the UTR-2 of the Ukrainian Academy of Sciences. Signatures of stellar activity phenomena (type II and type III bursts) which are correlated to CMEs and flares, as known from the sun, are searched for. Ten promising events, are selected , bearing a high resemblance to solar decameter type III bursts, in lifetime and driftrate. Only one night of optical photometry was possible. The lightcurve of this night shows a flare event on AD Leonis starting around 02 00 UT. No corrseponding radio event could be detected. We compiled a number of criteria to discriminate between stellar and artificial or terrestrial/atmospheric emission. Further we compute exciter velocities considering different parameters of M-stars atmospheres.

A5-P17 Locating the Open-Closed Magnetic Field Line Boundary from IMAGE FUV Auroral Images

N. Longden (British Antarctic Survey), Gareth Chisham, Gary Abel, Mervyn Freeman

Latitudinal profiles of auroral intensity derived from far ultraviolet (FUV) imaging can be used to estimate the location of the open-closed magnetic field line boundary (OCB) in the Earth's ionosphere. Estimates of the OCB can be made from properties of the distribution of intensities in the latitudinal profiles. Such profiles can often be described by a Gaussian. However, at times, such as during periods of substorm activity, images of the aurora can indicate a bifurcated oval. The bifurcated oval is more suggestive of a double Gaussian. Estimates of the OCB were made from auroral images recorded by the three FUV cameras onboard the IMAGE satellite during 2001. For each profile, it was determined whether the auroral intensities were better represented by a single or double Gaussian distribution, enabling the OCB to be estimated from a single image during all levels of geomagnetic activity. These OCB estimates provide a time series of the poleward extent of the auroral oval throughout the year at all magnetic local times and opens up possibilities for studying processes at this boundary, such as magnetic reconnection.

A5-P18 Activity of M-type Stars and the Effect on Planets

P. Odert (Institute of Physics, University of Graz), M. Leitzinger, A. Hanslmeier, H. Lammer, M. L. Khodachenko, I. Ribas, M. Vanko, A. A. Konovalenko, H. O. Rucker

During the last years, several planets orbiting M dwarfs have been discovered. It is still debated if these numerous, low-mass stars could possibly host habitable planets. It is well known that many M stars, especially the younger objects, exhibit high levels of activity which could be harmful to the evolution of life. In this context we compiling a catalogue of nearby M stars that could be suitable targets for future habitable planet searches. It will include important stellar properties, including data related to their activity (X-ray, EUV emission etc.). Here we summarize the current status of this work.

A5-P19 On planetary Period Oscillations of Saturn's Auroral Oval and Planetary Magnetic Field.

G. Provan (University of Leicester), S.W.H. Cowley, and J.D. Nichols

Previous analyses of Hubble Space Telescope (HST) images of Saturn's southern auroras obtained during two campaigns, in January 2007 and February 2008, have revealed that the auroral oval oscillates at a period close to the planetary rotation period, with its center describing an elongated ellipse of semi-major axis ~2 deg co-latitude aligned along the pre-noon to pre-midnight direction. Previous analyses of Cassini magnetic field data have established that planetary-period magnetic field oscillations are observed both on closed field lines in the near-equatorial region and on open field lines in the polar regions. In this paper we present a synthesis of previous results, and compare the phases of the auroral oval and the equatorial magnetic field oscillations. We show that the southern oval displacement is directed approximately opposite to the oscillatory equatorial field direction during both HST campaign intervals. We also examine the relation of the southern oval oscillations to the periodic modulations in Saturn kilometric radiation (SKR) power, and show that the oval is displaced sunward at SKR maxima. It is suggested that the oval displacements are related to magnetospheric field line distortions associated with the rotating magnetic field perturbations, though noting that this picture provides no immediate explanation for the significantly elliptical nature of the observed oval motion.

A5-P20 Small-Scale Structures in Flickering Aurora

D. Whiter (University of Southampton), B. S. Lanchester, B. Gustavsson, N. Ivchenko, J. M. Sullivan, H. Dahlgren

An auroral event exhibiting strong flickering patches was observed by the ASK (Auroral Structure and Kinetics) instrument at high temporal (32 fps) and high spatial (0.7 arcmin) resolution. The typical flickering frequencies observed were in the range 6-8 Hz, although flickering patches with both higher and lower frequencies were also identified. Scale sizes for the flickering structures were found to be regularly below 1 km. The flickering structure was correlated with the coincident non-flickering aurora, both temporally and spatially. It was found that there is a strong temporal link, but there is no spatial correlation between the two on the small scales observed here. These results support the theory that flickering structure is caused by interfering dispersive Alfvén waves.

A5-P21 Long Term Trends in the Correlation Length of the Solar Wind

R. Wicks (Imperial College London), T. S. Horbury

We present the results of a long term study of the correlation length, lambda, in the solar wind. Observations from the IMP 8 spacecraft and the OMNI dataset are used to estimate lambda quarterly between 1974 and the present day; this covers the last three solar cycles. There is clear evidence for a solar cycle effect on lambda in the magnetic field magnitude, with solar minimum having a shorter lambda by a factor of 2 than solar maximum. The correlation length of the solar wind speed also varies; with longer lambda seen in 1974 after the most recent weak cycle, and since 2005 in the recent unusual conditions. The components of B and V do not show a strong modulation of lambda with solar cycle and have very similar values for lambda of around 106 km. The lack of variation in lambda for the components of B and V can be explained by the presence of continuous Alfvénic turbulence which is not modulated by the activity of the Sun. The increase in lambda for the solar wind speed at solar minimum and during weak solar cycles is shown to be due to the presence of stronger co-rotating interaction regions. The increase in lambda of magnetic field magnitude at solar maximum is found to be due to increased magnetic field structure caused by increased solar activity. These results are important for the understanding of cosmic ray scattering in the Heliosphere, the turbulent behaviour of the solar wind and the interaction of the solar wind with other space plasmas, such as planetary magnetospheres and the termination shock. They also indicate that the recent unusual solar minimum is not necessarily unusual since solar wind parameters are indicating a return to behaviour previously seen at the end of solar cycle 20.

A5-P22 A study of Solar Wind transients using the STEREO Heliospheric Imagers and comparison to In-Situ measurements from ACE - Initial Results

T. Williams (University of Leicester), S. Milan, J. Davies, A. Rouillard, R.A. Harrison, C. Davies

Images from the Heliospheric Imagers on board the STEREO spacecraft are combined to produce "J-plots" [Davies et al 2009]. Thorough study of these J-plots reveals the path of transient events through the Solar Corona and into the Heliosphere. By tracing the paths it is possible to calculate the speed and direction of travel of the transient events. This then allows the arrival at 1AU to be estimated. Using in-situ measurements of the solar wind at the L1 point from the ACE spacecraft the arrival of transient events can then be examined and compared to the predicted arrival for events within 30° of the Sun-Earth line. The comparison reveals a disparity between the predictions and in-situ measurements, some events seen in the in-situ measurements are not predicted and some predictions are not seen in the in-situ data. Future work aims to investigate the reasons for this disparity.

Monday
4:30pm

A Comparison of 2D PIC Simulations of Collisionless Magnetic Reconnection in Sheared and Unsheared Current Sheets

T. Neukirch (University of St. Andrews), M.G. Harrison, M. Hesse

We will present some results of 2D PIC simulations of magnetic reconnection in sheared and unsheared current sheets. We consider initial states for an anti-parallel configuration and cases with varying magnitudes of constant guide magnetic field and compare these to a simulation starting from a force-free collisionless current sheet. Comparisons of a number of features, especially of the electron pressure tensor, of the reconnection processes in the various cases will be shown.

Monday
4:45pm

Magnetosonic Mach Number Dependence of the Efficiency of Reconnection between the Interplanetary and Terrestrial Magnetic Fields

A. Grocott (University of Leicester), S.W.H. Cowley, S.V. Badman, S.E. Milan, J.D. Nichols, T.K. Yeoman

We present a statistical investigation into the efficiency of reconnection between the interplanetary and terrestrial magnetic fields at the Earth's dayside magnetopause. Specifically, we have investigated the dependencies of the solar wind reconnection electric field and ionospheric transpolar voltage on the solar wind magnetosonic Mach number using 8 years' worth of 2-hour averaged data from the Advanced Composition Explorer (ACE) spacecraft and Super Dual Auroral Radar Network (SuperDARN). The transpolar voltage, which is derived from SuperDARN observations of the ionospheric electric field, provides a direct measure of the magnetic flux throughput of the magnetosphere and hence is a good proxy for the dayside reconnection voltage. Our results confirm that the transpolar voltage exhibits a similar sin^4(theta/2) IMF clock angle dependence to that derived for the solar wind reconnection electric field in previous studies. The results also show that the average voltage decreases with increasing Mach number in a similar way to the solar wind reconnection electric field, confirming that the latter is a valid measure, even at high Mach numbers. Interestingly, the solar wind reconnection electric field decreases more significantly than the transpolar voltage and hence the ratio of the voltage to the electric field actually increases with increasing Mach number. This implies that the reconnection mechanism in fact becomes more efficient at high Mach numbers, or operates over a wider portion of the magnetopause, such that significant magnetospheric circulation can still be driven despite a reduction in the reconnection electric field. Illustrative examples of SuperDARN convection maps from high Mach number, high flow intervals are presented. These results have implications for the solar wind-magnetosphere interaction during fast solar wind streams, as well as at the outer planets where the Mach number is typically much higher than it is at 1 AU.

Monday
5:00pm

Oscillatory Reconnection Driven by Nonlinear Fast Magnetoacoustic Wave Propagation in the Neighbourhood of a 2D Magnetic X-point

J. McLaughlin (University of St Andrews), De Moortel, I., Hood, A. W., Brady, C. S.

This paper reports for the first time an oscillatory reconnection solution naturally resulting from nonlinear fast magnetoacoustic wave propagation. This paper extends the MHD models of Craig & McClymont (1991) and McLaughlin & Hood (2004), and investigates the nature of nonlinear fast magnetoacoustic waves about a 2D magnetic X-point. We solve the compressible and resistive MHD equations using a Lagrangian remap, shock capturing code (Arber et al. 2001) and consider an initial condition in (v x B).z , a natural variable of the system. We observe the formation of both fast and slow oblique magnetic shocks. The nonlinear wave deforms the X-point into a 'cusp-like' point which in turn collapses to a current sheet. The system then evolves through a series of horizontal and vertical current sheets, with associated changes in connectivity, i.e. the system exhibits oscillatory reconnection. Our final state is non-potential (but in force balance) due to asymmetric heating from the shocks. Larger amplitudes in our initial condition correspond to larger values of the final current density left in the system. The inclusion of nonlinear terms introduces several new features to the system that were absent from the linear regime of McLaughlin & Hood (2004).

Monday
5:15pm

Interchange Reconnection Signatures in the Solar Wind Linked to Eruption from an Active Region inside a Coronal Hole - STEREO, ACE and Hinode Data Combined

D. Baker (UCL/MSSL), A. Rouillard, L. van Driel-Gesztelyi and L.K. Harra

Combining STEREO, ACE and Hinode has provided a unique opportunity to follow two eruptions, on the 17th and 18th October 2007, originating from the same on-disk source region into the heliosphere. With Hinode and STEREO data we were able to identify emergence times and types of structures seen in the in-situ data five days later. On the 21st, we see high plasma beta structures with sharp changes in magnetic field lines polarity from toward to away in ACE data which are not accompanied by clear changes in the pitch angles of suprathermal electrons from 180 to 0 degrees: these observations suggest the passage in-situ of refolded magnetic field lines. This is followed on the 22nd by a magnetic structure with a closed topology as evidenced by strong counter-streaming heat fluxes observed by in-situ instruments. The magnetic field configuration of the mature active region (AR) located inside an equatorial coronal hole (CH) has important implications for the different signatures of the two eruptions. We interpret the passage in-situ of refolded magnetic field lines to be a signature of interchange reconnection between closed loops of the AR and open field lines of the CH. Reconnected field lines appear to conserve some of the curvature of their newly reconnected shape. The field line alignment on the eastern side of the AR where its positive polarity is oppositely aligned to the CH's negative open field was driven to interchange reconnection by the eruption that occurred to the north-east of the AR on the 17th. The magnetic structure with closed topology can be attributed to a CME eruption on the 18th, which took place on the western side of the AR, where field line alignment was not favorable for interchange reconnection.

Monday
5:30pm

Effect of Non-Uniform Resistivity on Forced Magnetic Reconnection

M. Gordovskyy (University of Manchester), P.K. Browning and G.E. Vekstein

Observations show that high energy electrons and ions play a key role in energy transfer in solar flares. It has been widely proposed that the primary acceleration mechanism for these particles is the super-Dreicer electric field in the current sheet (CS). Therefore, a consistent model of particle acceleration in CS has to be based on a realistic configuration of magnetic and electric fields.

We investigate the evolution of a CS in a 2.5D model using the Lagrangian Remap MHD code (Arber et al. 2003). In this model, initially stable force-free magnetic configurations are perturbed by plasma flow through one of the boundaries that eventually leads to reconnection and magnetic energy release. We discuss the effect of non-uniform resistivity and the amplitude of the boundary perturbation on evolution of CS and magnetic energy release. The results of the numerical simulations are compared with the linear theory of forced reconnection (Hahm & Kurlsrud 1985; Vekstein & Jain 1998).

Further, the magnetic and electric fields obtained from the MHD simulations are used for calculation of electron and ion trajectories in CS.

Monday
5:45pm

The Nature of Separator Reconnection

A. Haynes (University of St Andrews), Clare E. Parnell (1), Klaus Galsgaard (2)
((1) University of St Andrews, (2) Niels Bohr Institute)

One of the key locations for three-dimensional magnetic reconnection are magnetic separators (also known as X-lines). Magnetic separators are special fieldlines that lie on the intersection of two separatrix surfaces and, hence, bound four magnetic flux domains. Using separators found in a magnetic flyby experiment (Galsgaard et al., 2000; Haynes et al., 2007), we are able to determine the following key features of separator reconnection. (i) Separator reconnection occurs along the length of the separator, not at the null points at its ends. (ii) It is non-uniform along the separator, with peaks at multiple locations. (iii) It can occur where the field perpendicular to the separator is either X-type or O-type. Contrary to popular belief, the magnetic field perpendicular to a separator is not necessarily X-type (saddle point), but may also be O-type (spiral, elliptic). Indeed, the perpendicular magnetic field is highly likely to vary in nature as you look along the separator. (iv) Finally, we find that counter rotating flows are important for driving separator reconnection, confirming Hornig and Priest's (2003) hypothesis that counter-rotating flows are a key component of 3D reconnection.

Wednesday
11:00am

When Did Solar Cycle 23 Go Wrong?

K. Strong (NASA GSFC / SP Systems), Julia Saba (Lockheed Martin Advanced Technology Center)

We use over 400 Kitt Peak synoptic maps of the unsigned solar magnetic flux to contrast and compare the magnetic evolution of the last 3 solar cycles. We find that flux levels and the spatial distribution of the strong field (>50G) during Cycle 23 are similar to the previous 2 cycles in the northern hemisphere. However, the southern hemisphere of the Sun has behaved anomalously during Cycle 23. Could we have predicted this? If so, how long ago would this change in the magnetic evolution in the South have become evident? The behavior of the strong-field flux poses several challenges for dynamo and flux transport models by imposing faster timescales and asymmetries that are currently not included in the simulations.

Wednesday
11:20am

Stark Differences between Solar Activity Data and Oscillation Frequencies Observed in BiSON Data

A. Broomhall (University of Birmingham), W.J. Chaplin, Y. Elsworth, S.T. Fletcher, R. New

It is well known that seismic frequencies obtained from Sun-as-a-Star Doppler velocity observations, such as those made by the Birmingham Solar Oscillations Network (BiSON), respond to changes in the surface activity associated with the solar cycle. The solar cycle shifts associated with p-mode frequencies are usually well correlated to activity proxies such as the 10.7cm radio flux. BiSON is in a unique position as it has now been collecting data for over 30yrs and so is able to compare observed frequencies with activity data for more than 2 complete solar cycles.

We find unusually large differences between the p-mode frequencies observed in BiSON data and the levels of activity indicated by different proxies during the declining phase of cycle 23 and the current solar minimum. Furthermore, we find that the cycle minimum indicated by the helioseismic data is significantly deeper than the minima observed by the activity proxies. We also observe a quasi-biennial signal in the p-mode frequencies.

Wednesday
11:35am

Observational Periodicities of Sunspot and Background Magnetic Fields in the solar cycle and their Role in the Future Prediction

S.Zharkov (University of Sheffield, University of Bradford) and
Zharkova V.V. (University of Bradford)

We will present comparative statistical analysis of latitudinal variations of the sunspot and background magnetic fields (BMF) in a few past solar cycles and deduce some additional periodicities fluctuating in time and latitudes. The deduced periods will be tested with Principle Component Analysis methodology and the principle eigenvalues are to be reported. The role of principal dynamo waves in the solar activity and their implications on sunspot numbers in the current cycle will be discussed.

Wednesday
11:50am

Open Solar Flux and Irradiance during the Current Exceptional Solar Minimum: Implications for Reconstruction of Past Solar Variability

M. Lockwood (Southampton University and RAL), Alexis Rouillard and Matt Owens

The current solar minimum has revealed record low values of both the open solar flux and the solar irradiance since space measurements began. The implications for reconstructions of the variations of both prior to the space age are discussed.

Wednesday
12:10pm

Heliospheric Observations of a Deep Solar Minimum

M. Owens (Imperial College London)

The deep solar minimum seen in remote observations of anomalously-low sunspot number and weak photospheric magnetic fields, is also present in heliospheric measurements made in situ. The solar wind dynamic pressure has dropped approximately 20 % from previous solar cycles and the near-Earth heliospheric field strength is at its weakest since observations began ~45-years ago. We interpret single point heliospheric observations in terms of the global heliosphere and show the total magnetic flux content of the heliosphere has been falling over the last three solar minima. The solar minimum-to-maximum cycle variation in flux can be attributed, to some degree, to closed magnetic flux added by coronal mass ejections (CMEs). There is some observational evidence that the CME rate is also slightly reduced this minimum compared to the previous, though not sufficiently to completely explain the weakening of the heliospheric magnetic field.

Wednesday
2:00pm

The 3D Heliosphere at the Minimum of Solar Cycle 23

R. Forsyth (Imperial College London), T S Horbury, A Balogh

The Ulysses spacecraft made its third set of polar passes through the heliosphere during the minimum of solar cycle 23 providing a 3D perspective on what has proved to be a dramatically different minimum from any other during the space age. Specifically the Ulysses observations also permit a direct comparison with the equivalent set of solar minimum passes 12 years previously during the late declining phase of solar cycle 22. Among the differences observed are a 22 % reduction in solar wind dynamic pressure, a 34 % reduction in the flux of the heliospheric magnetic field, and an approximately 40 % reduction in the amplitude of waves and turbulence in the high speed solar wind. A further emerging feature is evidence of a north-south asymmetry in the heliosphere, manifested for example in the structure of the heliospheric current sheet, the temperature of the high speed solar wind and the strength of magnetic field fluctuations. The sense of this asymmetry does not change through the solar cycle polarity reversal of the heliospheric magnetic field.

Wednesday
2:15pm

Monitoring and First-Light Spectra from SphinX on Koronas-Photon during the Present Solar Minimum

K. Phillips (UCL-Mullard Space Science Laboratory), B. Sylwester, J. Sylwester, and the SphinX Team

The levels of solar X-ray emission during the present minimum have dropped so low that one of the chief traditional means of defining the emission, viz. the 1-8 Angstrom channel of GOES, is below A1, the lowest level that can be reached by the ion chambers on board GOES. The SphinX instrument, part of the TESIS instrument package on KORONAS-PHOTON and built and operated by the Space Research Centre in Wroclaw, Poland (PI Prof. J. Sylwester), has been recording the emission in the 1.5-15 keV (0.8-8 A) band since shortly after spacecraft launch on 2009 February 20. SphinX is a spectrophotometer with four channels (D1-D4) able to record the solar spectrum with spectral resolution of between 320 eV (D2-D4) and 460 eV (D1) using PIN detectors, so enabling the main features of the solar spectrum to be identified and used for temperature determination. Pre-launch calibration procedures (at BESSY and Palermo) should enable a high intensity calibration accuracy. In this presentation, initial results including estimates of the solar soft X-ray flux and luminosity will be given and compared with those made during previous solar minima.

Wednesday
2:30pm

The Solar Cycle, the Mean Global Temperature and Solar Irradiance

A. Wolfendale (Durham), A.D.Erlykin and T Sloan.

The correlation of low cloud cover and mean temperature with cosmic ray flux and solar irradiance is examined. We find no genuine signal for the former but a small one for solar irradiance. However, even here there are problems.

Wednesday
2:45pm

Simultaneous Interplanetary Scintillation and STEREO Heliospheric Imager Observations of Coronal Mass Ejections and Stream Interaction Regions

Gareth Dorrian, Andy Breen, Richard Fallows (Aberystwyth University),
Alexis Roulliard (Southampton University),
Jackie Davies (STFC Rutherford-Appleton Laboratory)

We present results from simultaneous Interplanetary Scintillation (IPS) and STEREO Heliospheric Imager (HI) observations of coronal mass ejections (CMEs) and stream interaction regions (SIRs) in the inner heliosphere. The combination of IPS and HI is an extremely powerful one, with HI providing the global context for interpreting the high-resolution observations from IPS. This makes it possible - for the first time - to relate the small-scale structures revealed by IPS with the larger-scale structure seen by HI.

We discuss the methodology of combining IPS and HI measurements and go on to present results from two co-ordinated studies carried out in the spring of 2007, the first of which examines the interaction between two CME fronts, while the second considers a medium-scale solar wind transient captured by the compression region at the leading edge of a SIR.

Wednesday
3:00pm

Flux Rope Eruption From the Sun to the Earth: What do Reversals in the Azimuthal Magnetic Field Gradient Tell us About the Evolution of the Magnetic Structure

K. Steed (UCL-MSSL), C. J. Owen, L. K. Harra, L. M. Green, S. Dasso, A. P. Walsh, P. Demoulin, L. van Driel-Gezstelyi

Using ACE in situ data we identify and describe an interplanetary magnetic cloud (MC) observed near Earth on 13 April 2006. We use multi-instrument and multi-wavelength observations from SOHO and TRACE and ground-based observatories to determine the solar source of this MC. Here we present the evidence that supports the link between an eruption in a small, spotless, northern hemisphere active region and this magnetic cloud, despite the presence of a number of larger active regions on the Sun which initially appeared to be more probable source regions of the MC. This event highlights the complexities associated with locating the solar source of an ICME observed near Earth, and serves to emphasise that it is the combination of a number of physical characteristics and signatures that is important for successfully tying together the Earth-end and the Sun-end of an event.

Further investigation of this MC has revealed some sub-structure towards its centre, observed in the azimuthal magnetic field component of the MC. We explore several possible explanations for this signature, including multiple flux ropes and warping of the magnetic cloud. We also consider whether magnetic reconnection plays a role in creating the geometry which would explain these observations.

Wednesday
3:15pm

The Apparent Layered Structure of the Heliospheric Current Sheet: Multi-Spacecraft Observations

C. Foullon (University of Warwick), B. Lavraud, N.C. Wardle, C.J. Owen, H. Kucharek, A.N. Fazakerley, D.E. Larson, E. Lucek, J.G. Luhmann, A. Opitz, J.-A. Sauvaud, R.M. Skoug

Multiple current sheet crossings are ubiquitous features of the solar wind associated with high-beta plasma sheets, notably during the passage of the heliospheric current sheet (HCS). As the HCS is being convected past near Earth, we attempt to resolve spatial scales and temporal variations of the apparent layered structure of the HCS, including adjacent large scale field reversals. We use several spacecraft for good spatial and cross-scale coverage, spanning 550 RE across and 900 RE along the Sun-Earth line: STEREO, ACE and Cluster. The multi-spacecraft magnetic and plasma observations within the leading edge of the sector boundary are consistent with (i) a broad multi-layered structure; (ii) occasional non-planar structures and Alfv´enic fluctuations; (iii) various stages of transient outflowing loops formed by interchange reconnection. By comparison of the observations at each spacecraft, we obtain a synthesis of the evolution between the patterns of loops, and hence of the transient outflow evolution along the sector boundary. In particular, we present circumstantial evidence that a heat flux dropout, traditionally signalling disconnection, can arise from interchange reconnection and scattering. Moreover, the inter-spacecraft comparison eliminates ambiguities between interpretations of electron counterstreaming. Overall, the sector boundary layer remains, locally, a steady structure as it is convected in the solar wind across a radial heliospheric distance of 560-580 RE . However, non-planar structures on the Cluster spatial scale indicate that on the broader scale we are not following the evolution of single loops but more likely a bunch of loops with variable properties.

Monday
11:00am

The Role of Magnetic Fields in the Scattering of p-modes

A. Gascoyne (University of Sheffield), Rekha Jain

We investigate the direct (magnetic) and indirect (thermal) effects of magnetic field on p-mode scattering. We find that for vertical fields, the phase shifts are predominantly due to thermal effects, whereas in the case of flaring fields such as penumbral fields, there is significant contribution from the magnetic tension terms. The combined effects cannot always be well estimated by the sum of the thermal and magnetic effects seen separately because of the wave transmission, reflection and conversion. The findings have important consequences for Helioseismic inversions which are easily interpreted as thermal anomalies.

Monday
11:15am

Probing the 3D Structure of the F-Corona with the STEREO Heliospheric Imagers

D. Brown (Aberystwyth University)

The Fraunhofer corona is produce from solar light scattered by dust particles in the extended solar corona. At the distances covered by STEREO/HI instruments, the F-corona dominates the coronal emission, and is usually removed for the study of CMEs.

This paper will investigate the three-dimensional structure of the F-corona using HI-1A data. Each HI image is transformed into the Heliosphere and the three-dimensional profile is built up using data taken over the course of one orbit of the spacecraft. Once this profile is created, the axis-symmetric mathematical form of the F-corona intensity profile is deduced.

Monday
11:30am

Nanoflare Heating of the Solar Corona

A. Hood (St Andrews University), Philippa Browning, Ronald van der Linden

Nanoflares have been suggested as a possible mechanism for heating the solar corona. It is proposed that an individual nanoflare is triggered by an ideal MHD instability. MHD simulations follow the subsequent evolution and results are compared with the predictions of relaxation theory.

Monday
11:45am

Demystifying Active Region Outflows Detected by Hinode's EIS using Numerical Simulations

M. Murray (University College London/MSSL), D. Baker, L. van Driel-Gesztelyi & J. Sun

One of the major discoveries of the Hinode satellite is the universal occurrence of plasma outflows at the edges of active regions surrounded by quiet Sun. Here we present the very first observations from Hinode's Extreme Ultraviolet Imaging Spectrometer (EIS) of outflows at the edges of a mature active region that has developed in a coronal hole and find the plasma outflows have the same properties as those of active regions surrounded by quiet Sun.

Determining how the outflows are generated is exceedingly important since they have the potential to be a source of the slow solar wind. Using numerical simulations, we have investigated the origin of the outflows for the case of an active region in a coronal hole. In the simulations, active region expansion produces outflows in the immediately neighbouring coronal hole field, which have properties consistent with the observed plasma outflows detected by EIS. It is an established fact that active regions continually expand over their lifetimes and, in light of the simulation results, we believe active region expansion can accurately account for the plasma outflows observed at the edges of the mature active region in the coronal hole.

Furthermore, although not simulated, we believe that active region expansion is also a viable mechanism for generating outflows at the periphery of active regions surrounded by quiet Sun and, therefore, can account for the universal occurrence of outflows at the edges of active regions.

Monday
12:00pm

X-Ray Emission from an Erupting Filament Observed by RHESSI and TRACE

N. Labrosse (University of Glasgow), E.P. Kontar (Dept of Physics and Astronomy, University of Glasgow), S. Krucker (University of California, Berkeley)

We present RHESSI and TRACE observations of a failed eruption of a filament on 27 May 2002. This event has been described by Ji et al (2003) and Alexander et al (2006). Alexander et al (2006) interpreted the presence of a coronal hard X-ray source under the apex of the filament as evidence for ongoing magnetic reconnection in a current sheet. Using RHESSI imaging spectroscopy, here we discuss an alternative interpretation, whereby energetic electrons coming from the reconnection region travel along the magnetic field lines and emit bremsstrahlung X-ray radiation as they are slowed down in the dense and initially cold filament material.

Monday
12:15pm

Hinode EIS Observations of a Limb Active Region

B. O'Dwyer (University of Cambridge), G. Del Zanna, H. E. Mason, A. Sterling, D. Tripathi, P. Young

We have carried out a study of a limb active region using observations from the Extreme-ultraviolet Imaging Spectrometer (EIS) on board Hinode. The electron density and temperature distributions of the coronal emission have been determined using emission line intensity ratios. The highest electron density and temperature values are found to be located in the core of the active region. The variation of line intensity as a function of height was investigated for a sample of emission lines formed over the temperature range log T = 5.4 - 6.6. Differential emission measure (DEM) analysis and the emission measure (EM) loci technique were used to examine the thermal structure of the emitting plasma as a function of distance from the limb.

Tuesday
2:00pm

Large- and Small-Scale Turbulent Dynamo Action

D. Hughes (University of Leeds)

One of the greatest challenges in astrophysical dynamo theory is to explain the generation, by bodies such as the Sun, of large-scale magnetic fields - i.e. magnetic fields with a significant component on scales large compared to that of the fluid velocity. I shall discuss some of the problems in this area and when one might expect to observe small- or large-scale dynamos. These will be discussed with reference to the problem of dynamos driven by turbulent convection.

Tuesday
2:30pm

Probability Distribution Function of Self-Organised Shear Flows

E. Kim (University of Sheffield), H. Liu, J. Anderson

Understanding multi-scale interactions is an outstanding problem in astrophysical plasmas. Despite complex nonlinear dynamics, coherent structures such as shear flows often form from small-scale turbulence, which then feed back on small-scales. A remarkable consequence of this mutual interaction is self-organization, which provides a powerful paradigm for understanding complexity in many systems (e.g. population, forest fires, reaction-diffusion). In particular, self-organization has emerged as one of the key physical processes governing transport and mixing in plasmas, with a growing body of observational evidences. A non-perturbative statistical theory [probability distribution functions (PDFs)] is absolutely necessary for a proper modelling of self-organisation due to inherent intermittency, instead of traditional mean-field theory based on Gaussian distribution.

Here we present a novel statistical theory of self-organised shear flows, modeled by a nonlinear diffusion equation driven by a stochastic forcing. A non-perturbative method based on a coherent structure is utilized for the prediction of the PDFs, showing strong intermittency with exponential tails. We confirm these results by numerical simulations. The predicted power spectra are also in a good agreement with simulation results. Our results reveal a significant probability of supercritical states due to stochastic perturbation, which could have crucial implications, in particular in stellar rotational evolution (momentum transport). To elucidate a crucial role of relative time scales of relaxation and disturbance in PDFs, we present numerical simulation results obtained in a threshold model where the diffusion is given by discontinuous values.

Our results highlight the importance of the statistical description of gradients, rather than their average value as has conventionally been done. We discuss some of the important implications of these results for the dynamics of shear flows in solar plasmas, which is vital not only in momentum transport, but also in transporting chemical species.

Tuesday
2:45pm

Noise Reduction to Reveal Low Frequency p-modes

G. Davies (BiSON)

The solar interior provides a unique physical laboratory. With the tool of helioseismology we may infer conditions in the solar interior from observed frequencies of resonant modes. The internal structure and dynamics are now well known for r > 0.3R_(sol). Determining the structure and dynamics of the deep solar interior requires improvements in the helioseismic data portfolio. Of particular interest are low-frequency p-mode and g-mode oscillations. G-modes provide greater depth of penetration and the long lifetime of low-frequency p-mode oscillations produces narrow spectral features. Unambiguous detection of both types of oscillation, with the expected high accuracy, will provide greater constraints on the current solar model. Here we discuss some approaches to reducing the noise at frequencies around 1mHz of interest for low frequency p-modes.

Tuesday
3:00pm

Hydrodynamic Instabilities in the Solar Tachocline

F. Rashid (University of Leeds)

We consider the stability of simple hydrodynamic models of the solar tachocline. This study addresses only the non-magnetic instabilities. In our model there is a strong radial shear, which because of the rotation is coupled to a latitudinal temperature gradient. We also assume there is a strong stable stratification, appropriate for the slow tachocline. These instabilities are calculated by finding the eigenvalues and eigenfunctions using a matrix-based collocation method. We also find analytic expressions for the key instabilities in the relevant asymptotic limits of strong stable stratification and small Prandtl number. We find two distinct types of instability, axisymmetric modes of the Goldreich-Schubert type, and three-dimensional Eady-type modes. Both types of mode are affected by thermal diffusion. We find that the axisymmetric modes considered by Knobloch & Spruit (1982, A&A, 113, 261) are likely to dominate in the slow tachocline. The non-axisymmetric baroclinic instability of Eady-type may be important in the layers closer to the base of the convection zone.

Tuesday
3:15pm

The Influence of Spatial Correlations on Mean Induction and Diffusion

A. Courvoisier (University of Leeds), D.W. Hughes, S.M. Tobias

Understanding the turbulent transport of magnetic fields is essential to the description of stellar dynamos. Here we investigate how spatial correlations in a velocity field influence the mean magnetic induction (the alpha-effect) and the mean scalar diffusivity. To this purpose, we determine these quantities for two families of motions in which the degree of spatial coherence can be systematically varied. We show that the mean induction is substantially reduced in less spatially correlated flows whereas the mean diffusivity is not significantly altered.

Tuesday
4:00pm

Comparison of the Soft X-ray Emission from Capella and the Quiet Sun

K. Phillips (UCL-Mullard Space Science Laboratory), J. Sylwester, M. Kowalinski, B. Sylwester, and the SphinX Team

Much of the Sun's soft X-ray emission during the present solar minimum is in the form of numerous bright points and a faint corona that is visible off-limb with images made by the Hinode X-ray telescope (XRT), TRACE, SOHO, and TESIS on Koronas-Photon. The Koronas-Photon SphinX spectrophotometer is obtaining spectra in the 1.5-15 keV range with spectral resolution of between 319 eV and 465 eV. Initial results using the main spectral line features that are apparent enable temperatures and emission measures to be roughly estimated by comparison with CHIANTI simulated spectra. In this presentation, these values are compared with those for the giant G star binary system Capella that has been observed with Chandra. The Chandra observations indicate a coronal temperature of ~7MK and an emission measure that, combined with a density estimate of 10^10 cm^-3 from O VII line ratios, points to an emitting volume that is tiny compared with the dimensions of the two stars making up the Capella system. The lack of rotational modulation suggests that the coronae of Capella take a form not unlike the Sun's corona at the present time, with many very small emitting regions scattered rather uniformly over the surfaces of the two stars.

Tuesday
4:10pm

The EUV Spectral Irradiance of the Sun from 1997 to Date

G. Del Zanna (University of Cambridge), V. Andretta

Measurements of the EUV spectral irradiance (the Sun as a star in EUV) from 1997 to date are presented. They were obtained from full-Sun radiance measurements from the SOHO Coronal Diagnostic Spectrometer and a radiometric calibration of the instrument. The contribution of the various regions of the Sun to the total EUV irradiance and their dramatic changes in between the last two solar minima are discussed. The measurements are compared to the TIMED/SEE irradiances which have been available since 2002. Finally, we briefly discuss how changes in various activity indices compare with the EUV spectral variability, and the limitations of spectral modelling.

Tuesday
4:20pm

Non-Equilibrium Effects Observed in Soft X-Ray Spectra during Stellar Flares

U. Mitra-Kraev (University of Cambridge - DAMTP)

To interpret conditions in solar and stellar atmospheres, the coronal plasma is usually assumed to be in a state of collisional ionization equilibrium. However, it is not clear whether this assumption still holds during flares. Recent Chandra observations of the soft X-ray spectrum of stellar flares reveal that certain line ratios of the flaring spectrum are incompatible with a coronal plasma in thermal equilibrium. If this is indeed true for stellar flares, it is likely that the same would apply to solar flares, and our description of solar and stellar flares in general would have to incorporate non-ionization equilibrium effects.

Tuesday
4:30pm

Collisionless Phase Mixing as Solar Flare Electron Acceleration Mechanism -- a Parametric Study

D. Tsiklauri (IMR, University of Salford), T. Haruki

Previous studies of phase mixing of ion cyclotron (IC), Alfvénic, waves in the collisionless regime have established the generation of parallel electric field and hence acceleration of electrons in the regions of transverse density inhomogeneity. However, outstanding issues were left open. Here we use the 2.5 D, relativistic, fully electromagnetic particle-in-cell code and an analytic magnetohydrodynamic (MHD) formulation, to establish the following points: (i) Using the generalized Ohm's law we find that the parallel electric field is supported mostly by the electron pressure tensor, with a smaller contribution from the electron inertia term. (ii) The generated parallel electric field and the fraction of accelerated electrons are independent of the IC wave frequency remaining at a level of six orders of magnitude larger than the Dreicer value and approximately 20 %, respectively. The generated parallel electric field and the fraction of accelerated electrons increase with the increase of IC wave amplitude. The generated parallel electric field seems to be independent of plasma beta, while the fraction of accelerated electrons strongly increases with the decrease of plasma beta (for plasma beta of 0.0001 the fraction of accelerated electrons can be as large as 47 %). (iii) In the collisionless regime IC wave dissipation length (that is defined as the distance over which the wave damps) variation with the driving frequency shows a deviation from the analytical MHD result, which we attribute to a possible frequency dependence of the effective resistivity. (iv) Effective anomalous resistivity, inferred from our numerical simulations, is at least four orders of magnitude larger than the classical Spitzer value. Reference: D. Tsiklauri and T. Haruki, Phys. Plasmas 15, 112902 (2008); DOI:10.1063/1.3023157

Tuesday
4:45pm

Hard X-ray Emission from a Flare-Related Jet

H. Bain (University of Glasgow), Lyndsay Fletcher

Solar X-ray jets were first observed by Yohkoh (Shibata 1992, Strong 1992). During these events, collimated flows of plasma are accelerated in the corona. Previous observations have detected jet-related electrons directly in space as well as via radio signatures (type III bursts). However the major diagnostic of fast electrons is bremsstrahlung X-ray emission, but until now we have never seen any evidence of hard X-ray emission directly from the jet in the corona. This could be because it is rare to find a coronal jet dense enough to provide a bremsstrahlung target for the electrons, or hot enough to generate high energy thermal emission. We report what we believe to be the first observation of hard X-ray emission formed in a coronal jet. The event occurred on the 22nd of August 2002 and its evolution was observed by a number of instruments. In particular we study the pre-impulsive and impulsive phase of the flare using data from RHESSI, TRACE and the Nobeyama Radioheliograph. During this period RHESSI observed significant hard X-ray emission to energies as high as 50 keV in the jet. RHESSI spectroscopy suggests a temperature of the order ~20 MK for the jet material. Radio observations from the Nobeyama Radioheliograph show a positive spectral index for the ejected material, which may be explained by optically-thick gyrosynchrotron emission from non-thermal electrons in the jet.

Tuesday
5:00pm

Precipitation of Impulsive and Stationary Injected Beams in Converging Magnetic Loops

T. Siversky (University of Bradford), Valentina Zharkova

Precipitation of a fast electron beam with power-law energy spectrum in the solar atmosphere is studied by numerical solving of the time-dependent Fokker-Planck equation for impulsive and stationary injections. The influence of a converging magnetic field in comparison with collisional and Ohmic losses is studied. Three models of the converging magnetic field are considered: exponential, parabolic and exponential-constant. The exponential and parabolic magnetic field profiles are shown to affect only high energy electrons (>100 keV). The exponential-constant model, where the magnetic field exponentially increases with depth in the corona and becomes constant in the chromosphere, is found to be most effective for the whole spectrum of precipitated electrons. A comparison of stationary versus short impulsive injection allows to investigate further the dynamics of electron beams in time and depth.

Tuesday
5:15pm

Electron Beam-Driven Langmuir Wave Interactions in the Inhomogeneous Flaring Solar Corona

I. Hannah (University of Glasgow), Kontar E.P.

From hard X-ray observations of solar flares with the Reuven Ramaty High-Energy Solar Spectroscopic Imager (RHESSI) we are able to infer the characteristics of flare electron distributions. Examples are: the imaging spectroscopy shows a flatter X-ray spectrum at the footpoints compared to coronal sources inconsistent with current transport models; in microflares the transition between thermal and non-thermal emission does not support the low energy cutoff scenario; electron spectra of some solar events have very hard spectrum (flat) below the break energy. To investigate these observations we simulate the progression of an electron distribution from a coronal acceleration site to the chromosphere. The reaction of the inhomogeneous background plasma is handled in the form of electron beam-driven Langmuir wave turbulence. We investigate the effects of this inhomogeneous background and the wave-particle interactions on the flare electron spectrum.

Thursday
11:00am

State of the Art Dynamo Simulations Incorporating Helioseismology and Surface Magnetic Data

P. Martens (Harvard-Smithsonian Center for Astrophysics), Dibyendu Nandy, Andres Munoz, Leon Golub, Ed Deluca, Antonia Savcheva

In the last two decades the field of helioseismology has revolutionized our understanding of the internal velocity field of the Sun. In particular, the internal differential rotation of the Sun is now fairly well constrained by helioseismic observations almost throughout the solar convection zone, and information has been obtained about the depth-dependence of the meridional circulation in the near-surface layers of the Sun. However, the velocity inputs typically used in solar dynamo models continue to be an analytic fit to the observed differential rotation profile and a theoretically constructed meridional circulation profile that is made to match the flow speed only at the solar surface.

We have developed a new state-of-the-art kinematic dynamo code that has capabilities not previously achieved in other codes. We use this code for simulations using driven directly by helioseismic measurements for the differential rotation and profiles for the internal meridional circulation matching the helioseismically inferred near-surface depth-dependence. I will show how the results from these dynamo simulations differ from those that are driven by purely analytic fits to the velocity field. A salient result is that the latitudinal shear in the rotation in the bulk of the solar convection zone plays a more important role than either the tachocline or surface radial shear in the induction of the toroidal field.

Observations of surface magnetism near the poles during the current solar minimum have demonstrated a field that is both much more organized than previously assumed, and much smaller in magnitude than in previous solar minima. I will show how these data will be incorporated in our simulations using similar methods as those for the helioseismic data. We expect to present some preliminary simulation results that incorporate these new constraints.

Thursday
11:30am

Anatomy of a Solar Flare - Corona to the Photosphere and Beneath?

S. Matthews (MSSL-UCL), L.A. Bone, S. Zharkov, V.V. Zharkova

Some of the more challenging observations to explain in the context of existing flare models are those related to the lower atmosphere and below the surface. Such observations, including changes in photospheric magnetic field and seismic emission, indicate poorly understood connections between energy release in the corona and impacts at and below the surface. Using data from Hinode, TRACE, RHESSI and GONG we study the changes in the photosphere, including in the magnetic field, during an X-class flare and the associated changes in morphology of the sunspot and dynamics of the overlying corona to gain an insight into these connections.

Thursday
11:45am

The Role of Nanoflares in Coronal Heating

M. Bareford (University of Manchester), Philippa Browning, Ronald Van der Linden

It is thought likely that vast numbers of nanoflares occurring in the solar atmosphere are responsible for the corona having a temperature of millions of degrees. We propose a model of a nanoflare precursor, a coronal loop that flares (i.e., releases energy) when it becomes unstable to an ideal MHD kink mode. A feature of the model is that it predicts heating events with a range of sizes, depending on where the stability threshold for linear kink modes is encountered. Dissipation of the loop's magnetic energy begins during the nonlinear stage of the instability, which develops as a consequence of current sheet reconnection. The loop is represented as a straight line-tied cylinder. The twisting induced by random photospheric motions are captured by two parameters, representing the ratio of current density to field strength for specific regions of the loop. Onset of instability can thus be mapped as a closed boundary in the 2 dimensional parameter space. After flaring, the loop evolves to the state of lowest energy where the ratio of current to field is constant and helicity is conserved in accordance with Relaxation Theory. The model is applied such that the loop undergoes repeated episodes of instability followed by relaxation: hence, an energy distribution of the nanoflares originating from the loop is collated. This result is the first stage in determining if our model predicts that there are sufficient numbers of nanoflares to heat the corona. We also present the calculated relaxation states and energy releases for all stability threshold points. In addition, we show substantial variation in the radial magnetic twist profiles for the loop states along the linear stability threshold. It appears that instability cannot easily be predicted by any simple twist-derived property reaching a critical value.

Thursday
12:00pm

Modelling the Global Solar Corona: The Origin of the Hemispheric Pattern of Solar Filaments

D. Mackay (University of St Andrews), Yeates, A.R and van Ballegooijen, A.A.

In this presentation a new global non-linear force-free field model for the solar corona will be presented. The model considers the coupled evolution of photospheric and coronal fields over long periods of time. Through this evolution the build-up of magnetic helicity and shear within the solar corona can be followed on a global scale as a result of flux emergence and surface motions. The basic components of the model will first be presented, following this it is applied to consider the origin of the hemispheric pattern of filaments. It will be shown that the new model can successfully predict the correct magnetic field direction in over 96 % of prominences tested over a 6 month period.

Thursday
12:15pm

CME Initiation by Magnetic Flux Emergence

Zuccarello F.P., Soenen A., Poedts S., Zuccarello F., Jacobs C. and van der Holst B.

We study the initiation and early evolution of coronal mass ejections (CMEs) in the framework of numerical ideal magnetohydrodynamics (MHD). The magnetic field of the active region possesses a topology in order for the "breakout" model to work. An initial multi-flux system in steady equilibrium containing a pre-eruptive region consisting of three arcades with alternating flux polarity is kept in place by the magnetic tension of the overlying closed magnetic field of the helmet streamer. Both footpoint shearing and magnetic flux emergence are used as a triggering mechanism in this model. We compare the topological and dynamical evolution of the two triggering mechanisms and find that the overall evolution of the systems are similar. The boundary conditions cause the central arcade to expand and lead to the eventual ejection of the top of the helmet streamer.

B6-P01 Solar Network Contrast: Simulations and Observations

N. Afram (Imperial College London), Y.C. Unruh, S.K. Solanki, M. Schuessler

In this work we present a comparison of solar intensity contrast observerd with Hinode/SOT with that obtained from simulations. The direct measurement of the solar network contrast is, even for space instruments, affected by scattered light, instrument defocus and limited to a few wavelengths. Therefore, we calculated emergent intensities from 3-D simulations of solar magneto-convection to determine the impact of small-scale magnetic element configurations covering the surface area on solar secular variablility. Among the large number of time scales, on which the solar spectral irradiance varies, this long-term variablility, which is least well understood, is important to determine the impact on Earth's climate.

B6-P02 X-Ray Bright Points on the Solar Corona

C. Alexander (UCLAN), Giulio Del Zanna, Barbara Bromage

X-Ray Bright Points are small 'point-like' features observed at all latitudes on the Solar Corona. They ar associated with areas of opposite magnetic polarity on the potosphere with two thirds of bright points thought to be caused by cancelling magnetic features, and the other third by emerging magnetic flux. This study involves using data from the Hinode satellite to observe three examples of different XBPs- one above a cancelling magnetic feature, one above an area of emerging flux and one in a coronal hole. By using simultaneous studies form all thress of Hinode's instruments (Solar Optical Telescope, X-Ray Telescope and EUV Imaging Spectrometer) conclusions were drawn about the physical properties of the bright points such as density, velocity shifts and changes in magnetic flux in order to draw conclustions about teh physical mechanisms responsible.

B6-P03 Observing Solar Flux Changes using the SORCE

W. Ball (Imperial College), Y.C. Unruh, J.W. Harder

The variation of solar irradiance is an important factor in Earth climate models. Variation and impact of the solar flux depends upon the wavelength and so it is important that accurate measurements are made across the spectrum. The Spectral Irradiance Monitor (SIM), launched in 2003 onboard the Solar Radiation and Climate Experiment (SORCE), provides just this information and has afforded several years of detailed spectral data during the period of decline towards solar minimum.

We present here an outline of solar flux changes and variability detected in the SORCE data since launch alongside long-term trends in solar output. The summary will compare changes in the wavelength band of 200-1600nm with total solar irradiance and clearly delineate flux evolution in the ultraviolet, visible and infrared parts of the spectrum for the period from relatively high activity in 2004 to the current minimum.

B6-P04 The Anelastic Approximation: Magnetic Buoyancy And Convection

N. Berkoff (University of Leeds), S.M.Tobias and E.Kersalé

The anelastic approximation (AA) filters out fast moving waves, chiefly sound waves and fast magneto-acoustic waves. This filtering allows numerical schemes to take much larger time-steps. To make the AA we assume the Mach number of the flow must be small. A further assumption that the basic state is isentropic is used in some anelastic equations. This extra assumption allows the thermodynamic variables to be written in terms only of the entropy which creates a large computational saving.

My work is concerned with the uses of the AA and a isentropic AA. Some isentropic anelastic codes have been used in the sun for simulations from the tachocline to the corona. I will investigate when the two forms of the AA are valid, in particular for the magnetic buoyancy and convective instabilities.

B6-P05 Current Sheet Collapse in the Upper Solar Chromosphere

G. Botha (University of Warwick), T.D. Aber, C.S. Brady

Magnetic fields emerge from the solar convection zone through the photosphere in a topology far removed from being force-free. As they move through the chromosphere into the corona, these fields rearrange themselves to become force-free or potential when they reach the corona. We present a numerical study of the collapse of current sheets in the upper solar chromosphere, where the neutrals in the solar plasma and the perpendicular or Cowling resistivity play an important role in the physics.

B6-P06 Calibrating the Pointing and Optical Parameters of the Heliospheric Imagers

D. Brown (Aberystwyth University), D. Bewsher and C. Eyles

The STEREO Heliospheric Imagers (HI) observe solar plasma as it streams out from the Sun and into the heliosphere, by means of Thompson scattered photospheric light. The telescopes point off-limb and so the Sun cannot be used to confirm the instrument pointing. A new method is presented for deriving the instrument pointing along with other optical parameters, by comparing the locations of stars identified in each HI image with the known star positions predicted from a star catalogue. The pointing and optical parameters are varied in an autonomous manner to minimise the discrepancy between the predicted and observed positions of the stars. With this method, the HI images can be considered as self-calibrating.

B6-P07 Determining the Photometric Calibration and Large Scale Flatfield of the STEREO Heliospheric Imagers

D. Brown (Aberystwyth University), D. Bewsher, B. Kellet, G. White, B. Swinyard, and C. Eyles

The STEREO Heliospheric Imagers observe coronal mass ejections as they propagate from the Sun and into the heliosphere. The background star field that is also observed with the HI instruments can be used to determine the photometric calibration of the instruments and also the large scale flatfield. This paper develops a new method to derive the large scale flatfield, by tracking stars across the HI field-of-view over a number of days. The improvement of the calibrated flatfield over the pre-flight version will be demonstrated using specific stellar examples.

B6-P08 The Relationship between EUV Dimming and Coronal Mass Ejections: Statistical Study and Probability Model

D. Brown (Aberystwyth University), D. Bewsher and R. Harrison

There have been many studies of EUV dimming in association with coronal mass ejection (CME) onsets. However, there has never been a thorough statistical study of this association, covering appropriate temperature ranges. We use a large campaign database from SOHO/CDS and SOHO/LASCO to associate dimming events detected at 1 and 2 MK with CME activity. The results confirm the CME-EUV dimming association using statistical analysis for the first time. The results stress that one emission line may not be sufficient for associating dimming regions with CMEs.

B6-P09 Resonant Absorption of Fast Magnetoacoustic Waves in the Solar Upper Chromosphere

C. Clack (University of Sheffield)

Resonant absorption of fast magnetoacoustic (FMA) waves in an inhomogeneous, weakly dissipative, one-dimensional planar, strongly anisotropic and dispersive plasma is investigated. The magnetic configuration consists of an inhomogeneous magnetic slab sandwiched between two regions of semi-infinite homogeneous magnetic plasmas. Laterally driven FMA waves penetrate the inhomogeneous slab interacting with the localised slow and Alfven coupled inhomogeneous layer and are partly reflected, dissipated and transmitted by this region. Numerical results are analyzed to find the coefficient of wave energy absorption at this coupled resonance. The conclusions are based on the two simplifying assumptions that (i) nonlinearity is weak, and (ii) the thickness of the inhomogeneous layer is small in comparison to the wavelength of the wave, i.e. the so-called long wavelength approximation. The coefficient of wave energy absorption is derived and analysed. It is found that the wave energy absorption is heavily dependent on the angle of the incident wave in combination with the angle of the equilibrium magnetic field. It is proposed that these coupled resonances are regularly present in the solar upper chromosphere.

B6-P10 The Electromotive Force Generated by the Magnetic Buoyancy Instability

C. Davies (University of Leeds), D. W. Hughes

Turbulent flows at high magnetic Reynolds numbers have been shown to act as efficient small-scale dynamos, with the magnetic energy predominantly on the same scale as the turbulent velocity, and with negligible magnetic energy at large scales. This poses a problem in cases such as the solar dynamo, which acts as a large-scale dynamo. Here we investigate an alternative dynamo mechanism, by considering whether flows susceptible to magnetic buoyancy instability can generate an electromotive force on the scales required. We consider a plane layer of fluid in a configuration unstable to the magnetic buoyancy instability and calculate the emf generated by the resulting flows. We show the variation of the electromotive force with latitude, rotation rate, field strength and field gradient.

B6-P11 Measurement of Anisotropy in Solar Flare Electron Spectra using RHESSI Hard X-Ray Spectroscopy

E. Dickson (University of Glasgow), Dr Eduard Kontar

The angular distribution of electrons accelerated in solar flares is a key parameter in understanding the acceleration and propagation mechanisms that occur. Some solar flare models suggest a highly directed beam of electrons while others imply that the distribution should be isotropic. However the anisotropy is still a poorly known quantity with studies producing evidence for both isotropic and beamed cases. The effect of photospheric albedo may hold the key as this influences the differently directed photons in a different manner allowing us to better infer the electron distribution. A bi-directional approximation was applied and a regularized inversion was performed on RHESSI Hard X-ray spectral observations to deduce the electron spectra in both downward and upward directions.The method was applied to several stages of the flare to determine how the angular distribution changes with time. The photon spectra and photon spectral indices have also been modeled for different electron beam anisotropies.

B6-P12 MHD Relaxation of 2D Magnetic Fields Embedded in a Plasma

J. Fuentes-Fernandez (University of St. Andrews), Clare E. Parnell

It is well known that, in a vacuum, any two-dimensional magnetic configuration without null points will relax to a potential equilibrium that is unique for a set of specific boundary conditions. In fields containing null points, on the other hand, the relaxed configuration will be potential everywhere except in the location of the null, where a current sheet will have formed. However, these results are no longer valid if the volume is filled with a plasma. In this new situation, strong pressure gradients will develop and an equilibrium that does not involve a force-free field will be reached. We study the final MHD equilibria obtained from different initial magnetic configurations, with and without nulls, and with different initial plasma parameters. Particular attention is paid to the thermodynamic behaviour of the plasma during the relaxation.

B6-P13 Particle Motion and Energy Gains in Kinematic MHD Models of Collapsing Magnetic Traps

K. Grady (University of St Andrews), Thomas Neukirch

During solar flares a large number of charged particles are accelerated to high energies, but the exact mechanism responsible for this is still unclear. Acceleration in collapsing magnetic traps is one of the mechanisms proposed. In this poster we discuss analytic ideal kinematic MHD models for collapsing magnetic traps. Particle orbits are calculated using the guiding centre approximation. An illustrative example of a collapsing magnetic trap model will be presented together with some preliminary studies of the effects of the initial conditions of the particles on the trapping times and particle energy gains.

B6-P14 RHESSI Observations of the Quiet Sun

I. Hannah (University of Glasgow), Hudson, H. S., Hurford, G. J. & Lin, R. P.

We present new results from the Reuven Ramaty High-Energy Solar Spectroscopic Imager (RHESSI) of solar X-ray emission not associated with active regions, sunspots, or flares (the quiet Sun) during the minimum of solar cycle 23. RHESSI has greater sensitivity in the 5-25 keV range than previous missions, but since the quiet Sun sources may be well-dispersed spatially across the disk, RHESSI's normal imaging technique is not well suited to the task. Instead, we obtain observations in a special mode (fan-beam modulation, Hannah et al. RSI 78, 024501, 2007) to "chop" the quiet solar signal. This technique has been used seventeen times between between June 2005 and October 2008, obtaining limits to the emission between 3-200 keV. These limits improve on those previously reported (Hannah et al. ApJ 659L, 77, 2007). They are both lower and also extend the energy range covered by the pre-RHESSI results. We use the new limits to constrain the possible properties of the thermal and non-thermal emission of the quiet Sun. In particular we discuss the possible properties of hard X-ray nanoflares and the implications for nanoflare coronal heating models.

B6-P15 The Effects of Magnetic Resistivity on a Magnetic Fly-by Model

A. Haynes (University of St Andrews), Clare E. Parnell (1), Klaus Galsgaard (2)
((1) University of St Andrews, (2) Niels Bohr Institute)

The solar corona of the quiet-Sun is threaded by a complex magnetic field structure that evolves as it is dragged around by strong photospheric flows. These motions inject energy into the atmosphere where it is stored as currents in the magnetic field. Subsequently it is released into the corona as heat by magnetic reconnection. Here, using a 3D resistive MHD code, we consider the magnetic interaction of two opposite polarity sources driven by an anti-parallel flow on the photosphere within a uniform overlying field (Galsgaard et al., 2000; Haynes et al., 2007) and investigate how the magnetic resistivity affects the magnetic field structure and energy transported, stored and released by these motions. To fully understand the structure of the magnetic field we determine its magnetic skeleton, which contains the most important components of the magnetic field. The evolution of the magnetic skeleton is then analysed and compared to the reconnection and energetics within the model. In these models, we discover that the choice of resistivity is important: as the resistivity decreases the complexity and duration of the interaction increase, leading to more reconnection and a greater amount of energy released. Our results suggest that with a magnetic resistivity of a realistic value for the Sun, our magnetic interaction could lead to chaotic behaviour.

B6-P16 ROSA - A High Cadence SolaR Imaging System

D. Jess (Queens University Belfast)

ROSA (Rapid Oscillations in the Solar Atmosphere) is a Queen's University Belfast designed and developed high cadence imaging system. This STFC supported six camera system has been successfully commissioned at the Dunn Solar Telescope. First-light images are presented. ROSA will remain at the Dunn Solar Telescope as a common user instrument, with 20 days per year observing time for UK proposals.

B6-P17 The Velocities of a C-Class Flare

P. Keys (QUEENS UNIVERSITY BELFAST)

A C-class flare was observed with the Swedish Solar Telescope on active region NOAA 10969 on the 24th of August 2007. The flare kernel, observed in white-light, had a diameter of around 300km which is below the resolution limit of most spaced-based solar telescopes. The localised flare white-light emission peaks at about 300\% above the quiescent level. MDI magnetograms show that the continuum brightening occurs in the magnetic polarity inversion line. A detailed study of the Ha and Ca II K line reveals velocities in the range of 30 - 150 km/s . We suggest that white-light emission is a common feature of all solar flares and can only be detected at the highest spatial and temporal resolution.

B6-P18 Dynamos and Magnetic Diffusions in 3D Sheared MHD Turbulence: Dynamo Efficiency

E. Kim (University of Sheffield), N. Leprovost

Dynamo action is a fundamental mechanism that explains ubiquitous magnetic fields in a variety of systems, including astrophysical, geophysical and laboratory plasmas. In this contribution, we provide an analytical theory of dynamo (alpha and beta effects) in 3D forced helical MHD turbulence.

By non-perturbatively incorporating the effect of shear, we show that the alpha and beta effects are enhanced by a weak shear while strongly suppressed by strong shear. In particular, for strong shear, the beta effect is shown to be much more strongly suppressed than the alpha effect with the scalings alpha is proportional to A^(-5/3) and beta is proportional to A^(-7/3), respectively (A is the strength of the shear). The quenching of the alpha and beta effect by shear has recently been confirmed in a numerical experiment [1-2]. We discuss important implications of these results, including the dynamo efficiency, which is conventionally measured by the dynamo number D. Specifically, our results suggest that D depends more strongly on the shear as A^(4) than conventionally though (proportional to A). We then discuss the effect of a shear in the magnetic fields. In particular, magnetic shear stronger than flow shear is shown to destabilize. On the other hand, a weak magnetic shear compared to flow shear weakens the stabilizing effect of flow shear, thereby leading to a stronger turbulence than in the case without magnetic shear.

[1] D. Mitra, P. J. K\"apyl\"a, R. Tavakol, and A. Brandenburg, Alpha effect and diffusivity in helical turbulence with shear, {Astronomy and Astrophysics} {495}, 1-8 (2009).

[2] A. Cousevior and E. Kim, in preparation

B6-P19 Results of 20 Years Monitoring of Solar Vector Magnetic Fields: the Helicity Cycle

K. Kuzanyan (IZMIRAN, Russia), Obridko, V.N.^1), , Zhang H.^2) ^1) IZMIRAN, Moscow region, Russia ^2) National Astronimical Observatories of China, Chinese Academy of Sciences, Beijing, China

Over 20 years systematic solar vector magnetic field observations in active regions have been carried out at Huairou Solar observing station in China along with other observatories in the USA and Japan. Their analysis show that the mirror asymmetry of the magnetic field at the photospheric level has a significant hemispheric preference, which can be computed as average value of helicity and twist parameters over a hemisphere at a given interval of time. This hemispheric rule is persistent on very large amount of observational data. In the Northern hemisphere these quantities are mainly negative while at the Southern positive. This rule, however, is valid from one cycle to another despite the absolute values of these quantities vary a lot with the phase of the solar cycle.

We have found the helical quantities to change extremely fast changing on a short range scales in space and time, however on a larger scales they demonstrate regularities comparable wi the solar cycle variations. This indicates that helicity and twist at photospheric level are significantly influenced by a small scale sub-surface magnetohydrodynamics. Due to this variability the hemispheric rule can be established only in the sense of large scale averages in latitude and time.Thus, we have found particular latitudes and times over the phases of the solar cycle at which this rule fails, mainly at the raise and fall of the 11-yr cycle, and we have shown that this violation is statistically significant. These findings on spatial distribution and temporal variation of helical properties of the solar magnetic fields indicate global properties of their generation and shed light on the mechanism of the solar dynamo, therefore provide us with useful constrains on theoretical modelling and predictions of the solar activity.

B6-P20 Automatic Detection of Limb Prominences in 304 A EUV Images

N. Labrosse (University of Glasgow), S. Dalla, S. Marshall, and N. Gray

An algorithm for automatic detection of prominences on the solar limb in EUV images will be presented and results of its application to SOHO/EIT and STEREO/EUVI data discussed. The detection method is based on the method of moments combined with a linear classifier analysis aimed at discriminating between limb prominences, regions of enhanced brightness associated with active regions and the quiet Sun. Virtual Observatory approaches to applying the algorithm to large datasets will be discussed, as well as its application to 'on the fly' analysis of upcoming SDO images. It is planned that a catalogue of prominences identified in SOHO and STEREO data using this method will be made publicly available to the scientific community.

B6-P21 Electron Acceleration Efficiency in Solar flares

S. Liu (University of Glasgow), L Fletcher

We introduce the concept of elementary energy release events for the study of particle acceleration in solar flares and discuss the relevant physical processes in the context of stochastic particle acceleration by magnetized turbulence. Given the high energy release rate during flares, an energy cascade from large to small scales is inevitable, which we attribute to turbulence. We also propose a procedure to identify elementary electron acceleration events from the observed X-ray light curves. A comparison of the elementary energy release and electron acceleration event leads to a well defined and readily measurable electron acceleration efficiency. For flaring corona loops, the model predicts strong correlation between the thermal and nonthermal X-ray emission component, which can be tested with detailed data analyses.

B6-P22 Magnetic Null Points in Solar Emerging Flux

R. Maclean (University of St Andrews), C. E. Parnell, K. Galsgaard

Magnetic flux emergence through the photosphere is continually taking place on the Sun, and is a key driver for many types of observed solar activity including active regions, coronal bright points, and X-ray jets. It is known that the interaction of the newly emerged flux system with the pre-existing magnetic field must be the cause of the observed activity, but how do these flux systems interact in 3D? The only way of properly answer this question is to perform numerical simulations and determine the magnetic topology of the system. Here, we present the results of the first step in this analysis. The model involves the rise of a twisted magnetic flux tube through a stratified model atmosphere, and its interaction with a pre-existing horizontal coronal magnetic field. In this presentation, we will focus on the magnetic null points, as they are the key to locating all the topologically-important magnetic fieldlines in the model. Many more magnetic null points than expected were detected (up to 16 at any one time). They are found to be remarkably stable, with long lifetimes and stable orientations. All of the nulls are created and destroyed by known topological bifurcations. They form low in the solar atmosphere, near the boundary between the four different magnetic connectivities that are present in the model. We will discuss the relationship between the nulls and the current sheets that form in the model. Finally, we will consider their significance for locating sites of magnetic reconnection and energy release.

B6-P23 Inverse Compton X-Rays from Relativistic Flare Particles

P. Mallik (University of Glasgow), Alec MacKinnon

In our work on diagnosing flare ion and relativistic electron acceleration, we have also been reconsidering the role of inverse Compton scattering of photospheric photons. Gamma-ray observations clearly show the presence of ~100 MeV electrons and positrons in the solar corona, by- products of GeV energy ions. Here we will present results of IC scattering of such photons taking proper account of radiation field geometry near the solar surface. If observed, such radiation would let us determine the number of secondary positrons produced in large flares, contributing to a full picture of ion acceleration and to predicting neutron fluxes to be encountered by future inner heliosphere space missions.

B6-P24 Non-Linear Force-Free Field Models of the Magnetic Carpet

K. Meyer (University of St Andrews), D. H. Mackay

The Sun's magnetic carpet is key to the dynamics and origin of small scale events which occur on the order of just a few hours to days. Supergranular cells provide the dominant flow pattern on small scales on the Sun's surface, and hence play an integral part in the evolution of the magnetic carpet. The magnetic fields from the photosphere extend up into the chromosphere and lower corona, where a wide variety of connections are expected between each of the fragments (Close et al. (2003)). Since the photosphere is constantly evolving due to surface motions, we expect a significant amount of energy to be built up within the corona, which could be a cause of coronal heating. Our aim is to construct a non-linear force-free field model for the magnetic carpet, which will include flux emergence, cancellation, coalescence and fragmentation. We will also construct a model for the corona based on surface motions. The code is a two component model (van Ballegooijen et al. (2000), Mackay and van Ballegooijen (2006a), Mackay and van Ballegooijen (2006b)). A magnetofrictional relaxation technique is used for the coronal component rather than solving the full MHD equations, as this would be very compu- tationally intensive. The second part of the model evolves the normal component of the magnetic field at the photosphere through an analytical boundary condition. This boundary condition prevents undesirable numerical effects, such as Gibb's phenomenon and numerical diffusion, from occurring within the code. Applications of the code will be illustrated through test examples of the interaction of single magnetic elements.

B6-P25 A One-Dimensional Vlasov-Maxwell Equilibrium for the Force-Free Harris Sheet

T. Neukirch (University of St. Andrews), M.G. Harrison, F. Wilson

The first non-linear force-free Vlasov-Maxwell equilibrium is presented. One component of the equilibrium magnetic field has the same spatial structure as the Harris sheet, but whereas the Harris sheet is kept in force balance by pressure gradients, in the force-free solution presented here force balance is kept by magnetic shear. Magnetic pressure, plasma pressure and plasma density are constant. The method used to find the equilibrium is based on the analogy of the one-dimensional Vlasov-Maxwell equilibrium problem to the motion of a pseudo-particle in a two-dimensional conservative potential. This potential is equivalent to one of the diagonal components of the plasma pressure tensor. After finding the appropriate functional form for this pressure tensor component, the corresponding distribution functions can be found using a Fourier transform method. The force-free solution can be generalized to a complete family of equilibria that describe the transition between the purely pressure-balanced Harris sheet to the force-free Harris sheet.

B6-P26 Origin of Sun-Quakes

E. Pedran (MSSL, UCL), Dr Sarah Matthews

Sun-quakes, generated during the impulsive phase of some solar flares, are the most intense acoustic radiation observed on the solar surface and offer interesting possibilities for furthering our understanding of flares and active region helioseismology. Recent work has shown a close correlation between enhanced continuum emission and the seismic emission observed during the impulsive phase, and has also identified seismic emission associated with some M-class flares. For the purpose of this study X-class WL flares with and without sunquakes are studied using TRACE, Yohkoh data. We compare the characteristic of both groups to shed some light on why not all X-class WL flares produce a sunquake.

B6-P27 Firehose Constraint on Kappa Anisotropies in the Solar Wind

M. Lazar and S. Poedts

For several decades, the interplanetary missions have frequently confirmed the existence of suprathermal charged particle populations in the solar wind. Moreover, the velocity distributions in space plasma are observed to be anisotropic with a substantial amount of kinetic free energy residing in the direction of the interplanetary magnetic field (T_(parallel) > T_(perpendicular)) that may give rise to the excitation of the kinetic firehose instability. Such an instability can constrain the increase of the electron temperature anisotropy, explaining thus the observations. By comparison to bi-Maxwellian distributions, here it is shown that the presence of a bi-kappa distribution does not change significantly the growing time of the instability, but extends to a markedly larger broadband of the unstable wave-lengths. The firehose instability is thus more likely to be found in space plasmas with nonthermal anisotropic distributions.

B6-P28 The Role of Lateral Magnetic Reconnections in Solar Eruptive Events

Soenen, A., Bemporad, A., Jacobs, C., Poedts, S.

On December 10-11, 2005 a slow CME occurred in between two coronal streamers in the Western hemisphere. SOHO/MDI magnetograms show a multipolar magnetic configuration at the photosphere consisting of a complex of active regions located at the CME source and two bipoles at the base of the lateral coronal streamers. White light observations reveal that the expanding CME affects both of the lateral streamers and induces the release of plasma within or close to them. These transient phenomena are possibly due to magnetic reconnections induced by the CME expansion that occurs either inside the streamer current sheet or between the CME flanks and the streamer.

Our observations show that CMEs can be associated to not only a single reconnection process at a single location in the corona, but also to many reconnection processes occurring at different times and locations around the flux rope. Numerical simulations are used to demonstrate that the observed lateral reconnections can be reproduced. These simulations suggest that the shear to be applied to the erupting arcade decreases as the number of lateral induced reconnections increases. The observed secondary reconnections associated to CMEs facilitate the CME release by globally decreasing the magnetic tension of the corona. Future CME models should therefore take into account the lateral reconnection effect.

B6-P29 Hydrodynamics and Kinematics of Flares

C. Raftery (Trinity College Dublin), Peter T. Gallager

The hydrodynamic evolution of solar flare is analysed from both an observational and theoretical point of view. Combining the observations with hydrodynamic simulations allows the heating and cooling mechanisms, along with dynamic phenomena such as chromospheric evaporation to be fully investigated.

Following the analysis of flare hydrodynamics, flare loop top and CME kinematics are investigated. The evolution of a flare/CME limb event is analysed over >6 hours using multiple instruments, including STEREO/EUVI, SOHO/LASCO, RHESSI and Mercury Messenger. The observations show evidence for X to Y type reconnection along an extended arcade. The data are compared to a number of CME models to determine the acceleration mechanism of the CME and timescales of the flare loop evolution.

B6-P30 Propagation of an Impulsive Electron Beam in a Density Fluctuating Heliospheric Plasma

H. Reid (University of Glasgow), Dr Eduard Kontar

Electron beams propagating from the Sun to the Earth can generate Langmuir waves in the ambient solar corona plasma which in turn generate radio emission otherwise known as type III solar radio bursts. We model the onset and propagation of the electron beam-plasma structure created from flare related impulsive electron beams. The results show electron deceleration due to background plasma inhomogeneity which could account for the observed early injection of low energy electrons. This deceleration, heavily influenced by the structure of the heliospheric plasma, is decreased when density fluctuations are considered and acceleration can occur at certain energies dependent on electron beam parameters.

B6-P31 Diagnostics of Electron Beam Anisotropy from Hard X-Ray Emission and Polarization

T. Siversky (University of Bradford), Alexey Kuznetsov, Valentina Zharkova

We present steady state distribution functions for power law electron beam precipitating into flaring atmospheres with a magnetic field convergence. The solutions are obtained from Fokker-Planck equations by taking into account collisional and Ohmic energy losses and anisotropic scattering. Resulting HXR emission, directivity and polarization are also calculated for precipitating and returning particles at various precipitation depths and different viewing angles by using relativistic anisotropic bremsstrahlung cross-sections. We show that polarization measurements combined with the observations of HXR photon flux can be used as a diagnostics tool for electron anisotropy in deeper atmospheric levels which helps to explain some puzzling observational features for different flares.

B6-P32 A New Fast Reconnection Model in a Collisionless Regime

D. Tsiklauri (IMR, University of Salford)

Based on the first principles [i.e., (i) by balancing the magnetic field advection with the term containing electron pressure tensor nongyrotropic components in the generalized Ohm's law; (ii) using the conservation of mass; and (iii) assuming that the weak magnetic field region width, where electron meandering motion supports electron pressure tensor off-diagonal (nongyrotropic) components, is of the order of electron Larmor radius] a simple model of magnetic reconnection in a collisionless regime is formulated. The model is general, resembling its collisional Sweet-Parker analog in that it is not specific to any initial configuration, e.g., Harris-type tearing unstable current sheet, X-point collapse or otherwise. In addition to its importance from the fundamental point of view, the collisionless reconnection model offers a much faster reconnection rate than Sweet-Parker's classical one. The width of the diffusion region (current sheet) in the collisionless regime is found to be independent of the global reconnection scale L and is only prescribed by microphysics (electron inertial length, c/omega_(pe), and electron Larmor radius). Amongst other issues, the fastness of the reconnection rate alleviates, e.g., the problem of interpretation of solar flares by means of reconnection, as for the typical solar coronal parameters the obtained collisionless reconnection time can be a few minutes, as opposed to Sweet-Parker's equivalent value of less than a day. The new theoretical reconnection rate is compared to the Magnetic Reconnection Experiment device experimental data by Yamada et al. [Phys. Plasmas 13, 052119 (2006)] and Ji et al. [Geophys. Res. Lett. 35, 13106 (2008)], and a good agreement is obtained. Reference: D. Tsiklauri, Phys. Plasmas 15, 112903 (2008); DOI:10.1063/1.3029737

B6-P33 Coronal Heating by Drift Waves

J. Vranjes (KU Leuven), S. Poedts

The heating of the plasma in the solar atmosphere is discussed within both frameworks of fluid and kinetic drift wave theory. We show that the basic ingredient necessary for the heating is the presence of density gradients in the direction perpendicular to the magnetic field vector. Such density gradients are a source of free energy for the excitation of drift waves. We use only well established basic theory, verified experimentally in laboratory plasmas. Two mechanisms of the energy exchange and heating are shown to take place simultaneously: one due to the Landau effect in the direction parallel to the magnetic field, and another one, stochastic heating, in the perpendicular direction. The stochastic heating i) is due to the electrostatic nature of the waves, ii) is more effective on ions than on electrons, iii) acts predominantly in the perpendicular direction, iv) heats heavy ions more efficiently than lighter ions, and v) may easily provide a drift wave heating rate that is orders of magnitude above the value that is presently believed to be sufficient for the coronal heating. This heating acts naturally through well known effects that are, however, beyond the current standard models and theories.

B6-P34 Damping of Acoustic Oscillations in Solar Coronal Loops

J. Vranjes (KU Leuven), S. Poedts

Recently observed acoustic-type loop oscillations have so far been described in the literature exclusively within the frame of the one-fluid (magneto)hydrodynamic (MHD) model. We here show, however, that some of the essential features of such acoustic oscillations in the corona remain outside of such a one-fluid description, and that the kinetic and/or multi-fluid approach yield a more detailed and accurate description. Within the kinetic treatment the Landau damping of the acoustic-type waves is discussed and analytical expressions for the spectrum and the damping are given. A comparison is made with the two-component fluid theory within which an equivalent fluid model for the Landau damping is given. An excellent agreement between the kinetic and fluid models is demonstrated. It is shown that the Landau damping is for about one to two orders of magnitude stronger than the viscosity or gravity effects that have been used in the recent past in order to explain the nature of the observed acoustic oscillations within the one-fluid (MHD) model. The same Landau-fluid model may also be used within the MHD and hydrodynamic theory. We conclude that the kinetic and two-component theory gives a more detailed and accurate description of the acoustic oscillations, and it is able to describe phenomena that simply can not be predicted within the MHD theory.

B6-P35 Modeling the Longitudinal Asymmetry in Sunspot Emergence - the Role of the Wilson Depression

F. Watson (University of Glasgow), L Fletcher, S Dalla and S Marshall

The distributions of sunspot longitude at first appearance and at disappearance display an east-west asymmetry, that results from a reduction in visibility as one moves from disk centre to the limb. To first order, this is explicable in terms of simple geometrical foreshortening. However, Dalla, Fletcher, and Walton (2008) showed that the centre to limb visibility variation is much larger than predicted by foreshortening. Sunspot visibility is known also to be affected by the Wilson effect - the apparent 'dish' shape of the sunspot photosphere caused by the temperature-dependent variation of the geometrical position of the tau = 1 layer. We investigate the role of the Wilson effect on the sunspot appearance distributions, deducing a mean depth for the umbral tau = 1 layer of 500-1500km, based on the comparison of observations and Monte-Carlo simulations.

B6-P36 Advances in Particle Acceleration in Solar Flares in the RHESSI Era

V. Zharkova (University of Bradford),

A review of recent advances in particle acceleration and methods used to explore this process in solar flares will be presented. Advantages and disadvantages of each approach will be discussed as well as the relationship of proposed acceleration models with recent observational signatures.

B6-P37 Probing the Forthcoming Solar Cycle 24 with the Thin Shell Solar Dynamo and Additional Observational Proxies

Kuzanyan, K.M. (IZMIRAN, russia), Zharkov, S.I.(University of Sheffield, University of Bradford) and Zharkova V.V. (University of Bradford)

We present results of a series of studies on revealing regularities and predictions of the magnitude and duration of the solar cycle 24 by simultaneous use of the knowledge on the Solar Dynamo mechanism and the arsenal of time series methods, such as Singular Spectrum Analysis (SSA). The key properties of the solar dynamo have been obtained by consideration of the nonlinear Parker dynamo waves in a thin shell, which enables Links between amplitude and phase of the solar magnetic activity. Further, the sunspot index series have been analysed using time series methods (SSA), and predictions on the magnitude of this activity in the cycle 24 are produced.

Tuesday
11:00am

Solar Acceleration and Transport of Energetic Particles - Observations

L. Fletcher (University of Glasgow)

In this talk I will summarise the multiwavelength observational evidence for the acceleration and transport of non-thermal electrons and ions at the Sun, with special attention paid to solar flares and related processes. Such evidence is present across the electromagnetic spectrum, though the diagnostics which - at the present time - are best developed are concentrated in the microwave/radio and X-ray/gamma-ray regimes, which are therefore the focus of this talk. I will also discuss in situ observations, and look forward to future observations which may be made with planned missions such as the Solar Orbiter.

Tuesday
11:20am

Particle Acceleration in Solar Flares - An Overview of Theoretical Ideas

T. Neukirch (University of St. Andrews)

Finding a theoretical explanation for the observed acceleration of a large number of charged particles to high energies during solar flares is presently one of the most challenging, but also most interesting problems in solar physics. Part of the problem is the vast difference between the microscopic (kinetic) and the macroscopic (MHD) scales involved. Whereas the phenomena observed to occur on large scales are reasonably well explained by the so-called standard model, this is not the case for the small-scale (kinetic) aspects of flares. Over the past years observations, in particular by RHESSI, have provided increasing evidence that a naive interpretation of the data in terms of the standard solar flare/thick target model is problematic. In this talk, I will attempt to give an overview of the open problems and of some of the more recent theoretical developments of the field.

Tuesday
11:40am

Investigation of Acceleration Sources of the Major SEP Event on 13 December 2006

C. Li (Mullard Space Science Laboratory), C. J. Owen, A. N. Fazakerley, and S. A. Matthews

An X3.4 solar flare and the launch of a fast halo coronal mass ejection (CME) occurred on 13 December 2006. These were accompanied by the appearance of a high flux of energetic particles in interplanetary space, a so-called Solar Energetic Particle (SEP) event. Based on the observations of these particles and of multi-wavelength emission detected by both near-Earth spacecraft and a ground-based neutron monitor, we present studies of SEP dynamics (time history, spectrum and anisotropy), flare magnetic reconnection rate, and the magnetic configuration above the active region. Our analytic results suggest that flare acceleration dominates as the cause of the initial SEP injection and produces a highly anisotropic particle distribution with a hard energy spectrum. Subsequently, the acceleration source appears to switch to a wide-spread interplanetary CME-driven shock, which produces nearly isotropic particle distributions with a softer energy spectrum.

Tuesday
11:55am

Effect of Polarisation Electric Field on Particles Acceleration in a Reconnecting Current Sheet

T. Siversky (University of Bradford), Valentina Zharkova

The acceleration of protons and electrons in a reconnecting current sheet (RCS) is simulated with a particle-in-cell (PIC) 2D3V code. The electro-magnetic configuration forming the RCS incorporates all three components of the magnetic field (including the guiding field) and a drifted electric field. The additional electric and magnetic fields induced by plasma particles are also considered. The simulations reveal a strong polarisation electric field which appears during particle acceleration owing to a separation of electrons from protons towards the midplane of the RCS. The polarisation electric field is shown to essentially affects the trajectories of the accelerated electrons as well as their energy gains. It was also found that the periodic electric field in a form of the Langmuir wave can be generated by the beam of the accelerated electrons.

Tuesday
12:10pm

Detecting and Interpreting Quiet Sun Energetic Neutrons in the Inner Heliosphere

A. MacKinnon (Glasgow University), J M Ryan (University of New Hampshire)

Energetic neutrons have been detected in space following episodes of ion acceleration at the Sun. They complement gamma-ray measurements as a diagnostic of flare accelerated ions and are particularly sensitive to the presence of heavy fast ions. The flux of 1 - 20 MeV solar neutrons expected inside the orbit of Mercury will be several orders of magnitude greater than that surviving to 1 AU. Future inner heliosphere spacecraft may detect quiet time fast neutrons. We review the existing limits on Quiet Sun gamma-ray lines, estimate the maximum neutron fluxes consistent with them at 0.05 - 0.3 AU and discuss the sort of instrument needed for useful measurements. Finally we note some ways in which the Quiet Sun might accelerate ions and comment on the broader significance of such measurements for solar physics.

Wednesday
4:00pm

Cross-Scale: An ESA Cosmic Vision Mission to Study Multi-Scale Coupling in Plasmas

C. Owen (UCL/MSSL)

Cross-Scale is a mission under study by the European Space Agency and is a candidate for the first launch slot for the agency's Cosmic Vision 2015-2025 program. It will provide critical new information of several universal collisionless plasma processes (shocks, magnetic reconnection and turbulence) by performing the first exploration and quantification of simultaneous multi-scale coupling across three critical scales: electron, ion, fluid. It will answer fundamental questions in collisionless plasmas, notably "How do shocks accelerate and heat particles?", "How does reconnection convert magnetic energy?" and "How does turbulence control transport in plasmas?" These universal processes will be unravelled by a fleet of 12 specialised spacecraft in near-Earth built by ESA and partner agencies (e.g., JAXA, NASA, CSA). This contribution will focus on the science questions, how this Cosmic Vision mission will answer them and build on the recent advances of Cluster and those promised by MMS.

Wednesday
4:20pm

STEREO, Solar Orbiter and Solar Probe Plus

R. Harrison (STFC Rutherford Appleton Laboratory)

The STEREO mission was launched in late 2006 and the current separation, approaching 60 degrees from the Sun-Earth line for each spacecraft provides excellent observational opportunities for 3D CME studies, the tracking of Earth-directed events and their impacts and, in October/November, in-situ measurements of the L4/L5 Lagrangian environments. We will summarise the status of the spacecraft, with emphasis on the UK instruments, and on access to the data and future observational opportunities. In addition, looking to the future, we summarise the status of the Solar Orbiter mission which has just undergone instrument selection but is still in competition with the remaining Cosmic Vision projects. There are a number of key events this year for Solar Orbiter. Indeed, Solar Orbiter is increasingly being matched with the NASA Solar Probe Plus mission which will also be summarised.

Wednesday
4:40pm

SOHO Extended Mission and TRACE

R. Harrison (STFC Rutherford Appleton Laboratory)

SOHO is into its 14th year of operation and is in good health and still much in demand. Preparations are underway for an extended reduced mission concept which includes continued operation of the UK-led CDS instrument. Current operations are very much linked to multi-mission campaigns including Hinode and STEREO. We report on the mission status and the UK support. Our involvement in TRACE will also be summarised.

Wednesday
4:45pm

Hinode and the Follow-on Mission Solar-C

L. Harra (UCL-MSSL)

I will describe the current status of the Hinode mission, and how to get the best out of observing. I will then describe the follow-on japanese mission, solar-C.

Wednesday
4:55pm

The TESIS Instrument Package on Koronas-Photon

K. Phillips (UCL-Mullard Space Science Laboratory), S. Kuzin, Yu. Kotov, J. Sylwester

Coronas-Photon is a Russian solar spacecraft, successfully launched on 2009 January 30 and returning high-quality data. On board is the TESIS instrument package, a set of solar instruments built largely by the Lebedev Physical Institute of the Russian Academy of Science. The instruments cover the range from the soft X-ray to EUV wavelength regions emitted by the Sun's transition region to its far corona. An imaging spectro-heliometer (MISH) is obtaining images of the solar corona in the soft X-ray Mg XII line doublet at 8.42 Angstroms, emitted at 8-10MK, with 2 arcsec/pixel resolution. An EUV spectroheliometer (EUSH) operates in the 280-330 Angstrom range, getting characteristics of the emitting regions with imaging spectroscopy. A pair of full-disk EUV telescopes (FET) obtain images in the 130-136 and 171/295-315 Angstrom regions with multi-layer parabolic mirrors, with 1.7 arcsec/pixel resolution. A Solar EUV Coronagraph (SEC) is a coronagraph with Ritchey-Chretien optics, obtaining images of the corona in the 290-320 Angstrom range from 0.7 to 4 solar radii. Finally, the Polish SphinX instrument (PI Prof. J. Sylwester, Space Research Centre, Wroclaw) is a spectrophotometer with PIN detectors working in the 1.5-15 keV energy range, observing the total solar spectrum with a sensitivity far below the GOES A1 level with spectral resolution of between 316 and 465 eV. It is thus able to monitor, with considerable precision, the soft X-ray emission characteristic of the present solar minimum. In this short overview, some details of the instruments and initial results will be given.

Wednesday
5:00pm

The UK Solar Dynamics Observatory Datahub at UCLan

R. Walsh (University of Central Lancashire), Silvia Dalla, Len Culhane

The Solar Dynamics Observatory is the flagship mission of NASA's International Living with a Star (ILWS) program. Now with a firm launch window of between 8 October and 6 November, 2009, this science successor to SOHO will have an exceptionally high data rate capable of returning 1 arc sec resolution coronal images at a rate of 1.5 TB/day. In particular, the Atmopsheric Imaging Assembly (AIA) will observe the full disc corona in ten wavelengths with eight images acquired every 10 seconds. This massive volume of new data requires a completely new approach by UK solar physicists to acquiring, processing and analyzing the resulting multi-wavelength images.

This talk will outline how the University of Central Lancashire (UCLan) is well on the way to establishing a UK SDO AIA Data-Hub. It is planned for the Hub to host the SDO AIA Summary Data (a dataset at reduced spatial resolution but with full time resolution), the Heliophysics Events Knowledgebase (HEK) and selected full resolution images at regular intervals throughout each day. In addition, full resolution data will be available for specific interesting time periods, to be identified by means of the HEK e.g. for specific events like flares or CMEs, and by consultation with the UK community. The data products available will also include some SDO Helioseismic and Magnetic Imager (HMI) magnetograms to complement the AIA images and provide additional context.

UCLan has already begun the process of working with Lockheed Martin Solar Astrophysical Laboratory (LMSAL) and Stanford University (SU) in defining in detail the non-trivial task of managing the exceptional data flow. LMSAL are particularly concerned as to how efficiently they can supply the data on demand to the international community and thus are very supportive of the UCLan Hub to be used by UK (and possibly European) Solar Physics researchers.

Wednesday
5:05pm

A ROSA View of the Sun

M. Mathioudakis (Queens University Belfast), David Jess, Damian Christian, Philip Crockett, Francis Keenan

ROSA (Rapid Oscillations in the Solar Atmosphere) is a UK/STFC solar imaging system available at the Dunn Solar Telescope within the Sacramento Peak National Solar Observatory. ROSA comprises of six cameras and provides both unprecedented time resolution (5 msec) and diffraction limited spatial resolution (0.1 arc sec). All cameras can be synchronized to a high degree of accuracy (50 microsec), thus allowing observations of the photosphere and chromosphere as one coupled system. We outline ROSA's capabilities and observing modes together with some first-light images. ROSA is also considered as a prototype instrument for the 4 meter Advanced Technology Solar Telescope (ATST). The potential UK involvement in the next generation of solar ground based facilities will also be discussed.

Monday
11:00am

Magnetoseismology: Remote Sensing the Earth's Magnetosphere Using MHD Waves

F. Menk (University of Newcastle, Australia)

Although the general properties of the Earth's magnetosphere are well established, the averaged pictures seen in texts disguise the dynamic nature of this complex region. In situ spacecraft observations provide snapshot measurements and so compromise the spatial and temporal resolutions. On the other hand, ground magnetometers are relatively simple to establish and operate. Such instruments may be used to measure the local eigenfrequency of geomagnetic field lines, from which by using suitable models the equatorial mass density can be inferred. The travel time of propagating MHD waves can also be determined, providing further information on the density distribution. Measurements from ground arrays therefore provide information on the Alfvén continuum and hence the plasma density profile throughout the magnetosphere. Comparison of such observations with ground based VLF measurements, which relate to electron density, allow the plasma composition to be estimated. In a novel twist, HF radars can imagine wave signatures in the ionosphere with greater spatial resolution than afforded by ground magnetometers. We outline the relevant techniques and examine case studies illustrating magnetospheric properties before, during and after geomagnetic storms.

Monday
11:30am

Modulation of NTC frequencies by Pc5 ULF Pulsations: Experimental test of the generation Mechanism and Magnetoseismology of the Emitting Surface

S. Grimald, C. Foullon, P. M. E. Décréau, G. Lerouzic, X. Suraud, X. Vallières

Non-thermal continuum (NTC) radiation is believed to be emitted by the conversion of an electrostatic wave into an electromagnetic one, which takes place at the Earth's magnetic equator and in a density gradient. Moreover, it has been argued that the frequency of the electrostatic wave at the source is proportional to the electron cyclotron frequency, fce. We present an experimental test of this theory using data from Cluster, whose orbit at perigee in the plasmapause vicinity is well adapted to study NTC radiations near their sources. In an event on August, 14, 2003, we compare oscillations observed in a series of distinct NTC frequency bands with simultaneous Pc5 Ultra Low Frequency (ULF) pulsations in the magnetic field, which are expected to modulate fce. The latter magnetic perturbations are interpreted as magnetohydrodynamic poloidal waves, where fundamental and second harmonic modes coexist. The NTC oscillation and the fundamental wave have similar periods but are phase-shifted by a quarter of phase. From the localization of the NTC source, we infer that the poloidal perturbations are spatially uniform between the source and the satellites. We conclude that the electrostatic wave, which converts into NTC, is not the electron cyclotron wave in this event, but is likely to be governed by the plasma density. Furthermore, we demonstrate that the observations can be used to perform a magnetoseismology of the emitting surface. The results show a steepening of the plasmapause density profile near the satellites, which can be responsible for the generation of NTC emission.

Paper by S. Grimald, C. Foullon, P. M. E. Décréau, G. Lerouzic, X. Suraud and X. Vallières - presented by C. Foullon.

Monday
11:45am

Sounding of Space Plasma with ULF Waves: Lessons from the Earth's Magnetosphere

E. Fedorov (Institute of the Physics of the Earth, Moscow), V. A. Pilipenko

A short review is given of new effects recently found in the physics of the magnetospheric ULF waves which can be used in the solar physics and astrophysics:

- Competing saturation mechanisms of the field-line resonance: dissipation due to field-aligned potential drop, dispersive and nonlinear effects, stochastic background fluctuations

- Scale-dependent features of the Alfven wave propagation through a turbulent layer

- Occurrence of the quasi-Alfvenic resonators along open field-lines with complex geometry

- Field-line resonance and occurrence of stop-bands for Alfven waves in a finite-pressure plasma

- Resonant conversion of compressional disturbances into Alfven waves in a longitudinally-inhomogeneous unbounded plasma

Monday
12:00pm

An Empirical Model for Pi3/Pc5 Parameters at High Latitudes

N. Yagova (Institute of the Physics of the Earth, Moscow), V. A. Pilipenko, L. N. Baransky, M. Engebretson

Spectral parameters of the geomagnetic noise and pulsations in Pc5/Pi3 frequency range is analyzed for more than 30 observatories from polar to auroral latitudes. A technique based on the log-log spectrum expansion over orthogonal polynomials has been applied to describe quantitatively spectral parameters of high-latitude ULF disturbances. The analysis of latitude distribution and diurnal variations Pc5/Pi3 spectral moments shows the existence of systematic behavior not only of signal's spectral power, but also of the spectral slope and higher spectral moments. Elliptically (P) and randomly (N) polarized components of signal spectra are analyzed separately, and a non-negligible difference in their behavior is revealed, indicating different physical mechanisms for disturbances of different polarization. The 2-D distribution of Pi3 spectral moments in coordinates "corrected geomagnetic latitude-magnetic local time" are characterized by existence of narrow in latitude and extended in MLT structures, which can be attributed to the projections of different magnetospheric regions. The existence of regular features 2-D distribution of Pi3 parameters leads to the conclusion that "geomagnetic noise" is controlled by some very common magnetospheric parameters. 2-D distribution of Pi3 is quantified by a few parameters and their dependence on extra-magnetospheric factors as well as non-oscillatory plasma, particle and magnetic field parameters within the magnetosphere is analyzed. It is shown that higher spectral moments are mostly controlled by the factors inside the Earth's magnetosphere and in the magnetosheath and can be effectively used for several Space-weather problems.

Monday
12:15pm

Studying Ganymede's Magnetosphere with ULF Waves.

M. Volwerk (Space Research Institute, Graz), XianZhe Jia, Margaret Kivelson and Krishan Khurana

Ganymede, the largest moon of Jupiter and the solar system, has its own internal magnetic field, which is strong enough to hold off the Jovian magnetospheric field, thus creating a mini-magnetosphere inside the larger Jovian one. Ganymede's field is oppositely directed with respect to the Jovian field, which means that there is constant reconnection taking place at the upstream side of the moon. This leads to a dynamic magnetosphere, with strong ULF wave activity. Some of these waves, field line resonances, have already been shown to exist during the G8 and the G28 flybys. In this presentation we will take a look at these two flybys, which enter the mini-magnetosphere and concentrate on the different ULF waves present, and try to deduce some magnetospheric properties, such as plasma density.

Monday
2:00pm

Transverse Waves and Oscillations in the Solar Corona

E. Verwichte (CFSA, University of Warwick)

Since their discovery a decade ago transverse waves in solar coronal structures are a subject of continuous lively research. Transverse waves have been interpreted as fast magnetoacoustic kink waves and their study allows for the probing of the coronal plasma and magnetic field through the application of the technique of coronal seismology and for the validation of theoretical (wave) models. I will review highlights of ten years of transverse wave observations and the theoretical work they have triggered, including the detection of multiple harmonics in loop oscillations, down-wards propagating waves above flaring sites and the ground-based observation of the ubiquitous presence of low-amplitude transverse waves in the corona (including the Alfven wave versus kink wave debate). To illustrate the potential impact of the new fleet of solar missions, I will present a study of a transverse loop oscillation seen by STEREO and show how knowledge of the three-dimensional geometry of the oscillating loop enhances the analysis.

Monday
2:30pm

Kink Oscillations of Cooling Coronal Loops

R. Erdelyi (U. of Sheffield), R. Morton

Since the launch of SOHO and TRACE the dynamic and very fine structure of the ubiquitously magnetised solar corona has been extensively studied. Areas such as solar magneto-seismology have benefited greatly, as a considerable wealth of novel theoretical work has just emerged to explain the observations of a wide range of waves and oscillations in solar MHD waveguides. We are now on the advent of a new era, with a plethora of ground (ROSA, IBIS) and spaced based observatories (STEREO, Hinode and SDO soon) providing data with an unprecedented patial and temporal resolution. This new aquisition provides a solid confirmation of current theories on the solar corona and open up uncharted areas of research ways beyond refuting earlier models.

The study of delineated loops in the corona is a key subject of solar magneto-seismology. Applying theoretical models of magnetic waveguides to observations, the aim of solar magneto-seismology is to deduce otherwise unmeasurable or hardly measurable physical parameters (loop expansion, scale height, magnetic field, heating function, etc.) of the coronal loops.

In general, the magneto-seismic modelling of loops has sofar often assumed a time-independent background. This assumption is in contrast to the numerous observations clearly indicating non-static backgrounds involving flows and cooling. We present here the first simple though still robust model of oscillating coronal loops that takes into account the reported variable background. We will discuss the effect of cooling on loop oscillations.

In particular, the influence of cooling on the tranverse oscillations is investigated. It is found that both the eigenfunctions and eigenfrequencies, i.e. the two favourite magneto-seismological tools, of the transverse oscillations are effected. We will demonstrate that the inclusion of the observed variable background, applicable to typical solar conditions, is equally important as magnetic or gravitational stratification. One aspect of particular interest, in light of coronal seismology, is the widely reported damping of standing oscillations that arise due to the loop cooling. We quantise how cooling influences (i)the eigenfrequencies of standing kink oscillations, (ii) the frequency ratio of the fundamental and first harmonic oscillations, and (iii) cause shifts of anti-nodes of eigenfunctions.

Monday
2:45pm

Seismology of Transversely Oscillating Coronal Loops and Prominence Threads

I. Arregui (Universitat Illes Balears), J.L. Ballester, M. Goossens, R. Oliver, J. Terradas

We present recent results from the application of MHD wave seismology inversion techniques to transverse oscillations observed in coronal loops and prominence fine structures. In coronal loops, the combination of observed periods and damping rates with analytical and numerical results for resonantly damped kink waves in non-uniform flux tubes allows us to obtain a restricted 1D solution space that links the internal Alfven speed, the density contrast, and the transverse density structuring, in a fully consistent manner. The resulting Alfven speed is well constrained to a narrow range of values. Similar inversion techniques have been applied to oscillating quiescent and active region prominence threads. In quiescent filament threads, resonant damping becomes independent of density contrast, for the typical large filament-to-coronal values of this parameter. This allows us to obtain precise estimates for the internal Alfven speed and the transverse inhomogeneity length-scale. In an active region prominence, a seismological analysis of oscillating threads observed with Hinode SOT shows that, even if the available data are insufficient to derive well constrained values of the physical variables, a lower limit for the Alfven speed in each of the threads can be established.

Monday
3:00pm

Detection of Three Periodicities in a Single Oscillating Coronal Loop

T. Van Doorsselaere (University of Warwick), D.C.C. Birtill, G.R. Evans

TRACE 171 Ang observations of transverse loop oscillations on May 13 2001 have been studied by De Moortel & Brady (2007). They found hints of 3 periodicities present in this event. We aim to improve the analysis, and measure the periodicities more accurately in order to do coronal seismology. We create multiple (x,t)-slices across the loop, and determine the oscillatory parameters within those slices. We then use statistical methods to reduce the errors on the measured oscillations parameters. We find two populations with a clearly distinct period. The population at the loop top has a period of 895.3±1.9s, while the population in the loop leg has a period of 452.4±0.8s. The fact that the ratio of these two periods is roughly 2 and the geometry of the problem suggests that two harmonics are observed. In the residues, traces are found of a period in the range of 240s-320s, suggesting the presence of an even higher harmonic.

Monday
3:15pm

Coronal Seismology of 3D Numerical Simulations of Transverse Loop Oscillations

I. De Moortel (University of St Andrews), D.J. Pascoe, J.A. McLaughlin

We present 3D numerical simulations of transverse, coronal loop oscillations, excited impulsively by an external pressure pulse. We investigate how the attack angle (i.e. the position of the pressure pulse) affects the resulting loop oscillations and show that the transverse kink oscillations are excited efficiently for a range of attack angles. Additionally, we estimate the value of the magnetic field from the resulting transverse oscillations and compare this value, obtained from 'coronal seismology' with the actual value of the magnetic field

Monday
4:30pm

Diagnostics of Stellar Coronae using Quasi-Periodic Pulsations

A. Stepanov (Pulkovo Observatory)

Magnetic loops constitute the basic structural elements of the coronae of late type stars. Diagnostic tool for stellar coronae based on coronal seismology and solar-stellar analogy is proposed. Two approaches are applied. The first one regards a coronal loop as a resonator for MHD oscillations. Therewith both non-leaky and leaky modes of loop oscillations are studied. In the second approach the coronal loop interprets in terms of equivalent electric (RLC) circuit. Mechanisms of excitation of loop oscillations are discussed. Examples of the diagnostics of coronal loop plasma for the flaring events on AD Leo, AT Mic, EV Lac, and EQ Peg are given. Comparative analysis was made concerning the advantages of coronal seismology diagnostics vs. scaling-law method.

Monday
5:00pm

Heating Diagnostics with Magnetoseismology

Y. Taroyan (University of Sheffield), R. Erdelyi

The gaps between the observed features of solar coronal loop structures and the predictions of theoretical models represent a major obstacle in understanding the physical processes that govern the behaviour of the plasma and ultimately lead to multi-million degree temperatures in the corona. We propose a new seismological tool for understanding these processes. Different forms of heating result in different plasma behaviour. These differences are quantified and the response in terms of Doppler shift time series and eigenmode frequency ratios is analysed. The feasibility of the novel method is tested.

Monday
5:15pm

Multi-Periodic Oscillatory Events in Solar Flares

A. Inglis (University of Warwick), Valery Nakariakov

Ratios of different significant periods found in the lightcurves of solar flares exhibiting quasi-periodic pulsations (QPP) may be used to distinguish between the possible physical mechanisms responsible for such behaviour, even in the absence of good spatial resolution. To illustrate this, time series data of the flaring event of 3rd July 2002, observed via the Nobeyama Radioheliograph, Nobeyama Radiopolarimeters, and the RHESSI satellite, are investigated with the use of the Lomb-Scargle periodogram technique.

Statistical analysis of the periodogram results indicates three distinct periods above the 99 % confidence level in Nobeyama Radioheliograph and Radiopolarimeter data, at 28s, 18s and 12s respectively. The two longest of these periods were also observed in the RHESSI data at the same confidence level. Wavelet analysis demonstrated that multiple periods occurred simultaneously without any significant frequency shift over time. Consideration of the period ratios leads to the conclusion that the cause of this multi-periodic event involves different spatial harmonics of a resonator, possibly a kink mode periodically triggering magnetic reconnection. This technique has applications for both solar and stellar coronal oscillations.

Monday
5:30pm

The Nature of Kink MHD Waves in Magnetic Flux Tubes

M. Goossens (CPA K.U.Leuven), J. Terradas, J. Andries, I. Arregui, J.L. Ballester

This paper examines the nature of MHD kink waves. This is done by determining the frequency, the damping rate and the eigenfunctions of MHD kink waves for three widely different MHD waves cases: a compressible pressure-less plasma, an incompressible plasma and a compressible plasma with non-zero plasma pressure which allows for MHD radiation. The overall conclusion is that kink waves are very robust and do not care about the details of the MHD wave environment. In all three cases the frequency and the damping rate are for practical purposes the same as they differ at most by terms proportional to (k_z R)^2. In the magnetic flux tube the kink waves are in all three cases, to a high degree of accuracy incompressible waves with negligible pressure perturbations and with mainly horizontal motions. The main restoring force of kink waves in the magnetized flux tube is the magnetic tension force. The gradient pressure force cannot be neglected except when the frequency of the kink wave is equal or slightly differs from the local Alfv'en frequency, i.e. in the resonant layer. In a non-magnetic external plasma the wave is of course acoustic. The adjective fast is not the correct adjective to characterize kink waves. If an adjective is to be used it should be Alfv'enic. However, it is better to realize that kink waves have mixed properties and cannot be put in one single box.

Monday
5:45pm

Stellar Oscillations and Magnetic Fields

M. Thompson (University of Sheffield)

The CoRoT and Kepler missions in particular are increasing enormously the number of stars which we can investigate with the methods of asteroseismology. In this talk I review briefly the effects of magnetic fields on stellar oscillations in the context of asteroseismology.

Tuesday
11:00am

Magnetar Seismology

N. Andersson (University of Southampton)

In this talk I will review exciting recent results for magnetar seismology. Observations of quasiperiodic oscillations in the tails of flares from strongly magnetised neutron stars are thought to be associated with oscillations in the neutron star crust. This provides us with the first opportunity to carry out seismology for these ultradense objects, testing our understanding of much exotic physics. This leads to a number of challenging questions, likely forcing us to move beyond standard ideal MHD models. I will summarise recent ideas concerning the possible existence of an Alfven continuum, and discuss new models that account for the presence of superfluid and superconducting components in the stars core.

Tuesday
11:30am

A Unified View on the Coronal Loop Eigenmode Problem and the Scattering of p-modes by Photospheric Fluxtubes

J. Andries

In this contribution we will formulate the eigenmode problem of straight longitudinally stratified loops for beta non-zero in terms of an impedance matching scheme. This allows to summarize the entire procedure in a single line. Under the approximation that the field is straight (an assumption certainly not stronger than the thin flux tube approximation used to describe the interaction of photospheric flux tubes and p-modes), even gravity can be taken into account. We elaborate on the obtained equation and show that it offers a unified view towards both the coronal loop eigenmode problem and the scattering of p-modes by photospheric fluxtubes. Among other things it offers an extremely elegant formulation of the appearance of the jacket modes.

Tuesday
11:45am

Chromospheric Seismology

K. Reardon (QUB / INAF-Arcetri), Cauzzi, G., Vecchio, A.

Recent applications of imaging spectroscopy to studies of the solar chromosphere have confirmed the rich assortment of wave behaviour present in this region directly connecting the lower atmosphere with the corona. It is clear that the chromosphere plays a crucial role in significantly modifying the upward propagating spectrum of oscillations that impinge from the photosphere below. Observations from the Interferometric Bidimensional Spectrometer (IBIS) have shown how this redistribution occurs both spatially, due to the effect of the increased dominance of magnetic structuring in this region of the atmosphere, as well as in frequency, possibly due to a turbulent cascade of the energy from acoustic shocks to smaller temporal scales. Understanding the drivers of coronal oscillations appears to require a clearer understanding of the chromospheric dynamics.

Tuesday
12:00pm

Magneto-Seismology with Alfvén Waves

G. Verth (K.U. Leuven), Robert Erdélyi

(C) MHD seismology of solar, space and astrophysical plasmas (Joint with MIST and UKSP)

The propagation of Alfvén waves into the solar atmosphere may provide a significant energy source for plasma heating through possible dissipation mechanisms such as phase mixing and resonant absorption. In the magnetospheric context, e.g., in open flux tube structures, heating caused by Alfvén waves may have fundamental implications for the both the existence and the properties of the solar wind. In light of the recent unprecedented chromospheric observations of torsional Alfvén waves using the high resolution Swedish Solar Telescope, the future possibility of exploiting the unique properties of this incompressible wave mode with the purpose of performing magnetoseismology on both the Sun's upper and lower atmosphere will be discussed. The relevance of loop diagnostics in terms of Alfvén waves will be addressed for a number of representative waveguides present in the solar atmosphere.

Tuesday
12:15pm

Fast Quasi-Periodic Pulsations in Solar Microwave Bursts

B. Tan (National Astronomical Observatories, CAS)

Fast microwave quasi-periodic pulsations with very short period (VSP, the period P<0.1s) is a kind of fine structure in solar microwave emission spectrogram related to the small scale structure close to the source region of the solar flares. There are many peculiar properties with VSPs. Unlike the usual QPP with period P>0.1s, VSP seems not to be interpreted as the MHD oscillations. In this work, we investigate the observational properties of VSPs with the observations in Chinese Solar Broadband Radiospectrometer (SBRS/Huairou) during 2004-2006 for the VSPs, and make a detailed discussion. Based on this analysis, we hope to present a reasonable explanation.

C-P01

Properties of Mirror Waves: THEMIS Observations

R. Boynton (University of Sheffield), M A Balikhin, S N Walker

Mirror waves are a common feature for many key regions of space plasmas such as the solar wind, planetary magnetosheaths, cometary plasma, Io wake and the terrestrial ring current. The kinetic mirror instability was discovered by Vedenov & Sagdeev, [1958]. However in spite of its apparent simplicity, observations of mirror waves pose a number of puzzles. In contrast to other waves, the mirror waves are only occasionally observed as periodic structures. More often they are observed as either a sporadic decreases of magnetic field refered to as magnetic holes or sporadic increases of magnetic field refered to as magnetic peaks. THEMIS data are used for a statistical study of the spatial scales and properties of various types of mirror wave structures.

C-P02

Radio Observations of Long Period Oscillations in Sunspots

N. Chorley (University of Warwick), B. Hnat. V. M. Nakariakov, A. R. Inglis

Long period oscillations of the gyroresonant emission from sunspot atmospheres are studied. Time series data generated from images obtained by the Nobeyama Radioheliograph operating at a frequency of 17 GHz for three sunspots have been analysed and are found to contain significant periods in the range of several tens of minutes. Wavelet analysis shows that these periods are persistent throughout the observation periods. The presence of the oscillations is confirmed by several methods (periodogram, wavelets and the Fisher randomisation). Possible interpretation of the observed periodicities are discussed.

C-P03 High Frequency Waves in Photospheric Magnetic Bright Points

P. Crockett (QUB), Mihalis Mathioudakis, David Jess, Francis Keenan

Photospheric Magnetic Bright Points, (MBPs), are at the diffraction limit of modern ground based telescopes, with typical diameters of <300km. They are believed to be the foot points of magnetic flux tubes and appear bright due to the increased magnetic pressure. It has recently been suggested that short period (<100s) magneto-acoustic waves, formed in or near flux tubes, could be responsible for heating the chromospheric network. Quiet sun data taken, from the Swedish Solar Telescope at both high spatial and temporal resolution, is investigated using a new MBP identification and tracking algorithm. The wavelet analysis performed on these MBPs shows evidence for oscillations in the range of 40-100s.

C-P04 Characteristics of Energetic Protons during Selected Forbush Decrease Events in the Period of 1995 - 2007

I. Dorotovic (Slovak Central Observatory, Hurbanovo, Slovakia), M. Rybansky, Institute of Experimental Physics SAS, Watsonova 47, 043 53 Kosice, Slovak Republic

Properties of sudden decreases of cosmic radiation (Forbush Decrease - FD) have been studied by many authors during last seven decades. Recently we investigated temporal evolution of 34 selected FDs decreases of the Neutron Monitor (NM) level of the Institute of Experimental Physics SAS at Lomnicky Peak in the period of 1995 - 2007. Evolution of the individual FDs was supplemeted by data on the proton density and the magnetic field intensity in the interplanetary space according to measurements at the satellites WIND, ACE, and GOES. We indentified five types of FDs according to the shape of the evolution of a decrease. In this paper we continue to analyse proton counts evolution during the selected FDs in different energetic channels according to measurements at the satellites GOES 8 - 11 and we defined new classes of FDs.

C-P05 Slow Sausage Waves in Magnetic Pores and Sunspots

I. Dorotovic (Slovak Central Observatory, Hurbanovo, Slovakia), R. Erdelyi, Solar Physics and Space Plasma Research Center (SP2RC), Dept of Applied Mathematics, University of Sheffield, UK; V. Karlovsky, Hlohovec Observatory and Planetarium, Sladkovicova 41, SK-92001 Hlohovec, Slovak Republic; I. Marquez, Instituto de Astrofisica de Canarias, E-38205 La Laguna, Tenerife, Spain

Recently we identified slow sausage waves in a magnetic pore analysing 11-hour series of high resolution white light observations of the sunspot group NOAA 7519(Dorotovic et al., 2008). The resulted periods were in the range of 20-70 minutes, suggesting that the temporal evolution of the area of the studied pore could be considered as observational evidence of linear low-frequency slow sausage waves in magnetic pores. Here we selected several additional series of images with high angular resolution for purposes of the identification of slow sausage waves in magnetic pores and in sunspots, respectively. Our investigation revealed periods in the range of 3 - 20 minutes.

C-P06 MHD Wave Propagation in Localised Magnetic Flux Tubes Connecting the Photosphere to Corona

V. Fedun (University of Sheffield), R. Erdelyi

We examine numerically the linear and non-linear propagation of magneto-acoustic waves in flux tube embedded into the two-dimensional solar atmosphere.

To perform the modelling we employed our newly developed MHD code SAC (Sheffield Advanced Code) which exploits numerical variable separation and advanced hyper-resistivity and diffusivity techniques. The plasma equilibrium is constructed by a combination of the VAL IIIC and McWhirter solar atmosphere and corona density profiles. The localised magnetic flux tubes, embedded in the stable background, are modelled as a self-similar non-potential magnetic field configuration. Harmonic wave sources, located at the bottom of the magnetic flux tube representing photospheric motions at the solar temperature minimum, are incorporated to excite and drive a range of typical transverse and vertical (longitudinal) periodic motions propagating from the photosphere to the corona in this building box of the solar atmosphere.

The following results will be discussed in detail:

- The rich pattern of mode conversion at the region where the plasma beta is equal to unity;

- The slow and fast magneto-acoustic modes in the chromosphere form shock waves which then hit the transition region (TR). This impulsive impinging causes strong perturbations of the TR and forms shock wave fronts in the solar corona;

- High-frequency magneto-acoustic waves propagate from the lower atmosphere through the transition region, experience relatively low reflection, and transmit most of their energy into the corona;

- The thin transition region acts as a good wave guide for horizontally propagating surface waves for all types of drivers investigated.

With the above forward modelling we serve as impetus for magneto-seismologic acquisition of the complex and dynamic solar atmosphere.

C-P07 MHD Waves in Compressible Magnetically Twisted Flux Tubes

V. Fedun (University of Sheffield), R. Erdelyi

The oscillatory modes of a magnetically twisted compressible flux tube embedded in a compressible magnetic environment are investigated in cylindrical geometry. The complex dispersion equation in terms of Kummer's functions is obtained for the approximation of weak and uniform internal twist. The sausage, kink and fluting modes are examined by means of the derived exact dispersion equation. The solutions of this dispersion equation are found analytically for short and long wavelength limits under plasma conditions representative of the solar photosphere and corona. Numerical solutions for the phase velocity of the allowed eigenmodes are obtained for a wide range of wavenumbers and varying magnetic twist. Our results generalize previous classical and widely applied studies of MHD wave oscillations in untwisted loops. Applications to solar magneto-seismology are discussed.

C-P08 Evolution of Kelvin-Helmholtz Activity on the Dusk Flank Magnetopause

C. Foullon (University of Warwick), C.J. Farrugia, A.N. Fazakerley, C.J. Owen, F.T. Gratton, R.B. Torbert

Our purpose is to characterize the evolution of the magnetopause Kelvin-Helmholtz (KH) wave activity with changes in thickness of the adjacent boundary layer, geomagnetic latitude and interplanetary magnetic field (IMF) orientation. As the IMF turns northward, wave activity may be generated at the dayside before propagating down the tail, where the boundary layer is expected to support longer wavelengths. We use two-point observations on the dusk magnetopause at low latitudes, from Geotail on the dayside and Cluster tailward of the dusk terminator. We quantify the wavelength, power, wavefront steepness and propagation direction at Cluster. An estimate of the thickness of the low-latitude boundary layer (LLBL) is obtained by correlating normal distances to the magnetopause, derived from two empirical solar-wind-driven models, with a systematic relationship (the "transition parameter") found between the electron number density and temperature; the correlation factor is used to infer the temporal evolution of the thickness of the locally sampled layer. We find that wavelengths are controlled by the IMF clock angle, as expected when generated by the KH mechanism at the dayside, although amplitudes, wavefront steepness and propagation directions are more closely correlated with the layer thickness. A survey of parameter space provides evidence of the contribution of the KH mechanism to the widening of the electron LLBL.

C-P09 Ultra-Long-Period Oscillations in EUV Filaments near to Eruption: Multi-Wavelength Diagnostics and Seismology

C. Foullon (University of Warwick), E. Verwichte, V.M. Nakariakov

We investigate whether or not ultra-long-period oscillations in EUV filaments are related to their eruption. We report new observations of long-period (5 - 30 hours) oscillatory motions in a quiescent filament as it crosses the solar disk, in a 12-minute-cadence with SoHO/EIT 195A uninterrupted data set. This dataset is chosen to explore characteristics of the filament oscillations depending on its eruptive behaviour, which is observed while the filament is still on the disk. The periods are found to increase prior to eruption. For the events reported so far, we compare and link the EUV filament oscillations with pulsations in total solar EUV irradiance from SoHO/CELIAS/SEM 304A flux measurements. We find that the pulsations at 304A have similar periodicities but are not in phase with the 195A filament oscillations. We use the oscillation characteristics and the multi-wavelength diagnostics thus obtained to perform a seismology of the filaments and to better define the thermal effects in the oscillations. We discuss the implications of the detected variations for the forecasting of prominence eruptions.

C-P10 Microwave Observations with the RATAN-600 Radio Telescope of the Off-Limb Sources in Different Non-Stationary Solar Processes

I. Grigoryeva (Central Astronomical Observatory at Pulkovo RAS), Larisa K. Kashapova, Moisey A. Livshits, Valery N. Borovik

Multi-wavelength solar observations in microwaves were carried out at the RATAN-600 radio telescope after the peak of the X-ray flare in several eruptive events with post-eruptive arcade formation. The total flux spectrum and polarization of the radio sources associated with the post-eruptive arcades were analyzed and compared with the data in different spectral ranges obtained by RHESSI and other space crafts. Radio data obtained at the early stage of arcade formation (in the limb event on 25 January, 2007) can be interpreted as thermal free-free emission of a large hot plasma source plus a non-thermal contribution due to particle acceleration. We note that in different events this contribution depends on the amount of accelerated particles and the stage of the arcade formation. The scenario of the arcade formation for different eruptive events (either with well manifested impulsive part of the flare or with the filament eruption) is discussed.

C-P11 The Hilbert-Huang Transform in the Analysis of Quasi-Periodic Pulsations in Solar Flares

J. Harris (University of Warwick), A. R. Inglis, V. M. Nakariakov

Flaring energy releases are essentially nonlinear and non-stationary processes, and this should be taken into account in their analysis. We test the applicability of the Hilbert-Huang transform method which was specifically designed to work for non-stationary and nonlinear data, to the analysis of microwave and X-ray oscillatory light curves of the flaring emission. In particular, this technique provides us with a tool for the study of multi-periodic events with time modulation and mode coupling. Both synthetic and natural datasets are analysed using empirical mode decomposition with the Hilbert transform, also the results are compared against the wavelet analysis with the Morlet mother function, and against empirical mode decomposition combined with wavelets.

C-P12 The Web-Based System for the RATAN-600 Solar Microwave Data Analysis

T. Kaltman (Special astrophysical observatory), S. Sh.Tokhchukova, E.V.Modin, V.M.Bogod

The intelligent knowledge-based system (IKBS) with a network access is used now for on-line treatment of solar observational data of the large radio telescope RATAN-600 at http://www.spbf.sao.ru/prognoz/index_eng.php The circularly polarized solar emission (R and L) are regularly registered in a broad range of microwaves (3-18 GHz with 1 % spectral resolution) simultaneously.

Presented here an intelligent information system is intended to a data collection, storage, processing, analysis, modeling and a convenient using of the large data archive via the interactive web applications. The system carries out an automatic quality control and preprocessing of the data, a search of active regions (ARs) and their identification. The system provides the web interface to analyze a data, retrieve an intensity spectra of a selected point of the Sun, compare with data of other observatories (SOHO, SSRT, Nobeyama) and so on. The results of an express Gauss-analysis are also available for the more prominent radio sources of AR as a table filled with a source size, flux density, brightness temperature and polarization degree through the frequency range.

The system also provides interactive observational data simulations (for RATAN-600 radio telescope) based on simplified models of some typical solar sources. These simulations take into account free-free, gyro-resonance and gyro-synchrotron mechanisms of emission. A comparison of the modeling results with the observational data makes possible the plasma diagnostics at the corona and the transition region levels.

Statistical study revealed an existence of special features of flare-productive ARs (Bogod and Tokhchukova, 2003, 2006). The regular and broadband RATAN-600 observations are very convenient for the daily analysis and diagnostic of the pre-flare plasma. Now the web applications for such automatic diagnostic are under development.

V. M. Bogod and S.Kh.Tokhchukova, Astronomy Letters, 2003, 29, 4, p. 263. V. M. Bogod and S.Kh.Tokhchukova, Cosmic Research, 2006, 44, 6, p. 506.

C-P13 Acoustic Oscillations in the Field-Free, Gravitationally Stratified Cavities under Solar Bipolar Magnetic Canopies

D. Kuridze (Georgian National Astrophysical Observatory), T.V. Zaqarashvili, B. M. Shergelashvili, and S. Poedts

The main goal is to study the dynamics of the gravitationally stratified, field-free cavities in the solar atmosphere, located under small-scale, cylindrical magnetic canopies, in response to explosive events in the lower-lying regions. The resonant oscillations of these cavities explain the observed power halos near magnetic network cores and active regions.

C-P14 Solar Variability and CMEs in the 23rd Cycle of the Solar Activity

M. Lorenc (Slovak Central Observatory, Hurbanovo, Slovakia), I. Dorotovic, Slovak Central Observatory, P. O. Box 42, SK-94701 Hurbanovo, Slovak Republic

Coronal mass ejections (CMEs) are important phenomena of the solar activity. Their source is not clearly understood yet. Solar variability has strong correlation with global and local magnetic field on the Sun. Similarly, also evolution of CMEs is connected with structure of solar magnetic fields. Correlations between properties of CMEs and solar variablity indices are investigated in the paper. Cross-correlations show that stronger connectivity exists between faster CMEs and the solar activity represented e.g. by the sunspot number, Mg II index, etc.

C-P15 3-D Magneto-Seismology of Transverse Oscillations by Means of STEREO Coronal Loops

R. Morton (University of Sheffield), R. Erdelyi

Since the launch of SOHO and TRACE, the very complex fine structure of the dynamic and highly magnetised corona has been extensively studied. Areas such as solar magneto-seismology have benefited greatly as a wealth of novel theoretical work emerged to explain the observations of coronal loop oscillations. However, these satellites have only been able to provide line of sight information on the geometry of coronal loops.

The study of delineated loops in the corona is a key subject of solar magneto-seismology. Applying theoretical models of magnetic waveguides to observations of waves and oscillations in coronal loops, the aim of solar magneto-seismology is to deduce otherwise unmeasurable or hardly measurable physical parameters (loop expansion, scale height, magnetic field, fine structure, etc.) of these coronal loops. A popular measurement is the ratio of the periods of the fundamental kink mode to the first kink overtone (P1/P2), followed by the dedection of either the scale height or loop expansion.

The launch of STEREO has now allowed the improvement in the reconstruction of the geometry of coronal loops. Recent work on loop reconstruction by Aschwanden et al. (2008) provided detailed 3-D geometry of coronal loops including loop shape and inclination angle. It was found that most loops have a non-circular shape with a deviation from circularity up to 30 %. Armed with the knowledge of loop geometry (non-circular shape, inclination angle, position in the disk, stage of emergence) here we discuss the important influence of these parameters on the eigenfrequencies of standing coronal loop oscillations. In particular, we demonstrate how the lack of determination of such parameters as shape, inclination angle, stage of emergence would result in relevant errors of loops diagnostics (e.g. estimates of scale height, magnetic field strength).

C-P16 Numerical Investigation into Sheared MHD Turbulence

A. Newton (University of Sheffield), Dr Eun-jin Kim

Shear flows and magnetic fields are ubiquitous in astrophysical plasmas, playing a crucial role in turbulent transport. Here, we present the first numerical results of the suppression of magnetic diffusion by a shear flow in 2D MHD turbulence. For a very strong magnetic field, a new scaling regime of magnetic diffusion quenching by magnetic fields is found, with a stronger dependence on magnetic field strength compared to the previous result [1]. Furthermore, we show the first numerical evidence of enhanced transport due to the interaction between shear flow and magnetic field via resonances,which weakens the magnetic diffusion quenching. Similar results are also presented for momentum transport. These results highlight the importance of shear flows, (Alfven)waves, and resonances in understanding turbulent dissipation of magnetic fields. We discuss important implications of these results in turbulent magnetic reconnection and dynamos. [1] F. Cattaneo & S.I. Vainshtein, Astrophys. J. Lett. 376. L21 (1991)

C-P17 Numerical Simulations of Transverse Waves Propagating in the Corona

D. Pascoe (University of St Andrews), A. N. Wright, I. De Moortel

Low amplitude transverse waves propagating upwards along magnetic field lines are ubiquitous in the solar corona. We present numerical simulations of transverse velocity wave trains propagating in a low beta plasma. The effects of transverse density structuring of the corona on wave properties are considered in the context of coronal seismology.

C-P18 Acoustic Wave Propagation in the Solar Sub-Photosphere with a Localised Non-Uniform Magnetic Field Concentration

S. Shelyag (University of Sheffield), S. Zharkov, R. Erdelyi

Using the newly developed full non-linear MHD code SAC (Sheffield Advanced Code), here we analyse numerically the propagation and dispersion of acoustic waves in the solar-like sub-photosphere with localised non-uniform magnetic field concentrations, mimicking sunspots with various representative magnetic field configurations. We demonstrate that for the weakly magnetised case the effect of magnetic field is mainly thermodynamic, since the magnetic field changes the temperature stratification. For the strong magnetic field cases, we observe the signature of the slow magneto-acoustic wave mode, propagating downwards, besides the effect of changed thermal structure. Oscillatory energy damping is also observed in the magnetised regions during the forward modelling, complemented with energy leakage downwards due to the wave mode conversion from purely acoustic one to slow magneto-acoustic wave motions. We also perform time-distance helioseismic analysis of the simulated sunspots and show the dependences of the travel time differences between sunspot and non-magnetic regions of the simulations, and compare them with the ray approximation calculations. Finally, we demonstrate that the effect of magnetic fields on the wave propagation is mainly thermodynamic for the selected magnetic field configurations.

Monday
11:00am

Mercury: It's not the Moon!

D. Rothery (Open University), the BepiColombo Surface & Composition Working Group

The MESSENGER fly-bys have strengthened the view that Mercury's resemblance to the Moon is only superficial. Volcanic terrain is widespread and possibly virtually ubiquitous, whereas primary "floatation cumulate" crust has yet to be identified. These may be consequences of loss of iron-rich upper mantle in a giant impact.

Monday
11:25am

Solar Energetic Particles in Mercury's Environment

M. Laurenza (INAF/IFSI-Roma), A., Gardini, M. Storini

Mercury's magnetosphere only partially protects its surface from solar energetic particles (SEPs). When an SEP event impacts Mercury, a significant flux of energetic particles will reach Mercury's surface, according to their energy. Main SEP effects are as follows: i) production of secondary particles (by interaction with soil); ii) contribution to changes of Mercury's exosphere (e.g. Potter et al., 1999, Leblanc et al., 2003). This study is devoted to simulate the propagation of several SEP events characterized by different energy spectra in Mercury's environment by using the Planetocosmics code. In particular, we computed fluxes and tracks of primary and secondary particles at the surface level and different selected altitudes (e.g. 400 km and 1500 km) for the BepiColombo orbit.

Monday
11:45am

A New View of Mercury: What BepiColombo MIXS Can Expect to Find

J. Bridges (University of Leicester)

The Messenger mission has revealed a complex history of volcanism, tectonism, and impact basin modification on Mercury, establishing new constraints on the planet's formation and interior evolution that will guide many of BepiColombo's investigations. For instance, the initial Messenger encounters have imaged much of the surface that Mariner 10 missed, establishing the existence of pyroclastic deposits and widespread volcanism. The new discoveries are discussed in the light of BepiColombo's - and in particular the MIXS X-ray spectrometer - planned science activities.

Monday
12:05pm

The Mercury Imaging X-ray Spectrometer (MIXS)

A. Martindale (University of Leicester), G.W. Fraser, J.F. Pearson, C.H. Whitford, D.A. Rothery, E.J.Bunce, D.L.Talboys,

The Mercury Imaging X-ray Spectrometer (MIXS) is an instrument which will fly on ESA's BepiColombo mission to Mercury. It will measure fluorescent X-rays from the surface of the planet, which are induced by Solar-coronal X-rays, as well as X-ray emission induced by the impact of the energetic charged particles in Mercury's magnetosphere with the planet's surface. This enables the instrument to probe both the surface elemental composition and the complex surface-magnetosphere interactions. We present an overview of the capabilities, scientific goals and the enabling technologies for MIXS - the first ever imaging X-ray spectrometer for planetary science.

D-P01 Mercury's Surface Composition from Infrared Spectroscopy with IRTF/SPEX

D. Rothery (Open University), J. Warell, D. Rothery, R.W. Kozlowski, A.L. Sprague, J. Helbert, A. Önehag, G. Trout

The compositionally discriminative wavelength region 1-6 microns is an observationally largely neglected range for Mercury. While the NASA MESSENGER mission's MASCS instrument obtains surface spectra from 0.3 to 1.45 microns, only a few extending up to about 6 microns have been published. To remedy this situation, and to complement and extend close-range MESSENGER spectroscopic studies, we have largely completed the observational part of an extensive ground-based spectroscopic program of Mercury. Using the SpeX medium-resolution spectrograph at the NASA Infrared Telescope Facility (IRTF) on Mauna Kea, Hawaii, we have obtained disk-resolved spectra of a near-global part of Mercury's surface as well as lunar sites in the wavelength range 0.8-5.5 microns.

Ground-based reflectance spectroscopy from 0.4 - 1.0 microns indicates low or no FeO (likely <2 wt\%) on average. Previous results using SpeX (0.8 - 5.2 microns) verify these findings and have tentatively identified low-iron clinopyroxene in poalr regions. Thermal infrared spectroscopy indicates that the composition is definitely heterogeneous in composition, composed of low- to no-iron pyroxene and intermediate to feldspathic rock types with spotty regions of ultra-mafic make-up. These results on Mercury's surface composition are corroborated by MESSENGER MDIS imagery and MASCS spectroscopy obtained at the first flyby.

The fact that MASCS did not detect any sign of FeO stresses the need for complementary wavelength observations extending into the IR in to search of absorption features. The specific minerals and rock types present, as well as their abundances and geologic distributions, can be used to infer the type of crust, thermal and geologic history, composition of mantle magma source regions, bulk composition, and ultimately the mode of formation of the planet.

Tuesday
2:00pm

Spectroscopic Investigation of Small NEOs

S. Duddy (Queen's University Belfast), Fitzsimmons, A., Hsieh, H., Holman, M., Jedicke, R.

Close approaches and collisions of near-Earth objects (NEOs) with the Earth are more likely to be due to small (sub-kilometre) objects. In the last year there have been 91 known NEOs in this size range which have come within 5 lunar distances of the Earth. Unfortunately information about the physical properties of this small class of NEOs is limited and based mainly on knowledge of the kilometre-sized population. Spectroscopic observations covering the 0.4 to 1 micron wavelength range of a sample of 31 NEOs with H>20.5 (equivalent to diameters <300m) have been carried out using EFOSC2 on the NTT and ISIS on the WHT. The relative number of silicate to non-silicate objects in the sub-kilometre NEO population will be obtained. The results of this study will be compared to those expected from meteorite sampling, while the strength of the observed silicate absorption features will be used to test models of dynamical evolution.

Tuesday
2:15pm

The Marco Polo Mission: a Sample Return from a Near Earth Object for Laboratory Studies

I. Franchi (PSSRI, Open University), M.A. Barucci, D. Agnolon, R. Binzel, H.B. Bohnhardt, J.R. Brucato, E. Dotto, S.F. Green, J.-L. Josset, J. Kawaguchi, D. Koschny, P. Michel, K. Muinonen, J. Oberst, J. Romstedt, H. Yano, M. Yoshikawa

Marco Polo is a joint European-Japanese mission proposed as part of the Cosmic Vision program to perform a sample return from a primitive Near-Earth Object (NEO), such as a C- or D-type asteroid or extinct comet.

The principal scientific objective of the Marco Polo mission is to return unaltered NEO primitive materials for terrestrial laboratory studies. It is based on a launch with a Soyuz launcher in 2017/2018. The spacecraft would approach the target asteroid and spend a few months characterizing the target object. Then it would descend for a shot time to retrieve one or several samples, which will be transferred to a sample return capsule. The sample return capsule would return to Earth 5 to 7 years after launch.

NEOs are part of the small body population in the Solar System, which are leftover building blocks of the Solar System formation process. They offer important clues to the chemical mixture from which planets formed 4.6 billion years ago. They are connected very closely to the formation of the inner Solar System and maybe had a potential contribution to the formation of Life. Most of the measurements require detailed analysis demanding high levels of analytical accuracy, precision and sample selectivity that can only be attained in ground-based laboratories.

Once returned on Earth, samples will undergo preliminary characterization and classification within dedicated sample curation facilities before being delivered to worldwide laboratories for detailed investigation of the elemental and isotopic compositions, mineralogy, petrology, organic and interstellar grain inventories, etc. The samples returned from the surface of a primitive NEO will contain material more primitive than currently available from meteorites as this is generally lost during atmospheric entry, with only more coherent meteorites, the product of asteroidal modification, surviving to be collected on the surface of the Earth.

Tuesday
2:30pm

Surface Properties of Main-Belt Comets

H. Hsieh (Queens University Belfast)

We present the results of a study utilizing infrared data from Spitzer and optical data from a variety of ground-based telescopes to determine the albedos and physical dimensions of the nuclei of main-belt comets 133P/(7968) Elst-Pizarro and 176P/(118401) LINEAR. For 133P, we find an albedo of p_R=0.05+/-0.02 and an effective radius of r=1.9+/-0.3 km (estimated semiaxes of ~2.3 km and ~1.6 km). For 176P, we find an albedo of p_R=0.06+/-0.02 and an effective radius of r=2.0+/-0.02 km (estimated semiaxes of ~2.6 km and ~1.5 km). These albedos are consistent with low albedos found for both other cometary nuclei, as well as other B- and C-type asteroids in the Themis family, among which 133P and 176P are found, in the main asteroid belt. We therefore find that, in terms of albedo, there is no indication that 133P and 176P are compositionally unique among other dynamically similar (but inactive) Themis family asteroids, but also that low albedo (p_R<0.075) remains a consistent feature of all cometary (i.e. icy) bodies, whether they originate in the inner solar system, like the MBCs, or in the outer solar system, like all other comets. We will also discuss ongoing work to further characterise the properties of the MBCs and compare them to those of other small-body populations of interest. This work is supported by STFC fellowship grant ST/F011016/1. Reference: Hsieh, Jewitt, & Fernandez, ApJL 694, 111.

Tuesday
2:45pm

Photometric study of Distant Comets: C/2002 VQ94 (LINEAR) and 29P/Schwassmann- Wachmann- 1.

A. Ivanova (MAO NASU), Korsun P.P., Afanasiev V.L.

The photometrical analysis results of two distant comets C/2002 VQ94(LINEAR) and 29P/Schwassmann-Wachmann-1 are presented.The comets were observed at the 6-m telescope BTA (SAO RAS, Russia).The comets show considerable level of activity beyond a zone of sublimation of iced water (heliocentric distance more 5 AU).The CO+ and N2+ emissions in the comets comae evidence that they might be formed at the outer region of the Solar System or in the pre-solar interstellar cloud at the low temperature environment, T<=25 K. A photometrical maximum of the isolated CO+ ionosphere in comet VQ94 is shifted by 1.4 arcsec towards to a photometrical maximum of the dust coma in a direction that deviates by 63 grad from the sunward direction. Using the special filters for identification of jets in the inner coma of comet SW1, the dust productivity and the estimates of positive molecular ions production in cometary comas of VQ94 and SW1 were calculated.

Tuesday
3:00pm

Characterising the Members of the First TNO 'Collisional Family'

C. Snodgrass (ESO), B. Carry, C. Dumas, O. Hainaut

Brown et al. (2007, Nature, 446, 294) discovery of the first collisional family in the Trans-Neptunian Region; a group of objects with very similar spectral features that could be linked dynamically with 136108 Haumea (2003 EL61). They all show the same almost pure water ice spectrum as Haumea, and Brown et al. postulate that the family was formed in a collision with the large and already differentiated proto-Haumea early in the history of the Solar System, leaving the overly dense and fast spinning core with a thin covering of water ice as Haumea and generating a family of pure water ice bodies from the outer layers. Ragozzine & Brown (2007, AJ, 134, 2160) published a list of 36 potential family members selected on dynamical grounds.

We measure the physical characteristics of these proposed family members. We assess the membership of the family for each body by detecting the signature of water ice on the surface using optical and near-infrared colours; a unique strength of using the new HAWK-I imager at the VLT is that this instrument contains a medium band filter (CH4) that covers the water absorption band at 1.5 microns, making the (J-CH4) colour very sensitive to this feature and therefore a strong indicator of water ice. We test the idea that these bodies are composed almost entirely of water ice by placing limits on the density of the bodies by measuring light-curves: High minimum densities rule out a pure water ice composition.

We have observed 18 of the candidate family members. We report optical colours on 8 TNOs with no previous colour measurements, and near-infrared colours and an assessment on the presence or absence of water ice on the surface of 13 TNOs, plus observations of larger bodies with known spectra (including Haumea) to demonstrate the method.

Tuesday
3:15pm

A Herschel Survey of the Transneptunian Region

P. Lacerda (Queen's University Belfast), Herschel OT KP Team (PI: T. Mueller, MPE Garching)

Beyond planet Neptune lies a vast population of icy small bodies, in a region known as the Kuiper belt. These Kuiper belt objects (KBOs) are mostly outer solar system planetesimals that preserve key information about the physical and chemical conditions at the time if the formation of the solar system.

Over one thousand KBOs are currently known and they represent 1\% of the estimated total population of bodies larger than 50 km. The larger KBOs, larger than a few hundred kilometers and up to a few thousand in diameter, are particularly interesting in the sense that they are thought to have preserved many of their primordial properties.

The Herschel Open Time Key Programme "TNOs are Cool" will target over 140 KBOs (or TNOs, for trans-Neptunian objects), including at least 25 multiple systems, with the goal of measuring their thermal flux in up to six far-infrared bands from 70 to 500 micron. From these measurements we will derive fundamental (albeit hard to obtain) quantities such as as size, albedo and surface thermal properties for most targets. The resulting table of physical properties will allow 1) the determination of the size distribution of the larger KBOs, thought to have remained unchanged from the accretion phase, 2) a search for correlations between physical properties and orbital parameters, diagnostic of formation and evolution mechanisms, 3) robust mass-density estimates for at least 20 binary systems, diagnostic of interior structure and nebular chemistry, and 4) the first large-scale study of KBO thermophysical properties (thermal inertia and surface emissivity).

When combined with measurements (e.g. from the New Horizons mission to the outer solar system) of Kuiper belt dust, our results will provide a benchmark for understanding the debris disk of the solar system, as well as those around other stars.

E-P01

An Outer Solar System Ecliptic Latitude Survey

E. Ansbro (Open University), Simon Green, Apostolis Christou, John Murray

Edgeworth Kuiper Belt Objects (EKBOs) orbit beyond Neptune and offer important clues about the formation of our solar system. Far from resembling an accretion disk leftover, the discovery of some EKBOs with inclinations as high as 40 degrees demonstrates that the full latitudinal extent of the EK belt must be large. Ascertaining the true extent of the transneptunian objects (TNO) inclination distribution is important for planning TNO surveys. It is important for determining the total number of TNOs and the past and present mass contained in the EKB. It will also provide data that may confirm or alter our understanding of solar system formation.

Past surveys of TNOs are probably a poor representatiion of the true distribution of EKBO inclinations because most were found in surveys centred on the ecliptic. Such surveys were biased towards finding low inclination objects which spend the majority of their orbit close to the ecliptic.

A 0.9 metre telescope at Kingsland Observatory, County Roscommon, Ireland has been carrying out a two year statistical survey by imaging a range of ecliptic latitudes that are equidistant from each other and measuring the density of EKBOs found at each latitude. Imaging sets of fields spaced uniformly, in particular, North of the ecliptic will determine the resonance structure imposed on the belt by the gravitational effects of Neptune. At each longitude, fields at several ecliptic latitudes have mapped the inclination distribution of the belt, testing competing theories for the formation and orbital evolution of the giant planets.

The survey also includes a search for a hypothetical ninth planet beyond the EKB as a follow up survey of some 'suspected planets'. The follow up survey will attempt to detect whether or not this planet exists based on the targets located by prior research.

E-P02 Asteroid Electric Field Instrumentation and Modelling for the Marco Polo Mission

K. Aplin (Rutherford Appleton Laboratory), Esben Urbak, Neil Bowles, Eric Sawyer and Dave Parker

The Marco Polo mission has been selected by the European Space Agency as a candidate for launch under their 2015-2025 Cosmic Vision programme. The mission aims to understand the origins of the planets and even life itself, by returning a sample of material from a primitive asteroid, representative of the early Solar System. Physical mechanisms controlling dust transport on asteroids are poorly understood, and there is evidence for electric charging of the surface due to photoelectron emission. By analogy with the Moon, electrostatic dust levitation has been proposed as a possible method to redistribute particles, and as a loss mechanism for smaller particles which are poorly bound by the small gravitational field of the asteroid. Asteroid electric charge has never been measured, but models predict that an electric potential (~1 kV) can be attained on the dark side compared to the sunlit side, which becomes slightly positively charged (+5V) by photoelectron emission. These differences are enhanced further by local geometry at the terminator (the day/night boundary).

As the differing spacecraft and asteroid potentials are likely to be relevant to the sample return process, the Marco Polo Asteroid Charge Experiment (ACE) includes sensors to measure the asteroid's electrical properties. Vertical and horizontal electric fields can be determined from the differing potentials of two electrically isolated and spatially displaced electrodes. It may also be possible to determine the asteroid's floating potential through displacement current measurements.

This presentation will discuss the instrument concept, and related electrostatic modelling of Itokawa, (for which, unlike the Marco Polo candidate asteroids, a detailed shape model is available). The maximum horizontal electric fields at the terminator are expected to be ~40kV/m, consistent with model predictions. Electric fields of ~1kV/m are also generated in shadowed regions as a result of Itokawa's topography.

E-P03 The Asteroid Thermal Mapping Spectrometer: An Imaging Mid-IR Spectrometer for the Marco Polo NEO Sample Re-turn Cosmic Vision Candidate Mission

N. Bowles (University of Oxford), S. Calcutt, F. Reininger , S. F. Green and H. Mortimer

The Marco Polo Near Earth Object (NEO) sample return mission has been selected for further study as part of ESA's on-going Cosmic Vision mission planning exercise. The mission's primary aim is "To return a sample from a Near-Earth Object belonging to a primitive class to the Earth". A multi-spectral, mid-infrared imaging instrument is essential to the Marco Polo remote sensing payload. It will provide key information on the nature of the surface by measuring its diurnal thermal response (thermal inertia) and mineralogy, essential to selecting sampling sites compatible with the Marco Polo sample acquisition system. We describe the Asteroid Thermal Mapping Spectrometer (ATMS) currently under development at the University of Oxford. The ATMS is a compact Fourier transform spectrometer that fully meets the requirements of the Marco Polo mid-IR instrument. The ATMS uses a fixed set of beam splitters and Fourier optics rather than a traditional moving mirror design to generate an interferogram on a two dimensional detector array. The resulting instrument is compact (<3kg), robust (no moving parts except a scan/calibration mirror assembly) and has adequate spectral resolution (3-20cm-1) and spectral range (5-25 microns depending on detector array used).

E-P04 The Spectrum of the Earth-Impacting Asteroid 2008 TC3

A. Fitzsimmons (Queen's University Belfast), S. Duddy, H. Hsieh, G. Dalton

On 6th October the small Near-Earth Asteroid 2008 TC3 was discovered less than 24 hours before entering the Earth's atmosphere. We obtained the only known spectra of this object 4.4 hours before impact, using the the 4.2m William Herschel Telescope and ISIS spectrograph. We will present the spectrum of 2008 TC3 and discuss its interpretation in light of current models of NEA evolution.

E-P05 Insolation of a Cometary Crater by Stage Formation of a Dust Jets

A. Ivanova (MAO NASU), Chorny G.F., Shulman L.M.

The direct solar radiation illuminating a segment of surface without screening by dust appears to be important reason of activation and development of active processes on a surface of cometary nucleus. The intensity of solar radiation on the surface of cometary nucleus depends on the thickness of a dusty cloud over active area. The intensity becomes function dependent of time strongly under noticeable size changes of a dusty cloud. This paper the nonlinear equation of radiative transport through dust cloud, growing towards to light front with constant speed, is considered. The intensity distribution of direct solar radiation along dust ejection (jet) from active area on a surface of cometary nucleus is found. For comparison, the solution of linear equation of radiative transport for this problem is found. It turns out that the solution of problem considered in linear approximation leads to significant loss of quantity of direct radiation taking part in dust jet formation. The lost is comparable with intensity of the solar radiation that falling on an active area of cometary nucleus after atmospheric dispersion of comet.

E-P06 The Simulation of Dust Tail Striae in Comet C/2002 V1 (NEAT)

G. Jones (MSSL, University College London), J. Morrill

Striae are quasi-linear dust tail features that generally only appear in high dust production rate comets when close to the Sun. Several formation scenarios have been proposed for their formation; all of these involve the fragmentation of cometary dust into smaller particles. The differing efficiencies of radiation pressure on these dust grains is believed to account for their extension into elongated, near-linear tail structures. The number of comets which have displayed striae is small, but prominent examples include C/1965 S1 (Ikeya-Seki), C/1975 V1 (West), C/1997 O1 (Hale-Bopp), and most recently, C/2006 P1 (McNaught). The Solar and Heliospheric Observatory (SOHO) spacecraft continuously observes the Sun from the Lagrangian point ~1 million km sunward of the Earth. In February 2003, Comet C/2002 V1 (NEAT) approached to within 0.17 AU of the Sun, when within the field of view of SOHO's LASCO coronagraph, and displayed clear striae in its dust tail. The formation, development, and decay of these striae can be followed in the LASCO images. We present the results of modelling of these features, providing constraints on the physical characteristics of the dust, their bearing on the determination of the most likely formation model, and the possible effects of non-gravitational and radiation pressure-associated forces on the dust.

E-P07 Isotope Measurements of a Comet by the Ptolemy Instrument on Rosetta

A. Morse (Open University), D.J.Andrews, S.J.Barber, M.R.Leese, G.H.Morgan, C.T.Pillinger, S.Sheridan, I.P.Wright

The aim of the ESA Rosetta mission is to make long term measurements of a comet as it approaches the sun from 3.5 AU to 1.4 AU over a period of at least six months and includes the Philae lander as well as the orbiter spacecraft. Ptolemy, on board Philae, is a GC-MS instrument designed for the analysis of cometary volatiles, organic materials and silicates. The objectives of Ptolemy are to provide a complete description of the nature and distribution of light elements (H, C, N and O) present in the nucleus of the comet, as well as determining their stable isotopic compositions. Ptolemy also aims to provide ground-truth measurements of those volatiles that are subsequently detected further out from the nucleus in the coma. Samples from the surface and sub-surface, collected by the lander drilling system (SD2), are heated in an oven and can be injected into one of three gas chromatography columns (GC) for analysis by the mass spectrometer. Accurate isotopic analysis is achieved by chemical processing before and/or after the GC columns and by direct comparison with reference materials of known isotopic composition. The Rosetta spacecraft, launched in 2004, is currently about half way through its 6.5 billion km, 10 year journey to comet P67/Churyumov-Geriasemnko. Operations of the Ptolemy mass spectrometer during spacecraft checkout and preparation for the asteroid Steins flyby have shown that the Ptolemy instrument is operational and should be capable of meeting its science aims. The next major milestone for Rosetta is the flyby of asteroid Lutetia in July 2010 during which Ptolemy will by operating to attempt to detect any exosphere.

E-P08 Dynamical Evolution of Classical Kuiper Belt Bodies after Small Changes of their Orbital Velocity

E. Pittich (Astronomical Institute, Slovak Academy of Sciences), N.A. Solovaya

The investigation of the dynamical evolution of small bodies from the classical part of the Kuiper belt is presented. Analytical studies of motion of these bodies showed the existence of the periodic solution corresponding to Keplerian osculating orbits with small eccentricities. Therefore the process of the migration of these bodies to the inner/outer part of the planetary system requires the influence of additional external forces.

Our numerical studies of model circular orbits of bodies from the classical part of the Kuiper belt showed that collisions are one of possible mechanisms for the change of their orbits. New orbits have perihelium/aphelium outside of the Kuiper belt.

Wednesday
11:00am

CoRoT Eclipsing binaries

C. Maceroni (INAF - Osservatorio Astronomico di Roma), the CoRoT Binary Thematic Team

The space mission CoRoT was launched in December 2006 and the first data were delivered to the CoRoT community one year later. The distribution to public started last December, with the opening of the "Initial Run" archive and new fields data will be delivered after 1-year proprietary period. The exoplanet search provided, as a by-product, thousands new variable stars, among those the richest sample is that of eclipsing binaries (EBs). For the first time light curves of unprecedented precision and continuous coverage were made available for hundreds of EBs. Besides, EBs are present among asteroseismic targets, either because of intentional selection of known binary targets or as serendipitous discoveries; these binaries have light curves of the highest ever achieved photometric accuracy (~100 ppm). The exploitation of such a wealth of data is challenging, because Corot photometric properties were obviously tailored on the requirements of core programs (not always optimal for other science cases), but it is nevertheless very promising in terms of scientific results. We present here a few highlights of the CoRoT Binary Thematic Team results.

Wednesday
11:20am

New Massive, Eclipsing, Double-Lined Spectroscopic Binaries Cyg OB2-17 and NGC 346-13

V. Stroud (Faulkes Telescope Project/Open Univeristy/ LCOGT), J. S. Clark, I. Negueruela, P. Roche, A. J. Norton, D. J. Lennon, C. J. Evans

Massive, eclipsing, double-lined spectroscopic binaries are not common but necessary to understand the evolution of massive stars as they are the only direct way to determine the masses of OB stars and therefore obtain mass-luminosity functions. They are also the progenitors of energetic phenomena such as X-ray binaries and gamma ray bursts.

We discuss results from photometric and spectroscopic studies of two binary systems: Cyg OB2-B17 which is a semidetached binary located in the Cyg OB2 association and comprised of 2 O supergiants; and NGC 346-13 which is a system located in the Small Magellanic Cloud and comprised of a semi-evolved B1 star and a hotter, optically fainter secondary, suggesting mass transfer in the system.

Wednesday
11:30am

The Effect of Massive Binaries on Stellar Populations and Supernova Progenitors

J. Eldridge (Institute of Astronomy), Norbert Langer, Robert Izzard, Christopher Tout

Binaries are normally ignored when models of stellar popuations are created. I will outline the main effect of binaries on stellar populations of massive stars. Showing how incorrect ages may be found for unresolved stellar populations unless binaries are included. I will also discuss how binary evolution can effects the population of progenitors of supernovae and long gamma-ray bursts. And the implications of how runaway stars formed by the disruption of a binary after the first supernova, effect the distribution of supernova locations within their host galaxies.

Wednesday
11:50am

Rotational Mixing in Binaries: a New Formation Channel for Massive Black-Hole Binaries

S. de Mink (Utrecht University), Cantiello, M., Langer, N., Pols, O.R., Brott, I., Yoon, S.-Ch.

In close binaries, tides force the stars to rotate fast, in synchronous rotation with the orbit. Fast rotation is known to trigger internal instabilities which lead to mixing. Models of rotating single stars can successfully account for a wide variety of observed stellar phenomena, such as the surface enhancements of N and He observed in massive stars.

We investigate the consequences of rotational mixing for short-period binaries consisting of two massive main-sequence stars. Therefore, we use a state-of-the-art stellar evolution code including the effect of rotational mixing, tides and magnetic fields.

We find that helium produced in the center is efficiently mixed throughout the envelope for very massive stars (M1>~50 solar masses) in close binaries (Porb<~2 days). Instead of expanding during their main-sequence evolution, as normal stars do, these stars stay compact while they gradually become Wolf-Rayet stars. Whereas standard binary evolution theory predicts that such stars overflow their Roche lobe, transfer mass and probably merge, we find instead that these can avoid mass transfer completely.

We propose this evolution path as an alternative channel for the formation of tight Wolf-Rayet binaries with a main-sequence companion. It might also explain massive black-hole binaries such as the intriguing system M33 X-7, harbouring one of the most massive stellar-mass black holes orbiting a 70 solar mass O-star in a 3.5 day orbit.

Wednesday
12:10pm

Binaries from Afar: Impact on Integrated Photometry of Stellar Populations

P. Anders (Utrecht University), Rob Izzard, Evert Glebbeek

For most of the stellar systems in the Universe, individual stars/binaries cannot be resolved. Only integrated photometry (or spectroscopy) can be achieved. The major tool to interpret these integrated observations are evolutionary synthesis models: They predict integrated spectrophotometry based on isochrones/tracks and atmosphere spectra, and allow by comparison between models and observations to derive physical parameters (like age, metallicity, extinction ...) of the studied population (star clusters, galaxies etc).

We include detailed binary evolution models into the GALEV evolutionary synthesis code, identifying evolutionary phases and passbands which are specially affected by these channels beyond standard single-star evolution, and quantifying their effects. These include: blue stragglers (from binary evolution, not collisions), helium stars, sdO/B stars etc.

Wednesday
12:20pm

V458 Vul: a Nova inside a Planetary Nebula

R. Wesson (University College London)

The classical nova V458 Vul was discovered on 8 August 2007. It lay in a field imaged shortly beforehand as part of IPHAS (the INT Photometric H-alpha Survey), and this revealed that the progenitor star was surrounded by an extended nebula. Follow-up observations showed that the nebula has a high ionised mass and low expansion velocity, and thus is not nova ejecta but a planetary nebula. This is only the second known example of a classical nova erupting inside a planetary nebula.

V458 Vul and its nebula can provide a powerful tool for understanding the common envelope phase of close binaries. We have been monitoring the nova and nebula since the eruption, and have recently observed dramatic changes in the nebula as the nova flash passes through it. The system appears to have an orbital period of about 95 minutes - the shortest known for a PN binary central star.

Wednesday
2:00pm

The Impact of GAIA upon Studies of White Dwarf Binary Stars

T. Marsh (University of Warwick), Gijs Nelemans

The astrometric satellite GAIA is predicted to discover well over 100,000 white dwarfs. Moreover, they will be recognisable as such because of the precise parallaxes. This compares with around 10,000 known today. GAIA will have an even greater effect upon the field of white dwarfs in binary stars, including white dwarf/main sequence binaries, double white dwarf binaries and their accreting brethren. In this talk I will present simulations of the populations of these stars that will be detected by GAIA and discuss what can be learned from it, and the potential relevance of discoveries from GAIA for the proposed gravitational wave observatory, LISA.

Wednesday
2:20pm

A Rare Outburst of the WZ Sge Type Star GW Lib

K. Byckling (University of Leicester), J.P. Osborne, G.A. Wynn, A. Beardmore, V. Braito (UoL), K. Mukai (NASA/GSFC), R. West (UoL)

The WZ Sge type star GW Lib was discovered in outburst in 1983. The second outburst took place over 20 years later in 2007. WZ Sge stars, which show only superoutbursts, are known to have recurrence times of decades. This is a much longer timescale compared to normal dwarf nova interoutburst timescales (~ every few weeks). To date, the reason for the long recurrence times has remained a puzzle, and the physics of the accretion process in these systems is not well-understood. We have obtained simultaneous multiwavelength data of the 2007 outburst of GW Lib in the optical, UV and X-rays. We will present the outburst lightcurves and the results of X-ray spectral analysis throughout the outburst. The implications of these observations for accretion disc models will also be discussed.

Wednesday
2:30pm

The Role of Binaries in the Early Galactic Halo

T. Suda (Keele University), Yutaka Komiya, Yutaka Katsuta, Shimako Yamada, Chikako Ishizuka, Takanori Nishimura, Masayuki Y. Fujimoto

Binaries are important probes of the early epoch of the Galactic evolution from the recent studies of the observations of extremely metal-poor (EMP) stars and the models of stellar evolution and nuclosynthesis. One of the most important findings with the large-scale surveys of metal-poor stars in the Galaxy is that the fraction of carbon-rich stars is much larger in EMP stars than in Population I and II stars. This is consistent with the standard stellar evolution models of low- and intermediate-mass if the most of observed EMP stars are the survivors of the secondary component of binary systems and affected by binary mass transfer because their surface carbon abundances are expected to be enriched more efficiently during the thermal pulse in the AGB phase compared with more metal-rich counterparts. Actually, all of carbon enhanced metal-poor stars (CEMP stars) with enhanced s-process element abundances, which occupy 20 percent of EMP stars, are considered to have been in binary systems. Based on the hypothesis that binaries make a significant contribution to the chemical enrichment of the Galactic halo, we present a general picture of the origins of EMP stars and the chemical evolution of the Galaxy with the theoretical models of stellar evolution, nucleosynthesis, and hierarchical clustering, combined with the database of observed EMP stars that we have developed (The Stellar Abundances for Galactic Archaeology database available at http://saga.sci.hokudai.ac.jp). The present paper focuses on the quantitative comparison of metallicity distribution function of observed halo stars with the theoretical models of hierarchical merging based on the high mass-peaked IMF derived from the statistics of CEMP stars. We conclude that the most of observed EMP stars are the secondary members of binary systems when they were born in the early epoch of the Galaxy formation.

Wednesday
2:40pm

The Galactic Population of Compact Binaries

P. Groot (Radboud University Nijmegen), Gijs Nelemans, Danny Steeghs, Tom Marsh, Boris, Gaensicke, Peter Jonker, Gijs Roelofs

Compact and ultracompact binaries form an important part of general stellar and binary populations, as the progenitor systems of supernovae Type Ia's, the main sources of low frequency gravitational waves and as the main sources of high energy radiation in the local Universe. I will review the currently known populations and the ongoing major surveys, including the SDSS, the European Galactic Plane Surveys and the Galactic Bulge Survey that are uncovering the population of (ultra)compact binaries in a homogeneous way.

Wednesday
3:00pm

RATS - a Search for Short Period Faint Variable Objects

T. Barclay (Armagh Observatory / MSSL), G. Ramsay (Armagh Observatory), P. Halaka (Tuorla Observatory)

We present the latest results of the RApid Temporal Survey (RATS). The prime aim of the survey is to discover interacting ultra-compact binary systems. The space density of these objects has important consequences not only as a test of binary evolution models but they are also predicted to be the first objects detected by future gravitational wave observatories. Our high cadence wide field observations have allowed use to probe a parameter space previously untapped, as a results we have discovered many thousands of new variable systems including over 1000 contact binaries, several hundred eclipsing binaries and many new stellar pulsators and flare stars.

Wednesday
3:10pm

Discovery of the Jet Trail Nebula of Low Mass X-Ray Binary SAX J1712.6-3739

K. Wiersema (University of Leicester), D. Russell, N. Degenaar, R. Wijnands

In a multiwavelength program dedicated to identifying optical counterparts of faint persistent X-ray sources in the Galactic Bulge, we find an accurate X-ray position of SAX J1712.6-3739 through Chandra observations, and discover its faint optical counterpart using our data from EFOSC2 on the ESO 3.6m telescope. We find this source to be a highly extincted neutron star LMXB with blue optical colours. We serendipitously discover a bright and large bow shock shaped nebula in our deep narrowband H alpha imaging, most likely associated with the X-ray binary. A nebula like this has never been observed before in association with a LMXB, and as such provides a unique laboratory to study the energetics of accretion and jets. We put forward different models to explain the possible ways the LMXB may form this nebulosity, and conclude that the most likely explanation is a jet trail nebula, formed by long-term interaction of a jet with the ISM.

Wednesday
3:20pm

HST Imaging and Ground-Based Spectroscopy of the Expanding Nebular Remnant of the 2006 Outburst of RS Ophiuchi

V. Ribeiro (LJMU - Astrophysics Research Institute), M. F. Bode, M. J. Darnley, D. J. Harman, A. Newsam, T. J.O'Brien, J. M. Echevarria, J. Bohigas, R. Costero, M. Richer, L. Georgiev, S. V. Zharikov, V. H. Chavushyan, J. L. Tavares, V. V. Neustroev, S. P. S. Eyres, A. Evans, S. Starrfield, H. E. Bond

We report combined Hubble Space Telescope imaging obtained 155 and 449 days after the 2006 outburst of the recurrent nova RS Ophiuchi and spectroscopic observations obtained at the Observatorio Astronomico Nacional en San Pedro Martir, Mexico. These observations were then modelled to derive information about the geometry and kinematics of the RS Oph remnant using 'Shape'. The results of this modelling confirm a bipolar structure for the expanding remnant and strongly suggest that this is due to the interaction of the outburst with the pre-existing red-giant wind that is significantly denser in the equatorial regions of the binary orbit. We applied statistical tests to the observed and synthetic spectra to derive the inclination of the bipolar remnant and we compare this directly with that of the central binary.

F-P01

Binary Star and Light Speed

S. Cosofret (Romanian Academy)

The paper proposes to revive an old astronomical dispute about light speed and binary star system. A new interpretation of binary star system period related to a new concept - temporal aberration- is presented. For an Earth observer, when successively a star eclipses another in such system, depending on stars relative speeds, the photons are travelling with different speeds. Therefore further away is such system, smaller is the ,,apparent" period of revolution for an Earth observer.

F-P02

Follow-up Observations of Local Group Nova Eruptions

M. Darnley (ARI - LJMU Liverpool), Bode M.F. (Liverpool John Moores University)

The Liverpool Telescope (LT) has been involved in an extended project to follow-up the outburst of Local Group classical nova and recurrent nova. These observations have taken place in conjunction with other facilities, including the Hobby Eberly Telescope (HET), Spitzer Space Telescope and using archival Hubble Space Telescope (HST) data. This poster presents a selection of our data to-date, including strong evidence of a recurrent nova eruption.

F-P03 RS Ophiuchi: Neither a TNR nor SNe Ia Progenitor?

S. Eyres (University of Central Lancashire), Hannah Worters, Sotiris Adamakis

When RS Ophiuchi exhibited its sixth Recurrent Nova outburst in 2006, a survey of astronomers working in the area would have led one to conclude that the outburst mechanism was well understood: a thermonuclear runaway (TNR) resulting from the accretion onto the white dwarf (WD) from a giant companion. In fact a careful review of the literature shows little evidence to support this, and a paucity of inter-outburst observations to address the critical question of the means, variability and impact of accretion between outbursts. In addition it has been suggested that the current mass of the WD strongly supports RS Ophiuchi as a Type Ia supernova progenitor. This talk explores the links between this second claim and the proposed TNR mechanism, explains what needs to be done to test both hypotheses and addresses alternatives to the currently favoured explanation of this and other recurrent novae. We also examine the prospects for predicting outbursts in this and similar objects.

F-P04 Symbiotic Binary UV Emission Line Shifts

M. Friedjung (Institut d'Astrophysique), J. Mikolajewska, A. Zajczyk, M. Eriksson

In a new study of high ionisation emission lines of symbiotic binaries, the orbital variations of relative radial velocity shifts of UV resonance lines, intercombination lines and He II 1640 A are examined.Indications are obtained concerning the geometry of emitting regions of different binaries.

F-P05 Binarity of Brown Dwarfs

B. Goldman (MPIA), H.Bouy, M.R. ZapateroOsorio, M. B. Stumpf, W. Brandner, and T. Henning

The binary rate is observed to continuously decrease from early to late type stars. A possible exception in this trend might be the L/T transition brown dwarfs, which may in majority actually be a combinaison of a L dwarf with a cloudy atmosphere and a T dwarf with dust-depleted photosphere. This fact may explain that current atmospheric models cannot easily reproduce some of the spectral characteristics of the transition which occurs a nearly constant effective temperature.

We aim to refine the statistical significance of the seemingly higher frequency of binaries at the L/T type transition. Co-eval binaries are also interesting test-beds for evolutionary models. So far we have obtained high-resolution imaging for nine mid-L to late-T dwarfs, with photometric distances between 8 and 33pc, using the adaptive optics systems NACO at the VLT, and the Lick system, both with the laser guide star.

Here we present our current results. Combining our data with published results, we revise the frequency of resolved L/T transition brown dwarfs. Our results do not significantly support, nor contradict, the hypothesis of a larger binary fraction in the L/T transition. We place constraints on the existence of companions with effective temperatures as low as 360--1000K at separations larger than 0.5".

F-P06 Systematic Study of Variability in a Sample of Ultraluminous X-Ray Sources

L. Heil (University of Leicester), S. Vaughan, T. Roberts

We present results from a study of short term variability in 19 archival observations by XMM of 16 Ultraluminous X-ray Sources (ULXs). Eight observations (six sources) showed intrinsic variability with power spectra in the form of either a power law or broken power law-like continuum and in some cases quasi-periodic oscillations (QPOs) seen in previous studies of these observations. Seven observations (seven sources) yielded upper limits comparable to, or higher than, the values measured from those observations with detectable variations. These represented the seven faintest sources all with f_x < 3x10^-12 erg cm^-2 ~ s^-1.In contrast there are four observations (three sources) that gave upper limits significantly lower than both the values measured from the ULX observations with detectable variations, and the values expected by comparison with luminous Galactic black hole X-ray binaries (BHBs) and Active Galactic Nuclei (AGN). The lack of detectable variability from these bright sources, in the observed frequency bandpass (10^-3 - 1 Hz), is at odds with the expectations based on observations of Galactic BHBs and AGN. We present an analysis of these results in terms of the fluxes and X-ray luminosities from the observations, and discuss solutions for suppression of variability from these sources.

F-P07 The Nature of the Boundary Layer Emission in the Cataclysmic Variable Z Cha

R. Hickman (University of Warwick), Wheatley P., Marsh T.R., Dhillon V.S., Littlefair S., Gänsicke B.

We present high-speed X-ray and optical photometry taken with XMM and ULTRACAM/VLT of the dwarf nova Z Cha with the aim of determining the geometry of the X-ray emission which is usually thought to come from the boundary layer between the accretion disc and the equator of the white dwarf. We find evidence that the X-rays extend away from the equator, but they appear to be less visible from the lower half of the white dwarf compared to its upper half, possibly as a result of obscuration by the disc. If so then the disc does not have an inner hole but extends all the way to the white dwarf's surface. We compare our results with similar observations of the eclipsing dwarf nova OY Car.

F-P08 The X-Ray Corona of YY Gem: a Chandra Study of a dMe Eclipsing Binary System

G. Hussain (ESO), N.S. Brickhouse, A.K. Dupree, M. Jardine, F. Favata

We review X-ray techniques to probe the coronal structure in magnetically active binary systems including contact binaries and eclipsing binaries.

We present new results from a Chandra X-ray study of the active dMe eclipsing binary system, YY Gem. Our observations covered two full orbital periods - over the course of these observations we observed two moderate flares. We measure the densities, temperatures and velocities of the X-ray emitting plasma of the eclipsing binary corona both in and out of flaring states.

Velocity shifts in the phase-binned spectra are compared with the orbital motion of the system and used to infer the location of the emitting plasma and thus the coronal structure of the system.

F-P09 Results From the Faulkes Telescopes' LMXB Monitoring Campaign

F. Lewis (Faulkes Telescope Project/Open University/LCOGT), David M Russell (Amsterdam) Rob P Fender (Southampton) Paul Roche (Faulkes Telescope Project/LCOGT) J Simon Clark (Open University)

We present results from an ongoing 3 year monitoring project of 30 Low-Mass X-ray Binaries (LMXBs) using the 2-metre robotic Faulkes Telescopes. Since early 2006, we have performed multi-waveband optical photometry of LMXBs using the Faulkes Telescope North on Haleakala, Maui, and have added the Faulkes Telescope South at Siding Spring, Australia since summer 2007. We have detected outburst activity in six sources and variability in quiescence in many others.

Aside from our weekly monitoring of these sources, we are able to react to any outbursts or increased activity, either noted by us, or in Astronomers Telegrams. In these instances, we are able to increase the frequency of our observations or perform studies to detect orbital modulations.

Brighter LMXBs are imaged weekly in V,R, i' - fainter ones in i' only.

We detect outburst activity in 6 sources and quiescent variability in others. We focus on XTE J1118+480 and 4U 1957+11.

F-P10 Unveiling the Nature of the X-Ray Binary Systems OAO 1657-415 and EXO 1722-363 through Near-Infrared Spectroscopy

A. Mason, Andrew J. Norton, Simon Clark

The internal composition and upper mass limit of neutron stars (NS) are determined by the equations of state (EOS), which relate the density to pressure and allows a determination of the interior composition of the neutron star. These parameters are not well constrained theoretically. Observational results currently provide the only means of distinguishing between theoretical EOS models. Eclipsing X-ray binary (XRB) pulsar systems are the only interacting binaries in which the mass of the neutron star may be measured directly.

Only 10 such systems are known to exist, 6 of which have yielded NS masses in the range 1.06 -1.86 M_sol Here we present on-going work to determine the NS masses within two such eclipsing systems, OAO 1657-415 and EXO 1722-363. These two systems are effectively hidden by their high levels of interstellar absorption and the IR counterparts to the neutron stars have only recently been discovered.

The first part of our research is to provide for the first time an accurate spectral classification of the two counterpart stars of these XRB systems. This is accomplished using the techniques of Near-Infrared (NIR) spectroscopy. After comparative qualitative comparison with published atlases of IR spectra we conclude that OAO 1657-415 is of spectral type BO-BI Ia, displaying spectral features that indicate it is a highly obscured source with a strong wind outflow. We have also determined that EXO 1722-363 is of spectral type B0-BI Ia. On-going work involves the construction of radial velocity curves from NIR spectra to accurately determine the NS masses, increasing our knowledge of the distribution of NS masses in XRB systems by 25\% and enabling constrains to be placed on competing EOS models.

F-P11 What Does an Average Dwarf Nova Look Like in X-Rays?

K. Mukai (NASA/GSFC/CRESST & UMBC), Kristiina Byckling (Leicester) & John R. Thorstensen (Dartmouth)

Cataclysmic variables (CVs; white dwarfs accreting from a Roche-lobe filling, late-type dwarf mass donor) are a common type of interacting binaries. Of the various subtypes of CVs, dwarf novae, whose accretion disk stays mostly in low brightness state (quiescence) with occasional excursion to high brightness state (outburst), are the most numerous. Although dwarf novae have been observed in the X-ray band to probe the accretion flow onto the white dwarf for many years, it is quite likely that these observations focused mainly on atypically X-ray dwarf novae. We therefore argue that our current understanding of the X-ray luminosity function and the average X-ray spectrum of dwarf novae is biased and incomplete. We have therefore performed pointed Suzaku observations of 7 dwarf novae. The selection criteria for the targets were (1) they must have a parallax-based distance estimate of less than 200 pc; and (2) they must not have a previous pointed observation with an imaging X-ray telescope. We combine these new data with past X-ray (ASCA, XMM-Newton, and Suzaku) observations of other nearby dwarf novae satisfying condition (1) above. We present a preliminary analysis of these data and discuss implications.

F-P12 Photonic Solutions for High Performance Laser Metrology of the Optical Train of an Astronomical Interferometer

R. Neuhaeuser (AIU Univ. Jena), Stefano Minardi, Lourdes Patricia Ramirez, Stefan Kraemer, Arkadi Chipouline, Thomas Pertsch, Martin Vanko, Theo Pribulla, Gracjan Maciejewski (Univ. Jena)

Besides atmospheric turbulence, mechanical vibrations of optical components can seriously affect the fringe contrast in astronomical interferometers. Usually the frequencies of the mechanical resonances fall outside the detection bandwidth of conventional fringe trackers and therefore require dedicated metrology. Here we present our most recent achievements in the development of a fiber interferometer which could be used to measure the displacement of vibrating mirrors in a broad frequency range and with an accuracy better than 10 nm. We also discuss a few possible astronomical applications, in particular for binary stars.

F-P13 New Recalculated Orbit for Binary CHR 90

S. Ninkovic (Astronomical Observatory, Belgrade), Zorica Cvetkovic

In this paper the recalculated orbital elements for visual binary WDS 19531-1436 = CHR 90 are given. The calculation of the previous orbit includes measurements performed till 1996 and the orbital elements are given in the Sixth Catalog of Orbits of Visual Binary Stars. After this time four new measurements have been made. They show higher residuals with respect to the corresponding ephemerides calculated by using the elements of the previous orbit. For this reason we have recalculated the orbit of this binary. In addition to the orbital elements in this paper the mass, dynamical parallax, absolute magnitudes and ephemerides for the next five years are also given.

F-P14 Detection of Non--Radial Pulsation and Faint Companion in the Symbiotic Star CH Cyg

E. Pedretti (SUPA, University od St Andrews), J. D. Monnier, S. Lacour, W. A. Traub, W. C. Danchi, P. G. Tuthill, N. D. Thureau, R. Millan-Gabet, J-P. Berger, M. G. Lacasse, P. A. Schuller, F. P. Schloerb and N. P. Carleton

We have detected asymmetry in the symbiotic star CH~Cyg through the measurement of precision closure--phase with the IONIC beam combiner, at the IOTA interferometer. The position of the asymmetry changes with time and is correlated with the phase of the 2.1--yr period found in the radial velocity measurements for this star. We can model the time--dependent asymmetry either as the orbit of a low--mass companion around the M~giant or as an asymmetric, 20 % change in brightness across the M~giant. We do not detect a change in the size of the star during a 3 year monitoring period neither with respect to time nor with respect to wavelength. We find a spherical dust--shell with an emission size of 2.2±0.1~R*~FWHM around the M~giant star, The flux ratio star/dust is 11.63±0.3. While the most likely explanation for the 20 % change in brightness is non--radial pulsation we argue that a low--mass companion in close orbit could be the physical cause of the pulsation. The combined effect of pulsation and low--mass companion could explain the behaviour of the radial--velocity curves and the time--dependent asymmetry detected in closure--phase data. If CH~Cyg is a typical long secondary period variable then LSP variations could be explained by the effect of an orbiting low--mass companion on the primary star.

F-P15 Wide Halo Binaries: Dark Matter Constraints

D. Quinn (IOA Cambridge), M.I. Wilkinson, M.J Irwin, J. Marshall, A. Koch, V. Belokurov

Very wide and hence fragile halo binary stars are vulnerable to disruption from encounters with compact objects such as MACHOs. Recently in Quinn et al 09, we presented radial velocity measurements of four wide halo binary candidates from the sample in Chaname & Gould 2004 which, to date, is the only sample containing a large number of such candidates. The four that we have observed have projected separations >0.1 pc, and include the two widest binaries from the sample, with separations of 0.45 and 1.1 pc that are an order of magnitude greater than the separation of the widest previously known halo binary system. Here I will report on our measurements and discuss the implications for Dark Matter constraints.

F-P16 Dynamical Evolution of Hierarchical Stellar Systems

N. Solovaya (Sternberg State Astronomical Institute, Moscow)

The dynamical evolution of triple hierarchical stellar systems is studied. We consider the motion in the frame of the general three-body problem. In the differential equations of motion we used the Hamiltonian without short-periodic terms.

In the obtained solution the mean motions of the both components have the secular terms. Under the influence of perturbations of a distant companion the mean motion in the near pair is slowed and vice versa. Secular accelerations of the mean motion are added by perurbations of the third order. This changes are little, but on the cosmological time interval the hierarchical systems will convert to stellar systems which components have comparable distances. Such systems are unstable. They will either rapidly dissipated or stay to persist as binaries.

F-P17 Time-Resolved Photometry of Three Dwarf Novae during Outbursts

I. Voloshina (Sternberg Astronomical institute), V.Metlov

Here we report the results of CCD observations which were carried out during the outbursts of dwarf novae V1251 Cyg, KP Cas and UW Tri. All observations were made in October-November 2008 with 60-cm and 38-cm telescopes in Crimea. Our data clearly show the presence of superhumps in the light curves of these systems. The evolution of superhumps was followed up. The amplitudes and periods of detected modulations were estimated from the hump maxima. A comparison with the previous outburst is also provided.

F-P18 The Close Be Star Companion of Beta Ceph

H. Wheelwright (University of Leeds), R. Oudmaijer, R. Schnerr

The prototype of the beta Cephei class, beta Cep, rotates relatively slowly, and yet displays episodic H-alpha emission. For some time this posed a contradiction to current models of the Be phenomena as rapid rotation is thought to be a prerequisite for the characteristic emission phases of Be stars. Recent work demonstrated for the first time that the H-alpha emission is in fact due to a close companion of the star. This resolves the apparent enigma, if this close companion is a Be star. Here we employ spectroastrometry to split the un-resolved (0.2") binary spectra into its constituent spectra in the B and R band. We find that the primary of the close binary system has a spectral type of aproximately B2III and the secondary a spectral type of B5Ve. We confirm that the primary of the system is a slow rotator, while the secondary rotates significantly faster, at a v sini = 230 +/- 45 km/s. We show that the properties of the secondary are consistent with it being a classical Be star. In doing so, we resolve the enigma of the H-alpha emission of beta Cep, and remove the contradiction that beta Cep has posed to current understanding of the Be phenomena.

Thursday
11:00am

Effects of Rotation on Stellar Pulsation Frequencies

K. Burke (University of Sheffield), D. Reese, M. J. Thompson

Accurate measurement of stellar pulsation frequencies and identification of the corresponding modes are necessary for asteroseismic studies to yield useful results. Rotation must be taken into account when calculating theoretical mode frequencies as it causes a deviation from the theoretical values obtained in non-rotating stars and hence changes the expected frequency of each mode. The inclusion of rotational effects is essential for robust mode identification in fast rotators. Perturbative methods to calculate the effects of rotation on mode frequencies have been developed up to third order in rotational velocity (Soufi et al. 1998). More recently, non-perturbative methods have been developed to fully describe the effects of rotation by complete numerical integrations of eigenvalue systems. Non-perturbative calculations require substantial computational resources compared to perturbative calculations, however they provide more accurate results across a wide range of rotation velocities. The perturbative method provides additional physical insight into the effects seen but is only accurate to relatively slow rotation rates. Using the second order perturbative theory of Gough and Thompson (1990) and the non-perturbative method of Reese et al (2006) we investigate the range of rotation rates for which the perturbative and non-perturbative methods give consistent results, and the velocity above which the perturbative method is no longer valid. Our work extends that of Reese et al (2006) from polytropic models to uniformly rotating stellar models with velocities up to a quarter of the Keplerian breakup velocity.

Thursday
11:20am

Diagnostics of the Structure of the CoRoT Solar-Like Stars HD49933 and HD 181420

I. Roxburgh (Queen Mary University of London), Graham Verner

We present results on the Large and small separations, phase shifts and second differences of l=0,1,2 modes using frequencies determined for the CoRoT solar-like stars HD49933 and HD181420. These diagnostics show periodic modulation indicative of regions of rapid change in the acoustic structure of these stars. We discuss the reliability of the determination of these variations and inferences on the internal structure of these stars.

Thursday
11:35am

Fitting the p-modes of Sun-Like CoRoT Stars

G. Verner (Queen Mary University of London)

The CoRoT space telescope has made high-quality, long-duration observations of p-mode oscillations on a number of distant Sun-like stars. When the power spectrum of these oscillations is analysed, there are some surprising features that stand out from the solar case and complicate the analysis. Careful techniques are required to obtain reliable and robust p-mode parameters from these stars.

The fitting procedure, and problems arising, are presented for the stars HD49933, HD181420 and HD181906. The impact of different fitting regimes on the determined stellar-diagnostic parameters are also presented.

Thursday
11:55am

Narrow Windowed Autocorrelation as a Diagnostic of Solar-Type Oscillators

I. Roxburgh (Queen Mary University of London)

The autocorrelation of a time series, windowed in the frequency domain, can reveal both the variation of the large separations with frequency and of the (unequal) half large separations between modes of degree l=0,1, and modes of degree l=1,0. Results are presented for the CoRoT solar-like stars HD49933, HD181420, HD181906 and HD175726.

Thursday
12:10pm

New Oscillation Frequencies for 11 Beta Cephei Stars

K. Goss (University of Birmingham)

I am able to report and discuss new oscillation modes discovered in 11 Beta Cephei type stars, in the catalogue of Stankov & Handler (2005) using SMEI (Solar Mass Ejection Imager). SMEI has provided a long photometric time series of more than 1000 days (between April 2003 and March 2006), with a cadence of 102 minutes and fill factors typically between 60-70 %. It is able to detect mmag brightness changes in objects brighter than 6.5 magnitude. Beta Cephei stars are early type B-stars, ranging between B0-B2.5. They show light and radial velocity variations which are caused by non-radial pulsations, driven by the kappa-mechanism.

Wednesday
11:00am

What is the Stellar Mass Function of Whole Galaxies?

P. Anders (Utrecht University), Marcel Haas (Leiden)

Most, if not all stars form in clusters, with masses following some Initial Mass Function (IMF). The masses of the star clusters themselves follow a Cluster Mass Function (CMF). However, as a low-mass star cluster can not contain a single star more massive than the whole cluster, low-mass clusters are deficient in high-mass stars. If, as currently assumed, the galactic field population consists of dissolved star clusters, the Integrated Galaxial Initial Mass Function (IGIMF, 'the stellar IMF for galaxies as a whole') will be different from the stellar IMF in a cluster, with a steeper high-mass end. And, even if the IMF is universal, different CMFs (e.g. due to environmental effects) in galaxies will result in different IGIMFs.

Here we will show the results of Monte Carlo simulations of stellar mass distributions. We vary both the method in which we sample the stellar masses from the IMF, and the CMF. For the CMF we assume a power law description of which we vary the lower mass cut-off and the slope.

We find that the method of sampling is important, in that it results in slightly different IGIMFs. As we don't know the details of the star formation process, this means that the exact shape of the IGIMF can not yet be determined. More importantly, the steepening of the IGIMF depends strongly on the power-law slope of the CMF at the very low-mass end. The lower mass limit for clusters sets the stellar mass at which the steepening of the IGIMF sets in, while the power law slope of the CMF sets the slope of the IGIMF at the high stellar mass end. We will show how these steeper IGIMF influences photometry and chemical enrichment of the galaxy as a whole.

Wednesday
11:20am

Finding all Massive Young Stellar Objects in the Galaxy: the RMS Survey

R. Oudmaijer (University of Leeds), M. Hoare, S. Lumsden, T. Moore, J. Urquhart, J. Mottram, B. Davies et al.

The study of the formation of massive stars has been severely hampered by the lack of a proper, well defined sample of such objects. Due to the fact that they are embedded in their natal clouds and heavily obscured, most of the known massive Young Stellar Objects (MYSOs) had been discovered serendipitously. These known MYSOs constitute a heterogeneous set which is possibly not at all representative of the class.

In this presentation I describe the Red MSX Source (RMS) survey. This is the largest, systematic, galaxy-wide search for massive Young Stellar Objects yet undertaken. Mid-IR bright point sources from the MSX satellite survey have been followed-up with ground-based radio, millimetre, and infrared imaging and spectroscopic observations to identify contaminating sources and characterise the MYSOs and UCHII regions. With initial classification now almost complete the distribution of sources in the galaxy will be discussed, along with early results from the exploitation phase including results from IR spectroscopy, outflow mapping and luminosity functions.

Wednesday
11:40am

Galaxy-Scale Star Formation with the Herschel Infrared Galactic Plane

S. Molinari (INAF - Istituto Fisica Spazio Interplanetario), Hi-GAL Team

Dust is a most important and effective tracer of the global structural, physical and evolutionary conditions of the ISM material throughout the whole life-cycle of a galaxy. From diffuse interstellar cirrus to dense molecular clouds, from protostars to post-AGB envelopes, from supershells to supernovae remnants, the equatorial plane of our Galaxy provides the ideal laboratory to carry out investigations of the global and integrated properties of the different phases of the Galactic ISM, their evolution and interactions.

The Herschel satellite offers the optimum and unique combination of spectral coverage, unprecedented spatial resolution and sensitivity to efficiently map the bulk of dust emission in all ISM phases over the entire Galactic Plane. In combination with complementary and already available surveys both in the continuum at adjacent wavelengths, and in atomic and molecular gas tracers, it will be possible to address fundamental issues: What's the contribution of cold material to the overall mass budget of the Galaxy? What's the ISM temperature and the intensity of the Interstellar Radiation field throughout the Galaxy? What's the star formation efficiency as a function of Galactocentric radius and environmental conditions? What's the relationship between the local properties of star formation and the global integrated scaling laws derived for external galaxies? What's the timeline for the formation of massive stars? What are the variations in the gas-to-dust ratio, and what factors govern these variations?

Hi-GAL is a Herschel Open Time Key-Project project that will carry out a 60-600 microns 5-band photometric imaging survey of the inner Galactic Plane (between -60 and +60 degrees Galactic longitude and between -1 +1 degrees Galactic latitude), with an unprecedented 4-40" diffraction limited spatial resolution. Hi-GAL will provide the community with a publicly available, homogeneous and calibrated dataset of extraordinary legacy value for decades to come.

Wednesday
11:50am

Infrared Dark Cloud Cores in the SCUBA Legacy Catalogue Infrared Dark Cloud Cores in the SCUBA Legacy Catalogue

H. Parsons (CAR, University of Hertfordshire), M. A. Thompson and A. Chrysostomou

We present an investigation of candidate Infrared Dark Cloud cores as identified by Simon et al. (2006) located within the SCUBA Legacy Catalogue . We identify two populations of Infrared Dark Cloud cores; those that were detected by SCUBA (162) and those that were not (69). We derive column densities for each core from their 8um extinction and find that the IRDCs detected by SCUBA have higher column densities (a mean of 1.7E22 cm-2) compared to the SCUBA non-detected candidates (a mean of 1.0E22 cm-2). Combined with sensitivity estimates, we suggest that the SCUBA non-detected population are a low mass, column density and temperature population or misidentifications (voids or artefacts). The SCUBA detected cores are found to have masses consistent with the lower end of the observed mass distribution for high mass star formation and we find that for a subsample of the SCUBA detected objects (those contained within the MIPSGAL area) two thirds of the SCUBA detected cores are associated with 24um sources. Those cores not associated with 24um emission are potential low luminosity objects or "starless" IRDC cores that perhapse have not yet formed stars or YSOs. We see that those "starless" IRDC cores and the IRDC cores associated with 24um emission are drawn from the same column density population and are of similar mass. If we then assume the cores without 24um embedded sources are at an earlier evolutionary stage to cores with embedded objects we derive a statistical lifetime for the quiescent phase of a few 10^3 -10^4 years. Finally we make conservative predictions for the number of observed IRDCs that will be observed by the JCMT Galactic Plane Survey (JPS) and the SCUBA-2 "All Sky" Survey (SASSy) based on SCUBA detection fractions.

Wednesday
12:00pm

A GMM-EM Algorithm to Search for Stellar Clusters in Large Databases

D. Samuel (University of Hertfordshire), Dr Phil Lucas

An automated search for stellar clusters is performed on the UKIDSS database utilizing a Gaussian Mixture Model / Expectation-Maximization algorithm. The permits a fast and systematic way to search for clusters, and to establish consistent summary statistics for cluster candidates. An overview of the algorithm will be presented together with results, including some new cluster candidates.

Wednesday
12:10pm

The Gould Belt JCMT Legacy Survey

D. Ward-Thompson (Cardiff University), Gould Belt Legacy survey Team

This paper describes a JCMT legacy survey that has been awarded roughly 600 hrs of observing time. In this survey we will map with SCUBA2 and HARP almost all of the well-known low-mass and intermediate-mass star-forming regions within 0.5kpc that are accessible from the JCMT. We have begun the HARP observations in three CO isotopologues, of a large typical sample of molecular clouds. We will report on the initial results from this survey.

Wednesday
12:20pm

High-Mass Star Formation with the JCMT and Herschel Galactic Plane

T. Moore (LJMU - Astrophysics Research Institute)

As part of the JCMT Legacy Surveys programme, the JCMT Plane Survey (JPS) will map the northern Galactic Plane at 450 and 850um using SCUBA2. At around the same time, the Herschel infrared Galactic Plane Survey (Hi-Gal) will cover the inner Plane in 5 wavebands between 60 and 600um. The data from these two large observing programmes will make a huge contribution to the study of high-mass star formation in the Galaxy, constraining the evolution of massive young stellar objects from its earliest stages and determining the effect of environment and feedback on star-formation efficiency and mass function.

Wednesday
2:00pm

Spectral Energy Distributions of Methanol Maser and 8GHz Continuum Sources in Regions of Massive Star Formation

A. Avison (Jodrell Bank Centre for Astrophysics), G.A.Fuller

Class II Methanol Masers signpost the formation of massive stars (M >8M_o), existing during many phases from very early in the stars formation upto and including the creation of a stars Ultra Compact HII region. The 6.67GHz maser positions can therefore be used to probe the evolving characteristics of massive stars.

Using high resolution data from the Australia Telescope Compact Array (which forms part of the Methanol MultiBeam (MMB) survey (Green et al . '08)), the 6.67GHz maser line and 8.64GHz continuum emission were observed. Continuum emission at 8.64GHz is detected in ~25 % of the observed sources. These can be divided between two categories; those which have CH3OH closely associated (<1") with continuum and those with coincidental continuum observations with in the ATCA field of view.

The Spectral Energy Distributions (SEDs) of the maser and the continuum sites are being created to explore the difference in these regions. Spitzer Space Telescope MIPS instrument data (at 24 and 70 microns) and data from the MSX survey from the NASA/IPAC Infrared Science Archive (at 8, 12,14 and 21 microns) have been used to create initial SEDs in the infrared regime. These partial SEDs coupled with colour-colour plots can be used to identify the evolution of the IR environment of forming young massive stars. The outcome of this work will be shown in the presentation.

Wednesday
2:10pm

What Are Class II Methanol Masers Tracing

M. Gallaway (University of Hertfordshire)

The 6.67Ghz methanol maser line is the second brightest observed astrophysical maser and appears to be uniquely associated with high mass star formation. The Methanol Maser Multi Beam (MMB) Survey is an ongoing survey of the inner galactic plane deep survey for Class II Methanol Masers in the Galaxy and Magellanic clouds with a positional accuracy, comparable to the GLIMPSE and UKIDSS GPS surveys.

We outline the MMB and present the results of the cross match of the early MMB with GLIMPSE,UKIDSS and RMS surveys in order to confirm that Class II Methanol Masers are indeed tracers of high mass star formation and take tentative steps toward understanding the evolution stages that they trace.

Wednesday
2:20pm

Spectro- Astrometry of Herbig Ae/Be Binary Systems

H. Wheelwright (University of Leeds), R. Oudmaijer

Our recent work using spectro-astrometry indicates that the majority of Herbig Ae/Be stars, intermediate mass Pre-Main-Sequence stars, reside in close binary systems. Furthermore, it was found that circum-stellar disks in these systems seem to be preferentially aligned with the binary orbital plane. This strongly suggests that these systems formed via fragmentation of a molecular core. However, the precise mode of fragmentation is not well understood. In addition little is known or predicted about the mass ratio of the resulting binary. Here we show how spectro-astrometry can be used to disentangle un-resolved binary spectra, allowing the spectral type of each component to be determined. This leads to an accurate estimation of the mass ratio of the system. We present an overview of the binary properties of a sample Herbig Ae/Be objects and discuss the implications properties such as the mass ratio have on the formation mechanism of these systems.

Wednesday
2:30pm

Stellar Rotation at Young Ages: New Results from Corot's Monitoring of NGC 2264

F. Favata (ESA), G. Micela, S. Aigrain, S. Alencar, K. Zwintz and the Corot NGC 2264 team

Angular momentum is one of the driving forces in the early evolution of stars. Issues such as the coupling between the star and the accretion disk (the so-called disk regulation paradigm), are traced by the evolution of rotational momentum, but affect the star-forming process as a whole. One of the features observed in star-forming regions (e.g. ONC and NGC 2264) of age between 1 and few Myr, for masses above 0.25 solar masses, is a bimodality of the rotational period distribution, with a peak around 1 day and the other at around 4 to 7 days.

We recently observed the NGC 2264 star-forming region (age ca. 3 Myr) with the Corot space telescope, obtaining an uninterrupted 21 day long high accuracy photometric series. This allows the determination of rotational periods with high accuracy and the removal any biases due to the coverage imposed by ground-based observational campaigns. The Corot photometric campaign on NGC 2264 has resulted in a single-peaked distribution (with a peak at 3-4 days) and no short period peak. The bimodal distribution that has been reported based on ground-based campaigns disappears, and the short-period peak in the distribution (centered around 1 day) appears to be spurious and entirely due to aliasing effects between the actual rotational modulation and the observational window function.

We present the resulting Corot-based rotational period distributions for NGC 2264 and discuss the implications of the shift from a double-peaked to a single-peaked distribution on the angular momentum evolution in the few Myr age range.

Wednesday
2:50pm

The Low-Mass Initial Mass Function in the Young Cluster NGC 6611

J. Oliveira (Keele University), R.D. Jeffries, J.Th. van Loon

We present new ultra-deep observations of NGC 6611, the massive young 2-3 Myr-old cluster that ionises the Eagle Nebula. These photometric observations of the central region of NGC 6611 were obtained with the Hubble Space Telescope and the following filters: ACS/WFC F775W and F850LP and NIC2 F110W and F160W, loosely equivalent to ground-based IZJH filters. Our survey reaches down to I ~26 mag. A careful analysis of our photometry allowed us to get a good handle on two very important concerns of such deep surveys: contamination and completeness. We constructed the Initial Mass Function (IMF) from 1.5 Msun well into the brown dwarf regime (down to ~0.02 Msun). We have identified 30-35 brown dwarf candidates in our sample. The low-mass IMF constructed with the HST photometry is combined with a higher-mass IMF constructed from the groundbased catalogue of Oliveira et al. (2005). We compare the final IMF with those of well studied star forming regions and theoretical expectations. We find that the IMF of NGC 6611 more closely resembles that of the low-mass star forming region in Taurus than that of the more massive Orion Nebula Cluster. We conclude that there seems to be no severe environmental effect in the IMF due to the proximity of the massive stars in NGC 6611. We will discuss our results in the context of star and brown dwarf formation theories, taking into account modern formulations and model predictions.

Wednesday
3:10pm

Is the IMF universal? Latest results from the UKIDSS Galactic Clusters

N. Lodieu (IAC, Tenerife), Nigel Hambly, Richard Jameson, Simon Hodgkin, Giovanni Carraro

In this talk, I will focus on the latest results obtained from the UKIRT Infrared Deep Sky Survey (UKIDSS) Galactic Clusters Surveys (GCS) in 4 regions: Pleiades (130 Myr), IC 4665 (27 Myr), Upper Sco (5 Myr), and sigma Orionis (3 Myr). I will briefly describe the selection procedures used in each cluster to identify very low-mass star (M <= 0.5 Msun) and brown dwarf member candidates. Then, I will compare the mass functions in the 0.5-0.03 Msun mass range with the field mass function. I will show that these (system) mass functions follow the extrapolation of the field mass functions of Kroupa (2002) & Chabrier (2003) down to 0.03 Msun. However, we seem to observe a difference at lower masses for the youngest clusters, especially in the case of Upper Sco, for which spectroscopic follow-up is available. Under the assumption of a universal log-normal IMF for the star formation process, our results indicate that the characteristic mass is lower and the mass-scale (or width) is higher than was found by Kroupa (2002) & Chabrier (2003) using the higher mass and mixed-age field stars.

Wednesday
3:20pm

A Photoevaporating Proto-Brown Dwarf in Orion?

P. Lucas (University of Hertfordshire), Patrick F. Roche, Antonio C. Chrysostomou

We describe observations of the proto-brown dwarf candidate 047-436 in the Orion Nebula Cluster. Gemini NIFS+LGS adaptive optics integral field data reveals that the source is surrounded by a small halo of photo-excited molecular hydrogen and has a very red near IR continuum spectrum, similar to a Class I protostar. The optical spectrum is highly variable and sometimes shows the CaII emission lines commonly associated with strong accretion.

Wednesday
4:00pm

Three New Methane Dwarfs in the Star Forming Region IC 348

A. Burgess (LAOG, Grenoble, France), Jerome Bouvier, Estelle Moraux

Narrowband CH4off and CH4on WIRCAM observations of the young star forming region IC 348 reveal three faint, J~21mag, T-dwarf candidates with CH4on-CH4off colours >0.4mag. Extinction was estimated for each candidate from colour/colour diagrams, the 3Myr COND model, and comparison with known spectral types and found to be between Av~6 and 12mag, in keeping with previously found extinction for IC 348. These objects are not thought to be foreground field dwarfs from a number density arguments, and also the extinction arguments, nor background dwarfs as these objects would be far too faint to observe if that was the case. Comparisons with T-dwarf spectral type models, and colour/colour and colour/magnitude diagrams, appear to give three of the objects preliminary spectral types between T3 and T5, potentially making these among the youngest, and hence lowest mass objects detected in a star forming region.

Wednesday
4:10pm

The Formation of Brown Dwarfs and Low-Mass Stars by Disc Fragmentation; Theory vs Observations

D. Stamatellos (Cardiff University), Anthony P. Whitworth

We suggest that stars like our Sun should sometimes form with massive discs, and we show, by means of radiative hydrodynamic simulations, that the outer parts of such discs are likely to fragment on a dynamical time-scale, forming low-mass stars, brown dwarfs, and planetary-mass objects. I will present the predictions of this model and I will compare these predictions with the observed properties of low-mass stars and brown dwarfs. In particular, I will show that the model of disc fragmentation can explain the binary properties of low-mass stars, the brown dwarf desert, and the existence of free-floating planetary mass objects. I will also discuss predictions of the model that can be tested by future observations.

Wednesday
4:30pm

Star Formation Triggered by Expanding HII Regions

A. Whitworth (Cardiff University), Thomas Bisbas, David Hubber, Richard Wunsch

I will present SPH simulations of clouds overrun by HII regions. These simulations identify the circumstances under which the clouds experience radiation-driven implosion, leading to star formation; the circumstances under which the cloud is simply accelerated (by the rocket mechanism), thereby injecting turbulent energy into the interstellar medium; and the circumstances under which the cloud is simply evaporated.

Wednesday
4:40pm

Constraining the Kinematics of Serpens North Cluster: Comparison between (Sub)Millimetre Observations and SPH Simulations

A. Duarte Cabral (Jodrell Bank Centre for Astrophysics, Manchester), Gary Fuller, Nicolas Peretto, Clare Dobbs

The Serpens North Cluster is a low mass star forming region at 260pc from the Sun. It contains several submillimetre sources (Class 0 and I objects) in a compact region of about 0.3pc in size, and older, Class II and III objects dispersed in the field. It is thought these correspond to two different bursts of star formation, the more recent having occurred within the past 10^5 yrs. This study presents an explanation of the origin of this burst, based on the observed dynamics of the molecular gas, which has not previously been well studied. Based on the molecular line profiles of CO isotopes and the 850micron dust emission spatial distribution we present an hypothesis that a collision between two flows/cylindrical clouds is the main trigger for the latest episode of star formation in this region. We performed SPH simulations of cloud collisions and have been able to reproduce many of the observed characteristics of Serpens. This is one of the few direct comparisons between simulations and observations of nearby clouds to date.

Wednesday
5:00pm

The Structure of Molecular Clouds

J. Rowles (University of Kent), Dr Dirk Froebrich

Recent wide-field near- and mid-infrared survey observations have led to immense advances in our understanding of star formation. In giant molecular clouds star formation modes ranging widely from clustered to isolated are observed. The distribution of these modes within giant molecular clouds is certainly linked to their large scale density and velocity structure. To understand the causes for the distribution of clustered and isolated modes we investigate the column density distribution of a large number of giant molecular clouds by means of new all sky extinction maps created from 2MASS data (Rowles and Froebrich 2009). We present the analysis of the column density distribution at different spatial scales of all giant molecular clouds in our maps. Supplemented by forthcoming UKIDSS and VISTA data, this will allow us to investigate the column density structure and dust properties of all nearby giant molecular clouds on scales down to a few 10000AU. Our new all sky extinction maps will be a vital complementary tool for e.g. the upcoming sub-mm surveys with SCUBA2 (that will not pick up the low column density material) or investigations of the velocity structure using HARP-B.

Wednesday
5:10pm

Are Pre-Main-Sequence Stars Older than we Thought?

T. Naylor (Exeter)

We fit the colour-magnitude diagrams of stars between the zero-age main-sequence and terminal-age main sequence in young clusters and associations. The ages we derive are a factor 1.5 to 2 longer than the commonly used ages for these regions, which are derived from the positions of pre-main-sequence stars in colour-magnitude diagrams. From an examination of the uncertainties in the main-sequence and pre-main sequence models, we conclude that the longer age scale is probably the correct one, which implies we must revise upwards the commonly used ages for young clusters and associations. Such a revision would explain the discrepancy between the observational lifetimes of proto-planetary discs and theoretical calculations of the time to form planets. It would also explain the absence of clusters with ages between 5 and 30Myr.

Thursday
11:00am

The Fragmentation of Expanding Shells

J. Palous (Astronomical Institute, Academy of Sciernces), Jim Dale, Richard Wunsch, Anthony Whitworth

The fragmentation of expanding shells is analyzed with the thin-shell approximation, which is compared to 3 dimensional simulations using AMR and SPH numerical codes. When is the shell kept thin with a confining pressure of the ambient medium, the fragmentation process follows the prediction of the thin-shell dispersion relation. However, when a shell thickens, due to its internal overpressure as it expands into a low pressure ambient medium, short modes become stable. The observed shells in GLIMPSE survey (Churchwell et al. 2007) show the thickness growing with their radius. It means that the shells thicken as they expand, which implies that the star formation triggered due to their fragmentation should prefer high mass stars.

Thursday
11:20am

Using Molecular Complexity as Diagnostics of the Physical Characteristics of Low and High Mass Star Formation

S. Viti (UCL)

Within the context of Herschel (and future missions such as SPICA), I will present some recent observational and modelling work on molecular line emissions from galactic (and some extragalactic) environments. I will also show some observations and modelling of large and complex molecules associated with galactic star formation activity and show how molecular complexity may be used to determine the age of the star formation process.

Thursday
11:40am

Constraining Observables from Hydrodynamical Simulations of Prestellar Core Collapse

S. Walch (Cardiff University), A.Whitworth, D.Stamatellos, D.Ward-Thompson

In the near future the launch of the Herschel Space Telescope as well as upcoming large ground-based projects like ALMA will be used to observe the early star formation process in unprecedented detail. We use 3D SPH simulations of collapsing prestellar cores to constrain observables characterising the first 100,000 years of evolution. We thus follow the systems up to the point where one or many very young, embedded protostars have been formed. We concentrate on the observational appearance of warm and flattened disk-like torii, which are found to surround the young protostars. We argue that VELLOs may be forming protostars captured in a very short-lived and early evolutionary stage.

Thursday
12:00pm

Non-LTE Molecular Line Imaging of SPH Cluster Simulations

D. Rundle (University of Exeter), Dr T. J. Harries, Dr D. M. Acreman

We present the first non-LTE molecular line images of a Smoothed Particle Hydrodynamics (SPH) simulation of a star forming cluster. By re-sampling Bate et al.'s particle-based representation onto an adaptive mesh, we are able to use TORUS, a three-dimensional Adaptive Mesh Refined (AMR) radiative transfer code to solve self-consistently, the equations of radiative and statistical equilibrium in the co-moving frame. We obtain non-LTE level populations over the spatial extent of the cluster and create maps in multiple sub-millimetre lines (including but not limited to HCO+ J=1-0, N2H+ J=1-0 and C18O J=1-0) and the 850 micron continuum. We present a preliminary comparison of the synthetic maps to observations of star forming regions and discuss the implications of this work, and its potential future applications, for observers and theorists alike.

H-P01

Modelling Circumstellar Discs with 3D Radiation Hydrodynamics

D. Acreman (University of Exeter), Tim Harries, David Rundle

We present a three dimensional, radiation hydrodynamics code, which combines Smoothed Particle Hydrodynamics with Monte-Carlo radiative transfer, to give a flexible system which can be applied to arbitary geometries. The code is used to model a circumstellar disc around a classical T Tauri star and achieves an equilibrium state in which radiative and hydrostatic balance are reached. Future applications of this code will include modelling self-gravitating discs to study the impact of radiative feedback on disc fragmentation.

H-P02

A Survey of Star Formation Rates and Disk Dissipation Timescales using VO Tools

G. Barentsen (Armagh Observatory), Jorick Vink

We investigate the rate of star formation and disk dissipation in nearby star forming regions using optical and infrared photometry. We estimate the ages and circumstellar disk excesses of pre-main sequence stars using tools provided by the Virtual Observatory to cross-match catalogues from multiple surveys and literature sources. An approach like ours will be vital for effective use of future data deliveries from surveys such as WISE, Pan-STARRS, IPHAS and GAIA.

H-P03

Laboratory Astrophysics at the Lund Observatory

R. Blackwell-Whitehead (Lund Observatory), Hampus Nilsson, Henrik Hartman

The analysis of astrophysical spectra to reveal information on the processes in stellar and sub-stellar mass objects is dependent upon a detailed and precise knowledge of each molecule, atom, and ion present. Over the past fifteen years there have been vast improvements in the wavelength range and resolution of ground-based and satellite-borne telescopes with medium to high-resolution spectrographs observing spectra from the extreme UV to far IR. Of particular interest to our research is the development in infrared astrophysical spectroscopy for the study of dust-obscured objects such as young stars, the centre of galaxies, the composition of evolved stars and the interstellar medium, objects at high red shifts, and cool objects of sub-solar mass such as dwarf stars, brown dwarfs and extra-solar planets. However, the current laboratory IR atomic database is not sufficient for many modern astrophysical applications and is deficient in several key parameters; transition wavelengths by which one can identify elements, features and blends, and oscillator strengths by which one can determine elemental abundances. The Lund Observatory Laboratory Astrophysics group focuses on the measurement and analysis of atomic and molecular data for astrophysical applications and improvements in the laboratory database. The group uses two Fourier transform spectrometers; a Chelsea Instruments high-resolution FT500 spectrometer (185 to 900nm) and a modified Bruker IFS 125HR spectrometer (250 to 5,400nm). The combination of these two spectrometers provides high wavelength resolution, broad spectral range, high absolute wavelength accuracy, and good optical throughput, which is ideal for both emission and absorption spectroscopy. We use the instruments to determine accurate wavelengths (1 part in 1,000,000), energy levels and line broadening effects due to hyperfine splitting and isotope shifts. Furthermore, intensity calibration of the atomic spectra provides branching fractions that can be combined with radiative lifetimes to yield oscillator strengths.

H-P04 Constraint on Brown Dwarf Formation via Ejection: Radial Variation of the Stellar and Substellar Mass Function of the Young Open Cluster IC 2391

S. Boudreault (Max-Planck-Institut für Astronomie), Coryn A.L. Bailer-Jones

Here we present the results of a program to study the mass function and its radial dependence in one of the nearest open cluster, IC 2391 (age ~ 50Myr, distance ~ 146pc) in order to put constraints on the different formations mechanism of brown dwarf. The survey consist of 35 34x33 arcmin fields extending to 3 degrees from the center of the cluster, for a total coverage of 10.9 sq. degrees. We conclude that ejection formation scenario is not a significant BD formation mechanism if it results in a higher velocity dispersion of BDs compared to stars. However, if ejection mechanism is the unique BD formation path, then both BDs and stars should have the same velocity dispersion. We also present a preliminary spectroscopic follow-up of brown dwarfs and very low mass stars candidates from two fields. About 34 % of our photometric candidates are true physical member of the cluster. We also report here the discovery of 7 new BDs members of IC 2391.

H-P05 The Substellar Population in the Old Open Cluster Praesepe

S. Boudreault (Max-Planck-Institut für Astronomie), Coryn A.L. Bailer-Jones, Wei Wang, Bertrand Goldman, Thomas Henning, Jose A. Caballero, Rafael Rebolo

The origin and evolution of brown dwarfs remain a fundamental open question. For open clusters at different ages and environments the initial/present mass function is one of the main observational signatures which can be used to investigate this question. We have performed a deep, wide-area, optical and IR-photometric survey (riIYzJKs) in the old open cluster Praesepe (age ~ 650Myr, D ~ 190pc), using the IR-camera Omega-2000 at Calar Alto, the optical Wide Field Imager at La Silla, the Wide Field Camera at La Palma, and the LBT blue and red camera at Mt. Graham. The survey covers an area of 3.23 sq. degrees, reaching a 5sigma detection limit of J = 20.0 mag (50M[Jup]). Here we discuss preliminary results based on our photometry.

H-P06 First Results from the JCMT Gould Belt Legacy Survey in Orion

J. Buckle (University of Cambridge), The Gould Belt Survey Team

The Gould Belt Legacy Survey (Ward-Thompson et al. 2007) has been awarded a significant amount of time on the James Clerk Maxwell Telescope (JCMT) to survey nearby star-forming regions (within < 500 pc), using HARP (Heterodyne Array Receiver Program), SCUBA-2 (Submillimetre Common-User Bolometer Array 2) and POL-2 (Polarimeter 2). The HARP component will observe a large typical sample of prestellar and protostellar sources in three CO isotopologues. This poster describes the first HARP results for two sources in Orion B, NGC2024 and NGC2071.

CO 3-2 and the same transition in the isotopologues 13CO and C18O are excited in the typical physical conditions of star forming molecular clouds. The temperatures and densities are typically in the range 10-50 K and 104-105 per cubic cm. 12CO observations are used to search for and map any high velocity outflows present, while the isotopologues measure the line widths and velocity profiles in the cores and filaments, resolving detailed kinematic and density properties of the cores

The Orion B cloud complex is the closest high mass star formation region, and incorporates 5 main star forming regions. NGC 2024 is a bright emission nebula that is crossed by a prominent dust lane, which contains a number of SCUBA dust cores, and several young protostars. NGC 2071 is associated with a reflection nebula, containing several near infra-red sources, SCUBA dust cores, and also contains the most energetic bipolar outflows currently known. The dense molecular material towards both sources is distributed in filamentary structures and arcs.

H-P07 Measuring Anticlustering in Star Forming Regions

A. Cartwright (Cardiff University), Anthony P. Whitworth

Many techniques exist for the quantification of clustering in groups of objects, but here we show that the opposite phenomenon, Anticlustering, can also be measured. The Normalised Correlation Length, or mean distance between objects, can be used to exclude complete spatial randomness, and to indicate anticlustering. This is demonstrated on artificial data and also by analysis of observations from a region of triggered star formation around an expanding gas bubble. We are able to exclude the possibility of spatial randomness, and deduce the most likely 3d arrangement of the stars.

H-P08 A Magnetic Model for Episodic Accretion onto Protostars

C. D'Angelo (MPA, Garching), Hendrik Spruit

Protostars typically have rather strong magnetic fields (~1kG), which interfere with the accretion of mass from the disc surrounding it. We present new work exploring an instability that develops when the disc is truncated by the magnetic field of the star, and the inner radius of the disc is located very close to the corotation radius (the radius at which the Keplerian frequency matches the frequency of rotation). The instability we describe leads to cycles of episodic accretion, which we discuss in the context of EXors, a class of TTauri star that show periodic outbursts.

H-P09 MAD Observations of NGC2362

N. Huelamo (LAEX-CAB), A. Moitinho, H. Bouy, J. Alves, E. Marchetti, J. Kolb, E. Artigau, M. Hartung, M. Sterzik

I will present multi-conjugate adaptive optics observations of NGC2362, a ~5 Myr cluster at ~1.5 kpc. Its low interstellar and internal extinction, together with the lack of circumstellar disks, makes this cluster a template to study early stellar evolution. I will show preliminary results from our MAD/VLT observing run. These data, together with NACO/VLT observations, have allowed us to study the innermost regions of the cluster and its high-mass population.

H-P10 Young, Very Low-Mass Objects in the Elephant Trunk

B. López Martí (LAEX-CAB), Belen Lopez Marti, Maria Morales-Calderon, David Barrado y Navascues

The IC~1396 HII region is one of the best examples of star formation in dark cometary globules, triggered by the winds of the massive O6 star HD~206267 at its center. Here, we present the first results of a survey for very low-mass objects in the IC~1396A globule, also known as the Elephant Trunk Nebula. Our RIz and JHKs data are combined with the IRAC/Spitzer photometry from Morales-Calderon et al. (in press) to select candidate members of the region. Our objects have magnitudes between 14<I<$20, corresponding to masses down to about 40~M_J in the areas of low extinction. They are the first substellar candidates identified so far in this globule.

H-P11 Spectral Analysis of Late-Type Stars in the K-Band Region

Y. Lyubchik (Main Astronomical Observatory of NASU), H.R.A.Jones, Ya.V.Pavlenko, et al.

We analyse the spectra of 19 stars at a resolution of 20000 in the K band spectral region. The stellar spectra of different spectral types - from G8 to M9.5 - were used in analysis. The method of synthetic spectra was applied to determine effective temperatures, gravities and rotational velocities of these targets. Synthetic spectra modelling was carried out using the best for today model atmospheres, atomic line list and molecular line lists of the pricipal opacity sources.

H-P12 Formation and Evolution of Star-Forming Pillars in H II Regions

J. Mackey (Dublin Instituted for Advanced Studies), Dr. Andrew J. Lim

Dense elongated pillars of gas are one of the most striking features of massive star-forming regions (e.g. the Eagle (M16) and Carina (NGC3372) Nebulae). Despite extensive study in recent years, there is still no firm consensus as to the lifetimes of these structures or the mechanisms by which they form. We have developed a radiation-MHD code to study the possible formation scenarios of such pillars. We confirm previous work in finding that it is very difficult for the shadowing of ionising radiation by a single clump to produce a dense pillar on a timescale of 0.1Myr. We present here the results from 2D and 3D numerical simulations where we have investigated the evolution of a random distribution of dense clumps exposed to an ionising radiation source. We describe the structures that subsequently develop and assess the properties of the radiation and density fields that are required in this model to produce the large pillars which are observed.

2D models with uniform magnetic fields show that the neutral gas must be magnetically dominated in order for the field to significantly affect our results (plasma beta<=0.1). This is because the dynamical evolution is primarily driven by the greatly increased pressure of the ionised clump material. We anticipate that our future work, which will incorporate a density-dependent magnetic field, will produce significantly different results.

H-P13 Searching for Proto-Brown Dwarfs

M. Morales-Calderon (LAEX-CAB/INTA-CSIC), D. Barrado y Navascues, A. Palau, A. Bayo, I. de Gregorio, C. Eiroa, N. Huelamo, H. Bouy and O. Morata

We present a multi-wavelength search of very cool, very low luminosity objects (VeLLOs) in the Barnard 213 dark cloud, which is located at 140 parsecs. We have collected data ranging from near infrared at 1.1 micron up to 6 centimetre, including data from the Spitzer Space Telescope, the Caltech Submillimeter Observatory and the IRAM 30 meter antenna and the Very Large Array. The selection of candidates is done based on their magnitudes, colors and spectral energy distributions.

H-P14 The RMS Survey: The Luminosity Function of Massive YSOs in the Galactic Plane

J. Mottram (University of Exeter), Melvin Hoare, Stuart Lumsden, Rene Oudmaijer, James Urquhart, Ben Davies

The Red MSX Source (RMS) Survey is a multi-wavelength search for sites of massive star formation throughout the Galactic plane. Starting from a colour-selected sample of ~2000 candidates, follow-up observations have identified contaminants and provided distance information. Far-infrared (IR) fluxes have been obtained for a large proportion of the young sources within this list from IRAS Galaxy Atlas and MIPSGAL satellite data, allowing the determination of the luminosities of these sources. Of order 300 new massive young stellar objects (MYSOs) have been identified, which represents an order of magnitude increase in the number known. Many new ultra-compact HII regions have also been identified. We will discuss obtaining the far-IR fluxes and luminosities of these sources and present the first determination of the luminosity function of massive young stellar objects (MYSOs) and ultra-compact HII regions for the galactic plane. In addition, the timescales of these phases of massive star evolution as a function of luminosity will be discussed.

H-P15 IRAS 00117+6412: Three intermediate mass YSOs in the making

A. Palau (LAEX-CAB INTA-CSIC), Alvaro Sanchez-Monge, Gemma Busquet, Robert Estalella, Qizhou Zhang, Paul Ho

IRAS 00117+6412, located at a distance of only 1.8 kpc, is an intermediate mass star-forming region appropriate to study the clustered mode of star formation. We conducted high-resolution and high-sensitivity observations with the PdBI, SMA and VLA arrays to study the different young stellar objects (YSOs) embedded in this region through continuum, dense gas and molecular outflow emission. We present here the first results obtained from these observations. The region is dominated by three main YSOs in different evolutionary stages: (1) a shell-like ultracompact HII region produced by a B2 star at the border of a cloud with multiple subcondensations, (2) a dust compact source embedded in dense gas with near infrared emission, and powering one or more CO bipolar outflows, and (3) a compact dust source with no infrared neither outflow emission, but with signposts of rotation and infalling motions.

H-P16 A Search for Very Low-Mass Stars, Brown Dwarfs and Planetary-Mass Objects in Taurus-Auriga and other Young and Nearby Star Associations

M. Perger (Instituto de Astrofisica de Canarias (IAC)), Eduardo Martin, Nicolas Lodieu

In the very young and nearby Taurus-Auriga star-forming region a comparative deficit of substellar objects is measured. But so far only the highest stellar density regions were searched for such sources. To probe formation theories such as the embryo ejection model we investigate therefore areas of lower density in Taurus. We search for Brown Dwarfs with magnitude and color criteria using amongst others the UKIDSS GCS photometry. This near-infrared (ZYJHK bands) survey covers a yet unexplored area in the north of the main Taurus cloud. An infrared extinction map has been constructed and proper motion membership criteria were derived for brighter sources by comparing the data to 2MASS JHK photometry. By different search approaches over 50 low-mass star- and 10 T dwarf candidates have been selected that meet our different criteria. Follow-up spectroscopy and imaging of our candidates have already started at Lick and La Palma observatories. Preliminary results of spectroscopic data of 6 high priority Brown Dwarf candidates show at the most two early M type stars. The existence of Brown Dwarfs in the investigated area therefore is very doubtful. If the ongoing investigations will confirm this absence of Brown Dwarfs and T Tauri stars in Taurus' lower density areas, the connection between gas density and substellar objects and the higher low-mass cutoff would be verified. This could have strong implications on the IMF and substellar formation models.

H-P17 Star Formation in the W3 Giant Molecular Cloud with Spitzer

D. Polychroni (LJMU - Astrophysics Research Institute), Toby J.T. Moore, James Allsopp

We have completed the mapping of the W3 giant molecular cloud with the Spitzer space telescope and we present the results of our photometry analysis here. We have looked for IR counter parts to dense cores as identified in existing SCUBA maps of the cloud. We study their distribution in the cloud with respect to their luminosity and Class. We also study the core statistics in the different star forming regions within the cloud and between the triggered and spontaneous star forming regions of the clouds. We discuss the possibility of an age spread across the cloud supported by our recent HARP-B CO J=3-2 observations of the W3 GMC, as well as by other studies in the literature.

H-P18 The W3 Giant Molecular Cloud Mapped with HARP-B

D. Polychroni (LJMU - Astrophysics Research Institute), Toby J.T. Moore, James Allsopp

We have mapped the W3 Giant Molecular Cloud with the Heterodyne Array Receiver Program (HARP-B) on the JCMT in CO J=3-2 and its isotopes. We present here the first results of our analysis of the data. We have observed, for the first time, a temperature gradient across the cloud that is clear indication of a time sequence in the observed star forming regions (W3 Main, W3 (OH), AFGL 333) within the cloud. We use this result to measure with much greater accuracy the mass of the cloud as well as the star formation efficiencies across the different star forming regions in the cloud.

H-P19 Comparison of Starlink Clump-Finding Algorithms

L. Quinn (Jodrell Bank Center for Astrophysics), Dr. Gary Fuller

The Starlink Project is an astronomical computing project which supplies data reduction software. The software contains four clump-finding algorithms called Reinhold, Gaussclumps, ClumpFind and Fellwalker. The clump-findings algorithms take the input data (modified to include the inhomogeneous noise levels) and outputs a catalogue of clumps (position, size, peak & sum flux density) and an output image of where the clumps have been found. The algorithms are being tested on an area of 870 micron continuum emission, tracing areas of high molecular column density - which are areas of dense dusty clouds in which new stars are forming. The data is part of ATLASGAL a Galactic survey at 870 micron, which aims to produce a unbiased view of high mass star formation through out the Galactic plane. To correctly identify the emission for follow up work the right clump-finding algorithm needs to be selected.

Work for this project is motivated by the main PhD project: '6035 MHz excited OH masers in star forming regions' and participation in a survey for the 6035 MHz excited OH masers in the Galactic plane. These masers identify regions of massive star formation (MSF) along with probing the physical conditions of the regions. To build up a complete picture of what is occurring in the MSF regions, we need to be able to compare the high precision maser positions found from the survey with accurate "clump" (dense dusty clouds) peaks to properly identify what the excited OH masers are associated with.

H-P20 Young Stars in the Direction of the Perseus Arm

R. Raddi (University of Hertfordshire), J. E. Drew, D. Steeghs

Our study aims to identify and analyse, in a comprehensive and detailed manner, the population of optically-detected young stellar objects across an extensive region of the Galactic plane lying between Galactic Longitudes (120, 140) and Galactic Latitudes (-1, 4). In this direction, there is the Perseus Arm, at about 2.0 kpc from the Sun, which is home to both massive molecular cloud complexes like W3/W4/W5 as well as small isolated dark clouds and relatively quiescent regions. There is thus a range of different star-forming environments to explore in a uniform manner, beginning with the photometric detection of candidate emission line stars from the INT/WFC Photometric H-alpha Survey of the northern Galactic Plane. We present the results of follow-up spectroscopy of 252 candidate emission line objects. In the brightest magnitude interval studied ($12<r'<16$), classical Be stars seems to dominate the sample, with candidate young stellar objects becoming more frequent at fainter magnitudes ($16<r'<20$). Analysing the available spectra, infrared photometric colours (2MASS) and their spatial distribution, we have selected a reduced list of YSO candidates that will warrant closer examination. We present the data we have collected on this young population.

H-P21 2MASS J17112318-2724315: A Deeply-Embedded Low-Mass Protostellar System in the B59 Molecular Cloud

B. Riaz (IAC), Martin, E. L., Bouy, H., Tata, R.

We present near-infrared observations of the low-mass deeply-embedded Class 0/I system 2MASS J17112318-2724315 (2M171123) in the B59 molecular cloud. Bright scattered light nebulosity is observed towards this source in the Ks images, that seems to trace the edges of an outflow cavity. An interesting feature observed is a 'dark lane' that lies offset from the system. This suggests a morphology in which the protostar casts a shadow onto a nearby optically thick background cloud. We report the detection of a faint sub-stellar source 2M17112255-27243448 (2M17112255), ~8" (~1000 AU) from 2M171123. This is the first such detection in the B59 molecular cloud. The protostar 2M171123 exhibits a rarely observed absorption feature near 11.3 micron within its 10 micron silicate band. We find a strong correlation between the strength in this feature and the H2O-ice column density, indicating its origin in the thickness of the ice mantle over the silicate grains.

H-P22 A Very Extended Area Search for Very Low-Mass Stars and Brown Dwarfs in the Upper Scorpius Association

V. Sánchez Béjar (Instituto de Astrofísica de Canarias), Pérez-Garrido, A.; Díaz-Sánchez, A.; Villó-Pérez, I.; Rebolo, R.

Using the IJKs-band and the JHKs-band data from the Denis and 2MASS catalogs, respectively, we have performed a search for very low-mass stars and brown dwarfs covering an area of 168 deg^2 in the Upper Scorpius association (5Myr, 145pc). From I,I-J and I,I-Ks Color-Magnitude diagrams, we have selected about 1500 candidates in the magnitude range I=13-18.5, following the photometric sequence of previously known member of the association with available Denis and 2MASS photometry. According to evolutionary theoretical models, they span a mass range from 0.15 to 0.020 Msol for an age of 5Myr, well within the substellar regime. We investigate the number of possible contaminants by performing similar studies in different control fields at the same galactic latitude. We estimate the luminosity function and mass spectrum of present survey and compare them with previous studies in the association and other young regions.

H-P23 Photometric Study of the FUor Star V 1735 Cyg (Elias 1-12)

K. Stavrev (Institute of Astronomy, Sofia), S. P. Peneva, E. H. Semkov, K. Y. Stavrev

Results from optical photometric observations of V 1735 Cyg are reported. The star is located in the IC 5146 dark cloud complex - a region of active star formation. On the basis of observed outburst and spectral properties, V 1735 Cyg was classified as a FUor object. We present data from IRVB CCD photometric observations of the star, collected from March 2003 to November 2008. Plates from the Rozhen Observatory Schmidt telescope archive were scanned for a brightness estimation of the star. A sequence of sixteen comparison stars in the field of V 1735 Cyg was calibrated in the IRVB bands. The data from photographic observations made up to 1994 show a strong light variability. In contrast, the recent photometric data obtained from 2003 to 2008 show only small amplitude variations. The analysis of existing photometric data shows a very slow decrease in star brightness - 1.8 (R) for 43 years period. The possibilities for future photometric investigations of V 1735 Cyg using photographic plate archives are discussed.

H-P24 BLAST Observations of Star Formation in the Carina Nebula NGC 3372

S. Stickler (Cardiff University), D. Ward-Thompson, M. Griffin, J. Kirk, P. Hargraves, E. Pascale

The Carina region, NGC 3372, is an extremely bright nebula containing some of the most massive stars in our galaxy. We analyse observations of the nebula carried out with the Balloon-borne Large Aperture Submillimeter Telescope (BLAST) at 250, 350 and 500um, and covering an area of 152 sq. arcminutes. We combine these data with observations made using Spitzer MIPS at 24 and 70um. We identify 158 sources and show that there is a characteristic source size of between 1.7 and 2.2 parsecs, which is significantly larger than the angular resolution of the BLAST observations. We go on to show that the detected sources can be characterised by a single population of cores with an average temperature of 15 to 20K.

H-P25 Galactic Molecular Clouds and Stellar Clusters

L. Summers (University of Exeter)

Star formation is an important aspect when studying the evolution of and formation of the Galaxy. Any full and complete understanding of stellar evolution must also include study of Galactic Molecular Clouds (GMCs). GMCs are sites where all know star formation is thought to occur, hence, where young stars are found it is assumed that one will also observe a GMC.

The main aims of this work include; investigation of the variation with age of the mass of molecular Hydrogen associated with Stellar clusters, the variation of V(LSR) with heliocentric distance as a function of longitude. Stellar Cluster data have been extracted from the WEBDA online cluster catalogue and these clusters have been used to match to CO emission. Utilising data of the J(1-->0) transition of 12CO from the OGS (Outer Galaxy Survey) and EOGS (Extended Outer Galaxy Survey), using the FCRAO (Five College Radio Astronomy Observatory) ,the mass of Molecular Hydrogen surrounding Stellar Clusters, via equation of the CO intensity to Hydrogen, of varying age is determined. The preliminary findings of this work are presented.

H-P26 The SCUBA-2 "All-Sky" Survey

M. Thompson (University of Hertfordshire), The SASSy Consortium

I will describe a forthcoming survey with the SCUBA-2 camera on JCMT to map a large portion of the sky with the aims of making a complete census of Infrared Dark Clouds and searching for isolated star-forming regions. Predictions are made for the expected source counts from existing SCUBA surveys.

H-P27 Assessing the Performance of Sub-Millimetre Compact Object Detection Algorithms

M. Watson (University of Hertfordshire), Mark Thompson & Jason Stevens

There are numerous compact object detection algorithms being used at present with no particular evidence as to why one algorithm should be used over one of the others. Using data collected by SCUBA we will thoroughly test four compact object detection algorithms (Clumpfind, FellWalker, Reinhold and Gaussclumps). By inserting false data of a known size, flux and position and using the Cupid findclumps program, the output results can be directly compared to the input and therefore the completeness for each algorithm can be determined. We also intend to determine if there are any systematic errors in the algorithms which may lead them to produce incorrect results and if so provide a correction factor for future data.

H-P28 Modelling Dust Emission From Massive Protostellar Envelopes.

J. Williams (University Of Manchester), Gary Fuller

We are modelling the sub-millimetre dust emission from young massive protostellar cores to determine the properties of the dusty envelopes surrounding these sources. We used the 1-D radiative transfer code DUSTY to create models, with an adaptive grid of parameters, which are compared to spatial intensity profiles of the observations to find the model with the best fitting set of parameters. The parameters investigated are the density distribution using single power law profiles, temperature, optical depth and shell thickness. The models were compared to sources in SCUBA observations of the protostellar objects. We found 16 fits for sources at 850 microns (11 of these were simultaneously fit at 450 microns). These sources have power law density profile indices of -1.5 (+0.5/-0.25) at 850 microns and slightly flatter indices of -1.25 (+0.25/-0.5) at 450 microns. We suggest that the significantly flatter 450 micron fits (indices around -0.5) are due to substructures within the source starting to become resolved because of the smaller beam size at 450 microns.

H-P29 Simulated Observations of Planet Formation with MROI

J. Young (University of Cambridge), F. Baron

We present simulated observations of protostars undergoing planet formation with the Magdalena Ridge Observatory Interferometer (MROI). The MROI is a ten-telescope optical/near-IR interferometer currently under construction at a 10,000-feet altitude site in New Mexico. First fringes are expected in 2010. The MROI will offer the UK community a unique capability to perform model-independent near-infrared imaging on sub-milli-arcsecond scales. We discuss the feasibility of detecting gaps in protostellar disks with the MROI and the potential for complementary observations using ALMA.

Wednesday
11:00am

The Challenge of Modelling the Galaxy in the Era of Gaia

J. Binney (Oxford University)

A series of massive surveys of the Galaxy will culminate in the publication of the Gaia Catalogue of a billion stars in less than a decade. With these data we hope to map the DM distribution in the Galaxy, and to unravel how the Galaxy was assembled. Sophisticated dynamical models are a prerequisite for achieving these goals. New technologies are required for the construction of models of the required scope.

Wednesday
11:20am

Surveying the Galaxy from the Ground and Space: the RAdial Velocity Experiment (RAVE) and Gaia

G. Seabroke (e2v CEI, PSSRI, The Open University), Gilmore, G., Holland, A. D., Bienayme, O., Binney, J., Bland-Hawthorn, J., Campbell, R., Freeman, K. C., Gibson, B., Grebel, E. K., Helmi, A., Munari, U., Navarro, J. F., Parker, Q. A., Siebert, A., Siviero, A., Steinmetz, M., Watson, F. G., Williams, M., Wyse, R. F. G., Zwitter, T.

The RAdial Velocity Experiment (RAVE) is an ambitious spectroscopic survey to measure the radial velocities (RVs) and stellar atmosphere parameters (temperature, metallicity and surface gravity) of up to one million stars using the Six Degree Field multi-object spectrograph on the 1.2m UK Schmidt Telescope of the Anglo-Australian Observatory. Since RAVE started in 2003, to date it has obtained 316,000 medium-resolution spectra (median R=7500) in the Ca-triplet region (8410-8795 Angstroms) for 285,000 southern hemisphere stars in the magnitude range 9<I<12. RAVE's first data release (DR1, Steinmetz et al. 2006) contained ~25,000 RVs. DR2 (Zwitter et al. 2008) is publicly available, containing ~50,000 RVs, which includes DR1, and ~20,000 atmosphere parameters. DR3 is currently being prepared for public release this year, which includes DR2, containing ~80,000 RVs and ~60,000 atmosphere parameters. This talk will review RAVE's scientific harvest so far and look forward to DR3 and its future scientific promise. In particular, RAVE RVs may have discovered the first non-local detection of the Hercules dynamical stream, or another stream with Hercules kinematics, in red clump giant stars at ~0.7-3 kpc from the Sun, in the direction against Galactic rotation, Galactic longitude l=270 degrees (Seabroke et al. 2009, in prep.). Its detection in K-M dwarfs at ~50-250 pc and non-detection in F-G dwarfs at ~200-400pc suggests the furthest detection could be associated with different spiral structure than local streams. Looking further into the future, Gaia will achieve its spectacular scientific potential with detailed calibration and correction for space radiation damage to its CCDs. The talk concludes with how detailed, physical modelling of Gaia's CCD pixels is contributing to this European-wide calibration work.

Wednesday
11:30am

The Nature of Runway Stars Far from the Galactic Plane

M. Silva (University of Hertfordshire), Ralf Napiwotzki

Runaway stars are early-type, young, stars that have high peculiar velocities and/or are found far from their birthplaces in open clusters or O-B associations. It is thought that these stars were ejected by one of two possible mechanisms early in their lifetimes: the supernova ejection scenario and the dynamical ejection scenario. The early-type, Population I, stars that were discovered in the galaxy's Halo are thought to be extreme cases of runaway stars, the alternative being that they were instead born in the Halo. Since the two ejection scenarios can be distiguished by the high-end tail of the ejection velocity distribution they predict, the determination of the exact nature and predicted ejection velocity of this group of Halo stars is important. We present a systematic survey of runaway stars in the Halo. Combining data from literature with proper motion measurements allows the determination of reliable the ejection velocities and flight times (time the stars spend reaching their current postions) - for many of these objects for the first time. We have determined the ejection velocities and flight times for a sample of stars selected from various studies of earl-type stars in the Halo, includind stars from the Palomar-Green and the Edimburgh-Cape surveys. The inclusion of proper motion measurements for all stars and the correction for gravitational darkening have revealed that most stars are consistent with an origin in the Disk of our galaxy and subsequent ejection, including some former candidates for an Halo origin. A small sub-sample continues to defy the runaway hypothesis.

Wednesday
11:40am

Central Mass and Luminosity of Milky Way Satellites in the LCDM Model

A. Maccio' (MPIA - Heidelberg), Xi Kang, Ben Moore

It has been pointed out that the Galactic satellites all have a common mass around 1e7 Msun within 300 pc (M03), while they span almost four order of magnitudes in luminosity (Mateo et al. 1993, Strigari et al. 2008). It is argued that this may reflect a specific scale for galaxy formation or a scale for dark matter clustering. Here we use numerical simulations coupled with a semi-analytic model for galaxy formation, to predict the central mass and luminosity of galactic satellites in the LCDM model. We show that this common mass scale can be explained within the Cold Dark Matter scenario when the physics of galaxy formation is taken into account. The narrow range of M03 comes from the narrow distribution of circular velocities at time of accretion (peaking around 20 km/s) for satellites able to form stars and the not tight correlation between halo concentration and circular velocity. The wide range of satellite luminosities is due to a combination of the mass at time of accretion and the broad distribution of accretion redshifts for a given mass. This causes the satellites baryonic content to be suppressed by photo-ionization to very different extents. Our results favor the argument that the common mass M03 reflects a specific scale (circular velocity ~ 20 km/s) for star formation.

Wednesday
11:55am

The Local Group Satellite Galaxies: Testing Fundamental Physics

P. Kroupa (Argelander Institute for Astronomy, Univ. Bonn)

The satellite galaxies of the Milky Way, and to less-significant amount, those of Andromeda, are distributed anisotropically about their hosts. The MW system appears to be a disk-like feature which is rotating. These features of the satellite galaxy distribution indicate that many of the satellites may be ancient tidal-dwarf galaxies. If true this would have possibly major implications for fundamental physics.

Wednesday
12:10pm

On Star Orbits in an Axially Symmetric Force Field

S. Ninkovic (Astronomical Observatory, Belgrade), Bora Jovanovic

A set of star orbits for the case of a stationary and axially symmetric realistic potential is obtained. It is confirmed that for the same initial position and the same values of energy and angular momentum per unit mass one obtains various orbits mutually differing in the initial fractions of the effective kinetic energy (radial and vertical components). In order to examine this phenomenon the authors study the dependence on time of the phase-space coordinates. Although the already classical question - if there is a third integral of motion- cannot be answered definitely, the authors propose to characterize each orbit by its mean values taken over time for the components of the effective kinetic energy. If a real sample of stars, say from the solar neighbourhood, were under study, then by using these quantities together with the angular momentum one could explain the local kinematics of the Milky Way, known to be triaxial as for the components of the mean random-velocity square.

Wednesday
12:20pm

Lithium-6 in metal-Poor Stars

A. Garcia Perez (University of Hertfordshire), W. Aoki, S. Inoue, S.~G. Ryan, T. Suzuki, M. Chiba

The primordial abundance of the light elements are very important for understanding the formation of the Universe, in particular, for quantifying the amount of baryons-to-photons that existed at the early epochs. Detections of the light isotope lithium-6 in metal-poor stars have motivated a revision of the models of Big Bang and cosmic-ray nucleosynthesis. The detections have the problem that they are very challenging and are very sensitive to the assumptions made in the analysis. We would like to present some of these sensitivities and how they may question some detections.

Wednesday
2:00pm

Spectroscopy of the Milky Way's Dwarf Satellites

M. Walker (Institute of Astronomy, Cambridge)

I will report results from spectroscopic surveys of Milky Way dSphs ranging from the "classical" to the "ultra-faint". The large samples for the former now permit more sophisticated dynamical modeling and reveal details of the stellar populations: metallicity gradients, stellar subcomponents and localized substructure. The necessarily smaller samples for the ultra-faint satellites are still useful for confirmation and for determining the nature of these peculiar objects.

Wednesday
2:15pm

The Milky Way with SDSS: Mapping The Rosetta Stone of Galaxy Formation

M. Juric (Institute for Advanced Study), Z. Ivezic and the SDSS Collaboration

The distribution and properties of stars in the Milky Way hold information about the formation and evolution of the Galaxy. Traditionally, samples of stars with such measurements were often biased, included small numbers of stars, or did not extend far beyond the Solar neighborhood. The Sloan Digital Sky Survey allows us overcome these issues, and directly map the number density, kinematics, and metallicity distributions of stars over a representative portion of the Galaxy without the aid of tracers or model assumption. With SDSS, we are able to characterize the global properties of the Milky Way, identify infalling satellites and tidally disrupted remnants, measure the scales of Galactic components, and observe the relationships between various kinematic and physical properties. In particular, the latest maps of metallicity and kinematics reveal in dramatic fashion the differing content of metals and different rotational velocity distributions of disk and halo stars in our Galaxy. Maps such as these put new constraints on the structure and origin of Galactic components, and allowable dynamical models of the Milky Way.

Wednesday
2:35pm

Young stellar cluster in the Milky Way

M. Messineo (RIT), D. Figer, B. Davies, V. Ivanov, F. Schuller, K. Menten, H.Habing, M. Petr-Gotzens, E. Valenti, M. Rich

In the last decade there has been a revolution in our knowledge on Galactic young stellar clusters. More than 1500 candidate clusters have been discovered from the 2MASS and Spitzer surveys, doubling the number of previously known stellar clusters in the Galactic Disk. This opens new insights on the structure of the Milky Way, and on its current star formation. However, interstellar extinction hampers the detection of clusters, and their census is still incomplete. I will present examples of multi-wavelength analysis of candidate clusters (Infrared, Radio, and X-ray data). We confirm the existence of the studied clusters, and unveil their massive stellar content. Among cluster members we have identified several new Wolf-Rayet stars, Ofpe/WN9, Blue, Red and Yellow supergiants.

Wednesday
2:50pm

The Galactic Population of White Dwarfs from Photometric Surveys

D. Mortlock (Imperial College London), Hiranya Peiris, Zeljko Ivezic

It is possible to reliably identify white dwarfs (WDs) without recourse to spectra, instead using photometric and astrometric measurements to distinguish them from Main Sequence stars and quasars. Using these techniques ~10^4 WDs have been identified in the Sloan Digital Sky Survey (SDSS) and ~10^6 WDs will be detected by, e.g., the Large Synoptic Survey Telescope (LSST). Such samples can reveal the Galaxy's star formation history and provide a unique probe of the Galactic halo, but only if the WDs' properties can be estimated from the survey data. A Bayesian approach to obtaining photometric constraints on WDs reveals the critical role of prior information from spectroscopic surveys. Applying this rigorous approach shows, for example, that H and He atmosphere WDs can be separated using per cent level photometry, but onlyat temperatures between ~8000 K and ~20000 K. Comparing the Bayesian results with those from a best-fit approach to this problem is also revealing, as it demonstrates that many putative outliers (particular potential halo WDs) are actually unremarkable objects in the tails of the noise distribution.

Wednesday
3:00pm

SDSS, IPHAS and GALEX Photometry of Post-AGB Stars and Central Stars of Planetary Nebulae

S. Weston (Univ. of Hertfordshire), R. Napiwotzki

Asymptotic giant branch (AGB) and central stars of planetary nebulae (CSPNe) are thought to be the final evolutionary stages of most low/intermediate mass stars (M<8Msun) before they evolve onto the white dwarf (WD) cooling sequence. They are important tools for an understanding of the final phases of stellar evolution. PN birth rates are highly uncertain and have led to different evolutionary scenarios being hypothesized. Uncertainties are caused by difficulty in obtaining accurate distances and incompleteness as one looks further afield or delves into the galactic plane. Ongoing and upcoming photometric surveys present an opportunity for more systematic searches for planetary nebulae and their hot central stars. IPHAS is a nearly complete northern galactic plane survey in Halpha, r' and i' bands. IPHAS has detected over 200 newly discovered PNe visually in a subset of the survey. We show how CSPNe can be identified from a given stellar field using SDSS or IPHAS colours. Using our photometric model grids we have started an investigation into the population of post-AGB and CSPNe in the galactic halo. Few have been identified where many are predicted by standard evolutionary models. Combining SDSS and GALEX photometry we will be able to detect these stars far away from the galactic disc. Possible implications of our findings are discussed. Key to both projects is having an accurate model grid which is well calibrated. We present calibrated photometric grids of Kurucz O and B stellar and Koester WD model atmospheres in the SDSS, IPHAS and GALEX systems.

Wednesday
3:10pm

Photometric Mapping of the Outer Galactic disk using IPHAS A Stars

S. Sale (Imperial College London), Janet Drew, The IPHAS consortium

We will discuss how we have examined the outer Galactic thin disc using MS early-A stars identified from IPHAS photometry, in particular we will concentrate on the determination of the extent of the radial truncation of the disc. The measured distribution of MS early-A stars is compared to that produced by a Galactic model in order to constrain several key parameters, including: the radial scale length of the thin disc; the location of a knee in the thin disc density profile; the outer scale length. This method also enables us to constrain the mean radial metallicity variation in the thin disc. Early A-stars are used for this task as they are relatively easy to identify (Drew et al. 2008) and are bright enough to be visible to large Galactocentric radii (up to ~20 kpc near the anticentre).

Wednesday
3:20pm

Disk-Halo Interaction in the Inner Milky Way: the Ophiuchus Superbubble and HI Clouds

Y. Pidopryhora (JIVE), F. J. Lockman, J. C. Shields, M. P. Rupen

The Ophiuchus superbubble offers an unprecedented opportunity to study Galactic disk-halo interaction at close range. It is seen in both HI and Halpha. Using 100m Green Bank Telescope (GBT), we have measured about quarter of a million HI spectra at 9arcmin angular resolution in and around the bubble. Most of the HI structures seen in the bubble appear to break into numerous filaments, folds and cloudlets. Two compact HI clouds which seem to belong to the superbubble were studied at 30arcsec resolution using the Very Large Array (VLA) in C and D configurations together with the GBT providing the short-spacing flux. Analysis of their structure and physical parameters provides useful information about the disk-halo transition region as well as possibly reveals the origins of the lower Galactic halo HI cloud population.

I-P01

Diffuse Radio Recombination Line Emission on the Galactic Plane between l=36° and 44°

M. Alves (The University of Manchester), Richard J. Davis, Rod D. Davies, Clive Dickinson, Robert R. Auld

The upcoming high resolution and high sensitivity Cosmic Microwave Background experiments, e.g. Planck, demand a better understanding and more accurate templates of its foregrounds. Measurements of the free-free emission on the Galactic plane using the Hα line are difficult due to dust absorption and a radio technique is required in the region. Radio recombination lines (RRLs) can be used to determine the Emission Measure (EM) unambiguously along the plane of the Galaxy. We use the HI Parkes All Sky Survey, which includes 3 RRLs (H166alpha, H167alpha and H168alpha), to map the ionised gas in the region l=36° to 44°, b=-4° to 4°. Well known HII regions are identified as well as the diffuse emission on the Galactic plane. The Galactic latitude section of the integrated RRL emission across the plane has a half-power width of ~ 2°. This result can now be combined with low frequency radio data to derive a free-free and synchrotron distribution extending to higher latitudes and also to quantify the anomalous dust contribution using WMAP data.

I-P02 On the Metallicity Gradient in the Magellanic Clouds and M33

M. Cioni (University of Hertfordshire)

The [Fe/H] has been derived from the ratio of carbon-rich and oxygen-rich asymptotic giant branch stars. Its variation as a function of galactocentric distance across the Magellanic Clouds and M33 has been studied to gather information on the formation, evolution and structure of these galaxies.

I-P03 Chemical Abundance Patterns in the Inner Galaxy: the Scutum Red Supergiant Clusters

B. Davies (University of Leeds), Livia Origlia, Rolf-Peter Kudritzki, Don F. Figer, R. Michael Rich, Francisco Najarro, Ignacio Negueruela, J. Simon Clark

The location of the Scutum Red-Supergiant (RSG) clusters at the end of the Galactic Bar makes them an excellent probe of the Galaxy's secular evolution. Here we present a study of the RSGs' surface abundances using a combination of high-resolution H-band spectroscopy and spectral synthesis analysis. We provide abundance measurements for elements C, O, Si, Mg, Ti, and Fe. The average a/Fe ratios of the clusters are solar, consistent with a thin-disk population. However, we find significantly sub-solar Fe/H ratios for each cluster, a result which strongly contradicts a simple extrapolation of the Galactic metallicity gradient to lower Galacto-centric distances. In combining our results with other data in the literature, we present evidence for large-scale (~kpc) azimuthal variations in abundances at Galacto-centric distances of 3-5kpc. While we cannot rule-out that this observed behaviour is due to systematic offsets between different measurement techniques, we do find evidence for similar behaviour in a study of the barred-spiral galaxy NGC4736 which uses homogeneous methodology. We suggest that these azimuthal abundance variations could result from the intense but patchy star formation driven by the potential of the central bar.

I-P04 The VLT-FLAMES Tarantula Survey

C. Evans (UK Astronomy Technology Centre)

30 Doradus in the Large Magellanic Cloud is our closest view of a small-scale starburst region in the local Universe, providing an excellent laboratory in which to study both stellar evolution and cluster evolution. I will give an overview of the new VLT-FLAMES Tarantula Survey - an ongoing ESO Large Programme that has obtained multi-epoch spectroscopy of over 1000 massive stars in 30 Dor.

I-P05 The r-/s-Process Controversy in Metal-Deficient Stars. I. HD140283

A. Gallagher (University of Hertfordshire), Sean Ryan, Ana Elia Garcia Perez

In 1981 John Truran put forward a theory that states that abundances of heavier elements (Z>56) in the oldest, most metal-deficient stars in the Galaxy would be dominated by those synthesised through the r-process, even in the case of those elements with an s-process origin in solar system material. Several studies of one star in particular does not fit Truran's interpretation. HD140283 is very metal-deficient with [Fe/H]=-2.5 (Aoki et al. 2004), but an investigation by Magain (1995) found that its barium isotope ratio indicated that the star is s-process dominated. This challenge was addressed again by Lambert et al. (2002) using new high resolution, high signal to noise spectra. This study concluded that the star's heavy isotopic abundances were dominated by the r-process but we regard the errors in this study to be too large to be conclusive, however (of order 70% of the expected difference). By analysing the isotopic ratios of heavy elements in stars we can explore the r-/s-process controversy. Using constraints which we obtain from new high resolution, very high signal to noise data, we will address the issue again, the result of which should be a clearer interpretation of the star's isotopic ratios with significantly reduced errors.

I-P06 Temperature Scales and the Lithium Problem

A. Hosford (CAR University of Hertfordshire), S.G. Ryan, A.E. Garcia Perez, J.E. Norris, K.A. Olive, R. Collet

The discovery of the Spite plateau in the abundances of 7Li for metal-poor stars led to the determination of an observationally deduced primordial lithium abundance. However, after the success of the Wilkinson Microwave Anisotropy Probe (WMAP) in determining the baryon density, OmegaBh2, there was a discrepancy between observationally determined and theoretically determined abundances in the case of 7Li. Amongst possible solutions of the discrepancy are modification to big bang nucleosynthesis, with implications for particle physics, supersymmetry and the identification of dark matter. One of the most important uncertain factors in the calculation of the stellar 7Li abundance is the effective temperature, Teff. We use two different methods to calculate new Teff's of sixteen metal-poor halo dwarfs. Firstly we use an excitation energy method based on the assumptions of LTE, allowing the Boltzmann equation to be utilised to determine the Teff. Secondly we use a more sophisticated NLTE method, making use of the multi level NLTE radiative transfer code MULTI. With these temperature scales we then calculate new Li abundances for this group of stars in an attempt to resolve the 7Li discrepancy. We compare our Teff scale results to several other temperature scales, i.e. temperatures derived using the IRFM, the Balmer line wing method and a photometric method, and find, in the case of LTE, that our scale is very similar to the others with the exception of one set of IRFM temperatures. We also compare our different scales to deduce the effects of NLTE on detailed abundance analysis.

I-P07 The Milky Way as a Double-Barred Galaxy

T. Mahoney (Instituto de Astrofísica de Canarias)

We summarize recent results indicating that the Galaxy has a triaxial bulge with an opening angle of 20-35 deg and a long stellar bar with an opening angle of 44 deg.

I-P08 Spitzer Space Telescope Observations of Magellanic Clouds and Dwarf Spheroidal Galaxies

M. Matsuura (UCL), M.R. Cioni

We first present our analysis of Spitzer Space Telescope (SST) observations of the Large Magellanic Cloud (LMC). The SST has provided a large number of photometric and spectroscopic data of infrared (IR) sources in the LMC. This data set is ideal for investigating the populations of asymptotic giant branch (AGB) stars. AGB stars are in their late phase of stellar evolution (0.3 - 10 Giga years after main sequence). In particular, stars with large infrared excess are relatively young (0.3 - 3 Giga years). Hence, these stars trace star formation during the 0.3 to 3 Giga epoch. AGB stars with IR excess are concentrated in the LMC bar, while some are distributed in the disk. We compare these results with the spatial distribution of red-supergiants and AGB stars with little IR excess. In addition, we briefly show results from gas and dust observations in the LMC and nearby dwarf spheroidal galaxies.

I-P09 The Galactic Population of White Dwarfs and their Progenitors

R. Napiwotzki (University of Hertfordshire)

The contribution of white dwarfs of the different Galactic populations to the stellar content of our Galaxy is only poorly known. Some authors claim a vast population of halo white dwarfs, which would be in accordance with some investigations of the early phases of Galaxy formation claiming a top-heavy initial-mass-function. Here, I present a model of the population of white dwarfs in the Milky Way based on observations of the local white dwarf sample. One result of this investigation is that white dwarfs of the halo population contribute a large fraction of the Galactic white dwarf number count, but they are not responsible for the lion's share of stellar mass in the Milky Way. Another important result is the substantial contribution of the - often neglected - population of thick disc white dwarfs. The white dwarf population model was extended to include their direct progenitors: post-AGB stars/central stars of planetary nebulae. I'll point out possible disrepancies with observed populations which warrent further investigation.

I-P10 Kinematic Analysis of Structure in Open Cluster System of the Milky Way

I. Nikiforov (Saint Petersburg State University), Elena Kazakevich, Natalia Kretser

Spatially-kinematic modeling was used to investigate kinematics of open stellar cluster system of the Milky Way. The modeling, which enables fundamental characteristics of the Galaxy rotation including the distance to the Galactic center (R_0) to be estimated, was applied to open clusters (OCs) of different age groups. The data from Loktin et al.'s (2001, 2005), Dias et al.'s (2002, 2008), Piskunov et al.'s (2006), and Kharchenko et al.'s (2007) catalogues were used for analysis.

The results obtained argue for an anomalous kinematics of the OCs of intermediate ages (8.1 < log t < 8.8, where t is the age in years), the reasons for which are still to be established. Kinematic analysis for young (log t < 8.1) and old (log t > 8.8) OCs gives similar limits on R_0 value. However in this case the point estimations of R_0 appeared to be underestimated in comparison to the "best" value of R_0=7.9± 0.2 kpc, summarizing results of measuring R_0; besides, R_0 uncertainty remains rather high even with new OC data. Numerical simulations were used to find confidence regions for fitted parameters and to study the correctness of application of analytical linear estimates for confidence limits in this problem.

The feasibility of using the OCs for spatially-kinematic modeling the Galaxy in future is under discussion.

The work is partly supported by the Grant of Russian Foundation for Basic Research (RFBR) 08-02-00361 and Russian President Grant for State Support of Leading Scientific Schools of Russia NSh-1323.2008.2.

I-P11 Preparing for GAIA - Chemodynamical Simulations of Disk Galaxy Formation

A. Rahimi (MSSL -UCL), Daisuke Kawata

GAIA will provide detailed kinematical and chemical information on around 1 billion stars in our milky way. To be able to prepare for and extract suitable information from this vast quantity of data, theoretical hypothesis and predictions are crucial. We are currently working to develop chemodynamical simulations, which can directly be compared with the GAIA data in a star-by-star fashion. In our pioneering work we analyse data from two simulated Milky Way like galaxies with GCD+, our original chemodynamical simulation code. We compare the chemical and kinematical properties of the bulge and the disk for our simulated galaxies. Chemical and kinematical analysis between accreted and insitu stars are then carried out. Finally we investigate whether the chemical or kinetic properties of the stars in our galaxies reflect the formation histories of those galaxies. Looking at the bulge, we find signatures of a chaotic era in which there are many mergers with smaller dwarf galaxies and gas rich objects. We also find that accreted stars in our galaxies have on average higher energy than insitu stars and that using the total energy (Etot) against angular momentum (Lz) diagram is a good tool to distinguish accreted from insitu stars. We find some evidence for inside-out formation of the disk.

I-P12 High Spatial Resolution Empirical 3D Extinction Mapping With IPHAS

S. Sale (Imperial College London), Janet E. Drew, Robert Greimel, Yvonne C. Unruh and the IPHAS consortium

We present an algorithm which can determine extinction, distance and spectral type for early-A to K4 stars in the IPHAS database. These data can be binned up to map extinction in three dimensions. The large size of the IPHAS database (~200 million unique objects), the accuracy of the digital photometry it contains and its faint limiting magnitude (r'~20) allow extinction to be mapped with fine angular resolution (~10 arcmin) to distances of up to 10 kpc. The use of this algorithm (Sale et al, 2009) is demonstrated on two differing fields and the results compared to the literature.

I-P13 Wolf Rayet Nebulae in the Milky Way and LMC

D. Stock (UCL), M.J. Barlow

A survey of Wolf-Rayet (WR) nebular environments has been completed using SuperCosmos data from the Southern Hemisphere Halpha survey (SHS). This has confirmed known cases and added several new examples to the population of ring or ejecta nebulae surrounding WR stars in the LMC and the Milky Way. The fraction of WR stars with such nebulae for different WR types is presented, along with the striking result that no binary WR star is known to have a ring or ejecta nebula.

The WR stars in the Milky Way and LMC that have ring or ejecta nebulae are predominantly of WN-type but the sample includes several WC stars. Given that some chemical evolution models for galaxies predict that WC stars make a very signicant contribution to the overall carbon enrichment of galaxies, spectroscopic abundance studies of the WC-star nebulae can potentially test such models.

Monday
11:00am

When Cores Collapse: a Variety of Stellar Deaths

A. Gal-Yam (Weizmann Institute)

The term "core collapse" is commonly associated with the death of massive stars exploding as supernovae (SNe) and leaving behind compact neutron star remnants. The physics of this "standard" scenario are well-studied theoretically and are founded on the unique observations of the nearby SN 1987A. However, theory predicts that gravitational core collapse can also occur under different circumstances, and result in physical explosions and observational manifestations that are very different from SN 1987A. I will review some of these alternative scenarios, going from the lightest to the heaviest cores that may collapse. I will then present new observations suggesting that we have already identified some of these mechanisms in nature, and with the advent of new wide-field surveys, are likely to further explore this previously uncharted astrophysical territory.

Monday
11:30am

Adaptive Optics Assisted Infrared Searches for Supernovae

S. Mattila (University of Turku), Stuart Ryder, Erkki Kankare, Miguel Perez Torres, Petri Vaisanen et al.

Discovering the (still mostly unrevealed) population of highly-obscured core-collapse supernovae (CCSNe) within the nuclear regions of starburst galaxies and luminous infrared galaxies (LIRGs) will be crucial for revising the optically-derived SN rates. This will be essential when using CCSNe as probes of the star formation rates (SFR) at both low and high z. To detect such SNe we must work at near-infrared wavelengths, where the dust obscuration is significantly reduced. In addition, the tight concentration of the star formation within the innermost nuclear regions makes the detection of such SNe in natural seeing conditions very difficult. Our programmes using NACO on the VLT and ALTAIR/NIRI on Gemini North have recently demonstrated the potential of the current 8-meter class telescopes equipped with natural and laser guide star adaptive optics in detecting highly-obscured CCSNe within the innermost LIRG nuclear regions. Such observations can be used to estimate the number of CCSNe missed both locally and in the distant Universe where LIRGs become the dominant sites of the massive star formation.

Monday
11:42am

e-EVN and Global VLBI Observations of SN 2007gr

Z. Paragi (JIVE), C. Kouveliotou, E. Ramirez-Ruiz, Y. Pidopryhora, M. Bietenholz et al.

The nearest radio-detected type Ib/c supernova, SN2007gr at 7.3 Mpc was observed with the e-EVN and a global VLBI array shortly after its discovery. These quick response VLBI observations provided unique data that is useful to constrain the expansion of the SN.

Monday
11:54am

SN 2008S: an Electron Capture SN from a Super-AGB Progenitor?

M. Botticella (Queen's University Belfast), A. Pastorello, S.J. Smartt, W. P.S. Meikle, R. Kotak

We present comprehensive photometric and spectroscopic observations of the faint transient SN 2008S. It exhibited slow photometric evolution and almost no spectral variability during the first nine months, implying a high density CSM. Our quasi-bolometric lightcurve extends to 300 days and shows a tail phase decay rate consistent with that of {56}Co. We propose that this is evidence for an explosion and formation of {56}Ni. The large MIR flux detected shortly after explosion can be explained by a light echo from pre-exisiting dust. The late NIR flux excess is plausibly due to a combination of warm newly-formed ejecta dust together with shock-heated dust in the circumstellar environment. We reassess the progenitor object detected previously in Spitzer archive images, supplementing this discussion with a model of the MIR spectral energy distribution. The combination of our long term multi-wavelength monitoring data and the evidence from the progenitor analysis leads us to support the scenario of a weak electron capture supernova explosion in a super-AGB progenitor star embedded within a thick circumstellar gaseous envelope.

Monday
12:06pm

The First Case of a Low Energy Stripped-Envelope Core-Collapse Supernova

S. Valenti (Queen's University Belfast)

So far, no weak, hydrogen deficient core-collapse supernova has been detected. Here, we report that faint hydrogen-poor core-collapse supernovae do exist. We show that the recent SN2008ha is indeed one of the faintest envelope-stripped core-collapse supernovae ever observed, and that other similar events have been observed in the past but they have been misclassified as peculiar thermonuclear supernovae (sometimes labelled SN2002cx-like events).

Monday
12:18pm

On the Possible Nature of the Unusual Optical and X-Ray Transient SCP06F6

B. Gaensicke (University of Warwick), A.J. Levan, T.R. Marsh, P.J. Wheatley

SCP06F6 has been identified by Barbary et al. as an optical transient during the HST Cluster Supernova Survey. The object reached a peak magnitude of i,z~21, and showed roughly symmetric rise and decay times of ~60d each. No counterpart has been detected down to i=26.4 and z=26.1. The optical spectra of SCP06F6 obtained with Keck and the VLT were relatively red, peaking at ~6100A, and contained several broad (~200-300A) absorption troughs blue-wards of ~6500A. We show that the spectrum of SCP06F6 is consistent with emission of a cool, optically thick carbon-rich photosphere at a redshift z~0.14. In addition, we detect an transient X-ray counterpart to SCP06F6 in archival XMM data. We discuss the possible nature of SCP06F6, in particular a supernova-like event, or the tidal disruption of a white dwarf.

Monday
2:00pm

An Introduction to Gamma-Ray Bursts

R. Wijers (University of Amsterdam)

I will give a brief review of GRBs and recent developments in their science as a background and introduction to the following programme.

Monday
2:30pm

Recent Progress on Short GRBs

A. Levan (University of Warwick)

Despite the great strides made in understanding long duration gamma-ray bursts over the past decade the origins of the population with markedly shorter durations remains mysterious. I will discuss recent progress towards identifying the progenitors of short duration GRBs, based both on individual examples and more detailed analysis on the growing population of short bursts with measured afterglows. I will show that the redshift distribution for short bursts is very wide, and the implied lumonosity function possibly even wider than seen in the long bursts. This implies that short bursts are a diverse population, which may well arise through more than one production channel.

Monday
2:42pm

Beyond the Fireball Model : the Impact of Prolonged Central Engine Activity

A. Melandri (ARI - LJMU Liverpool), on behalf of Liverpool GRB group

Early time multiwavelength observations of Gamma Ray Bursts afterglows are tsting the widely accepted Fireball Model to the limit. Using a survey of 63 GRB with unprecedented temporal coverage, we classify the observed afterglows into four main classes and discuss the underlying physics that can explain them. The presence or absence of temporal breaks in X-ray nd optical bands is used to test the standard model; although the standard model works well in general, a growing number of GRBs are shown to deviate from the forward shock model even with inclusion of energy injection or ambient density gradients. We illustrate this in the case of GRB070419A for which we performed a detailed multiwavelength analysis; we show that additional emission in the early-time X-ray afterglow due to late-time central engine activity is key and may explain both GRBs whose afterglows do not fit the standard model and those GRBs that appear to be optically dark even at early times.

Monday
2:54pm

The Energetics of GRB 080721 and Constraints on its Progenitor

R. Starling (University of Leicester), Evert Rol, Alexander van der Horst

Gamma-ray Burst prompt emission is highly energetic. If emitted isotropically, the radiative energies implied for some bursts would be so implausibly large for a stellar core-collapse powered event that it has long been accepted that the emission is confined to a jet. Typical collimation-corrected energies are then of order 1e51 erg, which can be readily extracted from a collapsing core. However, increasing numbers of GRBs appear to have collimation-corrected energies that defy current progenitor models; energies up to a factor of ten greater than is typical. In the afterglows from these GRBs the tell-tale signs of the jet structure from which collimation can be measured are observed much later than expected, or are not present at all.

We followed the bright, highly energetic afterglow of GRB 080721 out to 36 days since the trigger in the optical and X-ray bands. Our search for a jet break in the late-time afterglow light curve is unsuccessful, implying a highly energetic burst. We set tight constraints on the total energy budget of the burst and we discuss how such high collimation-corrected energies could be accommodated with certain parameters of the standard massive star core-collapse models. We can, however, most probably rule out a magnetar progenitor for this GRB which would require 100\% efficiency to reach the observed total energy.

Monday
3:06pm

The Spiral GRB Host Galaxies

K. Wiersema (University of Leicester)

In recent years it has become clear that the study of GRB host galaxies in emission and absorption can provide meaningful constraints on the nature of the GRB progenitor stars. The difference between long and short bursts is reflected in their host galaxies: long GRBs occur predominantly in actively starforming dwarf irregular galaxies, while short bursts seem to have no preference for a particular type of galaxy. In this talk I will give an overview of the properties of the spiral galaxies hosting GRBs. Interestingly these galaxies have hosted examples of almost all interesting subtypes of GRBs: long bursts with and without supernovae, as well as short bursts. While spirals are somewhat more complicated than dwarf irregulars in terms of stellar populations and metal distributions, they are larger and brighter and therefore often more practical for spatially resolved spectroscopy. Through this we can contrast the properties within a few hundred pc of the GRB with unrelated parts of the same galaxy, and get additional information to interpret unresolved, more distant, GRB hosts.

Monday
3:18pm

Can Some X-Ray Plateaus Followed by a Steep Decay be Powered by a New-Born Magnetar as the GRB Central Engine?

N. Lyons (LEICESTER UNIVERSITY), P.T. O'Brien, B. Zhang, R. Willingale, E. Troja, R.L.C. Starling

Long duration gamma-ray bursts (GRBs) are thought to be produced by the core-collapse of a rapidly-rotating massive star. This event generates a highly relativistic jet and prompt gamma-ray and X-ray emission arises from internal shocks in the jet, although magnetised outflows have been also been suggested. If the stellar core does not immediately collapse to a black hole, it may form an unstable, highly magnetised millisecond pulsar, or magnetar. As it spins down, the magnetar would inject energy into the outflow causing a distinctive bump in the GRB light curve where the emission becomes fairly constant followed by a steep decay when the magnetar collapses. We assume that the collapse of a massive star to a magnetar can launch the initial jet. By examining the X-ray lightcurves of all GRBs observed by the Swift satellite we identified a subset of bursts which have a feature in their light curves which we call an internal plateau - unusually constant emission followed by a steep decay - which may be due to magnetar emission. We use the duration and luminosity of this internal plateau to place limits on the magnetar spin period and magnetic field strength. We find that they are consistent with the most extreme predicted values for magnetars.

Monday
4:30pm

The Next Generation of Surveys and Transient Science

R. Kotak (Queen's University Belfast)

Transient science has flourished over the last few decades. This trend is set to continue with the new breed of all-sky surveys that are due to start operations in the very near future. Hand-in-hand with the deluge of data will come exciting opportunities and a potential for the discovery of new phenomena. In this talk, I will attempt to provide an update on the status of such ventures with a focus on supernova science.

Monday
4:50pm

The Naked-Eye Gamma-Ray Burst 080319B

N. Tanvir (University of Leicester)

GRB 080319B reached naked eye brightness (mag 5.3) despite being at redshift 0.94. This extreme event was the subject of intensive followup with a wide range of facilities, and has challenged standard models for the production of long-duration GRBs. I describe what we have learnt from the afterglow, host galaxy and accompanying supernova of this GRB.

Monday
5:02pm

Particle Acceleration in the Jets of Swift GRBs

P. Curran (MSSL/UCL)

For one brief but intense moment, a gamma-ray burst (GRB) is the brightest object in the gamma-ray sky, and even the entire Universe - giving off more energy in just a fraction of a second to a few seconds, than our own Sun will over its entire lifetime. The long lived afterglow emission of GRBs is visible in the X-ray, optical, infrared and radio regimes for days to weeks to months and, in some extreme cases, even years. This afterglow is well described by the blast wave model, which details the temporal and spectral behaviour of the emission that is created by external shocks when a collimated ultra-relativistic jet ploughs into the circumburst medium, driving a blast wave ahead of it.

We compare multi-wavelength, ground-based and satellite, observations with the prevailing models of the relativistic jets that power GRBs, to derive certain physical parameters such as: the structure of the environment around the burst, the total amount of energy required to power the afterglow, and the underlying mechanism of accelerating the environmental electrons to relativistic speeds. Fundamental to this process is the electron energy distribution index, p; a characteristic parameter of the process by which the electrons emit light via synchrotron emission. There is no consensus as to whether it has a single, universal value or if it has a distribution and if so, what that distribution is. We also examine the constraints placed on the distribution of p by the observed spectral indices from a number of different burst samples. We compare our parameterization of the distribution to that expected from various calculations and simulations of relativistic jets in other astronomical sources such as AGN and X-ray binaries.

Monday
5:14pm

Realistic Model for the Prompt and High Latitude Emission in GRBs

F. Genet (University of Hertfordshire), J. Granot

There is good observational evidence that the Steep Decay Phase (SDP) observed in most Swift GRBs is the tail of the prompt emission. The most popular model to explain the SDP is Hight Latitude Emission (HLE). Knowing if the SDP is consistent with HLE would help distinguish between prompt emission models that give rise to HLE, and those who do not. In order to adequately address this question we develop a detailed, realistic self-consistent model for the prompt emission and its HLE tail, which can be used for combined temporal and spectral fits to GRB data that would provide strict tests for the HLE model. We model the prompt emission as a sum of its individual pulses and their tails, where the emission arises from a relativistically expanding thin spherical uniform shell over a finite range of radii, that emits isotropically in its own co-moving rest frame. The flux is calculated by integrating over the equal arrival time surface of photons to the observer. These assumptions hold well in the case of internal shocks, which is considered here. Analytic expressions of the flux for a power law and a Band function spectra are obtained. For IS the observed instantaneous spectrum is very close to the emitted one; it is expected to be well described by a Band function also during the rapid decay phase, and naturally softens with time. The observed flux during the RDP is initially dominated by the tail of the last pulse, but the tails of one or more earlier pulses can become dominant later on. A simple criterion is given for the dominant pulse at late times. The relation alpha=2+beta holds only at sufficiently late times, but also as alpha and beta change in time. Modeling several overlapping pulses as a single wider pulse would over-predict the emission tail.

Monday
5:26pm

A Statistical Study of UVOT GRB Afterglows

S. Oates (MSSL-UCL), M. J. Page, P. Schady, M. de Pasquale, T. S. Koch, and the Swift UVOT team

In the first two years of operation Swift/UVOT detected over 50 GRBs with optical afterglows. With this large sample, it is now possible to perform a statistical analysis of the UVOT afterglows and to derive a canonical form for the UVOT optical afterglow.

At this conference we present 26 well sampled optical/UV lightcurves observed with the UVOT. This sample have peak magnitudes of 18 or greater, were observed within the first 400s and until at least 100,000s after the trigger. We examine the correlations between the properties of the lightcurves, in both the observer frame and at 1600 Angstroms in the rest frame. In particular we find a correlation at 99.8% confidence, between the observed magnitude at 400s and the temporal index after 500s. We discuss the rises observed in the early afterglow and finally, we compare the UVOT canonical model with the XRT canonical model and the implications of this work for future GRB science.

Monday
5:38pm

Swift-UVOT Captures the Earliest Ultraviolet Spectrum of a Gamma Ray Burst: GRB081203A

P. Kuin (University College London), W. Landsman, M. Page, P. Schady, M. Still, A. Breeveld, M. De Pasquale, P. Roming, P. Brown, M. Carter, C. James, P. Curran, A. Cucchiara, C. Gronwall, S. Holland, E. Hoversten, S. Hunberger, T.Kennedy, S. Koch, H. Lamoureux, F. Marschall, S. Oates, A. Parsons, D. Palmer, P. Smith

We present the earliest ultraviolet spectrum of a gamma-ray burst as observed with the Swift-UVOT. The GRB 081203A spectrum was observed for 50 seconds with the UV-grism starting 251 seconds after the Swift -BAT trigger. During this time the GRB was ~13.4 mag (u-filter) and was still rising to its peak optical brightness. In the UV-grism spectrum we find a damped Ly-alpha line, Ly-beta, and the Lyman continuum break at a redshift z = 2.05 ± 0.01. A model fit to the Lyman absorption implies a gas column density of log NHI = 22.0±0.1 cm-2, which is typical of GRB host galaxies with damped Ly-alpha absorbers. This observation of GRB 081203A demonstrates that for brighter GRBs (v 14 mag) with moderate redshift (0.5 < z < 3.5) the UVOT is able to provide redshifts, and probe for damped Ly-alpha absorbers within 4-6 minutes from the time of the Swift -BAT trigger.

Monday
5:50pm

Near and Far: Luminosity Function Evidence for a Separate Population of Nearby, Under-Luminous Long GRBs

R. Chapman (University of Hertfordshire), Robert S. Priddey and Nial R. Tanvir

The three closest supernova-associated long duration GRBs so far observed share several similarities. GRBs 980425, 031203 and 060218 were all of low-luminosity, low-variability and spectrally soft compared to the majority of long GRBs. We have previously shown that a sub-sample of BATSE GRBs defined by these properties exhibits an increased level of correlation (28 %+/- 16 %) with large scale structure on the sky, implying a local rate density of underluminous long GRBs of 700 +/- 360 Gpc^(-3)yr^(-1) within 155 Mpc. Here we consider a number of single Luminosity Functions (LF) for long GRBs, and show that none of these can produce a local population at the level implied by the correlation analyses while remaining consistent with either the BATSE number counts or the Swift redshift distribution. However, dual LFs consisting of separate populations of low and high luminosity bursts and constrained by the (threshold-adjusted) BATSE number counts reproduce well the local population while also generating a realistic overall redshift distribution. Constraining the dual LF models by the Swift redshift distribution instead produces very good fits to the overall distribution while continuing to reproduce adequate numbers of local bursts. We thus suggest that nearby bursts such as the 3 known local events cannot be produced from the low luminosity tail of a single LF, but rather represent a class of low-luminosity long GRBs, with intrinsic rates in the local Universe several hundred times greater than that of their high luminosity, cosmological counterparts.

J-P01

GRB Lightcurves with a Double Component Outflow

M. DePasquale (MSSL/UCL), Evans, P.; Oates, S.; Page, M.; Zane, S.; Schady, P.; Breeveld, A.; Holland, S.; Kuin, P.; Still, M., Roming, P., Ward, P.

An increasing sample of Swift GRBs manifests evidence of 'chromatic breaks', i.e. breaks present in the X-ray but absent in the optical. Modelling the X-ray and optical data, we find that in a significant fraction of these GRB afterglows the component producing the X-ray emission cannot be the same component that is responsible for the optical emission. We propose that these afterglow lightcurves are the result of a two component jet, in which both components are energy injected for the whole duration of the observations and the X-ray break is due to a jet break in the narrow outflow. This study has important consequences for the GRB community, since a double component jet model provides us with an explanation for another surprising finding, the paucity of achromatic breaks at late times. We show that our model may explain the behaviour of GRB emission in both X-ray and optical bands. Furthermore, there are even examples of GRBs with X-ray data alone that require this model to fully explain their properties. The scenario we propose can be a radical and noteworthy alternative to the current interpretation for the 'canonical' XRT and UVOT lightcurves, bearing fundamental implications for GRB physics.

J-P02 Deep Optical Observations of GRB 051103 Placing Constraints on the Progenitor

A. Rowlinson (University of Leicester), N.R. Tanvir, P.T.O'Brien, K. Wiersema, E. Rol, A. Levan

The Inter Planetary Network (IPN) detected the Short Gamma-Ray Burst (SGRB) 051103 and provided a very large error trapezium for its position. GRB 051103 was an interesting SGRB due its proximity to the spiral arms of the nearby galaxy M81. This proximity has led to the suggestion that GRB 051103 could be a giant flare from a Soft Gamma-Ray Repeater (SGR) in M81. This paper reviews the previous work completed on GRB 051103, presents new data and uses a new refined error ellipse for the position. We obtained images covering part of the error ellipse to 25th magnitude (deeper than previous studies) using the Kitt Peak National Observatory (KPNO) and Canada-France-Hawaii Telescope Legacy Survey (CFHTLS). Visual inspection for variability and magnitude comparisons lead to no afterglow being identified in the images. We have reanalysed the potential progenitors in light of these observations and other observed SGRBs and SGRs. In conclusion, if it had been a typical SGRB in the region studied, we would have expected to detect an optical afterglow. The observational expectations for an SGR (i.e. a non detection of an optical afterglow) match our findings but this does not rule out any progenitor models.

J-P03 The Mean Dust Extinction Curve of GRB Host Galaxies

P. Schady (MSSL-UCL), T.Dwelly, M.J.Page. S.R.Oates & M.Still

An understanding of GRB host galaxy properties is pivotal to attaining accurate progenitor models and critical in identifying the effect of the GRB local environment on our observations. Through analysis of the GRB spectral energy distribution (SED), the imprint left by dust and gas absorption on X-ray and optical afterglows can be measured to a high level of accuracy, which, combined with spectroscopic observations, provides details on the elemental abundances and chemical composition of the interstellar dust and gas within GRB host galaxies. Nevertheless, the physical and chemical properties of the interstellar dust within GRB hosts continue to be poorly understood. The dust extinction properties of GRB host galaxies are typically best modelled on the Small Magellanic Cloud extinction law. However, the 2175A Galactic absorption feature has been detected in a number of GRBs optical afterglows.

The range in the chemical and morphological properties of the interstellar dust within GRB host galaxies has important consequences for our understanding of the environmental conditions that give rise to long GRBs, and in this talk we investigate the mean extinction properties of dust within GRB host galaxies, and discuss our results and implications. A GRB extinction law specific to GRB host galaxies would not only improve the accuracy of our GRB afterglow SED modelling, but also hold information on the characteristic grain properties of the dust in the GRB surrounding environment.

Wednesday
4:00pm

Particle Acceleration in Colliding Wind Binaries

J. Pittard (University of Leeds), Sean Dougherty

Massive binary systems, containing two early-type stars, display a variety of observational phenomena linked to the powerful collision of their winds, including an excess of hard thermal X-rays, non-thermal radio emission from accelerated electrons, and excess infra-red emission from the formation of dust. They are excellent laboratories for the study of the physics of high Mach number shocks and particle acceleration at high mass, radiation, and magnetic field energy densities. In this talk I will present the latest observations and theoretical modelling of high energy phenomena in colliding wind binaries.

Wednesday
4:20pm

H.E.S.S. Observations of Massive Stellar Clusters

S. Ohm (H.E.S.S. Collaboration), Jim Hinton, Dieter Horns, Olaf Reimer, Gavin Rowell on behalf of the H.E.S.S. Collaboration

Stellar clusters are potential acceleration sites of very-high-energy particles since they host supernova remnants and pulsar wind nebulae. Additionally, in stellar clusters, particles can also be accelerated e.g. at the boundaries of wind-blown bubbles, in colliding wind zones in massive binary systems or in the framework of collective wind or wind/SN ejecta scenarios. These acceleration mechanisms and the detection of the young stellar cluster Westerlund 2 in very-high-energy (VHE) gamma-rays suggest Westerlund 1 as the foremost promising target in that category for VHE emission. Here we summarize H.E.S.S. observations of massive stellar clusters in general with special emphasis on the most massive stellar cluster in the galaxy, Westerlund 1.

Wednesday
4:40pm

Extragalactic VHE Gamma-Ray Sources and the EBL

D. Mazin (IFAE, Barcelona), Martin Raue

Very high energy (VHE, $E > 30$ GeV) gamma-rays are absorbed via interaction with low-energy photons from the extragalactic background light (EBL) if the involved photon energies are above the threshold for electron-positron pair creation. The VHE gamma-ray absorption, which is energy dependent and increases strongly with redshift, distorts the VHE energy spectra observed from distant objects. The observed energy spectra of the AGNs carry, therefore, an imprint of the EBL. The detection of hard VHE gamma-ray spectra of distant sources ($z = 0.11 - 0.54$) by H.E.S.S. and MAGIC enabled to set strong upper limits on the EBL density, using certain basic assumptions about blazar physics. These assumptions are, however, under discussion. In this talk, we give an overview of the EBL constraints, their limitations and perspectives for the joint efforts of the Fermi Gamma-Ray Space telescope, current imaging atmospheric Cherenkov telescopes and future projects like the Cherenkov Telescope Array (CTA).

Wednesday
5:05pm

High-Energy Particle Acceleration at the Radio-Lobe Shock of CentaurusA

J. Croston (University of Hertfordshire)

Centaurus A is the nearest radio-loud AGN. It has recently been detected at TeV energies by HESS, and there is evidence that it is an important source of ultra-high energy cosmic rays. Cen A is also the first system in which direct evidence for a strong shock associated with radio-lobe expansion has been found. Our new, very deep Chandra observations have revealed that the X-ray emission from the shock front is dominated by synchrotron radiation, as is seen in some supernova remnants. I will discuss the implications of these results for particle acceleration at the shock, and for Cen A as a source of TeV radiation and UHECRs. I will also comment on other possible locations for TeV emission and cosmic ray production in Cen A.

Thursday
11:00am

Cosmic Rays from Extragalactic Sources

A. Wolfendale (Durham), T Wibig and A W Wolfendale

There is a problem with the AUGER observations of ultra-high energy cosmic rays from 'local AGN'. Angular coincidences indicate protons but the depth of shower maximum suggests primary heavy nuclei. Thus, either the positional identifications are often wrong or the physics of ultra-high energy interactions differs markedly from expectation. The lecture will examine these alternatives.

Thursday
11:25am

Early Results from the Fermi-LAT Mission

S. Funk (Stanford University), for the Fermi-LAT collaboration

The launch of the Fermi-LAT in June 2008 heralds a new era in GeV gamma-ray astronomy. With its unprecedented sensitivity and angular resolution, Fermi promises to deepen our knowledge about the gamma-ray sky by detecting thousands of new sources and bridging the energy spectra gap of ground-based VHE gamma-ray sources to well-studied objects at X-ray energies. I will discuss first results from the Fermi-LAT mission.

Thursday
11:50am

Multi-Wavelength Identification of High-Energy Sources

R. Mignani (UCL-MSSL)

The nature of most of the ~300 high-energy gamma-ray sources discovered by the EGRET instrument aboard the Gamma-ray Observatory (GRO) between 1991 and 1999 is one of the greatest enigmas in high-energy astrophysics. While about half of the extragalactic sources have been optically identified with Active Galactic Nuclei (AGN), only a meagre 10\% of the galactic sources have a reliable identification. This low success rate has mainly to be ascribed to the local crowding of potential optical counterparts and to the large gamma-ray error boxes (of the order of one degree in radius) which prevented a straightforward optical identification. The situation is now greatly improving thanks to the observations performed by the Fermi Gamma-ray Space Telescope which provides a factor of 50 improvement in sensitivity and a factor of 10 improvement in positional accuracy. However, while the smaller error boxes will make the multi-wavelength follow-ups easier, the larger sensitivity will enormously increase the number of detected gamma-ray sources, requiring an even larger effort in the multi-wavelength follow-ups. In this contribution, I outline multi-wavelength observation plans and strategies.

Thursday
12:10pm

The Cherenkov Telescope Array

S. Nolan (CTA / Univ. of Durham), The CTA Consortium

The newly-emerging field of ground based gamma-ray astronomy has shown recently that a plethora of different sources can produce radiation above and around 100 GeV. These exciting results from the current generation of Cherenkov telescope systems (H.E.S.S./MAGIC/VERITAS/CANGAROO) have shown that our own galaxy possesses a large number of highly energetic sources, and tackle such questions as the origin of cosmic rays. In addition the detection of significant fluxes of gamma-rays from extragalactic sources at large distances has provided insights into the star formation history of the early Universe, as well as allowing lower limits to be placed on the energy scale of quantum gravity. The development of a very large Cherenkov telescope array system (CTA) is currently at the design study stage. This observatory will reveal an order of magnitude more sources due to its higher sensitivity than current instruments. In this short talk, the potential of CTA to detect a large catalogue of both established and new source classes is discussed.

K-P01

Upper Limit on the Cosmic Ray Photon Fraction at EeV Energies

H. Cook (University of Leeds), On behalf of the Pierre Auger Collaboration

The Pierre Auger Observatory measures cosmic rays at energies above 10^(18)eV. Some models of cosmic ray origin predict large photon fractions. New upper limits have been found for the photon fraction at ultra high energies, using the Pierre Auger Fluorescence Detector. The limits are 3.8 %, 2.4 %, 3.5 % and 11.7 % at energies of 2, 3, 5, and 10 EeV respectively. These results extend the experimental limits to energies below 10^(19) eV for the first time and reduce systematic uncertainties on the interpretation of air shower data.

K-P02

How Cold Can a SNR be?

L. Drury (Dublin Institute for Advanced Studies), F. Aharonian, D. Malyshev, S . Gabici

If efficient particle acceleration provides the main energy dissipation mechanism in a SNR forward shock it is shown that the bulk remnant dynamics are little affected, but that the post-shock plasma temperature can be substantially lower than that conventionally assumed.

K-P03

The Origin of Magnetars and the Spin Evolution of Radio Pulsars

C. Espinoza (The University of Manchester), Andrew Lyne

Radio pulsars and magnetars are believed to be neutron stars which have been formed in the collapse of the cores of massive stars in supernova explosions. Radio pulsars generally rotate with periods of 0.1-1 second and slow down gradually due to magnetic braking arising from surface magnetic fields of 10^12 G. Magnetars on the other hand have much longer periods in the range 7-14 seconds and are slowing down rapidly, an effect which is attributable to strong surface magnetic fields of order 5*10^14 G. Magnetars are intense sources of X-rays, thought to be powered by the decay of the neutron star magnetic field. They are observed to suffer violent energetic events, detected as gamma and x-ray outburst episodes, involving x-ray bursts and flux increases, and gamma-ray flares.

A popular hypothesis about the origin of magnetars assume they are born with a very strong magnetic field, generated via dynamo processes during the formation of the neutron star. Evolution of radio pulsars can be well described by the braking index, a number estimated only via observable parameters. Under the standard magnetic braking model the magnetic field of a pulsar is constant on time, and there is not place for a relationship between radio pulsars and magnetars.

We present braking index estimations of four radio pulsars and, hitherto believed to be separate populations, show how their spin parameters seem to be evolving toward magnetar values. Such an evolution might be driven by the increase of the surface magnetic field, suggesting magnetars are the product of the magnetic field evolution of young radio pulsars. This hypothesis is supported by X-ray observations of a number of high magnetic field radio pulsars, for which magnetar-like behaviour has been observed.

K-P04 Radio and X-Ray Observations of the Probable Gamma-Ray Binary HESS J0632+057

J. Hinton (University of Leeds), J.L. Skilton, M. Pommier, C. C. Cheung, J. Brucker, F.A. Aharonian, G. Dubus, A. Fiasson, Y. Gallant, W. Hofmann, A. Marcowith, O. Reimer

HESS J0632+057 is one of the only point-like, unidentified TeV sources in our Galaxy. The association of this source with the massive (B0pe) star HD 259440 has led to the suggestion that HESS J0632+057 may be a new gamma-ray binary system. We will present the results of X-ray and radio observations of this object with XMM-Newton and the VLA and GMRT. We find a variable non-thermal, point-like source coincident with this star in both X-ray and radio, strengthening the identification of HESS J0632+057 as the forth well-established gamma-ray emitting binary system.

K-P05 Simultaneous Optical-Radio Observations of a Rotating Radio Transients

E. Keane (Jodrell Bank Centre for Astrophysics), M. Kramer, V. K. Dhillon, A. G. Lyne, C. A. Jordan, B. W. Stappers

Rotating Radio Transients (RRATs) are a population of neutron stars which emit short isolated bright bursts of radio emission a few times per hour. The origin of these RRAT bursts is unclear despite many proposed models. Some have proposed them to be similar to the so-called 'giant radio pulses' seen in the Crab pulsar. To test whether there is optical emission from RRATs during their radio pulses we have observed them using the high-speed optical camera ULTRACAM on the William Herschel Telescope (WHT). The original attempt was unsuccessful which is most likely due to the fact that RRATs are mostly 'off'. In fact RRATs typically emit for only 1 second per day in radio! To improve on this we have performed a simultaneous radio-optical observation now using the Lovell Telescope in conjunction with ULTRACAM on the WHT. The times of the strong radio bursts can be identified in the radio observation and using this information we can select only the corresponding optical frames to co-add. We discuss the method, present our initial results and provide a discussion of our plans for improving on this observation even further.

K-P06 The Discovery of New Rotating Radio Transients

E. Keane (Jodrell Bank Centre for Astrophysics), M. Kramer, A. G. Lyne, R. P. Eatough

In 2006 a search for transients radio bursts in the Parkes Multi-beam Pulsar Survey (PMPS) revealed 11 sources from a previously unknown population of neutron stars. These sources - known as Rotating Radio Transients (RRATs) emit very occasional bright bursts of radio emission. Such sources are difficult to find and population estimates predict that they are even more abundant than the well studied radio pulsars - neutron stars which pulse regularly. As well as being of intrinsic interest due to their unusual emission properties the existence of RRATs has large implications for the Galactic population of neutron stars. To improve on the initial RRAT population estimate the discovery of more sources is needed as well as a quantitative estimate of the effects of radio frequency interference in the survey. To this end we have performed a full re-processing of the PMPS using the Jodrell Bank Pulsar Group's newly acquired HYDRA super-computer cluster. In addition we have implemented a new technique for mitigating the radio frequency interference which plagues such surveys. We discuss the techniques used as well as the results of the re-processing which has been very successful such that now the known RRAT population in the PMPS has been doubled to more than 20.

K-P07 The Neutron Star Birthrate Problem

E. Keane (Jodrell Bank Centre for Astrophysics), M. Kramer

The known Galactic population of neutron stars has increased immensely of late. The discovery of a huge population of neutron stars dubbed Rotating Radio Transients (RRATs) is the latest discovery. These sources, which are thought to outnumber the regular radio pulsars, join the other classes of neutron stars which we now know of. In addition to the RRATs and radio pulsars there are the millisecond pulsars, x-ray binaries, magnetars, the isolated thermal x-ray neutron stars and the compact central objects which harbour neutron stars. With so many different types of neutron stars we discuss the various estimates for the birthrates of these populations. We revisit the question as to whether the Galactic supernova rate can account for all of the known groups of isolated neutron stars. After reviewing the rates and population estimates we find that, if the estimates are in fact accurate, the current birthrate and population estimates are not consistent with the Galactic supernova rate. We discuss possible solutions to this problem including whether or not some of the birthrates are hugely over-estimated. We also consider a possible evolutionary scenario between some of the known neutron star classes which could solve this potential birthrate problem.

K-P08 The Timing Properties of Rotating Radio Transients (RRATs)

E. Keane (Jodrell Bank Centre for Astrophysics), M. Kramer, A. G. Lyne, M. A. McLaughlin, C. A. Jordan

We present results from ongoing regular radio observations of Rotating Radio Transients (RRATs) - a recently identified class of neutron stars. The aim of these observations is to determine the 'timing' parameters of the RRATs, most importantly their spin-periods and slow-down rates. Ongoing timing observations result in an increasingly accurate positional determination for the sources. This is desirable for follow-up observations at other wavelengths - in particular in the X-ray and gamma-ray regimes. Our observations using the Lovell Telescope at Jodrell Bank and the Parkes Telescope in Australia have revealed a number of interesting properties of RRATs. These include glitches - a sudden speed-up in rotation period of the neutron star thought to be related to the unpinning of magnetic flux vortices in the star's interior. Glitches are usually seen in energetic young pulsars and magnetars so that a possible link between these populations is suggested. Furthermore - RRAT J1819-1458, the most regularly bursting RRAT, is seen to have very unusual emission. It appears that pulses are emitted only from one of a number of allowed phase 'windows' and which window is emitting is apparently random from burst to burst. This is unlike what is seen in the ~1800 known pulsars. We discuss this behaviour as well as the techniques and difficulties for dealing with this in our timing models.

K-P09 Latest Observations of Pulsar Wind Nebulae from H.E.S.S.

D. Keogh (Durham University), Jim Hinton, Jo Skilton and Paula Chadwick

Over the past decade the number of sources observed in the TeV waveband has increased dramatically. Many of the new sources are pulsar wind nebulae discovered with the H.E.S.S. Cherenkov telescope array in Namibia. This talk outlines some of the interesting recent observations of pulsar wind nebulae by H.E.S.S.

K-P10 Cosmic Rays and Non-Thermal Radiation from Collapsing Magnetized Stars

V. Kryvdyk (Taras Shevchenko University of Kyiv)

The particles acceleration and a non-thermal radiation in the magnetospheres of collapsing stars with initial dipole magnetic fields and a certain initial energy distribution of charged particles in a magnetosphere are considered. The electric field in magnetosphere will accelerate the charged particles. These particles will generate the non- thermal radiation. As follow from analysis of particle dynamics and its emission in the magnetosphere, the collapsing stars can by powerful sources of the charged particles and the non-thermal radiation in a wide bandwidth, from gamma to radiowaves . The radiation flux can be observed in the form of radiation bursts with duration equal to the stellar collapse time. The radiation flux depends on the distance to the star, its magnetic field, and the particles spectrum in the magnetosphere. The radiation flux is calculated for various collapsing stars with initial dipole magnetic fields and an initial power-series, relativistic Maxwell, and Boltzmann particles energy distribution in the magnetosphere. This radiation bursts can be observed by means of modern astronomical instruments.

K-P11 Poise and Evolution of the Galaxy : Structure, Flares and Cosmic Rays

M. Laloum (CNRS / IN2P3 / LPNHE Paris)

Many essential paradoxes in the mechanical balance of the Galaxy are highlighted. Their outstanding relevance demands a coherent and likely explanation. We propose a unique and synthetic interpretation, including a cosmological theory of the origin of the observed cosmic rays, especially at the highest energies known. It involves matter-antimatter annihilation in the median plane of the Milky Way, as a source of "dark matter". Accordingly, we discuss the structure and balance of the Galaxy, seen as made of two parallel disks of matter versus antimatter dominance, and opposed by the repulsion of an annihilation gas, settled in the equator disk. The admitted suppression of antimatter in the Universe, just after the "Big-Bang", is questioned. Ultra-relativistic thermodynamics of cosmic rays are still settled. Many stringent tests tend to confirm our theory ; pointedly, the now classical energy behaviour of the incident flux of energetic cosmic rays is easily derived as a power law, quite with expected exponents of -2.5 and -3, possibly (main dependence, including the first knee). Ultra-high energies, further, are easily attainable, with no necessary restriction of the "GZK" kind , for instance. Above 10^20 eV, rather,a new break is still thus made feasible.

K-P12 Analytical Insight into the Formation and Characteristics of Gamma-Ray Bursts

H. Ziaeepour (MSSL-UCL)

We briefly present a recent reformulation of the kinematic and dynamics of a collision between two spherical relativistic shells leading to a gamma ray burst. This formulation includes more detailed parametrization of the time variation of physically important quantities. Notably, it suggests two phenomenological models for the evolution of the emitting region during the collision, one of them is more suitable for the prompt/internal shocks and the other for the afterglow/external collisions. We also present the results of some simulations based on this model. They are meant to reproduce the prompt and afterglow emission in some intervals of time during a burst and compare them with the observed properties of GRBs.

(L) The local volume: constraints on galaxy formation and evolution

Tuesday
11:00am

Black Hole Scaling Relations

J. Magorrian (University of Oxford)

This talk gives an overview of the various relations between BH masses and host galaxy properties, concentrating on the 40 or so galaxies for which we have reliable constraints on the BH mass, and looking to how this sample can be extended in the future.

Tuesday
11:20am

The SINFONI Black Hole Survey

R. Saglia (MPE), Ralf Bender, Peter Erwin, Nina Nowak, Stefanie Rusli, Jens Thomas

Using SINFONI at the VLT with Adaptive Optics we have collected diffraction-limited 2D kinematics for the central regions of ~20 galaxies, to measure the mass of their central supermassive black holes. The sample covers both pseudo and classical bulges, low and high velocity dispersions objects and ellipticals with cores. Dynamical modeling based on axisymmetric Schwarzschild orbit superposition is presented and the consequences for the MBH-sigma and MBH-luminosity relations are discussed.

Tuesday
11:40am

Feeding the Central Black Hole and Nuclear Starbursts: Gas Inflow in Nuclear Spirals

W. Maciejewski (Liverpool John Moores University), Ric Davies, Erin Hicks

After a brief review of the role of nuclear bars and spirals in driving gas to the innermost ~10 pc of a galaxy, we will focus on the particular example of NGC 1097, for which spatially resolved distributions and kinematics of the stars and molecular gas in the central 350 pc were observed with the SINFONI IFU at the VLT. The stellar continuum confirms the previously reported 3-arm spiral pattern extending into the central 100 pc. Using hydrodynamical models of nuclear spirals, we show that when deriving the accretion rate into the central region, outflow between the arms has to be taken into account. For NGC 1097, the net gas accretion rate to the central few tens of parsecs is 0.06 Msun/yr. This inflow rate is consistent with the observed properties of the nuclear stellar population. The nuclear spiral represents a mechanism that can feed gas into the central parsecs of the galaxy, with the gas flow remaining in equilibrium for timescales of a Gigayear.

Tuesday
12:00pm

Dynamical Properties of Nearby Early-Type Galaxies through Atlas3D Survey

D. Krajnovic (University of Oxford)

Atlas3D is a multi-wavelength survey of a volume limited sample of nearby early-type galaxies. The observations include integral-field spectrography up to 1 effective radius, multi-band photometry, radio (HI) and millimeter (CO) observations and are accompanied by state-of-the-art numerical simulations and dynamical models. A specially selected subsample is also observed at high spatial resolution with laser guide star adaptive optics in order to probe the nuclear regions. Our sample spans over a factor of 1000 in environmental density, including galaxies in the center of Virgo cluster and in the lowest density regions of the field. This survey aims to quantify the kinematical and dynamical structure of early-type galaxies, probe the interplay between the stellar populations and inter-stellar matter, and offer constraints to theoretical and numerical models of galaxy formation and evolution. I will present the Atlas3D Project with emphasis on the separation of early-type galaxies into the fast and slow rotators, and their different dynamical structure and formation mechanisms. In addition, I will present a subproject of measuring the masses of supermassive black holes in smallest early-type galaxies based on the combination of the large scale and high resolution integral-field data.

Tuesday
12:20pm

A Census of Nuclear Stellar Disks in Early-type Galaxies

H. Ledo (University of Hertfordshire), M. Sarzi, E. Brinks

Nuclear Stellar Disks, of a few tens to hundreds of parsecs across, are an apparently common feature in early-type galaxies and still a poorly studied one. Yet, such small disks represent a powerful tool to constrain the assembly history of galaxies, as they are sensitive to the epoch when galaxies experienced their last major merger event. Nuclear disks are relatively fragile structures that do not survive such collisions, as shown by N-body simulations, and can form only during a major merging event of their host galaxy or after such an event from the gradual accretion of gaseous material.

By studying the fraction and age of Nuclear Stellar Disks we can therefore test the predictions for the assembly history of early-type galaxies according to the current hierarchical paradigm for galaxy formation.

We have searched for these disks in nearby early-type galaxies using images from the Hubble Space Telescope and obtained the fractions of galaxies with disks as a function of galaxy type (E, E-S0, S0 and S0a) and magnitude. We have produced the most comprehensive census of Nuclear Stellar Disks in nearby early-type galaxies and found that they are present in approximately 20\% of them. Furthermore, we have separated the light contribution of twelve such disks from that of their surrounding stellar bulge in order to extract their physical properties.

Tuesday
2:00pm

Dynamics of Elliptical Galaxies at Large Radii

O. Gerhard (MPE Garching)

With the recent Planetary Nebula Spectrograph survey it has been possible to extend kinematic measurement in elliptical galaxies into their outer halos. New X-ray data from Chandra and XMM have been used to determine the gravitational potential in massive, gas-rich ellipticals over a similar radial range. Combining these and other data, dynamical modeling with the NMAGIC particle code is being used to derive the orbit structure and mass distribution in elliptical galaxy halos. This talk describes recent results from this project.

Tuesday
2:20pm

Mass Modelling of the Fornax Dwarf Spheroidal with 2200 Tracers

G. Mamon (IAP, Paris & Oxford), A. Biviano (Trieste), M. Walker (IoA, Cambridge)

New multi-object spectroscopy by Walker et al. has produced radial velocities for well over 2000 stars of the Fornax dwarf spheroidal galaxy, permitting detailed modeling of the mass and velocity anisotropy profiles. Fornax is analyzed with new techniques: an anisotropic mass inversion and the MAMPOSSt method that fits the full distribution of stars in projected phase space. The data allows to partially lift the mass/anisotropy degeneracy and produces interesting constraints on the dark matter content of Fornax.

Tuesday
2:40pm

Orbital Structure, Entropy and Formation of Elliptical Galaxies

J. Thomas (MPE), R. Saglia, R. Bender

We discuss the dynamical structure of Coma early-type galaxies -- derived from orbit models including dark matter. We find a large variety of orbital compositions and no clear trend between classical anisotropy measures and flattening. However, we find systematic trends between the entropy of the phase-space distribution of stars and other global parameters: the brightest and most massive early-types have entropies close to the maximum achievable (given their luminosity density), are non-rotating, have low dark-matter densities and old stellar populations. Lower-mass early-types have low entropy, more prominent rotation, high dark matter densities and young stellar populations. We discuss how these findings can be understood in terms of differences in the evolutionary histories of early-type galaxies: the most massive galaxies have formed their stars early but have assembled only relatively recently, in a dynamically violent process; lower mass galaxies have collapsed early with some subsequent, dynamically relatively quite star-formation.

Tuesday
3:00pm

Dark Matter in Gravitational- Lens Galaxies

L. Koopmans (Kapteyn Astronomical Institute)

I will shortly discuss how gravitational lensing can quantify the amount and distribution of dark matter in galaxies from their smallest (substructure) to largest (extended halo) scales. I will then highlight several recent results from strong and weak-lensing studies and discuss their implications for dark-matter and galaxy formation studies. I end with a short forward look, in particular how lensing can play a leading role in studies of dark matter in galaxies.

Tuesday
3:20pm

No Escape from Vesc: a Global and Local Parameter in Early Type Galaxy Formation

N. Scott (University of Oxford), Michelle Capellari, Roger L. Davies, the SAURON team

We present the results of an investigation of the influence of the local gravitational potential on the line-strength indices and single stellar population equivalent age (t) , metallicity (Z) and alpha-enhancement ([alpha/Fe]) in early-type galaxies. We have made use of integral field spectroscopy of the SAURON sample of early-type galaxies alongside photometric observations and dynamical modelling.

We have found that the line strength indices Mgb, Fe5015 and Hbeta are all tightly correlated with the potential (characterised here by Vesc.) In the case of Mgb and Fe5015, not only does this hold for the relationship between the centres of different galaxies but it is also true within individual galaxies. The local linestrength indices are strongly dependent on the depth of the local potential.

We also explore the correlation between Vesc and the local SSP equivalent t, Z and [alpha/Fe]. We find that in this 4-D space galaxies are (to a very good approximation) confined to a 2-D plane.

This link between local relations within individual galaxies and global relations between different galaxies can offer important insight into the process of galaxy formation and evolution. We consider how our result fits into the modern picture of hierarchical assembly and the constraints it places on monolithic collapse and merger scenarios of galaxy formation.

Tuesday
4:00pm

Secular Evolution in Spiral Bulges

D. Thomas (University of Portsmouth), Davies, R.

We compare the stellar population properties of spiral bulges (of Hubble types Sbc and earlier) and early-type galaxies. It turns out that bulges are rejuvenated systems with relatively low luminosity-weighted ages as young as 1.3 Gyr. We show that the smallest bulges must have experienced star formation events involving 10-30 per cent of their total mass in the past 1-2 Gyr. This age-mass relationship coincides perfectly with the ages of early-type galaxies. At a given mass, bulges and elliptical galaxies are indistinguishable as far as their stellar populations are concerned. These results indicate a common formation history of spiral bulges and elliptical galaxies. Secular evolution triggered by disc or bar instabilities appears to be negligible in spiral galaxies of Hubble types Sbc and earlier.

Tuesday
4:20pm

New Light on the Analysis of Star Formation Histories

I. Ferreras (MSSL/UCL), Ben Rogers, Reynier Peletier, Joseph Silk

I will present a summary of present work done in the analysis of the unresolved stellar populations of local and distant early-type galaxies. A new method for the estimate of equivalent widths in moderate resolution spectra is presented. This method reduces the contribution from neighbouring lines, achieving "cleaner" measurements of the targeted absorption and reducing the age-metallicity degeneracy. I will discuss the systematic biases inherent to simplistic descriptions of the star formation history of galaxies. Results are presented for low and moderate redshift samples.

Tuesday
4:40pm

Galaxy Mergers and the Formation of Elliptical Galaxies

T. Naab (University Observatory Munich)

Galaxy mergers are the driver for galaxy formation and evolution in concordance cosmological model. I will present the latest results on isolated binary merger simulation and black hole growth as well as cosmological simulations on the formation of elliptical galaxies. There is growing evidence for the importance of minor mergers for the star formation turnoff and the strong evolution of masses and sizes of elliptical galaxies since redshift two.

(L) The local volume: constraints on galaxy formation and evolution

L-P01 Kinematics of the Diffuse Light in the Virgo Cluster Core and its Large Scale Distribution

M. Arnaboldi (ESO), O. Gerhard, N. Castro-Rodriguez, M. Doherty, P. Das, J.A.L. Aguerri

We use the phase space information (projected distance and line-of-sight velocities) for intracluster planetary nebulae (ICPN) in the Virgo core to infer the core dynamical status. We sumrise that M87 and M86 are falling towards each other nearly along the line of sight, and that we may be observing then in the phase just before the first close pass. These data support the view that the core of the Virgo cluster is not yet virialized, but in an ongoing state of assembly. The line-of-sight velocity distribution of the intracluster PN in the Virgo core and the spatial distributiom of a larger PN dataset, sampling several fields at different distances from M87 out to 3.5 degrees, are then used to set constraints the formation mechanisms of the diffuse light in clusters.

L-P02 The Fine-Scale Structure of the Neutral ISM

I. Bagetakos (University of Hertfordshire), E. Brinks, F. Walter, W.J.G. de Blok , J.W. Rich, A. Usero, R.C. Kennicutt, Jr.

The neutral hydrogen (HI) distribution of galaxies is characterized by filaments and cavities, as previous studies of the Milky Way galaxy and nearby galaxies have shown. The dominant mechanisms responsible for these structures are thought to be supernova (SN) explosions and stellar winds of the most massive stars in OB associations and super star clusters. The purpose of this study is to expand the sample of galaxies and compare the properties of these HI holes across different types of galaxies. Our sample consists of 20 spiral and dwarf galaxies that are part of "The HI Nearby Galaxy Survey" (THINGS). We report on the detection of more than 1000 holes in total. Their sizes range from about 100 pc (our resolution limit) to about 2 kpc, their expansion velocities range from 4 to 36 km/s, and their ages are estimated to range between 3 and 150 Myr. The holes are located throughout the disks of the galaxies, out to the edge of the HI layer. We derive the surface and volume porosity and find that this correlates with the type of the host galaxy: later Hubble types tending to be more porous. The size distribution of the holes in our sample follows a power law with a slope of a = -2.9. Working under the assumption that the holes are the result of massive star formation, we derive values for the supernova rate and SFR which correlates with the SFR derived based on other tracers albeit that we underestimate the SFR by 2-3 orders of magnitude. The correlation improves dramatically if we extrapolate the observed number of holes to include those that fall below our resolution limit, down to holes created by a single supernova, indicating that our results are compatible with the hypothesis that HI holes result from star formation.

L-P03 Dark and Luminous Galaxies in 8 THINGS Dwarf Galaxies

E. Brinks (University of Hertfordshire), Se-Heon Oh, W.J.G. de Blok, Fabian Walter, Robert C. Kennicutt, Jr.

We present the density profiles of 8 dwarf galaxies culled from "The HI Nearby Galaxy Survey" (THINGS) and compare them with those from Lambda Cold Dark Matter simulations (LCDM). The THINGS high-resolution data significantly reduce the observational uncertainties, and thus allow us to derive more accurately the dark matter distribution in the galaxies. To derive the rotation curves we use "bulk velocity fields" as these more efficiently filter out random motions in a galaxy and therefore better trace the underlying kinematics. Spitzer Infrared Nearby Galaxies Survey (SINGS) 3.6 micron and ancillary optical data are also used for separating the baryons of the dwarf galaxies from their total matter content. We find a significant discrepancy between the derived dark matter distribution of the THINGS dwarf galaxies and those of LCDM simulations in terms of the rotation curve shape and the inner density slope. We also find that the amount of non-circular motions in THINGS dwarf galaxies is not enough to explain the discrepancy between the observed and predicted dark matter distributions.

L-P04 Kinematic Properties of Early Type Galaxy Halos using Planetary Nebulae

L. Coccato (MPE), O. Gerhard, M. Arnaboldi, P. Das, N. Douglas, K. Kuijken, M. Merrifield, N. Napolitano, E. Noordermeer, A. Romanowsky, M. Capaccioli, A. Cortesi, F. De Lorenzi, K. Freeman

We have combined new PNe radial velocities with literature data for 16 early-type galaxies and derived the two-dimensional kinematics. Our work extends the information derived from stellar absorption-line up to ~8 effective radii, providing important data when studying dark matter distribution. The combination of photometry, absorption-line and PNe kinematics shows: i) a good agreement between the PNe number density distribution and kinematics with the surface brightness and kinematics of the stars; ii) that the mean rms velocity profiles fall into two groups, with part of the galaxies characterized by slowly decreasing profiles and the remainder having steeply falling profiles; iii) that outer haloes are characterized by more complex radial profiles of the specific angular momentum-related lambda parameter than observed within 1 Re; and iv) that the halo kinematics are correlated with other galaxy properties, such as total B-band and X-ray luminosity, isophotal shape, total stellar mass, V/sigma, and alpha parameter, with a clear separation between fast and slow rotators.

L-P05 The Dynamical Life of Lenticular Galaxies

a. cortesi (nottingham university), The Planetary Nebula Spectrograph Consortium

In the standard cosmological model, galaxies grew hierarchically through mergers. Small groups, where the group dispersion velocity is comparable to stellar velocities inside the galaxies themselves, are probably the best site for galaxies interactions. Lenticular galaxies are widely present in small groups and their debated evolutionary history could be linked to this particular environment. Are they the product of unequal mass mergers and therefore dynamically similar to ellipticals, or are they gently quenched spirals that have lost their gas through interactions?

In order to address this question, we have used data, obtained with the Planetary Nebula Spectrograph, of nearby S0s, all belonging to small groups. We complement our planetary nebulae (PNe) catalogue, which provides positions and line-of-sight velocities within 4 R_(e), with photometric information from the 2MASS catalogue. Using PNe as kinematic tracers and the ratio of disc-to-bulge light as an external constrain, we performed a maximum likelihood analysis to recover the exact relationship between circular speed and random motion, and thereby discriminate between formation scenarios.

L-P06 Star Formation in Early-Type Galaxies

A. Crocker (University of Oxford), Martin Bureau, Lisa Young, Francoise Combes

Some early-type (elliptical and S0) galaxies are now known to host cold gas and star formation. To investigate the details of the relation between the cold molecular gas and star formation in these galaxies, I compare new interferometric maps of the molecular gas with optical integral-field unit (IFU) data. This comparison identifies three categories of early-type galaxies with molecular gas: 1) galaxies that are clearly star forming, evidenced by star-forming emission line ratios, 2) galaxies that have young populations of stars, evidenced by absorption linestrengths, and most surprisingly, 3) galaxies that have no signs of star formation or young stars, despite the presence of molecular gas. To see if star formation in early-types follows the same relations as observed in spiral galaxies, I compare classical star formation tracers, such as LFIR, LHbeta, and radio continuum. The most strongly star forming galaxies appear to follow the classical relations, although the situation is less clear for the weakly star-forming galaxies and the relations clearly fail for galaxies with significant AGN.

L-P07 The Dark Matter Haloes and Orbital Structure of Massive Elliptical Galaxies

P. Das (Max Planck Institute for Extraterrestrial Physics), Ortwin Gerhard, Emily McNeil, Flavio de Lorenzi, Eugene Churazov, Lodovico Coccato, Roberto Saglia, Hans Boehringer, Magda Arnaboldi, Ken Freeman

In the current cosmological paradigm, simulations predict substantial dark matter haloes for objects at all mass scales, characterised by a 'universal mass density profile'. In massive elliptical galaxies there is evidence for dark matter haloes from stellar dynamical models, X-ray analysis of the surrounding hot interstellar medium (ISM) and gravitational lensing work. In hierarchical models of galaxy formation, massive ellipticals are created through mergers involving spiral galaxies and smaller ellipticals and this is supported by observations. These formation channels should leave an imprint in the orbital structure of their stars.

The aims of this project are two-fold: to obtain the total gravitational potential out to large radii for a small sample of massive ellipticals and then use the flexible made-to-measure code NMAGIC to create dynamical models in this potential and derive their orbital structure.

Massive ellipticals harbour a hot interstellar medium (ISM) in the form of a low-density plasma trapped in the galaxy's gravitational potential. In quiescent galaxies, where the gas is not significantly distorted by interactions with companion galaxies, one can assume hydrostatic equilibrium and use the temperature and density profiles derived from X-ray spectra to obtain the potential.

Using XMM-Newton and Chandra observations, we obtain the potential out to 10 effective radii in NGC 5846 and NGC 1399 and then create dynamical models in this potential using NMAGIC. As observational constraints we make use of photometric data, 1-D kinematics from long-slit data, 2-D kinematics from SAURON and PNe radial velocities measured using the Planetary Nebula Spectrograph (PN.S.) and FORS1 on the VLT.

L-P08 Molecular Gas in Early Type Galaxies

T. Davis (University of Oxford), K. Alatolo, L. Blitz, M. Bureau, L. Young

As part of the ATLAS-3D project, we have conducted the first complete, volume limited survey of the molecular gas content in over 250 nearby early-type galaxies using the IRAM-30m telescope. We report a detection rate of ~ 20 %, independent of environment, and molecular gas masses in the range 10^7-10^9 solar masses. We are now in the process of mapping the molecular gas with the CARMA interferometer. This allows us to study the molecular gas distribution, kinematics and, by combining with the available IFU data, the recent star formation history in a statistically significant sample of early-types. We first compare the molecular gas extent in early and late-type galaxies. We find that although the molecular gas extent is smaller in absolute terms in early type galaxies, the size distribution appears to scale fairly robustly with the optical/stellar characteristic scale-lengths. Secondly, from the molecular gas kinematic misalignment we present preliminary results suggesting that~ 50 % of the molecular gas in early-types has an external origin, and that the ionized and molecular gas seem to share a common origin.

L-P09 The Dark Matter Content of the Intermediate LuminosityElliptical Galaxies NGC 4697 and NGC 3379

F. De Lorenzi (MPE), O. Gerhard, et al.

The interpretation of the radially falling planetary nebulae velocity dispersion profiles of several intermediate luminosity elliptical galaxies (NGC 4697, NGC 3379, NGC 4494, NGC 821) as a lack of dark matter in ordinary ellipticals, has challenged the current Lambda-cold dark matter scenario. In the light of this, we have performed a further careful analysis and constructed dynamical N-body models for NGC 4697 and NGC 3379 with the very flexible NMAGIC particle code, combining photometric and kinematic data. We find that (i) the kinematic data for NGC 4697 is not consistent with low density halos such that the circular velocity v_c <~ 200 km/s at 5R_e. The best fitting models with v_c ~ 250 km/s at 5R_e are slightly radially anisotropic (beta~0.5 at radii >~ 2R_e). (ii) The observational data of NGC 3379 are consistent both with near-isotropic systems dominated by the stellar mass, and with models in moderately massive halos with strongly radially anisotropic outer parts (beta >~ 0.8 at 7R_e). Formal likelihood limits would exclude (at 1 sigma) the model with stars only, as well as halo models with v_c(7R_e) ~> 250 km/s. NGC 4697 and NGC 3379 may well have dark matter halos as predicted by recent merger models within Lambda-CDM cosmology.

L-P10 Modelling Ultra-Fine Structure in Dark Matter Halos

D. Fantin (University of Nottingham), Michael R. Merrifield, Anne M. Green

In the past detection of dark matter was only possible via indirect observations. With the current technology new horizons are close to be reached in the next few years, through particle detectors designed to capture the "signature" of dark matter. Fundamental aspects in the current discussion are the predictions of the dark matter phase space density and the local velocity distribution because of their crucial impact on the signal prediction. Very recently, large simulations, analysing the effect of mergers in the history of the Milky Way, have resolved a huge amount of substructure in the central region of the Galaxy. Unfortunately the scales relevant for terrestrial instruments are of the order of milliparsecs, too small even for the most powerful simulation. To avoid this problem alternative approaches have to be designed. Through a backwards-in-time evolution technique, we calculated the velocity distribution of dark matter in the solar neighbourhood, based on merger trees which describe the history of a Milky Way-like halo. The method is very flexible: it allows to make predictions, to calculate the evolution of the spatial distribution in the Galaxy and to map out the velocity structure at any time and position at arbitrarily-high resolution. Our current analysis shows that although the dark matter particles are spread through all the parameter space, evident structures are present even after billions of years. Future detectors would be able to pick out these peculiar features in the velocity distribution, thus not only determining the nature of dark matter, but also providing insight into the formation history of the Milky Way.

L-P11 Two LITTLE THINGS Dwarf Galaxies Revealed: DDO133 and DDO168

D. Ficut-Vicas (University of Hertfordshire), Deidre Hunter (Lowell Obs) , Elias Brinks (Univ of Hertfordshire), Bruce Elmegreen (IBM T.J Watson Reseach Centre), Michael Rupen (NRAO), Caroline Simpson (Florida International Univ), Fabian Walter (MPIA), David Westphal (New Mexico Tech), Lisa Young (New Mexico Tech)

The LITTLE THINGS Survey has set out to shed light on the star formation mechanisms in dwarf galaxies, to provide a better understanding of galaxy evolution and, by studying their kinematics, to investigate Dark Matter in dwarfs. Half a year after the completion of the NRAO Very Large Array (VLA) radio interferometric observations, first results are presented of two dwarf systems, DDO133 and DDO 168, to give a flavour of the science LITTLE THINGS will be capable of. We combined VLA B-, C-, and D-array configuration data to obtain high angular resolution and sensitivity HI maps, which along with infrared, ultraviolet and optical images demonstrate the potential of this project.

L-P12 Hybrid Galaxy Evolution Modeling: MCMC Parameters Estimation in Semi-Analytic Models

B. Henriques (University of Sussex), Peter Thomas, Seb Oliver, Isaac Roseboom

Present day semi-analytic (SA) models, qualitatively reproduce a vast range of observable properties. However, considering the complexity of the processes involved in the study of galaxy formation and evolution, the discrepancies between theory and observations should naturally arise. Whenever this happens, it reveals a fundamental problem in SA models: the growing complexity of physics included and the considerably large number of variable parameters, makes it difficult to understand if there is a fundamental problem with the underlying galaxy formation physics or just a failure in adjusting the parameters into a maximum agreement configuration. Monte Carlo Markov Chain methods have been extensively used to select between different models with different parameters in theoretical cosmology. We apply this technique to sample the parameter space in a semi-analytic model. Using the De Lucia & Blaizot 2007 SA code and a range of observational constraints, we quantify the relative impact of the different physics in the model on the predicted galaxy properties. This is achieved by sampling the parameter space and its allowed likelihood regions in order to correctly predict the observational K-band, g-r colors and black hole-bulge mass relation. The correlations between the parameters give us insight on the meaningful physical quantities governing galaxy evolution that are represented by the parametrization. We present a best fit model with parameter values that considerably improve the quantitative agreement between the model and the selected observations.

L-P13 Arp 78 and the Universality of the Stellar Initial Mass Functions

R. Kotulla (University of Hertfordshire), John S. Gallagher III & Uta Fritze

In recent years a number of authors proposed an Initial Mass Function that changes depending on the environment of the star formation region. One prediction of this scenario, which would have tremendous impact on the way we currently model galaxy evolution, is a change in the far-UV to Halpha ratio: Star formation regions in low-density environments should have a IMF that is truncated at the high-mass end, which in turn would significantly reduce the Halpha luminosity while leaving the UV luminosity essentially unchanged.

We present very deep R and narrow-band Halpha images of Arp 78 obtained with the WIYN 3.5-m telescope on Kitt Peak. GALEX observations had shown a very extended UV structure for this system, reaching beyond the optical radius of Arp 78 and also beyond its previously known Halpha-radius. These GALEV observations triggered new assumptions about a non-stanard IMF. Our new Halpha data now show very good agreement with the spatial extent of the near- and far-UV maps - even in terms of structural details. Star formation rates derived from L(Halpha) and L(FUV) are in reasonable agreement, indicating that in this case the upper stellar IMF in the UV-bright outer arm is relatively normal. The star forming sites in the outer arms are younger than ~15 Myr and massive enough to properly sample the IMF up to high masses; their low optical visibility evidently is a property of their youth.

L-P14 Using Plantary Nebulae to Trace the Dark Matter of NGC 1399

E. McNeil (MPE), Payel Das, Ortwin Gerhard, Magda Arnaboldi, Ken Freeman, Flavio DeLorenzi

Our understanding of the distribution of dark matter in ellitpical galaxies is restricted by the limited kinematic data at large radii. We describe a large (~200) sample of planetary nebula (PN) velocities in the outer regions of the cD ellitpical NGC 1399. These data were obtained with a counter-dispersed slitless-spectroscopy technique which allows the efficient detection of these emission-line objects out to about 10 effective radii. The PNe complete the velocity and velocity dispersion profiles at these previously unattainable radii, allowing us to explore the matter distribution of a central cluster galaxy. In combination with integrated light kinematics from the inner regions (within ~2 effective radii) and a mass determination from X-rays, we can use these PN velocitues to locate the transition from baryonic to dark matter dominance. We use NMAGIC, a new adapative N-body code, to create a dynamical model of our galaxy from the central regions to the outer halo.

L-P15 Byurakan- IRAS Galaxy Pairs as Indicators of Starburst and Galaxy Evolution

A. Mickaelian (Byurakan Astrophysical Observatory (BAO))

The Byurakan-IRAS Galaxies (BIG objects) are the result of the project of optical identifications of IRAS point sources based on their DSS images and the DFBS (Digitized First Byurakan Survey) low-dispersion spectra. As a result, 1278 galaxies have been revealed at high galactic latitudes, including 42 PSC sources identified with 103 galaxies that make up 30 physical pairs and 12 multiples (interacting systems and 'mergers'). These BIG objects have been observed spectroscopically and the redshifts have been measured. Using more accurate FIRST positions, we have defined the IR real sources; they might be either one of the components or all components are responsible for the IR radiation. It is shown that for the cases where more than one component is an IR source, the average IR luminosity is higher; typically IR luminosity >1012 Lsun is coming from the whole system, which means that the interactions induce vast amounts of dust and/or trigger intense starburst processes in these objects. The dependence of the mean distances of components on the IR luminosity and redshift has been studied to follow the evolution of these interacting/merging systems. Some of the systems contain AGN that allows us investigate the interrelationship between starburst, nuclear activity, and interactions phenomena.

L-P16 From Antarctica To Australia, from Submm to Optical: Spectroscopic Follow- up of BLAST Sources Sheds New Light on the FIRB Composition in the Pre-Herschel Era

L. Moncelsi (Cardiff University), the BLAST collaboration

We present the results obtained so far by combining the data from an extragalactic survey at 250, 350 and 500 um, carried out with the Balloon-borne Large Aperture Submillimeter Telescope (BLAST; Devlin et al. 2004, 2009) in the GOODS South region and from spectroscopic follow-up in the optical of a significant fraction of BLAST brightest sources, carried out with AAOmega, the fibre-fed spectrograph at Anglo-Australian Telescope. Fibres were placed at precise coordinates of statistically significant counterparts to the BLAST sources identified in radio interferometric imaging and/or 24 um Spitzer imaging (refined by IRAC positions). The majority of counterparts were subsequently matched to COMBO-17 and SWIRE photometric redshifts determined from broad and medium band photometry ranging from the optical through to the infrared. After all, the number of 5 sigma BLAST sources with an associated spectroscopic redshift is 104. Combining the unique BLAST filters with these redshifts enables the first detailed census of the physical properties (L, T) of the galaxies that make up the FIRB (Devlin et al. 2009, Marsden et al. in preparation) and will provide a direct measurement of the low-z luminosity function in the submm. We emphasize how relevant these results will be in view of Herschel.

L-P17 NGC 765 - A Disturbed HI Giant?

A. Portas (CAR - University of Hertfordshire), Elias Brinks, Mercedes E. Filho and Antonio Usero

We present multi-wavelength observations of the spiral galaxy NGC 765, emphasizing our studies of the gaseous component. To do so, we analyzed archival VLA D-array observations and made a comparison with Chandra and GALEX data. NGC765 reveals itself to be a unique object, in that it might have retained some information about its formation history. It has one of the largest HI diameters of any galaxy measured, the outer parts of this system having undergone at most a few full rotations. We discovered the HI-to-optical ratio to be ~ 12, one of the largest known to date in a spiral galaxy. In addition we also refer to one of the largest known HI disks in absolute size: The HI integrated map reveals a disk diameter of 12.6' along the major axis or 280 kpc at a distance of 72 Mpc. Although the column densities in the HI disk out to >100 kpc are well above the star formation threshold, no evidence for star formation in the HI disk was found in GALEX maps. Chandra X-ray data, combined with infrared and radio-continuum detections of the core of this galaxy point to the presence of a black hole powering an active LLAGN.

L-P18 Kinematical Signatures of Mergers in Early-Type Galaxy Haloes

A. Romanowsky (UCO/Lick), L. Hoffman, R. Proctor, J. Brodie, D. Forbes

Early-type galaxies at low redshift are now understood to be largely populated by the sub-type of "fast-rotators" with remarkably uniform structural and dynamical properties. However, the observational and theoretical focus has been on their central regions, while their haloes should contain important and unique clues to their evolutionary histories. We present a breakthrough method using the Keck/DEIMOS multi-slit spectrograph to obtain two-dimensional kinematic maps of nearby galaxies with an order of magnitude more areal coverage than SAURON, reaching typically three effective radii. Our pilot study reveals that the fast-rotator homology breaks down outside the central regions -- confirming in more detail the findings at larger radii from planetary nebulae. To understand the origin of these apparent kinematic twists, we analyse high-resolution simulations of gas-rich disk-galaxy mergers, finding strong halo twists as a natural outcome of the orbit families in triaxial remnants. This unique signature may be the smoking gun that clinches the formation mechanism for these galaxies.

L-P19 Polytropic Dark Halos of Isolated Elliptical Galaxies

C. Saxton (MSSL-UCL), Ignacio Ferreras

Dynamical and kinematic evidence has long suggested that disc and dwarf galaxies possess cored dark matter halos (with flat central density gradients) seemingly contradicting the dense cusps of popular collisionless dark matter theories. The dark profiles of isolated elliptical galaxies are therefore vitally independent tests of the dark physics. Some kinematic studies have implied a dearth of dark matter in elliptical galaxies. Here we fit kinematic data (extracted from the literature) with two-component models comprising a Sersic stellar profile plus a polytropic dark halo in equilibrium. The polytropic equation of state can describe alternative dark matter theories with dark self-interaction, non-extensive thermostatistics or boson condensation (in a classical limit). The halo is innately cored at some radius, but the density is centrally pinched by the stellar mass. Preliminary results prefer dark particles to have F~8 effective degrees of freedom but not 9 or more. This complements the range 7<F<10 derived from contraints on galaxy cluster core radii and black hole growth (Saxton & Wu 2008).

L-P20 A New Estimation of SMBH Mass Function in the Local Universe

M. Vika, Simon Driver

We present our latest measurement of the super massive black hole (SMBH) mass function at redshift zero based on detailed structural studies of 1743 galaxies extracted from the B-band Millennium Galaxy Catalogue. Using the empirical correlations between the mass of the black hole and the photometric properties of the spheroid, M_{bh} - L and M_{bh} - n we estimated the SMBH mass of each galaxy. From this we construct empirically derived SMBH mass functions and the SMBH mass density.

L-P21 The Globular Cluster Luminosity Function as a Distance Indicator

D. Villegas (ESO), The ACSVCS team

We use a highly homogeneous set of data from 143 galaxies in the Virgo and Fornax clusters in order to study the properties of the globular cluster luminosity function (GCLF) as a distance indicator. The globular cluster system of each galaxy was studied using a maximum likelihood approach to model the intrinsic GCLF after accounting for contamination and completeness effects. We have found that the relative distance modulus between the Virgo and Fornax clusters is systematically lower than the one derived by other distance estimators, and in particular it is 0.2 mag lower than the value derived from surface brightness fluctuation measurements on the same data. From a numerical simulation aimed to reproduce the observed dispersion on the value of the turnover magnitude we estimate an intrinsic dispersion on this parameter of 0.04 mag and 0.06 mag for Virgo and Fornax respectively. All in all, our study shows that the GCLF properties vary systematically with galaxy mass and may be additionally influenced by the cluster environment.

L-P22 Kinematic Constraints on Dark and Stellar Mass in Local Spiral and S0 Galaxies

M. Williams (University of Oxford), Martin Bureau and Michele Cappellari

(L) The local volume: constraints on galaxy formation and evolution

I present quantitative constraints on the dark matter fractions and stellar mass-to-light ratios of a sample of 30 edge-on spiral and S0 galaxies. Using K-band photometry, I generate two-parameter mass models for each galaxy that include an axisymmetric stellar component and a spherically symmetric NFW dark halo. Under the justifiable assumption of constant anisotropy, I then solve the Jeans equations for the corresponding potentials and compare the predicted kinematics to observed stellar kinematics. The dark halo components of the best-fitting mass models typically comprise 14 per cent of the total mass at 1 Re and 33 per cent at 3 Re. This result significantly extends the radial range over which we can make statements about the dark matter content of S0 galaxies, which had previously only been possible to 1 Re. Our findings are also consistent with previous studies of spiral galaxies. The mean stellar dynamical mass-to-light ratio at K-band is 1.25. I also present preliminary work which seems to demonstrate that spirals and S0s share a Tully-Fisher relation, contrary to recent results and expectations based on our understanding of how S0s form. I speculate on the reasons why other groups have found different results, and what this result might mean for models of disk galaxy evolution.

Wednesday
4:00pm

Evolution, Downsizing and Environment: Results from Faint Cluster Galaxies

R. Smith (Durham University), John Lucey, Mike Hudson, Steve Allanson, Terry Bridges, Ron Marzke, Ann Hornschemeier, Neal Miller

Recent cluster surveys suggest there is a factor-of-two deficit of faint galaxies on the red sequence in clusters at redshifts above z~0.4, relative to the number of giant galaxies. Spectroscopic observations of today's passive dwarfs indicate that indeed many were forming stars at z<1, and were thus absent from the red sequence.

In this talk I will make a direct confrontation between these two complementary probes of galaxy evolution, using deep spectroscopy of Coma cluster dwarfs. In particular, I will discuss the impact of environment in forming the faint end of the red sequence.

Wednesday
4:15pm

LoCuSS: The Mid-Infrared Butcher- Oemler Effect

C. Haines (University of Birmingham), G.P. Smith

We present a study of the mid-infrared properties of galaxies in 30 massive galaxy clusters over 0.02<z<0.4. The selected clusters all have panoramic Spitzer/MIPS 24micron observations and near-infrared photometry from the LoCuSS and ACCESS surveys, and represent the largest sample of clusters to date with such high-quality mid-infrared data covering not only the cluster cores, but extending into the infall regions. We find that when considering the fraction of massive galaxies with L_IR > 5x10^10L_sun within ~r200, we reproduce the original Butcher-Oemler trend, with the fraction of IR-bright galaxies increasing steadily with redshift. We show however, that this effect can be explained as due to the global decline in star-formation in field galaxies, and that the cluster population is rather homogeneous and has evolved little over 0<z<0.4.

Wednesday
4:30pm

The Gas Properties of Cluster Starbursts

J. Geach (Durham University), Ian Smail, K. Coppin, S. Moran, A. C. Edge, R. S. Ellis

I present some new results of CO(1-0) observations of cold molecular gas in infrared-selected starburst galaxies in the outskirts of a rich cluster at z=0.4. These new observations suggest that not only are there sufficient gas reservoirs to assemble ~10^10 solar masses of stars in these galaxies, but also that this occurs early on during cluster infall: the SFRs of ~60 Msun/yr implies that the gas reservoirs will be exhausted in as little as 150Myr, long before the galaxies reach the cluster core. This combination of large gas mass and prodigious SFR means that these galaxies could rapidly build the bulge mass required for them to evolve into local S0s. For spiral galaxies entering distant rich clusters of galaxies, the ability to retain cold gas is vital if they are to evolve into massive S0s by the present day, since there are several mechanisms that serve to remove or prevent further cooling of halo gas during cluster infall. These preliminary results suggest that these processes are not important for these galaxies -- their major epoch of star formation occurs in the outskirts of cluster environments, long before such effects become important.

Wednesday
4:45pm

AGES : Deep HI Observations of the Virgo Cluster

R. Taylor (Cardiff University), J.I. Davies

I present the results of the AGES observations obtained thus far from the Virgo Cluster. AGES is a deep, blind HI survey with a mass sensitivity at 17 Mpc of ~1E7 Msolar. Currently 15 square degrees have been surveyed in Virgo with 77 detections in the cluster (cv < 3000 km/s) of which 25 are new. Of the early-type galaxies listed in the optically selected Virgo Cluster Catalogue for this region, complete to B < 18, up to 6 % are detected in HI. This is a high fraction compared to the similar (but shallower) ALFALFA survey, which measures 2 %. In contrast, many late-type galaxies show strong HI deficiency. If this is caused by gas removal mechanisms (such as ram pressure stripping) then intracluster HI streams may be expected, but none are detected. Spatial averaging is used in an attempt to increase sensitivity to faint diffuse HI, reaching a column density sensitivity of order 10^17 atoms cm^-2, though no detection results. I discuss the implications of these results for environmental mechanisms of galaxy evolution.

Wednesday
5:00pm

The Effect of Ram Pressure on the Star Formation, Mass Distribution and Morphology of Galaxies

W. Kapferer (University of Innsbruck), C. Sluka, S. Schindler, C. Ferrari and B. Ziegler

We investigate the dependence of star formation and the distribution of the components of galaxies on the strength of ram pressure. Several mock observations in X-ray, Haplha and HI wavelength for different ram-pressure scenarios are presented. By applying a combined N-body/hydrodynamic description (GADGET-2) with radiative cooling and a recipe for star formation and stellar feedback different ram-pressure stripping scenarios were calculated. The star formation of a galaxy is enhanced by more than a magnitude in the simulation with a high ram-pressure in comparison to the same system evolving in isolation. The enhancement of the starformation depends more on the surrounding gas density than on the relative velocity. Up to 95 % of all newly formed stars can be found in the wake of the galaxy out to distances of more than 350 kpc behind the stellar disc. Continuously stars fall back to the old stellar disc, building up a bulge-like structure. Young stars can be found throughout the stripped wake with surface densities locally comparable to values in the inner stellar disc. Ram-pressure stripping can shift the location of star formation from the disc into the wake on very short timescales. As the gas in a galaxy has a complex velocity pattern due to the rotation and spiral arms, the superposition of the internal velocity field and the ram pressure causes complex structures in the gaseous wake which survive dynamically up to several 100 Myr. Finally we provide simulated X-ray, Haplha and HI observations to be able to compare our results with observations in these wavebands. These simulated observations show many features which depend strongly both on the strength and the duration of the external ram pressure.

Thursday
11:00am

The Thermal History of the Intragroup Medium

R. Bower (University of Durham), On behalf of the OWLS team

Few of the universe's bayons are locked up into stars. Most are found in the intragroup medium. The thermal state of the IGM gives us a window into the flipside of galaxy formation, allowing us to identify the key processes that regulate the condensation of baryons to form stars. I will present a comparison between X-ray observations of galaxy groups and the the suite of OWLS numerical simulations. As you will see, the comparison is allowing us to unravel the puzzlling X-ray properties of groups and develop a better understanding of galaxy formation.

Thursday
11:15am

JKCS 041, a z=1.9 Cluster Optically Detected with a well Developed Potential Well

S. Andreon (INAF-Oss. Astr. Brera)

I present the discovery of JKCS 041, a z=1.9 cluster of galaxies, the highest redshift known thus far. The cluster has been optically discovered, and then confirmed to be a real cluster-size structure by its detection with Chandra X-ray images. The latter also fix the cluster temperature, extend cluster scale relationships at a previous uncharted redshift. Fourteen-band photometry for JKCS 041 galaxies is available (from Galex bands to 24 microns), and these confirm the cluster detection, and allow to infer interesting properties of its galaxies. Finally, X-ray scale relationship will be investigated, fully accounting for selection effects and uncertain assumptions.

Thursday
11:30am

Combining Semi-Analytic Models of Galaxy Formation with Simulations of Galaxy Clusters

C. Short (University of Sussex), Peter Thomas

X-ray observations of galaxy clusters have established that there is much less cold gas in cluster cores than predicted. The most likely explanation for this deficit is that energy feedback from galaxies offsets radiative losses. To date, the most successful theoretical tool for the study of galaxy formation is semi-analytic models (SAMs). However, existing SAMs are designed purely to reproduce the properties of the observed galaxy distribution. We aim to extend the predictive power of these models by investigating the effect of feedback from model galaxies on the intracluster medium (ICM). This is done by employing a novel hybrid approach which couples SAMs to cosmological N-body hydrodynamical simulations. We assess the impact of feedback from model galaxies on intracluster gas by focusing on two key observables of galaxy groups and clusters: the X-ray luminosity-temperature relation and the halo gas fraction. It is shown that SAMs can reproduce the observational data only if there is a large energy input from active galactic nuclei (AGN).

Thursday
11:45am

Hot Gas in Galaxy Clusters & Cool-Core/Non-Cool Core Bimodality

A. Sanderson (University of Birmingham)

Most of the baryons in galaxy clusters still remain in a hot phase, in the gaseous intracluster medium (ICM), despite radiating X-rays profusely. The fact that this hot gas has not yet cooled to form stars at the expected rate highlights the importance of galaxy feedback and cluster physics in replenishing and/or impeding radiative energy losses. While the details of these processes are not well understood, X-ray analysis of galaxy clusters has proved to be very effective in tackling these issues, since the ICM preserves a record of past heating and enrichment associated with AGN and supernova driven feedback. This talk will present results from an analysis of galaxy clusters observed with the Chandra X-ray satellite, to map the thermodynamic and chemical structure of the hot gas. In particular I will focus on the important distinction between clusters with and without a cool core and the origins for the dichotomy in the population, and how this relatesto activity in their central brightest galaxies.

Thursday
12:00pm

The X-Ray Luminous Cluster Underlying the Bright Radio-Quiet Quasar H1821+643

H. Russell (Institute of Astronomy, Cambridge), Andy Fabian, Jeremy Sanders

It has been known for some time that the observed scaling of X-ray temperatures and luminosities in galaxy clusters does not follow the predictions of gravitational infall alone. Additional heating is required to account for the mismatch. Radio-quiet quasars pumping energy into the cores of clusters at early times are a plausible solution to this problem. We present a Chandra observation of the only low redshift, z=0.297, galaxy cluster to contain a highly luminous radio-quiet quasar, H1821+643. This object is a rare example of a cool core cluster with a bright active quasar at the centre. Subtracting the quasar emission allows us to determine the physical properties of the cluster gas down to 3 arcsec from the point source and analyse the interactions between the quasar and intracluster medium.

M-P01 CBI2 Observations of the SZ Effect in Galaxy Clusters

J. Allison (University of Oxford)

CBI2 is an upgrade to the original Cosmic Background Imager experiment, designed for greater sensitivity on longer baselines. This makes the instrument ideal for exploring the physics of clusters on the largest scales, and the high-l CMB power spectrum.

We have recently completed a program of pointed SZ observations at 30GHz, accumulating a sample of around 40 clusters. These include X-ray luminosity selected samples observed with XMM-Newton at different redshifts, and also objects of special individual interest such as the Shapley supercluster.

I will talk about our initial results and our analysis of the cluster physics out to large radii. From the samples we will obtain scaling relations between the global SZ and X-ray clusters for different redshifts.

M-P02 Star formation in ngc 1275

B. Canning (Rebecca Canning)

We present the results of observations on the extended star formation around NGC 1275, a cD galaxy in the centre of the Perseus cluster. Measurements of the physical parameters of star clusters in these galaxies can allow us to constrain both the rates of star formation and the underlying physical processes behind their development.

NGC 1275, a cooling flow BCG, shows the presence of star formation which, in some regions, appears spatially linked to the extended filamentary H alpha system characteristic of these objects. Determining the properties of these star forming regions can help us establish whether there is a link between the ionised gas and the star formation which is a step in understanding the wider heating and cooling processes occurring in these objects.

M-P03 The Build-up of the Colour-Magnitude Relation in Low-Redshift Galaxy Clusters

D. Capozzi (LJMU - Astrophysics Research Institute), Collins C A, Stott J P.

It is still unclear how galaxies evolve over the Hubble time and the picture is complicated because galaxy poperties also depend on environment and mass. An excellent probe of this evolution is the colour-magnitude relation (CMR)for early-type galaxies in clusters and groups.

We have studied the CMR in the low-redshift domain (0.05<z<0.26), using data from Sloan Digital Sky Survey (SDSS) DR6. We performed our study on optically and X-ray selected cluster samples. The former contains 518 clusters selected from ~400 deg2 of early SDSS commissioning data, while the latter consists of 97 clusters included in the XMM Cluster Survey (XCS). For both of them we observed a decrease of the g/d ratio with redshift. Our results, obtained in the poorly studied low-redshift dominion (0.05<z<0.26), are consistent with the trend found by De Lucia et al. (2007), covering the intermediate-redshift domain (0.4-0.8). The implications on evolution and the differences between the X-ray and optically selected samples as well as those between the two identification algorithms used to build the latter, will be discussed.

M-P04 | Early Assembly of the most Massive Galaxies

C. Collins (LJMU - Astrophysics Research Institute), John Stott and the XCS Survey Team

The current consensus is that galaxies begin as small density fluctuations and grow by hierarchical merging. However, exactly when this assembly takes place is a matter of some debate. Here we report that the stellar masses of Brightest Cluster Galaxies (BCGs), which are the most luminous objects emitting stellar light, some 9 billion years ago are not significantly different from their stellar masses today. BCGs are almost fully assembled 4-5 billion years after the Big Bang, having grown to more than 90 per cent of their final stellar mass by this time. Our data conflict with the most recent galaxy formation models based on the largest simulations of dark-matter halo development. These models predict protracted formation of BCGs over a Hubble time, only 22 per cent of the stellar mass assembled at the epoch probed by our sample. Our findings suggest a new picture in which BCGs experience an early period of rapid growth rather than prolonged hierarchical assembly.

M-P05 | The Large-Scale Structure of Galaxy Clusters - Spectroscopic Surveys of A1835 and A1689

O. Czoske (Kapteyn Institute, Groningen)

I present definitive redshift catalogues for the rich clusters Abell 1835 (z=0.25) and Abell 1689 (z=0.185) derived from a wide-field spectroscopic survey using VIMOS on the VLT. Each catalogue comprises spectra of several thousand galaxies in a field of 0.5 x 0.5 deg^2 around the cluster centres. I discuss the three-dimensional structure of the clusters.

M-P06 | The Relation between Overdensity Radius and Observable Properties of Galaxy Groups and Clusters

A. Dariush (School of Physics & Astronomy, Cardiff University), Somak Raychaudhury, Trevor Ponman, John Mulchaey, Jesper Rasmussen

We have explored the Millennium dark matter simulations, together with the semi-analytic galaxy catalogues and the Millennium hot gas simulations to examine how the overdensity radius (R200) of groups and clusters scales with velocity dispersion and cluster temperature, and other parameters that are traditionally used to estimate the sizes of bound structures. We compare these estimates with those in common use in the literature.

M-P07 | The Environments of AGN at z=1

J. Falder (University of Hertfordshire), Jason A. Stevens, Matt J. Jarvis, Mark Lacy, Ross Mclure, Evanthia Hatziminaoglou, Mat J. Page, Ismael Perez-Fournon

It is now widely accepted that Active Galactic Nuclei (AGN) harbour accreting supermassive black holes and as such are the most massive objects in the universe at their epoch. It makes sense then that these objects would form and reside in the highest density regions of the dark matter distribution. Hence allowing us to use them as signposts to locate early galaxy clusters and large scale structure in the process of formation. We present the initial results of a study, with SPITZER IRAC data, of the environments of 160 plus AGN at around a redshift of 1. The AGN have been searched for an overdensity of galaxy counts surrounding them when compared to a blank field sample. It appears that there is a significant (5 sigma) overdensity out to ~300 kpc from the AGN as well as a possible larger overdensity extending further out. The sample consists of three subsets of AGN type radio galaxies, radio loud quasars and radio quiet quasars. When these subsets were searched separately it was found that the overdensity was most pronounced in the radio loud quasars and radio galaxies. As well as this when we split the radio loud quasars in to bins of radio power we find an apparent increase in the significance of the overdensity with radio power. This suggests that in some way the environments of AGN have a role to play in determining whether we observe them as radio loud or radio quiet and in the power of the radio emission.

M-P08 — Environmental Effects on the Evolution of Dwarf Elliptical Galaxies in the Virgo Cluster

O. Hielscher (ZAH Heidelberg (ARI))

Based on multicolor SDSS data and GALEV evolutionary synthesis models, we derive stellar population ages of Virgo cluster dwarf ellipticals. Our study shows a clear correlation between the age and the local environmental density. We also investigate whether stellar population differences exist between the previously identified subclasses of Virgo dwarf ellipticals, with their significantly different clustering properties. Based on these characteristics, we discuss the implications for their evolutionary history.

M-P09 — A Search for Compact Ellipticals in SDSS DR7

A. Huxor (University of Bristol), S. Phillipps, R. Harniman, J. Price,

Compact elliptical (cE) galaxies are a rare morphological type exemplified by M32, which been suspected to be the victims of tidal truncation or similar processes driven by interactions with near neighbours. In addition to M32 as a very close satellite of M31, the other known similar objects also occur close to massive galaxies in groups (e.g NGC5846A) or to giant ellipticals in clusters - NGC4486B close to M87 in Virgo, two objects in Abell 1689 and one in Abell 496.

In this poster we present work in progress, in which the seventh SDSS Data Release (DR7) is used to explore the region of the surface-brightness/effective-radius parameter space that is occupied by known cEs. DR7 offers a very large and homogeneous database, covering a wide area of contiguous space, enabling the identification of members of this unusual galaxy type.

We identify compact galaxies in a wide range of environments to investigate the relation between the size of early-type galaxies and the local density. In many cases additional archive material is available for more detailed study of the candidate galaxies. We present early results in which we find relatively compact galaxies in a variety of environments: from dense clusters, through compact groups to isolated environments. We present our results so far, the properties of the galaxies, and comment on the implications for the truncation theory of cE formation.

M-P10 Probing Galaxy Formation and Evolution using Luminosity Gap in Groups and Clusters

H. Khosroshahi (IPM), Tavasoli A., Koohpaee A., Dariush A.

Galaxy luminosity function is widely used to probe the semi-analytic models of galaxy formation. We show that the galaxy luminosity gap in galaxy groups and clusters provides a powerful test for this purpose. We study a sample of 60 massive clusters, using data from the Hubble Space Telescope and Palomar Observatory. We focus on the statistics of the luminosity gap between the brightest and second brightest cluster galaxies, in particular the fraction of fossil clusters in which the luminosity gap exceeds 2 magnitudes. While we find that 8 % of the galaxy clusters are fossils, in broad agreement with the predictions based on semi-analytic models of galaxy formation used in the Millennium simulation, there is a significant difference in the predictions of the luminosity of bright galaxies in clusters with the least luminosity gap.

We also extend this study to galaxy groups regime, where most of the systems are believed to be currently forming, allowing us to probe the models in a wide dynamical range (log M~13-15 solar mass). If galaxy merger is responsible for the development of the luminosity gap and is more efficient in low mass groups, due to the lower velocity dispersion, the fraction of large luminosity gap should be higher in low mass systems. This is not seen in the observations.

M-P11 Modelling Galaxy Transformation Scenarios at z~0.4 with GALEV

R. Kotulla (University of Hertfordshire), Marie-Aylin Tyra and Uta Fritze

Understanding the different paths that transform blue star forming galaxies into "red and dead" ellipticals on the red sequence is crucial for our understanding of galaxy evolution, in particular for galaxies in high-density environments like galaxy clusters.

I will present a recent study in which we used a large grid of galaxy models computed with our GALEV evolutionary synthesis code to study possible formation scenarios of k+a galaxies in galaxy clusters at z~0.4. K+a's, i.e. galaxies with spectra typical for ellipticals but strong indications for recent star formation, are prime candidates for galaxies in the process of transformation. Based on colours, luminosities, and on the strengths of the [O II] and Hdelta line we could effectively rule out pure star formation truncation events, whereas strong starbursts accompanying mergers in late-type spirals readily explain all the observed phenomena.

M-P12 The XMM Cluster Survey: First Results for Cluster Scaling Relations

E. Lloyd-Davies (University of Sussex), XCS Collaboration

The XMM Cluster Survey (XCS) will exploit the entire XMM-Newton data archive to find clusters. XCS already covers 170 square degrees and has found more than 2000 cluster candidates. Of these, more than 400 have been optically confirmed so far; z_max=1.45. A companion presentation will give a general review of XCS methodology and present forecasts for cosmological parameter estimation (Sahlen et al.). Here we describe the XCS spectroscopy pipeline designed to measure X-ray temperatures and luminosities for a large catalogue in a highly automated fashion. We then present the first results for cluster X-ray scaling relations from an initial XCS sample and discuss their implication. Unlike most previous measurements of scaling relations, XCS has a well characterised selection function, which will allow much more accurate inferences about the underlying cluster relations to be made from the measurements. To this end we also explore the effects of selection and measurement errors on our ability to measure scaling relations by folding clusters drawn from n-body/hydro simulations through the XCS selection function to infer selection and measurement biases.

M-P13 | Can we Find Backsplashed Galaxies in Clusters?

S. MAHAJAN (UNIVERSITY OF BIRMINGHAM), Dr Gary A. Mamon, Dr Somak Raychaudhury

We use dark matter particle simulations to predict the expected fraction of infalling galaxies, whose orbits have taken them to the far end of a cluster before turning around ("backsplash"), as a function of (projected) cluster-centric radius and radial velocity. This helps us to statistically identify populations of backsplashed galaxies. We then use observable properties such as star formation rate, specific star formation rate, stellar mass, colours etc. derived from the data obtained by SDSS to study the differences between the properties of infalling and backsplash galaxies.

M-P14 | Star Forming Galaxies on the Outskirts of Clusters

S. MAHAJAN (UNIVERSITY OF BIRMINGHAM), Dr Somak Raychaudhury, Dr Kevin Pimbblet

The star formation rate of a galaxy depends on the richness of the environment it is in- the abundance of passively evolving early-type galaxies in the core of clusters have been known for several decades. With wide-field spectroscopic observations being increasingly available, a new class of actively star forming galaxies has been uncovered in the passive rich environment of clusters, especially on their outskirts. We study a sample of rich clusters (z <0.12) from the Sloan Digital Sky Survey that contain galaxies with high star formation rate, and attempt to understand the link between environment and star formation in these systems. We also investigate the link between star formation and the large-scale environment the galaxy resides in, and the physical processes that govern high star formation activity in galaxy clusters.

M-P15 | The Nature of Compact Groups of Galaxies from Cosmological Simulations

G. Mamon (IAP, Paris & Oxford), E. Diaz-Gimenez (Cordoba, Argentina)

It is still not clear what fraction of the compact and isolated groups of 4 or more galaxies such as those catalogued by Hickson represent truly dense systems of at least 4 members or if they are caused by chance alignments along the line-of-sight within looser groups or possibly extending slightly beyond along cosmological filaments. After reviewing the pros and cons, we will present the first case where the 3D structure can be directly probed by accurate distance estimators. We will then present an analysis of the compact groups arising in mock catalogues of galaxies obtained from 3 galaxy formation models run on top of the Millennium dark matter simulation. We will describe the strong incompleteness of the Hickson sample of compact groups and discuss the fraction of groups that are caused by chance alignments.

M-P16 Galaxy Cluster X-Ray Scaling Relations

B. Maughan (University of Bristol), Scott Randall

We will present results from a Chandra study of the X-ray scaling relations in a sample of 115 galaxy cluster at $0.1<z<1.3$. We find evidence that X-ray luminosity can be used as a surprisingly reliable and cheap mass proxy, and examine the sources of scatter in the scaling relations. We also discuss the effects of selection bias on measurements of the evolution of X-ray scaling relations, and present new evidence that cluster mergers drive the observed steepening of the luminosity temperature relation.

M-P17 A Deep Chandra Search for High Redshift Groups

A. Pascut, Trevor Ponman , Alastair Sanderson

We are conducting a search for groups at $z>0.3$ using deep archival data from the Chandra observatory, in order to constrain group evolution, which provides a sensitive test of cosmic feedback. From the first fruits of this survey, we present the X-ray properties of extended sources detected in the 2Ms Chandra Deep Field North Survey, one of the deepest observations in the Chandra data archive. The hot gas properties of these groups will be compared with multiwavelength data on the group galaxies, to explore the relationship between group and galaxy evolution.

M-P18 X-Ray Luminosity Scaling Relations for a Representative Sample of Local Galaxy Clusters

G. Pratt (MPE Garching), J.H. Croston, M. Arnaud, H. Boehringer

The X-ray luminosity is an important quantity both for investigation of the astrophysics of clusters and for the exploitation of the cluster population as cosmological probes. I will describe the X-ray luminosity scaling relations for a representative sample of local galaxy clusters (REXCESS), with particular emphasis on the origin of their steep slopes and causes of scatter about them. I will also describe the effect of Malmquist bias on the luminosity-mass relation, and compare with recent determinations.

M-P19 Low-Frequency Radio Observations of AGN Feedback in Groups and Clusters

S. Raychaudhury (University of Birmingham, UK), S. Giacintucci, E. O'Sullivan, J. Vrtilek, L. David [CfA], T. Venturi [Bologna], R. Athreya [NCRA-TIFR]

Elliptical galaxies with powerful radio sources frequently occupy the central regions of galaxy groups and clusters. The interactions of these radio sources with the X-ray emitting ICM form part of the motivation for the growing acceptance of AGN feedback as the principal mechanism for the regulation of cooling in cluster cores. For a better understanding of the feedback process, the mechanisms and timescales of energy injection, and the effects on group and cluster evolution, we have embarked on a study of groups and clusters, with excellent Chandra/XMM X-ray observations, for which we have obtained GMRT observations at 240, 320 and 610 and 235 MHz. Multiple low frequency observations indicate the radiative aging of electron populations, and reveal the interactions between radio sources and their environments.

M-P20 Warmth and Fragility of Gas and Dark Matter Profiles in a Doubly Polytropic Cooling Flow Cluster

C. Saxton (MSSL-UCL), Kinwah Wu

The observed dynamics of diverse galaxies apparently exclude the dark cusps predicted by popular theories of collisionless dark matter. This prompted propositions of "baryonic feedback" disrupting the cusps (in some far, primordial era), and alternative theories of dark physics (in which the lack of cusps is innate). We take the latter approach, building analytic models with a live, gravitationally consistent (naturally cored) adiabatic dark component (replacing rigid approximations like "pseudoisothermal spheres"). We explore the stationary structures of spherical galaxy clusters comprising a dark halo plus X-ray emitting gas, coupled via the shared potential. All steady solutions have a nonzero floor temperature in inflowing gas (even without cluster-scale heating) and shallow central entropy gradients. Stationarity also demands a minimal central point-mass. These limits are consistent with observed ranges of supermassive black holes (SMBH) if DM particles have 7 to 10 effective degrees of freedom. The gas profile is gravitationally stable, but an inner part of the dark halo teases the threshold of collapse: implying that perturbations could induce SMBH growth via dark gulping (evading Eddington and Soltan limits). Inserting a central galaxy's stellar mass profile can lower the central mass limit slightly, but the prospect of dark gulping remains.

M-P21 Metal Enrichment Processes in the Intra-Cluster Medium

S. Schindler (University of Innsbruck), Kapferer, W., Unterguggenberger, S., Lovisari, L., Pancisin, M., Stöckl, J., Ferrari, C.

We present simulations of metal enrichment processes like ram-pressure stripping and galactic winds. We find that these processes produce inhomogenous metallicity distributions in the ICM. We compare these distributions with observed metallicity maps obtained from X-ray observations. Furthermore we present detailed simulations of ram-pressure stripping in isolated and interacting galaxies. We find enhanced star formation - not only in the disk but also in the wake of the galaxies. This star formation in the wake has been confirmed recently by observations.

M-P22 ISM in Late-Type Galaxies of Abell 1367

T. Scott (University of Hertfordshire), BRAVO-ALFARO, Hector (Universidad de Guanajuato, Mexico), BRINKS, Elias (University of Hertfordshire, UK), CORTESE, Luca (Cardiff University, UK), USERO, Antonio(Observatorio Atronomico Nacional, Spain) and BOSELLI, Alessandro (Laboratoire d'Astrophysique de Marseille, France)

We are reporting a programme of single dish CO and interferometric HI observations in the nearby galaxy cluster Abell 1367 (z=0.02). The aim is to better understand the processes driving the evolution of the ISM in bright late-type galaxies (spirals) in the cluster environment. Abell 1367 is a dynamically young cluster with its SE and NW subclusters having begun merging ~1.8 Gyrs ago. Our study revealed a population of blue, gas-rich galaxies in the NW, a smaller red HI rich population in the NE, and an arc of highly HI deficient red galaxies running NE to SE through the cluster centre. VLA D-array imaging centred on the NW subcluster shows most galaxies in that field have their HI intensity maximum offset relative to their optical counterpart, implying a recent disturbance. But the offset direction is not always consistent with ram pressure stripping by the cluster high density ICM. Recent CO data from the IRAM 30m telescope indicates the molecular gas in a significant fraction of spirals in the volume is deficient or has an asymmeteric distribution, which are expected signatures of tidal interactions.

M-P23 Substructure in Abell S1136: Results from a Combined X-Ray and UV Observation

J. Weratschnig (University of Innsbruck), Daniel Clarke, Wolfgang Kausch, Chiara Ferrari, Dirk Grupe, Sabine Schindler

We present first results from a combined X-ray and UV observation of the cluster of galaxies Abell S1136, which was observed with the SWIFT satellite. AS1136 is part of the Pisces-Cetus supercluster filament and lies at a redshift of 0.06. Apart from an image on the ROSAT all sky survey this is the first X-ray observation of this cluster. We present the usage of a principal component analysis to study the X-ray surface brightness map in order to detect substructure in the Intra cluster medium (ICM). With this method we are able to find evidence for substructure in the ICM, which hints towards a dynamically active and still forming cluster: The second X-ray clump could be an infalling smaller cluster. By extracting an X-ray spectrum we calculate the cluster temperature and metallicity. Furthermore, we test whether different regions have different temperatures. There is no sign for a cool core, which is in agreement of the possible detection of a substructure. Subsequently, we compare these findings with the UV brightness of the cluster galaxies, to find correlations between star formation in galaxies and the ICM structure which hints towards a merger cluster. From the UV image, we get the impression that no red cluster galaxies are in the area of the found substructure, but we find some blue sources for which no redshift is known so far. This feature will be investigated further in the near future.

M-P24 Resimulations of a Sample of Rich Clusters from the Millennium Simulation

O. Young (University of Sussex), Chris Short, Adrian Jenkins, Peter Thomas

We are undertaking a series of resimulations of a sample of several hundred rich clusters from the Millennium Simulation.

We have an adiabatic simulation for determining which properties are determined by the formation history of the cluster, a run with preheating and radiative cooling for defining the spine of the scaling relations, and a feedback run for determining the causes of scatter in real clusters.

These form an excellent sample for elucidating the origin of variations in concentration, baryon fraction and deviations from the scaling relations in clusters.

Monday
2:00pm

Phenomology of Reionization and the CMB

R. Battye (JBCA, University of Manchester)

I will discuss what can (and cannot) be deduced about reionization from measurement of CMB polarization. The talk will mainly be based on use of phenomonological models which can be compared to observations. I will comment on the present status of observations and the future possibilities.

Monday
2:30pm

Observabity of the Epoch of Reionization: the View from the Simulations

I. Iliev (University of Sussex), Garrelt Mellema, Paul Shairo, Ue-Li Pen

Simulations of the early structure formation and the Epoch of Reionization have finally reached sufficient volume, dynamic range and resolution to make reliable predictions for the fundamental features and observable signatures of these epochs. I will review recent progress we have made in this area, which include performing the largest and most detailed EoR simulations. I will discuss the predicted observational signatures at 21-cm, kSZ and Ly-a surveys with a particular focus on the best observational strategies, and will briefly outline the current challenges we face and how we plan to resolve them.

Monday
2:50pm

Theoretical Modelling of Inhomogeneous Reionization by Combining Radiative Transfer and Galaxy Formation Modelling

M. Raicevic (Institute for Computational Cosmology, Durham), Tom Theuns, Cedric G. Lacey, John C. Helly, Jan-Pieter Paardekooper

Galaxies are now thought to be the most likely sources for starting the reionisation process at redshifts greater than 10. Initially, most ionising photons will be produced by small galaxies, with more massive galaxies becoming increasingly important as hierarchical structure formation proceeds. The luminous properties of the small galaxies may be affected by the reionisation process itself, as heating of the gas in halos and the IGM deprives them of their fuel for star formation. Such suppression may be required to explain the 'missing satellite problem' at z=0. Photo-heating associated with ionisation may provide positive or negative feedback for the reionisation process, depending on the balance between the decrease in emissivity as small sources get suppressed (which delays percolation) with a decrease in the average recombination rate as the filaments get destroyed (which speeds-up percolation).

I will present a new code framework developed to study these intricacies. It uses GALFORM, a semi-analytic galaxy formation and evolution code, as a realistic model for the evolution of the source population for a given reionisation history. Ionising photons predicted by GALFORM are propagated through a gas density field, using the SIMPLEX radiative transfer scheme. This combination allows us to perform radiative transfer simulations with realistic source suppression in large boxes with millions of sources in a few days on a single work station. It is then possible to perform many simulations that vary the main uncertainties in this modelling, for example in the escape fraction or initial mass function of the early galaxies. I will discuss the radiative transfer method, coupling algorithm, and present some preliminary first results.

Monday
3:05pm

Lya Radiation Transfer in Hydrodynamical Simulations of Galaxies

A. Verhamme (Oxford University / Swiss National Fund), Adriane Slyz, Julien Devriendt, Yohan Dubois

I will present the early results of lya RT in a simulated isolated galaxy. In particular, I will discuss the effect of viewing angle on the shape of the emergent spectrum, as well as its evolution with time, when a wind driven by supernovae grows to galactic scales. Finally I will discuss the effect of the clumpiness of the interstellar medium on the spectral shape and lya escape fraction.

Monday
4:30pm

New Results on Reionization from Metal Absorption Lines

G. Becker (Institute of Astronomy)

Metal absorption lines are proving to be a valuable tool for studying the z~6 Universe. I will present recent results from high-resolution searches for both high (C IV) and low-ionization (O I) metals at z~6. The combined data suggest that the IGM is significantly enriched by this epoch. In contrast to lower redshifts, however, most of the metals we see are in a neutral state. I will discuss the implications for reionization, including the possibility that the tail of reionization extends down to redshift six and concludes with the ionization of these O I systems. I will also discuss the constraints placed by their elemental abundances on the kinds of stars that ended the dark ages.

Monday
4:58pm

Probing reionization with the UKIDSS quasar ULASJ1319+0950

M. Patel (Imperial College London), Steve Warren, Daniel Mortlock, Paul Hewett, Bram Venemans

The UKIRT Infra-red Deep Sky Survey (UKIDSS) is the next generation deep sky survey. The Large Area Survey (LAS), within UKIDSS, aims to observe 4000 deg^2 in Y, J, H and K, and provide near-IR counterparts to SDSS which are 3 magnitudes deeper than 2MASS.

We present the first z>6 quasar discovered by UKIDSS-LAS. Using optical and near-IR spectra we constrain the continuum power-law and thus, are able to perform a detailed study of the Lyman alpha forest. We find that this object has similar Lyman alpha absorption properties as other high-redshift quasars found in optical surveys. This suggests that subsequent high-redshift quasars discovered in near-IR sruveys like UKIDSS will be accurate probes of cosmological reionization to a redshift of 7 and beyond.

Monday
5:10pm

JANUS Will Find Hundreds of Quasars 6<z<10 by 2015

S. Warren (Imperial College London), Derek Fox (PSU), Terry Herter (Cornell), Daniel Mortlock (ICL), Mat Page (MSSL), Pete Roming (PSU), Don Schneider (PSU), Martin Still (MSSL)

I will describe the aims of the Joint Astrophysics Nascent Universe Satellite (JANUS) mission, a NASA SMEX proposal which, if approved in June this year, would be launched ca. 2013. JANUS will use an X-ray monitor to detect high-redshift GRBs, and at the same time will undertake a low-resolution R=14 slitless near-infrared spectroscopic survey to J=19.5 over 20,000 sq degs, to identify high-redshift quasars 6<z<10. I will present the results of a detailed simulation of the spectroscopic survey, undertaken with the purpose of quantifying the completeness and contamination of the quasar sample. I will compare the predicted number of quasars 6<z<10 against the same quantity for UKIDSS, VISTA, and PanStarrs.

Monday
5:25pm

Pushing to the Limits: NB Imaging and NIR Spectroscopy of Critical Line Mapping

J. Kneib (CNRS-LAM)

I will give a status report of 2 projects focussed at discovering hi-z galaxies: NB IR imaging and IR Sinfoni spectroscopy of massive clusters. I will also give some future prospects for follow- up and future discovery.

Monday
5:40pm

Star Formation at z>6 and Implications for Reionization

A. Bunker (Oxford University), Elizabeth Stanway, Richard Ellis, Kuenley Chiu, Richard McMahon, Laurence Eyles, Daniel Stark, Mark Lacy

Redshift 6 and beyond, within one billion years of the Big Bang, marks the end of the reionization epoch. A crucial question is whether the UV flux from young starbursts at this redshift is sufficient to achieve this reionzation. We have used the Lyman break technique to identify candidate star-forming galaxies at this redshift in deep HST ACS & NICMOS and ground-based IR images, including the Hubble Ultra Deep Field. Some of these exhibit Balmer breaks in mid-IR Spitzer data, indicating that a subset have evolved stellar populations even at z~ 6, implying star formation commenced at even higher redshifts. Spectroscopic confirmation of this population is crucial, to guard against low-redshift interlopers and to study the Lyman-alpha emission line properties of z~6 galaxies. We have undertaken the deepest spectroscopy yet to achieve this. We also present evidence of much bluer colours at high redshift, indicating great evolution in the dust extinction and possibly the initial mass function.

Monday
5:55pm

The Search for Galaxies at z > 7

J. Dunlop (University of Edinburgh), Ross McLure, Michele Cirasuolo

At present the most distant spectroscopically-confirmed galaxy lies at z = 6.96. We summarize and revisit the few current credible claims for photometrically-selected objects at still higher redshifts, and discuss the extent to which the limitations of current near-infrared imaging facilities has prevented progress beyond z = 7. During 2009 this situation is set to change with the planned installation of Wide Field Camera 3 on the Hubble Space Telescope, and the commissioning of the VISTA survey telescope in Chile. We discuss the prospects for studying the evolution of massive galaxies beyond z = 7 with the UltraVISTA survey, and for the study of lower-mass objects with the refurbished HST.

N-P01

Redshift Clustering of Dark Matter Halos at z~5: A Comparison to Lyman Break Galaxy Populations

L. Davies (University of Bristol), M.N. Bremer, M.D. Lehnert, E.R. Stanway, L.S. Douglas

We examine redshift and spatial clustering of halos at z~5 using the high resolution N-body Millennium Run simulations. We investigate clustering over a large sample of 6.5'x 6.5' pointings and compare them to Lyman Break galaxy (LBG) over-densities detected in spectroscopically confirmed samples of comparable size. By examining the statistical distribution of redshift over-densities we find that current estimates for LBG halo masses and occupation functions can not fit the observed clustering. However lower mass halos distributions are consistent with LBG populations. We trace the fate of halos in over-densities with similar distributions to LBG over-densities and find a large percentage (~50\%) will go on to form the most massive halos (<10^14Msun) at z=0, in comparison to less than 5\% from a random sample of comparable mass halos. This suggests that structure formation is well established at z~5 and that these over-densities maybe the precursor to the most massive cluster halos seen at the present epoch. In addition, these 'proto-clusters' also contain a small number of larger mass halos which may host the UV faint, molecular line emitting galaxies recently discovered in over-dense LBG fields (Stanway et al. 08). We display that current fields containing LBG over-densities may only represent a small region of these z~5 'proto-clusters' and hence suggest the undertaking of larger area surveys to trace the large scale structure at these early epochs. We also identify that the most likely sites for detection of these structures is in the proximity of high-z quasars.

N-P02 The Clustering of Ly-alpha Emitters in a LCDM Universe

A. Orsi (Durham University), Cedric Lacey, Carlton Baugh, Leopoldo Infante

We combine a semi-analytical model of galaxy formation with a very large simulation which follows the growth of large scale structure in a LCDM universe to predict the clustering of Ly-alpha emitters. We find that the clustering strength of Ly-alpha emitters has only a weak dependence on Ly-alpha luminosity but a strong dependence on redshift. With increasing redshift, Ly-alpha emitters trace progressively rarer, higher density regions of the universe. Due to the large volume of the simulation, over 100 times bigger than any previously used for this application, we can construct mock catalogues of Ly-alpha emitters and study the sample variance of current and forthcoming surveys. We find that the number and clustering of Ly-alpha emitters in our mock catalogues are in agreement with measurements from current surveys, but that there is a considerable scatter in these quantities. We argue that a proposed survey of emitters at z=8.8 should be extended significantly in solid angle to allow a robust measurement of Ly-alpha emitter clustering.

N-P03 HeII Reionization around AGN

E. Tittley (Royal Observaotry Edinburgh), Avery Meiksin

We examine the temperature structure of the intergalactic medium (IGM) surounding a hard radiation source, such as a Quasi-Stellar Object (QSO), in response to the onset of helium reionisation by the source. We model the reionisation using a radiative transfer (RT) code coupled to a particle-mesh (PM) N-body code. We find that the post-ionisation temperature of the reionised IGM increases systematically with distance from the source, with the most recently reionised gas the hottest, producing a "thermal proximity effect". With time the temperature relaxes with a reduced spread as a function of impact parameter along neighbouring lines of sight, although the trend continues to persist until $z = 2$. The Doppler widths of HI absorption features in mock spectra along neighbouring lines of sight show a weak trend with impact parameter prior to full helium reionisation reflecting the behaviour of the underlying density and peculiar velocity fields, but take on a near constant value after helium reionisation, with a median value of 20 to 25 km/s at $z = 3$.

Monday
11:00am

AGN Feedback

A. King (University of Leicester)

I review the effects of outflows from AGN on their hosts. These probably account for the well known M-sigma and black hole - bulge mass correlations. I suggest that there may be other effects too.

Monday
11:30am

Modelling X-Ray Spectra for AGN Outflows

S. Sim (MPA Garching), Lance Miller, Knox Long, Jane Turner

I will discuss our recent work on multi-dimensional modelling of X-ray spectra for outflows around active galactic nuclei. I will present a set of theoretical calculations for parameterized outflow geometries and conditions and will discuss the range of spectral features to which they can give rise. This will include both absorption and emission line features similar to those reported in observations. In particular, for sufficiently high wind densities, moderately strong Fe K emission lines can form and electron scattering in the flow may cause these lines to develop extended red wings.

Monday
11:45am

Hunting Ghosts: Observational Evidence for Radiatively Driven Outflows in Quasars

C. Cottis (University of Leicester), M.R. Goad

Broad absorption line quasars(BALQSOs) represent ~15\% of the quasar population but the mechanism responsible for accelerating these outflows remains uncertain. The ghost of Lyman-alpha is a feature seen within the absorption trough of a small fraction of BALQSOs and is believed to be produced by radiative acceleration of outflowing N V ions by Lyman-alpha emission. N V ions moving at -5900km/s 'see' the Lyman-alpha emission from the AGN at the energy of their own emission resulting in a large increase in the scattering cross section to Lyman-alpha photons. This results in a large injection of momentum into the outflow which drags other absorbing species to higher velocities producing a decrease in the optical depth at 5900km/s which manifests as a peak within the absorption trough of other lines, principally C IV. It is this peak that is poetically named the ghost of Lyman-alpha. We have compiled the largest sample of ghost-candidates using the most robust and complete sample of BALQSOs from data release 5 of the Sloan Digital Sky Survey. With this sample we have tested the criteria set out by Arav(1996) necessary for the formation of this feature by radiative acceleration.

Monday
12:00pm

Radio Constraints on the Volume Filling Factors of AGN Winds

A. Blustin (Institute of Astronomy, University of Cambridge), A. C. Fabian

To understand the role that AGN winds play in AGN-galaxy feedback processes, we need to know how much mass they transport. The mass outflow rates are, however, difficult to estimate since the volume filling factors of the winds are unknown. We use the magnitude of the observed radio emission to obtain upper limits to the volume filling factors of wind components in certain nearby AGN. We do this by predicting the 1.4 GHz radio flux densities emitted by those components, assuming a uniform volume-filling wind, and then comparing these with the actual observed flux densities for each AGN at this frequency. We find that the upper limits to the volume filling factors are in the range 10^(-4)-0.5.

Monday
12:15pm

Outflows and Non-Circular Motions in Nearby AGN Observed with Integral-Field Spectrograph OASIS

I. Stoklasova (Astronomical Institute Prague), P. Ferruit, E.Emsellem, B.Jugwiert, E.Pecontal, S.Sanchez

In order to study the interaction between the active galactic nuclei and their host galaxies, we map the central kiloparsec in a sample of 16 nearby Seyfert galaxies using the optical integral-field spectrograph OASIS on CFHT (Stoklasova et al. 2009, A&A accepted).

The velocity fields measured in narrow-line emitting gas (unlike those of underlying stars) show that the central galactic regions are characterised by non-circular motions of gas. Thanks to the spatially resolved spectroscopic data, we map the details of outflows in several of the objects of the sample, most prominent being NGC 4051, reaching velocities of 600km/s in [O III]5007.

In addition, eighty percent of the observed targets possess twisted ("S-shaped") isovelocity contours typical of non-axisymmetric gravitational potentials or outflows, and might give evidence of a link between the host galaxy and the AGN. We construct kinematic models in order to discriminate between the non-circular rotation, outflows and inflows.

Monday
2:00pm

X-Ray Spectra of AGN: Obscuring Material and Winds

L. Miller (Dept of Physics, Oxford University)

Long X-ray observations of bright local AGN with XMM-Newton, Suzaku and Chandra have given us new insight into the physical processes that shape their X-ray spectra. There is growing evidence that Type I AGN can have high column densities of patchy ionised material obscuring them at keV energies. Modelling the spectral variations in a few AGN indicates that this plays a major role in shaping what we see. A likely origin for the obscuring material is ejecta or winds from the accretion disk on scales of order 100 gravitational radii from the central black hole. We describe the modelling of the X-ray spectra and discuss the results in the context of recent modelling of accretion disk winds, which are expected from AGN with high Eddington ratios.

Monday
2:20pm

AGN-Induced Feedback in Young, Radio-Loud AGN

J. Holt (Leiden Observatory, Leiden University), C. N. Tadhunter, R. Morganti

In active galaxies, two key concerns are the impact of the central activity on the circumnuclear gas and its subsequent effect on the evolution of the host galaxy. In this talk, I present results of my work on compact (young) radio sources as probes of this AGN-induced feedback in the early stages of radio source evolution. Through intermediate resolution, large range optical spectroscopy we can efficiently search for evidence of the activity in the kinematics and physical conditions of the circumnuclear gas, namely emission line outflows, and assess the impact of the outflows on the system.

Monday
2:40pm

Giant outflows in powerful radio galaxies: evidence for AGN feedback in high-z galaxies -- and beyond.

N. Nesvadba (Institut d'Astrophysique Spatiale Orsay)

To accomodate the seemingly 'anti-hierarchical' properties of massive galaxies within our hierarchical paradigm, models of galaxy evolution now postulate a phase of vigorous AGN feedback at high redshift, which effectively terminates star formation by quenching the supply of cold gas. Using the SINFONI IFU on the VLT and the IRAM millimeter interferometer, we identified kpc-sized outflows of several 10^10 M_s of ionized gas in z~2-3 radio galaxies, and a remarkable deficiency of molecular gas in the same sources. These are the expected signatures of AGN-driven winds that may terminate star formation in the most massive galaxies. I will discuss these results and their implications for galaxy evolution. I will also present our recent CO emission line observations, which suggest that the powerful jets may play a significant role in "pre"-heating the intracluster medium in the collapsing massive structures that surround many z~2 radio galaxies, in broad analogy to the AGN feedback often observed in clusters at lower redshift.

Monday
3:00pm

A Multi-Wavelength View of Accretion Modes in Radio-Loud AGN

M. Hardcastle (University of Hertfordshire), Dan Evans, Judith Croston

We use new observations in the X-ray, optical and mid-infrared to constrain the nature of the active nuclei in the 3CRR sample of powerful radio-loud AGN. Our observations provide the clearest evidence yet that the well-known weak/strong emission-line dichotomy in these AGN really does reflect a difference in accretion mode. We show that the evidence supports a model in which the different accretion modes are a consequence of accretion from different phases of the ISM, with important consequences for 'feedback' models.

Monday
3:15pm

Feedback in the AGN Population of the Extended Groth Strip

J. Rodriguez-Espinosa (Instituto de Astrofisica de Canarias), Cristina Ramos-Almeida

We have analysed a sample of Active Galactic Nuclei (AGN) in the Extended Groth Strip. We find photo-z for all the objects and clasify them in AGN or host dominated objects with various degrees of starburst contamination. We show the z and X-ray luminosity distribution of the various classes found and interpret it as a process in which starbursts and AGN feedback determine the evolution towards local quiescent galaxies.

Monday
4:30pm

SUZAKU Observations of Bright Compton-Thin Seyfert2

V. Braito (University of Leicester), J. N. Reeves, R. Della Ceca, G. Risaliti, t. Yaqoob

Recent X-ray observations of Seyfert 2 galaxies have shown that the distribution and ionization state of the circumnuclear absorbing material is more complex than the simple homogeneous and relatively cold torus predicted by the Unification Scheme of AGN. Hard X-ray observations above 10 keV represent a key to investigate the nature of this absorbing material, since they can make a precise measurement of the Compton reflection hump. We present the first results of a sample of the local brightest nearby Compton Thin Seyfert2 observed with Suzaku. The sources were selected among the Swift/BAT high-latitude survey, with a flux in the 14-195 keV band of at least ~1e-10 cgs. Suzaku's high sensitivity and broad bandpass allowed us to better constrain the primary X-ray continuum and investigate the nature of the reprocessing matter.

Monday
4:45pm

The Seyfert AGN RX J0136.9-3510 and the Spectral State of Super Eddington Accretion Flows

C. Jin (Department of Physics, Durham), Chris, Done, Martin Ward, Marek Gierlinski

We have carried out a survey of long 50ks XMM-Newton observations of a sample of bright, variable AGN. We found a distinctive energy dependence of the variability in RXJ0136.9-3510. The energy dependence of its variability has a fractional amplitude which increases with energy from 0.3 to 2~keV, and then remains constant. This is in sharp contrast to other AGN where the X-ray variability is either flat or falling with energy, sometimes with a peak at ~2 keV superimposed on the overall trend. Intriguingly these unusual characteristics of variability are shared by one other AGN, namely RE J1034+396, which is so far unique showing a significant X-ray QPO. In addition the broad band spectrum of RXJ0136.9-3510 is also remarkably similar to that of RE J1034+396, being dominated by a huge soft excess in the EUV-soft X-ray bandpass. The bolometric luminosity of RX J0136.9-3510 gives an Eddington ratio of about 2.7 for a black hole mass (from the H beta line width) of 7.9 x 10^(7)M_sun. This mass is about a factor of 50 higher than that of RE J1034+396, making any QPO undetectable in this length of observation. Nonetheless, its X-ray spectral and variability similarities suggest that RE J1034+396 is simply the closest representative of a new class of AGN spectra, representing the most extreme mass accretion rates.

Monday
5:00pm

A Sample of Radio Galaxies Spanning Three Decades in Radio Luminosity - The Fundamental Plane

P. Herbert (University of Hertfordshire), M.J. Jarvis, R.J. McLure, C.J. Willott, S. Rawlings, G.J. Hill, J.S. Dunlop

We present the preliminary results of our complete investigation of the host galaxies and environments of a sample of radio galaxies spanning a factor of 1000 in radio luminosity at a single cosmic epoch ($0.4<z<0.6$). We describe our investigations into the fundamental plane of z~0.5 radio galaxies using deep spectroscopic data combined with the HST data from McLure et al. (2004). We have developed a direct spectral fitting procedure to determine the velocity dispersions of our galaxies. We combine these values with the effective radii and surface brightnesses determined by McLure et al. (2004) and employ a Monte Carlo technique to determine the parameters of the fundamental plane best fitting our data. We find that at z~0.5 a fundamental plane of radio galaxies still exists. It is, however, markedly different to the familiar fundamental plane observed in the local universe. In particular, we find that at z~0.5 the mass and size of these powerful radio galaxies are less closely related than in the local universe.

Monday
5:15pm

A Dichotomy in Radio Jet Orientations in Elliptical Galaxies

I. Browne (University of Manchester), Richardd Battye

We have examined the position angle differences of the optical and radio emission of 14302 SDSS galaxies identified with extended FIRST radio sources. We separate optically passive elliptical galaxies from star-forming and other galaxies by a combination of colour and concentration. In the ellipticals there is a statistically highly significant trend for the radio emission to be aligned with the optical minor axes, something which expected for oblate spheroidal galaxies with jets emerging along their minor axes. Remarkably this trend is confined to the radio quieter portion of the elliptical population. We suggest that this dichotomy in nuclear alignment properties relates to whether or not the galaxy is rotationally supported or not. This implies that the accretion efficiency would have to be significantly higher in non-rotationally supported galaxies.

Monday
5:30pm

X-Ray-IR Diagnostics for High Redshift Active Galaxies

M. Brightman (Imperial College London), Kirpal Nandra

We make use of the local 12 micron galaxy sample (12MGS) and it's abundant supporting data to gain insight on the MIPS 24 microns selected galaxies at z~1. We collect optical spectroscopy on the 12MGS from the literature, augmented with X-ray data (XMM) and define a well defined sample of AGN within the 12MGS. We collect available IR (IRAS, H, K) photometry on the entire sample from the literature and characterise these AGN on various diagnostic plots. Our findings include the following: Galaxies dominated by an AGN are well separated from galaxies that are dominated by star forming processes on a FX/F12 vs NH diagram; it is not possible to use mid-IR diagnostics alone to select AGN, and that X-ray and far-IR data are needed to pick AGN apart from starburst galaxies; Compton thick AGN are not distinguishable from Compton thin AGN using these diagnostics, and that only a direct measurement of the NH can confirm whether an AGN is Compton thick. This has important implications for current deep surveys which extensively use Spitzer data alone to search for high redshift AGN.

Monday
5:45pm

Towards a Complete Census of Local AGN Activity: A Large Population of Optically Unidentified AGNs

A. Goulding (Durham University), D. M. Alexander

Using Spitzer-IRS spectroscopy, we present the ubiquity of AGN in a complete, volume-limited sample of the most bolometrically luminous galaxies (L_IR > (0.3--20) x 10^10 L_o) to D < 15 Mpc. Our analyses are based on the detection of the high-excitation emission line [NeV] (14.32um, 97.1 eV) to unambiguously identify AGN activity. We find that 17 of the 64 IR-bright galaxies in our sample host AGN activity (~ 27 %), ~ 50 % of which are not identified as AGNs using optical spectroscopy. The large AGN fraction indicates a tighter connection between AGN activity and IR luminosity for galaxies in the local Universe than previously found, potentially indicating a close association between AGN activity and star formation. The optically unidentified AGNs span a wide range of galaxy type (S0--Irr) and are typically starburst-dominated systems hosting modest-luminosity AGN activity (L_[NeV] ~ 10^37 -- 10^39 erg s^-1). The non-identification of optical AGN signatures in the majority of these galaxies appears to be due to extinction towards the AGN, rather than an intrinsically low-luminosity AGN or dilution from star-formation activity. Examination of optical images shows that the majority of optically unidentified AGNs are hosted in either highly inclined galaxies or galaxies with dust lanes, indicating that obscuration of the AGN is not necessarily due to an obscuring torus. We therefore conclude that optical spectroscopic surveys miss at least half of the AGN population simply due to extinction through the host galaxy.

O-P01 Imaging AGN with Optical/IR Interferometry at MROI

F. Baron (Cavendish Laboratory), John Young, David Buscher, Chris Haniff

The Magdalena Ridge Observatory Interferometer is a US/UK 10-telescope optical/near-IR interferometer currently under construction in New Mexico, with first fringes expected in 2010. It will permit imaging of the central regions of more than 100 of the nearest and brightest AGN with sub-milli-arcsecond resolution, allowing the measurement of the size and shape of their broad line regions, as well as the direct observation of the potential dusty tori. We present here simulated observations of typical AGN sources using model-independent image reconstruction techniques.

O-P02 Adaptive Mesh Refinement Simulation of Galactic Disk Chemistry

C. Few (UCLAN), Brad Gibson, Stephanie Courty

The effect of different chemical species on supernova feedback is an important consideration for the evolution of galaxies. Precious computational resources are generally better spent examining the dynamics of gas, stars and dark matter. While some treatment of chemical composition is considered in most recent simulations, it is always simplified, considering only the most important elements and isotopes.

Adaptive Mesh Refinement is an extension of grid-based hydrodynamics solver that allows us to increase resolution in areas of interest, thus avoiding redundant calculations. This allows us to introduce what was once an impractical detailed treatment of chemical elements in order to increase the accuracy of our models and provide further comparison with observed trends in chemical distribution.

O-P03 Inverse-Compton Emission in 3C353

J. Goodger (University of Hertfordshire), Hardcastle, M.J., Croston, J.H. (UH)

X-ray emission due to inverse-Compton scattering of microwave background photons by electrons in the lobes of powerful radio galaxies has now been seen in a large number of objects. Combining an inverse-Compton model for the lobe X-ray emission with information obtained from radio synchrotron emission provides a method of constraining the electron population and magnetic field energy density, which cannot be accomplished using the radio data alone.

Using six frequencies of new and archival radio data and new XMM-Newton observations of the Fanaroff Riley class II radio galaxy 3C353, we show that inverse-Compton emission is detected in the radio lobes of this source at a level consistent with other objects. We argue that variations in the X-ray\radio ratio in the brighter eastern lobe require positionally varying magnetic field strength. We also examine the X-ray nucleus and the cluster, Zw 1819.1-0108, spatially and spectrally.

O-P04 | Particle Acceleration in the Jet of Centaurus A

J. Goodger (University of Hertfordshire), Hardcastle M.J., Croston, J.H. (UH), R.P. Kraft (CfA) et al.

I will present the results of decades of monitoring the jet in our nearest radio galaxy Centaurus A in the radio and X-ray which has allowed us to investigate jet dynamics and particle acceleration at a level of detail not possible for any other extragalactic jet. Understanding how energy is transferred from the jet to the lobe and the surrounding material is crucial to models of AGN feedback.

With 17 years of 8.4 GHz VLA radio data and 10 years of Chandra X-ray data, we have detected flux and polarization variability in the knots. The data allow us to rule out models involving impulsive particle acceleration within the jet; instead we see evidence of particle-acceleration processes which are long-lived compared to the synchrotron loss time. We argue that the majority of the jet knots are likely to arise due to collisions giving rise to local shock acceleration, although some may be due to changes in the fluid flow resulting in beaming and apparent motion of some knots downstream.

O-P05 | Constraining the SEDs of an SDSS - X-Ray Selected Sample of AGN

S. Hutton (Durham University), Chris Done, Martin Ward

Our aim is to study AGN whose accretion disc component can be well constrained by optical/UV and X-ray data. To this end we have constructed SEDs some SDSS broad line AGN which have XMM-Newton spectra, giving 190 AGNs. A final sub-sample of XMM objects was defined including all AGN that in addition had XMM-Optical Monitor (OM) data to extend the SDSS optical coverage into the UV. The black hole mass is derived from the SDSS FWHM of the H beta lines and the continuum at 5100 A and ranges from 2x10^5 to 3x10^9 solar masses. This sets the size scale of the disc, so that its temperature can be derived from fitting the optical/UV emission. This does not reproduce the X-ray data, which require either a power law or power law plus soft excess. The total SED model is used to get the bolometric luminosity so we can calculate Eddington fraction. Of the 48 objects without significant intrinsic dust or gas absorption, 12 have a Eddington ratio greater than 1 showing that this is an efficient selection technique for high accretion rate objects.

O-P06 | Radio Variability of NGC 4051

S. Jones (University of Southampton), Ian McHardy, Derek Moss

NGC 4051 is a Narrow Line Seyfert 1 Active Galactic Nucleui (AGN) with a detectable nuclear radio source which is shown, by VLBI observations, to have a jet-like structure. It has extended radio emission on a variety of size scales but we require to measure just the nuclear radio flux. Correlated radio and X-ray flux observations of NGC 4051 provide the first method of studying the relationship between the X-ray and radio emission in soft-state systems. Here we report the results of radio observations at 8.4GHz, carried out over a 16 month period in 2000-2001 at the Very Large Array (VLA) and compare with X-ray data from Rossi X-ray Timing Explorer (RXTE). When the VLA changes array configuration from A at 36km to D at 1km the synthesised beam size changes, resulting in differing amounts of extended emission being included within the unresolved nuclear component of NGC 4051. In order to estimate the nuclear flux we have derived a method to measure the offset contribution from extended emission in the various arrays and, using simulations, we have estimated the accuracy of these offset measurements. Although there are considerable uncertainties, the resultant observations indicate a broad correlation between the radio and X-ray fluxes, however we are unable to measure an accurate lag. These observations imply that jet-like activity continues in accreting black hole systems even in the soft-state and that, like the X-ray emission, the jet power is related to the accretion rate.

O-P07 The Suzaku View of the Low Luminosity Seyfert Galaxy, NGC 7213

A. Lobban, J.N. Reeves, D. Porquet

We present the results of the very first observation of the nearby (z = 0.005839) low-luminosity AGN NGC 7213 with Suzaku. X-ray spectroscopy has revealed that NGC 7213 is unique among Seyferts with spectral properties intermediate of those of LINER (low-ionisation nuclear emission-line region) and higher luminosity Seyfert galaxies. Narrow K-alpha emission (velocity width ~2700 km/s) from neutral and highly-ionised (Fe xxvi; Fe xxv) iron was clearly present in the data (equivalent widths of 83.1 +/- 11.0, 62.3 +/- 15.0 and 24.1 +/- 7.9 eV respectively) yet no significant Compton reflection component was observed confirming the findings from previous Chandra and XMM-Newton/BeppoSAX observations. The lack of reflection suggests that the iron line complex is not produced in a Compton-thick material such as the disk or torus but instead could perhaps originate in a Compton-thin gas such as the Broad Line Region (BLR). No He-like resonance line was detected indicating that the ionised emission does not originate in collisionally ionised material; a view which is strengthened by the possible detection of the He-like forbidden line suggesting that the emission could instead originate from low-density photo-ionised material. An alternative suggestion is that this emission is actually originating from less-ionised material (Fe xxiii). No other significant emission or absorption lines are found.

O-P08 Delayed Dust Recovering in NGC 4151

V. Oknyanskij (Sternberg Astronomical Institute), V.M. Lyuty, O.G. Taranova, E.A. Koptelova, V.I. Shenavrin

We combine all published and new unpublished yet NIR (near infrared) photometrical observations of NGC 4151 which can be used for determination of time delays between optical and NIR variations. In previous study we have found that the values of time delay in NIR filters are not the same for different states of the luminosity. Here we consider the new photometrical data for the deep minimum in 2003-2007 following the very high state of the nucleus. We conclude that after sublimation in high state of nucleus the dust particles were recovering during at least several years.

O-P09 Observations of Energetic Outflows in AGN

J. Reeves (Keele University)

It is already known that UV observations of BAL quasars contain powerful outflows with velocities of several 10000 km/s. Here I review evidence for powerful outflows from quasars in the X-ray band, in particular in the iron K band. Several AGN show near relativistic winds with outflow velocities of the order 0.1c and kinetic power close to the observed bolometric luminosities of the quasars. Such flows may have a significant impact on the quasar host galaxy, through feedback.

O-P10 Testing Clumpy Torus Models in AGN through Mid IR Observations

J. Rodriguez-Espinosa (Instituto de Astrofisica de Canarias), Cristina Ramos-Almeida & Nancy A. Levenson

High spatial resolution mid-IR TRecs (Gemini) observation of a sample of nearby Seyfert galaxies are used to constrain clumpy torus models of AGN. We use a bayesian inference code to run through the model parameter space and estimate the most probable fit to the AGN Spectral Energy Distribution.

O-P11 A Weak Jet Spawns Dense Circumnuclear Clouds and thereby Thwarts Itself

C. Saxton (MSSL-UCL), Kinwah Wu

We use numerical hydrodynamics with cooling to simulate the progress of a weak AGN jet (~1e40 erg/s) through a dense circumnuclear interstellar medium (ISM, n~1/cm^3) at kiloparsec scales. In some regimes, the jet-driven bow shock is thermally unstable and collapses to a cold, wrinkled shell around the cocoon of radio emitting plasma. Shell densities are several orders of magnitude above ambient ISM. Compact clouds (several pc across) detach from the shell and drift through the jet interaction region. Clouds that hit the jet are compressed or ablated, and can temporarily deflect or decollimate the jet. However the global geometry is crucial to this interplay: fewer clouds are spawned in 3D than 2D. When the jet subsides, clouds evolve via passive cooling: the biggest grow into a filamentary texture via local cooling flows from the diffuse intercloud medium. A resuming jet traverses the vacuoles rapidly, but decollimates spasmodically whenever it encounters a giant cloud or filament. Ultimately, the jet clears a channel out of the nucleus, and cloud growth proceeds unmolested on the sides.

O-P12 AGN Feedback in Galaxy Formation

D. Thomas (University of Portsmouth), Schawinski, K., Lintott, C., Sarzi, M., Maraston, C., Kaviraj, S., Joo, S.-J., Yi, S.K., Silk, J.

Modern models of hierarchical galaxy formation include the feedback from an active central massive black hole in order to suppress star formation in elliptical galaxies at later epochs. This mechanism is called the 'radio-mode' of AGN feedback. First results look very promising and succeed to bring theory and observation closer together. However, the implementation of this process is still highly approximate, as it parametrises a mechanism the physics of which is very poorly understood. To set further constraints on this problem we have carried out a detailed mapping of the formation histories, the star formation activities and black hole activities in 16,000 morphologically selected elliptical galaxies drawn from the SDSS database. From colours and absorption line strengths we derive star formation histories. We find a clear evidence for an evolutionary sequence starting with star formation activity in early-type galaxies in the blue cloud being quenched by nuclear activity, which leads then to the long-lived phase of a dormant elliptical galaxy on the red sequence. Recent radio IRAM observations reveal that molecular gas is destroyed by AGN in the galaxies along this sequence, giving further support to the interpretation that we are seeing AGN feedback in action.

O-P13 | The Total Power Output of AGN

R. Vasudevan, Andy Fabian, Richard Mushotzky

Determining the broad-band spectral energy distribution (SED) from Active Galactic Nuclei (AGN) is crucial for understanding accretion onto supermassive black holes (SMBHs). The optical--UV emission from the accretion disc and the X-ray emission from the corona constitute the bulk of the accretion luminosity from AGN. A significant fraction of this emission is absorbed by a dusty torus and re-emitted in the infrared.

Our optical--to--X-ray SEDs for 54 AGN with UV data from FUSE indicate that X-ray bolometric corrections (ratios of bolometric luminosity to 2-10keV luminosity) sharply increase from low to high values above an Eddington ratio of approximately 0.1. This may indicate parallels with Galactic Black Hole (GBH) accretion which shows similar changes between accretion states. The average low and high Eddington ratio AGN SEDs support such parallels. This picture is reinforced using simultaneous broad-band SEDs from XMM-Newton for the reverberation mapped sample of AGN with good SMBH masses. We also present simultaneous SEDs from Swift for a well-selected sample of local, low-absorption AGN from the complete, hard X-ray selected Swift/BAT 9-month catalogue and find predominantly low bolometric corrections and Eddington ratios.

We also discuss the use of the AGN SED in understanding absorption in AGN. The effect of radiation pressure from the AGN on dusty gas depends on the amount of absorption present and the AGN SED. This leads to the concept of an effective Eddington limit for dusty gas, below which the gas is stable to radiation pressure. We find that the gas in most AGN lies below this limit, using data on various AGN samples.

We finally discuss using re-processed infrared emission along with very hard X-ray luminosities from Swift/BAT to constrain the bolometric output of AGN across the range of absorption properties probed by the 9-month catalogue, providing a more complete picture of local SMBH accretion.

Tuesday
2:00pm

Gravitational Wave Astronomy

B. Allen (Albert Einstein Institute, Hannover)

The efforts to detect gravitational waves are surveyed. Current first-generation ground-based detectors have already made observations of astrophysical relevance. Upcoming second- and third-generation ground-based detectors, as well as space-based detectors and pulsar timing array detectors should enable direct observations of gravitational waves, and provide new astronomical insights.

Tuesday
2:30pm

The Search for Gravitational Waves from Known Pulsars

M. Pitkin (University of Glasgow), The LIGO Scientific Collaboration, the VIRGO Collaboration

Millisecond and young pulsars provide an enticing target for gravitational wave searches. Our most sensitive searches for these objects require precise knowledge of their phase evolution and therefore rely greatly on up-to-date electromagnetic observations. Here I review the current search for gravitational waves from about 100 pulsars using data from LIGO's fifth science run and discuss how these have been enabled by close collaboration with pulsar astronomers. I will also discuss plans for the upcoming S6 run.

Tuesday
2:50pm

Searching for gravitational wave bursts associated with gamma-ray bursts

G. Jones (Cardiff University), Gareth Jones for the LIGO Scientific Collaboration and Virgo Collaboration

We present the status of the search for short-duration gravitational-wave bursts (GWBs) associated with gamma-ray bursts (GRBs) detected by gamma-ray satellite experiments during the fifth LIGO science run and first Virgo science run. The central engine of GRBs are thought to be good emitters of gravitational waves at frequencies observable by ground-based interferometers (LIGO, Virgo). Using the measured time and sky-location of the GRB observed by satellite-experiments we are able to perform targeted searches for their GW emission. We utilize a coherent network analysis method that takes into account the different locations and orientations of the interferometers at the three LIGO-Virgo sites to construct linear combinations of the data that maximize or minimize the SNR of a GW signal with a given polarization. This allows for both powerful consistency tests for eliminating background noise and high sensitivity to real GWs without making prior assumptions about the GW signal. By injecting simulated GW signals into the data, we are able to set upper limits on the amplitude of short-duration GRBs. We conclude with prospects for fully autonomous, near real-time triggered burst searches in the next LSC-Virgo Science Run.

Tuesday
3:10pm

The Search for Low Mass Compact Binary Coalescences in LIGO's S5 Data

I. Harry (Cardiff University), The LIGO Scientific Collaboration and the Virgo Scientific Collaboration

We report on the search for gravitational waves from coalescing compact binary systems with total mass from 2-35 solar masses in the LIGO Fifth Science run (S5) data. We describe the pipeline employed by the LSC to search for such waveforms in LIGO data including how we suppress false signals originating from instrumental noise, how we evaluate the search efficiency for systems which may include spinning component objects, and how we establish confidence in likely detection candidates. Finally, we describe coalescence rate calculations as a function of the mass of the binary system and for several canonical mass systems including mass distributions representing binary neutron stars, binary black holes, and black hole neutron star binaries.

Tuesday
4:00pm

Gravitational Waves Associated with Timing Glitches in Pulsars

I. Heng (University of Glasgow), I. Santiago, J. Clark, D.I. Jones, M. Pitkin, F. Speirits, G. Woan

Pulsars are neutron stars that emit pulses of electromagnetic radiation (radio, X-ray, etc.) at regular intervals. Sudden changes in the pulse periods have been observed. These "timing glitches" signal a change in the angular momentum of the neutron star which can excite its normal modes, leading to the emission of gravitational waves. Here, we present a study on the gravitational emissions associated with these glitches. We simulate data containing a gravitaitonal wave signal with parameters from our study and demonstrate its recovery with a Bayesian Evidence method.

Tuesday
4:15pm

LISA and LISA Pathfinder

D. Hollington (Imperial College London), Prof Timothy J Sumner, Dr Markus Schulte, Dr Diana Shaul, Dr Simon Waschke

The Laser Interferometer Space Antenna (LISA) is an ambitious project aiming to build the first space based gravitational wave detector. Designed to compliment ground based detectors, it will observe lower frequency sources than are possible on Earth. The extreme sensitivities required coupled with considerations unique to space based experiments present a serious technical challenge. For this reason a test mission, LISA Pathfinder, has been developed which aims to show the feasibility of such a mission. Here an overview of both missions will be discussed.

Tuesday
4:30pm

Overview of the monolithic suspension work for Advanced LIGO

G. Hammond (University of Glasgow), Authors: Giles Hammond, Mark Barton, Tim Bodiya, Alan Cumming, Liam Cunningham, Gregg Harry, Karen Haughian, Alastair Heptonstall, Jim Hough, Russell Jones, David Kelley, Rahul Kumar, Rich Mittleman, Norna Robertson, Sheila Rowan, Brett Shapiro, Ken Strain, Kirill Tokmakov, Calum Torrie, Marielle van Veggel, Alexander Wanner

After 5 successful data gathering runs of the worldwide ground-based interferometric gravitational wave detectors a 6th run will soon start with improved sensitivity using "enhanced" detectors. In parallel, work is underway for the "Advanced LIGO" upgrade that is scheduled to be installed from ~2012. The aimed improvement in strain sensitivity is a factor of 10. To achieve this improvement requires a full redesign of the suspension systems for better seismic performance and a lower stage to be constructed from monolithic fused silica to improve the thermal noise performance. In this lower stage silica interface pieces ("ears") are bonded to the test masses (mirrors) using the hydroxy-catalysis bonding technique and silica fibres are welded to these ears to suspend the mirror. A prototype of the full suspension system, the LIGO Advanced Systems Test Interferometer (LASTI), is currently being built at the Massachusetts Institute of Technology (MIT). In this talk we will present an overview of the work ongoing at the Institute for Gravitational Research (IGR), University of Glasgow to prove and provide the monolithic lower stage for Advanced LIGO. This includes a discussion on ear design, fibre geometry and production, and techniques to weld the fibre to the ear.

Tuesday
4:45pm

Optical Sensors for the Next Generation of Gravitational Wave Observatories

S. Aston (University of Birmingham), C.C.Speake, A.Vecchio, F.Pena, and D.Hoyland

We discuss developments made in optical sensing technologies at the University of Birmingham that will aid the detection of gravitational waves by both ground-based and space-borne observatories. We outline our involvement with providing optical sensors for the Advanced LIGO project, as well as novel interferometric displacement sensing techniques that could be employed as part of the drag-free control system on board the LISA mission.

Tuesday
5:00pm

Displacement Noise Free Interferometry in Gravitational Wave Detectors

A. Perreca (University of Birmingham), Simon Chelkowski, Stefan Hild, Andreas Freise

Interferometric gravitational wave detectors are designed to detect ripples in space-time by monitoring the distance between mirrors using a laser beam as a 'meter stick'. Local disturbances of the mirror positions cause output signals which are similar to gravitational wave signals. This so-called displacement noise is limiting the sensitivity of current detectors. However, because gravitational waves and motions of mirrors couple into the measurement process in different ways, it is theoretically possible to discriminate between the two. A newly proposed technique claims that this can be achieved using linear combinations of multiple output signals instead of the single optical signal. We report on the progress of an experiment that uses a Fabry-Perot cavity to test this technique.

Tuesday
5:15pm

Gravitational Wave Signal to Displacement Noise Ratio of a Grating Cavity

J. Hallam (University of Birmingham), B. Barr, O. Burmeister, S. Chelkowski, A. Freise, S. Hild

Michelson-configured interferometers with Fabry-Perot arm cavities are to be used in both the Advanced LIGO and Virgo gravitational wave detectors. All-reflective configurations implemented using diffraction gratings may allow future gravitational wave interferometers to reduce thermal noise and (by allowing higher power without worsening technical problems like thermal lensing) shot noise contributions.

Unlike mirrors, lateral grating displacement couples phase-noise [1] into the gravitational wave (GW) signal. Using a steady-state/frequency domain technique [3,4] we have derived the signal to noise ratio (SNR) for this noise source at each of the output ports for a popularly proposed case - that of the three-port-coupled second-order-Littrow configured diffractive Fabry-Perot cavity [2].

It is found that the SNR is much improved at the forward-reflected port. The implications of this for Advanced Virgo mirror/diffractive optic suspension requirements are demonstrated.

References

[1] A. Freise, A. Bunkowski, and R. Schnabel. Phase and alignment noise in grating interferometers. New Journal of Physics, 9:433--+, December 2007.

[2] A. Bunkowski, O. Burmeister, K. Danzmann, and R. Schnabel. Input-output relations for a three-port grating coupled fabry-perot cavity. Opt. Lett., 30:1183--1185, 2005.

[3] J. Mizuno and I. Yamaguchi. Method for analyzing multiple-mirror coupled optical systems. Journal of the Optical Society of America A, 16:1730--1739, July 1999.

[4] Gerhard Heinzel. Advanced optical techniques for laser-interferometric gravitational-wave detectors. PhD thesis, MPI fuer Quantenoptik, 1999.

P-P01 Generating Ultra-Pure Laguerre-Gauss Modes for Future Gravitational Wave Detectors

P. Fulda (University of Birmingham), Audley, H.; Beesley, M.; Chelkowski, S.; Freise, A.

The sensitivity of future ground-based gravitational wave (GW) detectors will be limited partly by noise stemming from the Brownian motion of atoms that make up the coatings of the interferometer mirrors [1]. One way of reducing the effects of this noise is to spread the beam power over a larger surface area on the mirrors. It has been shown that a new class of laser beams comprised of higher-order Laguerre-Gauss (LG) modes are better at spreading the beam power than the currently favoured fundamental mode beams [2]. However, the LG laser modes that have been produced to this date have neither sufficiently high power or mode purity to allow for their use in GW detector interferometers. I will present a method for generating ultra-pure LG modes using a spatial light modulator, an astigmatic mode-converter [3] and a four-mirror modecleaner. This method is among the candidates for new interferometry techniques that will be used to increase the sensitivity of future GW detectors such as ET [4].

[1] Hild, S.; Chelkowski, S.; Freise, A., Pushing towards the ET sensitivity using 'conventional' technology, Technical note: http://adsabs.harvard.edu/abs/2008arXiv0810.0604H

[2] Mours, B.; Tournefier, E. & Vinet, J., Thermal noise reduction in interferometric gravitational wave antennas: using high order TEM modes, Classical and Quantum Gravity, 2006, 23, 5777-5784

[3] Courtial, J.; Padgett, M. J., Performance of a cylindrical lens mode converter for producing Laguerre-Gaussian laser modes, Optics Communications, 1999, 159, 13-18

[4] Chelkowski, S.; Hild, S.; Freise, A., Prospects of higher-order Laguerre Gauss modes in future gravitational wave detectors, Submitted, preprint at: http://adsabs.harvard.edu/abs/2009arXiv0901.4931C

P-P02 Exploring the Parameter Space of Simulated Waveforms

I. Heng (University of Glasgow)

Numerical simulations of gravitational wave emissions are often characterised only by the parameters of the simulated models. As model parameters are varied, the resulting gravitational wave signals can have very similar waveforms. We study the parameter space covered by gravitational wave signals predicted by core-collapse supernova simulations. We show that, by decompsing the predicted signals into an orthonormal basis set, we can span the parameter space of all signals with a small subset of basis vectors. This implies that there are many common features in the chosen signal set. Finally, the relevance of the produced basis set to parameter estimation techniques and the use of data decomposition techniques on other kinds of signals are discussed.

P-P03 Charge Management for LISA and LISA Pathfinder

D. Hollington (Imperial College London), Prof Timothy J Sumner, Dr Markus Schulte, Dr Diana Shaul, Dr Simon Waschke

In order for the space-based gravitational-wave detector experiment LISA to be a success, acceleration noise arising from test mass charging needs to be kept at a minimum. This talk will discuss the charging environment, as well as the charge management system on board the technology demonstration mission, LISA path finder. In addition, work carried out by the author to simulate the discharging process within MATLAB will also be presented.

P-P04 Phase Effects in Gaussian Beams on Diffraction Gratings

D. Lodhia (University of Birmingham), Dr Andreas Freise

Gravitational Waves are a new and growing branch of astronomy, and Gravitational Wave Detectors are currently one of the largest scientific instruments. Gravitational Waves cause changes in length of less than 1 in 10^-20, and so the sensitivity requirements of the detectors are extremely high. Gratings have been proposed as possible elements in future Gravitational Wave Detectors. Reflective gratings avoid the problem of power absorption in substrates, and so can replace transmissive optics. There is an urgent need for a consistent analytic way of describing and manipulating phase effects in gaussian beams on diffraction gratings. Currently, these phase effects cannot be incorporated into existing simulations. We will show the mathematics behind gaussian beams and diffraction gratings, demonstrate the phase effects occurring in different situations and integrate this into computer simulations.

Tuesday
11:00am

The International X-ray Observatory

A. Parmar (European Space Agency), H. Kunieda, N. E. White and the International X-ray Observatory Team ESA/ESTEC; Nagoya University, Japan; NASA/GSFC

The International X-ray Observatory (IXO) with the participation of ESA, NASA and JAXA will address many timely science topics including black holes and matter under extreme conditions, galaxy formation, galaxy clusters and cosmic feedback and the life cycles of matter and energy. The baseline mission implementation consists of a single optic with an effective area of 3 sq m at 1 keV and 5 arc sec resolution, and the instruments include a micro-calorimeter spectrometer array, wide field and hard X-ray imagers, a grating spectrometer, a high-time resolution spectrometer and an X-ray polarimeter. This presentation will summarize the current science goals and mission implementation approach based on the on-going NASA, ESA and JAXA design studies.

Tuesday
11:20am

Decoding X-Ray Variability

P. Uttley (University of Southampton)

The X-ray variability from compact objects encodes information about the structure of the X-ray emitting region and the accretion flow close to the black hole event horizon or neutron star surface. I will show how we can use spectral-timing information to interpret this variability. In particular, I will demonstrate the power and promise of "X-ray reverberation mapping" - using time-lags between different bands to map out the parts of the accretion flow which reflect or reprocess the continuum. I will show how X-ray reverberation mapping with XMM-Newton and RXTE is already starting to reveal structures on size scales close to a Schwarzschild radius. I will also highlight the enormous potential of a future high-throughput mission, such as IXO, to unlock the black boxes which are responsible for most of the gravitational potential energy release in the universe.

Tuesday
11:40am

The First Detection of a Broad Iron L Line and Reverberation in NLS1 1H0707-495 with XMM-Newton

A. Zoghbi (Institute of Astronomy, Cambridge), A.C. Fabian, P. Uttley

Broad iron K line emission have been seen in all types of accreting sources, including AGN, Galactic black holes and neutron stars. In this work, we present recent results of the detection of the accompanying broad iron L emission line, expected to be present at ~ 1keV. A long XMM-Newton observation of the Narrow Line Seyfert 1 1H0707-495, shows two clear broad features corresponding to K and L lines. This confirms the reflection nature of the spectrum, and indicates that most of the radiation is emitted within few gravitational radii from the black hole. Furthermore, the strong L line has enabled us, for the first time, to measure a 30s time lag between the direct and the reflected emissions. The lag is comparable to the light-crossing time at few gravitational radii around the black hole, and is interpreted as a reverberation signal, opening the window for future studies of extreme environments around black holes.

Tuesday
11:50am

The Future of Strong Gravity Studies with X-Ray Spectroscopy

S. Vaughan (University of Leicester)

We will start by reviewing some of the progress made in recent years using X-ray spectra to study the extreme environments around the supermassive black holes that power AGN. We will discuss the questions that remain to be answered and why future X-ray missions (such as the IXO) are needed to advance our understanding of this important physics.

Tuesday
12:00pm

The Ultraluminous State

J. Gladstone (Durham University), Timothy Roberts, Chris Done

The spectra from ultraluminous X-ray sources have been described by several different models which give very different results for the inferred black hole mass, ranging from intermediate (>100 solar masses) to standard mass (~ 5 - 20 solar masses) black holes. Here we revisit the question of the nature of ULX through a detailed investigation of their spectral shape using the highest quality X-ray data currently available in the XMM-Newton public archives. We apply phenomenological models to characterise the spectra of these objects and more physically motivated models in order to explore the physical processes underlying these characteristics. Results show that the spectra of these sources are fundamentally different to that of Galactic X-ray binaries, whilst the application of physical models indicates a more extreme version of the highest known luminosity state, the very high state. We therefore speculate that in observing ULXs we are observing stellar-mass black holes residing in a new "ultraluminous" state.

Tuesday
12:10pm

Science with the ASTRO-H X-ray calorimeter and hard X-ray telescope

A. Fabian (Institute of Astronomy Cambridge)

The next Japan - US mission in X-ray astronomy is ASTRO-H, due for launch in 2013. It will fly a calorimeter with 5eV resolution for 0.5 - 10 keV X-ray spectroscopy and a hard X-ray telescope with good sensitivity up to 70 keV. Science prospects will be outlined.

Tuesday
2:00pm

The Coolest Gas in Galaxy Clusters

J. Sanders (IoA, Cambridge)

Many clusters of galaxies contain gas with short radiative cooling times in their core. XMM-Newton, with its high spectral resolution RGS detector, has allowed us to quantify the amount of cool X-ray emitting gas in the centres of these objects, showing it to be much less than expected from simple cooling in the absence of heating. Chandra, with its high spatial resolution, has shown a different aspect to galaxy cluster cores. There are many cavities observed and also shocks and sound-like pressure variations seen in deep observations. Bringing these results together strongly suggests that central AGN, via feedback mechanisms, are responsible for the lack of cool X-ray emitting gas in these objects. I will review the current X-ray evidence for AGN feedback in clusters. IXO, with its large effective area and very good spectral resolution, will tell us in detail how this feedback operates. I will simulate data to show what we might expect to observe in the future with IXO. Understanding these feedback processes is not only important for understanding cluster physics, but also tells us about the growth of the most massive galaxies.

Tuesday
2:20pm

Evolution of Cluster Properties from IXO Observations

N. Slack (University of Birmingham), Prof. Trevor Ponman

Different studies with current X-ray observatories have produced conflicting results for the evolution of the X-ray properties of clusters. Much of this confusion probably results from inadequate treatment of the survey selection function. Approaches taken have ranged from simple assumptions of a flux limited sample, to a more sophisticated treatment allowing for cluster surface brightness profiles. We have developed an image simulator for the International X-ray Observatory (IXO), which allows us to study the effect of different assumed selection functions on the recovered evolution of the L-T relation. In this way, we explore the limitations imposed by survey selection on our ability to discriminate between different evolutionary models for the X-ray properties of clusters.

Tuesday
2:30pm

Galaxy Group and Cluster Science with eROSITA

G. Pratt (MPE Garching)

eROSITA (extended ROentgen Survey with an Imaging Telescope Array) is a fully-funded X-ray survey satellite to be launched in 2012. The primary scientific goal is the detection of 50-100 thousand clusters of galaxies up to redshifts $z > 1$ in order to study the large scale structure of the Universe and test cosmological models. The mission scenario comprises a wide survey of the complete extragalactic area and a deep survey in the neighborhood of the Galactic Poles. I will describe the mission and some of the expected science return in the context of galaxy cluster and group studies.

Tuesday
2:50pm

Probing the Evolution of Accretion Activity over Cosmic Time

J. Aird (Imperial College London), Kirpal Nandra

It is now clear that the properties and evolution of galaxies are closely linked to the growth of their central supermassive black holes. Over the coming decades, a number of future facilities (e.g. JWST, ALMA, E-ELT) will intensively observe the starlight from the very earliest galaxies, which form at z=6-10. However, X-ray observations are required to reveal the extent of accretion activity in the earliest supermassive black holes. I will present new measurements of the evolution of the X-ray luminosity function (XLF) of AGN, probing to the limits of current observatories, and accounting for the uncertainties in redshift measurements and the incompleteness of high-redshift samples. I will then discuss the potential of the International X-ray Observatory (IXO) to detect low-luminosity AGN at z>6, in this early epoch of galaxy formation. I will present the results of simulations to determine the sensitivity of IXO observations, put forward a prospective observing programme and predict the numbers of detected AGN based on extrapolations of the XLF evolution at lower redshifts.

Tuesday
3:10pm

Synergies between Future X-ray and Infrared Facilities

F. Fiore (INAF-OAR)

I will discuss possible synergies between future X-ray missions and present and future infrared and sub-mm facilities such as Spitzer, Herschel, WISE, JWST and ALMA.

Q-P01

Probing Accretion Disk Properties with Long-Term X-Ray Light-Curves

P. Charles (SAAO), Marissa Kotze

I will summarise the importance of all-sky monitors on X-ray astronomy missions, with particular emphasis on RXTE, for studying the long-term, superorbital variations seen in a variety of X-ray binaries. These modulations can provide significant constraints on the physical properties of accretion discs, e.g. the 35d cycle in Her X-1 and related objects are interpreted as irradiation-driven, tilted, precessing accretion discs. Others show more complex light curves, with the period changing on timescales >1000d, and allow an investigation of the disc stability criteria. We propose a categorisation of these variability properties into several different types, based on their observed characteristics.

Q-P02

On the Stark Broadening of Ar XV X rays

M. Dimitrijevic (Astronomical Observatory), A. Kovacevic, Z. Simic, S. Sahal-Brechot

With the development of satellite born spectroscopy, the spectral lines of trace elements become astrophysically significant and for example, far UV lines of Ar VII were discovered recently in the spectra of very hot neutral stars of planetary nebulae and white dwarfs. In order to provide Stark broadening data in X-ray wavelength region, of interest for modelling and analysis of astrophysical plasmas in extreme conditions, we performed semiclassical calculations of Stark broadened line widths and shifts for 8 Ar XV multiplets with wavelengths less than 10 nm.

Q-P03

Breaking the Record: Discovery of the Most Luminous Ultra-luminous X-Ray Source

S. Farrell (University of Leicester), N. A. Webb, D. Barret, O. Godet & J. M. Rodrigues

Ultra-luminous X-ray sources (ULXs) are extragalactic objects located outside the nucleus of the host galaxy with bolometric luminosities >1E39 erg/s. These extreme luminosities - if the emission is isotropic and below the Eddington) limit - imply the presence of an accreting black hole with a mass of ~100-100,000 times that of the Sun. The existence of such intermediate mass black holes is in dispute, and though many candidates have been proposed, none are widely accepted as definitive. Luminosities up to ~1E41 erg/s can be plausibly explained through beaming effects and/or hyper-accretion onto stellar mass black holes. A rare class of ultra-luminous X-ray sources - the hyper-luminous X-ray sources - emit X-rays at luminosities >1E41 erg/s and require increasingly complicated scenarios without invoking the presence of an intermediate mass black hole. We present here the detection in the 2XMM catalogue of an X-ray source coincident with a z=0.0224 galaxy with a maximum 0.2-10 keV luminosity of ~1E42 erg/s. The derived luminosity is almost an order of magnitude higher than the previous most-luminous ULX, and is difficult to explain without the presence of an intermediate mass black hole with M > 500 Msun.

Q-P04 AGN Properties in a Cosmological Evolution Scenario

S. Raimundo (IoA, Cambridge), Andy Fabian

The cosmological evolution of Active Galactic Nuclei (AGN) is important for understanding the mechanism of accretion onto supermassive black holes, and the related evolution of the host galaxy. In this talk, we present results obtained by considering objects with very low Eddington ratio (0.001 - 0.01) in an evolution scenario, and comparing the evolved mass function with the observed local distribution of black holes. We test several possibilities for the AGN population, considering obscuration and dependence with luminosity, and investigate the role of the Eddington ratio and radiative accretion efficiency on the shape of the evolved mass function. We find that three distinct populations of AGN can evolve with a wider parameter range than is usually considered, and still be consistent with the local mass function. We also find that, in general, the black holes in our solutions are spinning rapidly.

Q-P05 Evidence against Disk Truncation in J1118+480 and Similar Sources in the LHS

R. Reis (Institute of Astronomy, Cambridge), A.C. Fabian & J.M. Miller

The geometry of the accretion flow in the low/hard state (LHS) is a topic of much debate. The presence of a cool accretion disk is usually invoked in all models however the extent of its inner radius differs significantly between models. Either the geometrically thin disk in the LHS extends close to the inner most stable circular orbit or is truncated far from the black hole. This issue is verifiable using high quality X-ray data.

Here we present evidence of a thermal-disk component in the stellar-mass black hole binary J1118+480 in the canonical low/hard state and argue that the accretion disk in this system is not truncated far from the central black hole in contrast with previous claims. Furthermore, we show that for at least two other systems (GX 339-4 and Swift J1753.5-0127) in a similar spectral state the accretion disk extends down to the ISCO.

Q-P06 An XMM Look at the Complex Absorption of NGC4395

D. Walton (IoA, Cambridge), Andy Fabian

Based on a 90ks observation of NGC4395 with XMM-Newton, we present a new spectral and timing analysis of the complex absorption seen in the galactic nucleus, with the aim of constraining the location at which the absorption is occurring with respect to the central ionising source.

Wednesday
2:00pm

A Practical X-Ray Interferometer

G. Butcher (University of Leicester), R. Willingale

In X-ray astronomy the technique of interferometry has the potential to provide ultra high angular resolution imaging. However designing an interferometer which is practical, fitting within a reasonable envelope and having sufficient collecting area, is a challenge. We are proposing a simple system which can be built using current X-ray optics capabilities and existing detector technology. The key to the design is the use of a slatted mirror to combine the two beams.

Wednesday
2:20pm

Solar Sailing as an Enabling Technology

M. Macdonald (University of Strathclyde)

Solar sailing has long been envisaged as an enabling technology; the promise of an infinite propulsive capability allows consideration of radically new trajectories and the delivery of spacecraft to previously unviable or unsustainable observation outposts. This presentation will explore the science enabled through solar sailing, discussing key missions, the technology requirements of these missions and the current state-of-the-art. The presentation will summarise over four-years of effort in the study of solar sail mission and science applications, along with their technology requirements and the development of a solar sail technology roadmap from the current state-of-the-art through to a viable Interstellar probe mission, using each new science mission as a technology stepping-stone to the next.

Wednesday
2:40pm

OLFAR - Orbiting Low frequency Antennas for Radio Astronomy

M. Bentum (University of Twente / ASTRON), Dr. A.J. Boonstra

New interesting astronomical science drivers for very low frequency radio astronomy have emerged, ranging from studies of the astronomical dark ages, the epoch of reionization, exoplanets, to ultra-high energy cosmic rays. However, astronomical observations with Earth-bound radio telescopes at very low frequencies are hampered by the ionospheric plasma, which scatters impinging celestial radio waves. This effect is larger at lower frequencies. Below about 5 MHz at night or about 10 MHz during daytime, the ionosphere is even opaque for radio waves. That means that earth-bound radio astronomy observations in those bands would be severely limited in sensitivity and spatial resolution, or would be entirely impossible. A radio telescope in space would not be hampered by the earth's ionosphere, but up to now such a telescope was technologically and financially not feasible. However, extrapolation of current technological advancements in signal processing and small satellite systems imply that distributed low frequency radio telescopes in space could be feasible. In order to achieve sufficient spatial resolution, a low frequency telescope in space needs to have an aperture diameter of approximately 100 km. Clearly, only a distributed aperture synthesis telescope-array would be a practical solution to explore the new frequency band for radio astronomy. We propose an autonomous distributed sensor system in space to explore this new low-frequency band for radio astronomy. The array will have identical elements (nano satellites), and ideally no central processing system. An advantage of such a system is that it is highly scalable and, due to the distributed nature, virtually insensitive to failure or non-availability of a fraction of its components. In the paper we will present this novel concept of OLFAR, the orbiting low frequency antennas for radio astronomy in space.

Wednesday
3:00pm

FIRST - A Space-Borne Low-Frequency Radio Observatory using Passive Formation Flying

J. Bergman (Swedish Institute of Space Physics), R. Blott, A. Forbes, D. Humphreys, D. Robinson, and C. Stavrinidis

Space-borne low-frequency radio astronomy has been identified by ESA as a key science application for a pathfinder mission called FIRST (Formation-flying sub-Ionospheric Radio astronomy Science and Technology). Its objective is to demonstrate passive formation-flying and at the same time perform unique world class science with a very high serendipity factor, by opening a new frequency window to astronomy. Passive formation-flying is a novel space-flight concept, in which the satellites are allowed to drift so that no expensive and complex position control systems are required to maintain the spacecraft in predefined positions. Instead, precise knowledge of the orbits enables the continuous phase re-construction of a high-performance radio telescope aperture to be performed while the individual constellation satellites rotate and drift. The FIRST constellation consists of six daughter spacecraft with radio astronomy antennas, and a mother spacecraft for data processing and communications. The location of the constellation at the second Lagrange point (L2) allows for a stable, low-drift orbit that is sufficiently far away from Earth to avoid severe radio frequency interference (RFI). FIRST will provide low-frequency all-sky images with unprecedented sensitivity and angular resolution and can be used to image the low-frequency Sun and the evolution and propagation of coronal mass ejections (CME) at higher resolution than before. With suitable long integration times, FIRST may even glimpse the dark ages by means of high red-shift 21 cm line emissions. Larger future space observatories based on the enabling passive formation-flying technology, but consisting of several small satellite constellations, are being considered as the next step. These will have enhanced sensitivity and resolving power to address many fundamental science objectives in radio astronomy, such as direct observation of earth-like exo-planets, by detection of their burst planetary radio emissions, as well as comprehensive studies of the dark ages and the epoch of reionization.

R-P01

Mars Riometer System

F. Honary (Lancaster University), E. Nielsen , V. Romano, T. Ulich, M.A. Hapgood, P. Janhunen, and J. Johansson

The aim of Mars Riometer System project is to develop a riometer (relative ionospheric opacity meter) that can measure ionisation levels in the upper atmosphere of Mars, especially at altitudes below those accessible to existing orbiter-based instruments. Riometer measurements will provide a range of information on the physical environment in which exploration must take place, e.g. the effect of energetic radiation (charged particles or electromagnetic waves) on the atmosphere/ionosphere of Mars and the resulting impact on radio wave propagation and absorption. The latter will become increasingly important as exploration activities make more use of radio links within Mars atmosphere, e.g. for distributed sensor networks and navigation systems. In addition to energy precipitation, the riometer will be able to detect radio emissions from micro-lightning in the Martian atmosphere. Electric fields associated with lightning represent a hazard to electronic equipment and cause an increase in the electromagnetic noise level. The riometer will be a valuable tool for remote sensing of Martian electrical discharges and the assessment of level of risk that exploration activities must consider. At present we are working to develop a prototype that will provide proof-of-concept that existing terrestrial riometer technology can be adapted for use on a planetary lander. This includes a vital element of enabling science - using existing knowledge of Mars' environment to model the signals that the riometer will measure. This science will help us develop the technical specification of the instrument and thus guide the development and testing of the prototype. The short-term aim is to demonstrate scientific and technology readiness at a level that will allow us to compete for flight opportunities on future mission opportunities.

R-P02 Enabling Technologies for Fundamental Physics in Space

C. Warren (EADS Astrium), C. Trenkel,

An overview is given of on-going R&D activities at Astrium Ltd, concentrating on those which should be of particular interest to the Fundamental Physics Community. The aim of this technology is to enable a new generation of high precision experiments to be carried out in space, through the creation of ultra-stable environments providing stability levels many orders of magnitude better than those achievable on ground. The general approach that is adopted is to achieve stability by design. Astrium Ltd is at the forefront of some of the key developments in spacecraft environmental control: drag-free satellite technology and in particular precision micro-thrusters; gravitational modelling tools; thermoelastic stability tests at whole spacecraft structure level. Another highly relevant technology area in which Astrium Ltd is currently engaged is the development of vibration-free, in-space cryogenic cooling systems. The current status and future prospects are discussed.

Monday
2:00pm

The OPTICON Trans-NAtional Access Programme

J. Davies (UKATC, Edinburgh)

Through its framework programmes the European commission provides access to a range of European operated 2-4m telescopes which are made available to new European users at no cost and with subsidised travel arrangements. This talk will outline the history the programme since early 2000, ie in FP5 and FP6, and describe how it will be evolved in FP7 (2009-2013) as part of the process of rationalising Europe's suite of medium sized telescopes.

Monday
2:10pm

Nationally Operated Telescopes: An Obsolete Paradigm?

J. Andersen (Nordic Optical Telescope)

Today, most of Europe's 2-4m optical telescopes are planned, equipped, scheduled, and operated as isolated entities, with no overall coordination. This not only leads to duplication of effort, notably in instrumentation, but impedes any efforts to mount coordinated ground-based programmes in tandem with space missions or other major ground-based facilities. It also constrains the options for funding these telescopes from non-traditional sources. A better model is urgently needed.

Monday
2:25pm

ING, La Palma - 2020 Vision

C. Benn (ING, La Palma), Don Abrams, Ian Skillen

The 4.2-m William Herschel Telescope on La Palma hosts a broad range of common-user instruments, and is an increasingly-popular platform for innovative visiting instruments (e.g. EXPO, FASTCAM, PNS, SAURON, ULTRACAM).

In June 2009, ING will commission a new common-user instrument, ACAM, a versatile imager/spectrograph replacing the current aux-port camera. ACAM will be mounted permanently at the Cassegrain focus.

In 2010/11, a team from Harvard CfA will commission HARPS-NEF on the WHT. HARPS-NEF is a twin of HARPS on the ESO 3.6-m, and will provide follow-up spectroscopy of exoplanet candidates identified by the Kepler mission.

The WHT also serves as an E-ELT testbed facility, and the existing laser-guide-star system GLAS is being modified to allow the WHT to host the CANARY experiment (a demonstrator for E-ELT EAGLE) at one Nasmyth focus.

Longer-term, ING's strategy for maximising scientific impact will be guided by the ING Science Advisory Committee, and by the broader European vision (e.g. Astronet) for medium-sized telescopes. The Science Advisory Committee recently held its first meeting, and has suggested construction of a wide-field multi-object spectrograph for WHT prime focus, to complement AAOmega in the south.

We summarise the current status of ING's telescopes, and plans for the future.

Monday
2:40pm

The New La Silla Operations Paradigm

M. Sterzik (E.S.O.)

In 2007 ESO STC and Council endorsed a concept to maintain the La Silla site within the context of a streamlined operational and support scenario. La Silla remains part of the LaSilla Paranal Observatory Division, and continuous to support science projects of the ESO community at the NTT and 3.6m telescope. Additional projects at national telescopes will be hosted. Meanwhile, a detailed Site Operations Plan for LaSilla 2010+ has been developed. It is currently implemented, with implications on staffing, infrastructure, and science operations. I will describe how the La Silla site of the LSP Observatory will be organized and operate from October 2009 onward.

Monday
3:00pm

Calar Alto 2.0

J. Alves (Calar Alto Observatory)

There is a growing realization that 4m class observatories have an important role to play in frontline Astrophysical research in the beginning of the 21st century. Calar Alto Observatory is today a fully independent research center, operated jointly by the MPIA-MPG and the IAA-CSIC, providing its community with state-of-the-art instrumentation, optimized operations, a graduate students program, and public outreach. In this presentation we will discuss the results of a full characterization of Calar Alto sky quality and latest developments, including the ongoing design studies for a new instrument to the CAHA's 3.5m.

Monday
3:15pm

Medium Sized Telescopes and Training of Young Researchers

M. Dennefeld (IAP-Paris), M. Dennefeld

With instruments of increasing complexity, many large telescopes are now working mostly in service mode, operated by specialised astronomers/operators. Young researchers (e. g. PhD students) have thus no chance to learn the basics of observing techniques at the telescopes they "use" for their PhD. Telescopes in the 2m class, if well equiped, are ideally suited to give this training, especially in spectroscopy. Executing small research projects which can give publishable results, rather than doing conventional exercises on smaller university telescopes, is a major incentive for both the students and their teachers. When combined with archival data, particularly from space, these projects give good examples of the multi-wavelength approach most needed today. The NEON schools have been working on these principles for over 10 years now, but they require continued access to suitable telescopes with modern instrumentation and adequate funding.

Monday
4:30pm

AAO Wide-Field Spectroscopy Facilities

M. Colless (Anglo-Australian Observatory)

The Anglo-Australian Observatory (AAO) operates two of the premier facilities for wide-field spectroscopy. The Anglo-Australian Telescope (AAT) has a 3 sq.deg. prime focus field of view that is accessed by 400 fibres feeding the AAOmega spectrograph. This facility is being used for two large programs - the WiggleZ dark energy survey and the GAMA galaxy evolution survey - together with a host of small programs exploiting the AAT's unique combination of aperture, field of view and multiplex. The UK Schmidt Telescope (UKST) is currently dedicated to the RAVE survey, which is using the 30 sq.deg. field of view and the 100-150 fibres feeding the 6dF spectrograph to measure the radial velocities, metallicities and abundance ratios of up to a million stars. RAVE will provide the most comprehensive map to date of the kinematic structure of the Galaxy. A recent announcement of opportunity asks for proposals for the use of the UKST after the completion of RAVE. Both the AAT and the UKST are accessible to European astronomers through the OPTICON Access programme.

Monday
4:50pm

UKIRT: Current Status and Future Plans

G. Davis (Joint Astronomy Centre)

The United Kingdom Infrared Telescope (UKIRT) is the largest telescope in the world dedicated exclusively to observing in the infrared. Over its 30-year history, it has been responsible for pioneering observations and discoveries in this region of the spectrum using a succession of ambitious instruments, including most recently the Wide-Field Camera (WFCAM). The bulk of the telescope time is committed to campaign-style science, of which the most prominent example is the UKIDSS survey. I will present a summary of recent developments, of the current status of the observatory, and of plans for its future development.

Monday
5:00pm

Canada-France-Hawaii Telescope: Status and Prospects

C. Veillet (Canada-France-Hawaii Telescope)

Located on the summit ridge of Mauna Kea, the Canada-France-Hawaii Telescope (CFHT) will celebrate its 30th birthday later this year. The success of CFHT comes from (1) the careful selection of its instrument suite, either making the best use of the telescope capabilities and of the unique characteristics of its site, or filling a niche while serving a wide community of users, and (2) the decision to move to large programs like the CFHT Legacy Survey (CFHTLS), allowing CFHT to remain at the forefront of today's ground-based astronomy in spite of its age and modest size. With the CFHTLS observing part now completed, new Large Programs are now underway, some continuing to use the wide-field imaging capabilities of the observatory, and others devoted to the study of stellar magnetic fields. While these large Programs will maintain the telescope very busy over the next five years, CFHT is looking at new instruments to offer to its users unique capabilities for the second half of the coming decade. High dispersion and very precise spectro-polarimetry in the near-infrared or wide field imaging in the visible with ground layer adaptive optics correction are some of the concepts currently undergoing various levels of studies. Canada, France and Hawaii have been an exemplary ménage à trois for the past 35 years. This close relationship between its namesake communities has been spiced by various openings: a collaboration with Korea brought Asia to CFHT for a few years at the beginning of this decade; Taiwan has been a steady partner since 2001; Brazilian astronomers will have access to CFHT starting with the second semester of this year; through the OPTICON Access Network, astronomers from the European Community have also access to the telescope. Those openings have been a source of great enrichment for all involved.

Monday
5:15pm

Recent Results and Future Improvements of OHP 193cm Telescope with SOPHIE

M. Boër (OHP), F. Bouchy, H. Le Coroller, S. Ilovaisky, M. Veron

The SOPHIE high resolution echelle spectrograph came into service at the OHP 193cm telescope by November 2006. Since then, excellent results on exoplanets as well as in stellar physics have been obtained. We will present the current capabilities of SOHPIE, the main results obtained, as well as the next improvements which are currently under construction both for the telescope and SOPHIE: we hope to reach an accuracy less than 1m/s.

Monday
5:30pm

The 2 Meter Telescope of the National Astronomical Observatory Rozhen: Status and Prospects

T. Bonev

The 2 meter reflector of the National Astronomical Observatory (NAO) Rozhen was commissioned 30 years ago. The telescope offers two main modi of observations: imaging in the Ritchey-Chretien (RC) focus and spectroscopy in the Coude focus. In the direct imaging mode a back-illuminated CCD camera VersArray 1330B is used comprising 1340x1300 px yielding a FOV of 7 arcmin. A faster alternative for direct imaging is provided by a two-channel focal reducer. This instrument allows observations in the blue and red spectral region simultaneously. It transforms the focal ratio from f/8 to f/2.8 and offers several additional modi of observations: narrow-band imaging, polarimetric imaging, Fabry-Perot imaging, low-dispersion spectroscopy. The Coudé spectrograph allows obtaining high signal-to-noise, high resolution (up to 35000) stellar spectra. The most recent upgrade of the 2 meter telescope was accomplished in 2008, the main mirror and the first deflecting mirror to Coude were recoated with a new reflective layer. This increased the efficiency of the observations by a factor of two. Plans for the future include: (a) design, manufacturing and installation of a new telescope control system (should be commissioned in 2009) and (b) design and manufacturing of an echelle spectrograph with parameters similar to FEROS. An improvement of the infrastructure around the telescope is planned for 2009: the Observatory should be connected to the National Research and Educational Network by an optical fiber, thus ensuring faster communication with the rest of the world. We will present the existing instruments at the 2-m telescope, illustrate their capabilities by several samples of observations and will show how do the plans for modernization fit in the vision about the role of medium telescopes in Europe.

Monday
5:45pm

Robotic Telescopes: The Liverpool Telescope Experience

I. Steele (Liverpool JMU)

Robotic telescopes can make routine science programmes in time-domain astrophysics that are difficult to organize on conventional telescopes. I will use the Liverpool Telescope as an example of such a facility in describing the unique contribution that it can make to a European suite of medium size telescopes. I will describe both its operating modes and instrumentation as well as giving examples of science highlights in the areas of gamma ray bursts, exoplanets and Supernovae.

Monday
6:00pm

The Magdalena Ridge Observatory Interferometer (MROI): First Light and Beyond

D. Buscher (University of Cambridge), Dr C A Haniff, Dr J S Young

The MROI is a US/UK optical/IR interferometer, under construction in New Mexico USA, which will make true images at 0.3 milli-arcsecond resolution. It is targeted at imaging studies of AGN, star and planet formation, and stellar accretion and mass loss phenomena. A key science advantage of the MROI is that it has been designed to image objects 100 times fainter than are currently accessible with existing arrays such as the VLTI, CHARA and NPOI interferometers. We discuss progress towards first fringes in 2010. We explain the available options for European access to the MROI both for early science at the commissioning stage and longer term during the science operations phase.

S-P01 ACAM - a new imager / spectrograph for the William Herschel Telescope

C. Benn (ING, La Palma), Dee K.M., Agocs, T.

ACAM is a new wide-field imager/spectrograph, to be mounted permanently at a folded-Cassegrain focus of the 4.2-m William Herschel Telescope on La Palma, from June 2009. It's expected that ACAM will be used for a broad range of high-impact science programmes requiring rapid response (e.g. supernovae, gamma-ray bursts) or awkward scheduling (e.g. exoplanet transits) or the use of specialised filters (e.g. narrow-band Halpha imaging of low-redshift galaxies). We present here the optical and mechanical design.

S-P02 Visiting instruments at the William Herschel Telescope

C. Benn (ING, La Palma), Samantha Rix, Miguel Santander, Chris Benn

In recent years, the 4.2-m William Herschel Telescope on La Palma has become a popular platform for innovative and productive visiting instruments. We describe some of these instruments and their key scientific results, and highlight the attractions of the WHT for visiting-instrument teams.

S-P03 A New HARPS for the WHT

I. Skillen (Isaac Newton Group), Don Abrams, Chris Benn

HARPS-NEF is a high-resolution, fibre-fed, environmentally-controlled optical spectrograph being built for the WHT in a collaboration between scientists of the Harvard Origins of Life Initiative, New Earths Facility and the HARPS team of the Geneva Observatory, with significant engineering support from ING. It is designed primarily for radial-velocity follow-up of low-mass, in particular terrestrial-mass, transiting exoplanet candidates identified by NASA's recently-launched Kepler mission. HARPS-NEF will incorporate improvements on the original HARPS spectrograph in La Silla, and by using a laser frequency comb as its wavelength reference will deliver unparalleled radial-velocity precision at a level of centimetres per second.

HARPS-NEF will be offered to the ING's user community for a wide range of science applications, excluding of course the reserved science of the instrument builders. Commissioning is expected to begin in the second half of 2010.

Wednesday
11:00am

VO and GRID in the Context of ESA Science Archives

C. Arviset (ESA-ESAC), Deborah Baines, Isa Barbarisi, Ignacio de la Calle, Carlos Gabriel, Aitor Ibarra, Pedro Osuna, Inaki Ortiz, Jesus Salgado

ESA's European Space Astronomy Centre, near Madrid, hosts most of ESA astronomy and planetary missions' science operations and their respective scientific archives (eg XMM-Newton, ISO , Integral, Herschel, Mars Express, Venus Express, Rosetta, Soho, ...). Through its ESA-VO project, ESAC is the European VO node for space based astronomy, playing a leading role in European and international VO initiatives, ensuring ESA's scientific archives are VO compliant, developing VO tools (eg VOSpec, DALToolkit) and facilitating science with the VO. Over the years, in close collaboration with ESA missions at ESAC, ESA has also set up an EGEE compatible GRID infrastructure. This has been built to facilitate daily research for scientists at ESAC and to provide high computing capabilities for project data processing pipelines (eg Herschel). As an other GRID use case, the Remote Interface to XMM-Newon SAS Analysis (RISA), a web service-based system, allows users to launch SAS tasks transparently to the GRID, save results on VO storage and vizualize them through VO tool.

The authors want to thank the ESAC Science Archives and VO Team, the ESAC Computer and GRID Support Group, the XMM-Newton SAS team and the Herschel Data Processing Team.

Wednesday
11:25am

Astronomer- Steered Pipelines for Access to Radio Interferometry Data using VO Techniques

A. Richards (JBCA, Manchester), P A Harrison, S Etoka, N A Walton. K T Noddle, S T Garrington, T W Muxlow.

We review progress in providing access to interferometry data for all astronomers. We look forward to the future needs of e-MERLIN, EVLA, ALMA, SKA etc., including finding and handling data cubes, coping with very large data sets and interfacing with the next-generation CASA software package.

Wednesday
11:45am

VOSpec: a VO Spectral Analysis Tool

D. Baines (ESA), P. Osuna, J. Gonzalez, I. Barbarisi, J. Salgado, A. Laruelo, C. Arviset

VOSpec is a multi-wavelength spectral analysis tool developed by the ESA Virtual Observatory Team. The tool is able to handle spectra in the VO context as well as providing analysis capabilities and easy integration of spectra coming from different data providers, wavelengths and different metadata. Since its first development from a very simple interface, VOSpec has gone through a series of changes and evolutions converting it into a fully functional Analysis tool for VO data. The next version of VOSpec is due to be released in early April 2009. In this talk I will give an overview of the VOSpec tool and discuss the new functionalities of the latest release.

Wednesday
12:00pm

Data Publishing and Science: The European Virtual Observatory Data Centre Alliance

J. Tedds (University of Leicester), F.Genova (CDS), M.Allen (CDS), P.Padovani (ESO), A. RIchards (JBO), N.Walton (Cambridge) and the EuroVO science team

The European Virtual Observatory Data Centre Alliance project (DCA, http://www.euro-vo.org/pub/dca/overview.html) is a Coordination Action funded by the European Commission within the Sixth Framework Program. It aims at assisting European astronomers and astronomical data centres to publish their datasets and services to the Virtual Observatory (VO), using standards defined by the International Virtual Observatory Alliance (IVOA). Single or multiple VO published datasets can be searched, queried, visualised and cross matched in one shot to improve visibility and enable wider science exploitation of your facility. We have been assisting both current and future facilities to publish their datasets and services. We describe already published examples of European datasets using VO infrastructure, including e.g. UKIDSS, ESA XMM-Newton, ESO and Swift datasets. We provided workshops and technical visits to enable planning for existing and future facilities and a census has been compiled of European based data holdings and archives to enable us to focus assistance at both national and European level.

Wednesday
12:15pm

Bulgarian Virtual Observatory: Link to Astroinformatics

M. Tsvetkov (Institute of Astronomy, BAS), Ognian Kounchev

The project of the Bulgarian Virtual Observatory got an indirect support from the Bulgarian Government - National Science Fund (BGNSF) who granted two related BGVO projects: Astroinformatics and Wide-Field Plate Database for the next 3 year period. In this projects participate at the moment Institute of Astronomy, Institute of Mathematics and Informatics, Institute of Information Technologies and Central Laboratory of Geodesy, all of them from Bulgarian Academy of Sciences. This will contribute a lot of to the way of integration of Bulgarian scientists working on the projects aiming development of Bulgarian VO and its integration with the EURO_VO and related project like EURO Data Center Alliance. The main direction of the Bulgarian part of this initiative is complement of the world database of photographic astronomical plate archives, focusing on European plate collection, their digitization, improvement of the standards for the plate digitization using the novel commercial precise flatbed scanners, creation of the new methods for the wife-fields images compression, improvement of the interoperability standards according to the VO requirements data mining, etc. On this base participation and including the Bulgarian scientists from the academic institutes working on the topic of EURO_VO Program in the FP7 will be one step farther on the integration of Bulgaria in European initiatives. Some more specific details concerning BGVO development are also discussed.

Wednesday
2:00pm

Improving Ease-of-Access to Virtual Observatories using Web Based Visualization Tools

J. Fay (Microsoft Research), A. Conti

As astronomy visualization tools grow more powerful, traditional web based search tools have become antiquated and require a redesign to keep up with growing user expectations. We will show how tools like the WorldWide Telescope web control can be user to enable richer visualization and preview of catalog and image data searches, with examples from data archives, research projects and outreach.

Wednesday
2:25pm

Virtual Observatory Activities at ESO

F. Comeron (ESO)

After a fruitful stage of development closely linked to the European Union-funded collaborations, including its current participation in the FP7 Euro-VO AIDA (Astronomical Infrastructure and Data Access) project, Virtual Observatory (VO) activities at ESO are now reaching maturity and being closely integrated in the core of the planning for the development and exploitation of the vast data holdings in its Science Archive Facility. Major opportunities for the development of a VO-friendly archive will present themselves in the coming years with the start of operations of VISTA and VST, the survey telescopes on Paranal, whose science-ready data products will be VO compliant. Furthermore, ESO will also host a copy of the ALMA archive, whose pipeline-processed data products are designed to be VO compliant as well. In parallel, efforts are undergoing to reprocess and publish through the ESO Science Archive Facility large amounts of data obtained in the past years as part of regular programmes executed with the VLT, making them accessible to VO tools. From its advantageous position as one of the major centres of ground-based astronomical data, ESO intends to continue to be an important player in the further development of VO standards, and to continue to promote the adoption of VO tools, resources and methodologies by the community.

Wednesday
2:50pm

Cambridge Astronomical Survey Unit: Providing Data Products for the VO

E. Gonzalez-Solares (Institute of Astronomy), N A Walton, M J Irwin, S T Hodgkin, J R Lewis, (Cambridge)

This presentation will provide a brief overview of the current activities of the Cambridge Astronomical Survey Unit (CASU) and how it is providing the essential data products which provide the vital information resource component of the Virtual Observatory. Note will be made of the major surveys currently underway or planned for which CASU is responsible for generating the data products. These include the UKIRT WFCAM surveys, the INT WFC surveys and future large scale surveys from VISTA and ESO's VST. A brief summary will be given of the key science data products that the community will be able to access and how CASU is ensuring that all data products are compatible with newly emerging data publishing standards sch as those from the Virtual Observatory movement.

Mention will be made of how the techniques developed at CASU are relevant for a wide range of data types, across astronomy and other research fields. Finally the presentation will note how the demands of moving to large scale production of science data has impacted on the evolution of software and hardware systems used at CASU.

Wednesday
3:05pm

Cloud Cosmology

T. Kitching (University of Edinburgh), Adam Amara, Anais Rassat, Alexandre Refregier

I will present some simple and readily available technologies allow any cosmologist to turn their code into a web interface.

The move towards replacing the downloading of code with such web interfaces represents the move away from the traditional use of the internet by cosmologists towards a cloud computing methodology that we call Cloud Cosmology.

This will be presented as part of the online suite of resources iCosmo available at http://www.icosmo.org

Wednesday
3:20pm

VAMDC: Virtual Atomic and Molecular Data Centre

N. Walton (IoA, Cambridge), M L Dubernet (LPMAA, Paris), N J Mason (Open), N Piskunov (Upsalla), the VAMDC Consortium

The Virtual Atomic and Molecular Data Centre (VAMDC) aims to build a secure, documented, flexible and interoperable e-science environment-based interface to existing Atomic and Molecular (AM) data. The VAMDC will be built upon the expertise of existing AM databases, data producers and service providers with the specific aim of creating an infrastructure that is easily tuned to the requirements of a wide variety of users in academic, governmental, industrial or public communities.

VAMDC will be enabled by the utilisation of the excellent grid and Virtual Observatory data and application infrastructure that has been created across Europe by initiatives such as the Euro-VO and EGEE. VAMDC will commence in July 2009.

This presentation will provide a brief overview of the project, aims and objectives, and describe the key infrastructure that will be created during he project lifetime.

T-P01

The Virtual Meteor Observatory (VMO) of the International Meteor Organization

G. Barentsen (Armagh Observatory), Detlef Koschny (ESA/RSSD), Rainer Arlt (IMO)

Meteor science is concerned with very small particles in the Solar System. The investigation of meteoroids, their origin and their orbital dynamics tells a lot about the next-larger classes of objects - asteroids and comets. Studies of meteor showers are in most cases of statistical nature; large quantities of individual meteor observations are necessary to arrive at meaningful conclusions. The advent of Virtual Observatories in space science is ideally timed with observational advances in data recording in meteor science. The International Meteor Organization (IMO) participates in this advent with the creation of a VO-enabled data centre for meteor science: the Virtual Meteor Observatory (VMO).

T-P02

The Project of Serbian Virtual Observatory and the Connection with VAMDC

D. Jevremovic, M. S. Dimitrijevic, L. C. Popovic, M. Dacic, V. Protic-Benisek, E. Bon, V. Benisek, A. Kovacevic, S. Sahal-Brechot

We present and discuss the project of Serbian Virtual Observatory. The digitization and publication in VO of around 15000 photo plates archivated on Belgrade Asttronomical observatory, as well as stella catalogues produced in Serbia, and digitization of astronomical publications, is in progress. Also, together with french colleagues, in progress is the development of the database STARK-B with Stark broadening data of interest for stellar spectra analysis and modelling, produced during more of 30 years of French-Serbian collaboration. It will enter in VAMDC - Virtual Atomic and Molecular Data Center, MOLAT and SerVO.

T-P03 Using VO Tools for Multiwavelength Studies of Markarian Galaxies

A. Mickaelian (Byurakan Astrophysical Observatory (BAO)), L.A. Sargsyan, D.W. Weedman, et al.

The VO tools, such as VOSpec and VOSED are extremely useful and important for combining multiwavelength (MW) data for various astronomical objects and building their MW SEDs, especially in case of large amount of data. The project of multiwavelength (MW) studies of Markarian galaxies is based on combining all available MW photometric data and spectra from various ground-based and space observatories for Markarian galaxies, including X-ray (ROSAT, Chandra, XMM), UV (GALEX), optical (MAPS, SDSS), NIR (2MASS), FIR (IRAS, ISO, SST), and radio (NVSS, FIRST) fluxes and optical and IR (ISO, SST) spectra. A comparison and matching of the spectra with MW SEDs is being done; objects of various classes are being distinguished and matching with their IR spectra is being done to reveal their still unknown properties. A comparison will be made with SEDs of other bright AGN and ULIRGs. The final goal is the establishment of interrelation of the MW properties of various AGN types, starbursts, and ULIRGs, and understanding their populations in the Local Universe and beyond. At the end a MW catalog of Markarian galaxies will be published with all available data.

T-P04 The Synthetic Spectra Modeling under GRIDCOM Interface

S. Mikolaitis (ITPA VU), Prof. TAUTVAISIENE, Grazina (ITPA VU)

We present The Stellar Spectra Modeling tool SYNTSPEC on GRIDCOM interface. The gridified tool for stellar spectra analysis - as an example of data - and compute-intensive application running on the testbed of the EU BalticGrid-II Project (http://www.balticgrid.org). The application brings the new quality to the research in astrophysics. The multi job application and the user friendly interface of the GRIDCOM connects the scientific group for the work virtually together, but physically remote. Results are fully compatible to VO spectra analysis tools. The SYNTSPEC benefits usage of the BalticGrid-II testbed because of the need of powerful computing resources. The application calculates normalized to the continuum stellar spectra that serve for determinations of e.g. chemical composition, effective temperatures and surface gravities of stars. This is very important in a preparation of infrastructure and procedures for the analysis of large quantities of spectra from many ground observatories and those which will be produced by the European Space Agency's GAIA space observatory to be launched in 2011. The special added value is implementation of the application in the GRIDCOM interface on the BalticGrid- II Special Interest Groups site (http://sig.balticgrid.org).

T-P05 Planetary Atmospheres: Developments of Data Archiving, Tools and Services at IPSL

A. Sarkissian (LATMOS)

Study of planetary atmospheres has been enhanced these last years because of numerous recent space probes (Mars Express, Venus Express and Cassini-Huygens). Data archiving and access improvements, i.e., interoperability of data bases did not follow because of the priority given to data production. At LATMOS, one of the laboratories of the Institut Pierre Simon Laplace (IPSL) in France, we are involved and interested in most of these space experiments and data archiving and exchanges for planetology is becoming an hot topic worldwide and therefore at our institute. We will present here our activities and projects toward a Virtual Observatory in Planetology.

Tuesday
11:00am

Recent Developments in Bayesian Methods in Cosmology

R. Trotta (Imperial College London)

In the last 2 decades, the application of Bayesian methods to cosmology has flourished. I will review applications ranging from parameter inference, to model selection and data consistency checks. I will also survey the status of Bayesian forecasting and experiment optimisation.

Tuesday
11:15am

Classification and Astrophysical Parameter Inference for Large Surveys

C. Bailer-Jones (Max Planck Institute for Astronomy, Heidelberg)

I will report on two methods for extracting information from astronomical data. The first is a probabilistic technique for modifying classifier probabilities which takes into account the expected relative frequencies (priors) of different classes in the target domain. I will show how, when combined with a support vector machine (SVM) classifier, this simple idea can be used to build very pure samples of rare objects (Bailer-Jones et al. 2008, MNRAS 391, 1838). The second method concerns the estimation of astrophysical parameters from spectra. Standard machine learning methods try to solve an inverse problem, namely the inference of the parameters from the data. In doing so, these methods implicitly learn the sensitivity of each data dimension to the parameters. But they don't always do this very well, partly because the data to parameter mapping is not unique. I have developed a new method (ILIUM) based on forward modelling which calculates the sensitivities explicitly and uses these to iteratively estimate the astrophysical parameters. On the problems tested so far it is more accurate that nearest neighbours and SVMs, and has the additional advantage of easily providing parameter covariance and goodness-of-fit estimates as well as giving direct measures of the relevance of each data input in determining the output parameters.

Both of these methods are being developed in the context of the Gaia Galactic survey mission. After launch in 2012, Gaia will perform an all-sky magnitude-limited astrometric survey and simultaneously obtain low resolution spectra of over 10^9 sources, of which half a million will be quasars and a few million galaxies.

Tuesday
11:30am

Automated classification of variable stars from the CoRoT exoplanet database

C. Aerts (Leuven, Belgium), Luis Sarro, Jonas Debosscher, Mauro Lopez and the CoRoT team

We present automated classification methods for large datasets containing light curves of variable stars. The methodology is developed to treat the exoplanet database of the operational CoRoT space mission. While the main scientific goal of this database is to hunt for exoplanets through the transit method, an important by-product is the availability of ten thousands of uninterrupted light curves of stars of typically a factor 100 better precision compared to ground-based variability surveys. This results in the discovery of numerous new low-amplitude variables, with a strong emphasis on multiperiodic main-sequence pulsators, of which several occur in eclipsing binaries. We highlight how the most interesting stars from an astrophysical point of view can be detected and classified from the database and why this is relevant for follow-up studies of their physical properties.

Tuesday
11:42am

A Comparison of Photometric Redshift Methods on a Sample of Luminous Red Galaxies

M. Banerji (University College London), F. Abdalla, O. Lahav and V. Rashkov

We present photometric redshifts for a sample of Luminous Red Galaxies derived with a neural network method, ANNz as well as five other publicly available photo-z codes (HyperZ, SDSS, Le PHARE, BPZ and ZEBRA) for ~1.5 million Luminous Red Galaxies (LRGs) in SDSS DR6. This allows us to identify how reliable codes are relative to each other if used as described in their public release. We compare and contrast the relative merits of each code using ~13000 spectroscopic redshifts from the 2SLAQ sample. We find that the performance of each code depends on the figure of merit used to assess it. As expected, the availability of a complete training set means that the training method performs best in the intermediate redshift bins where there are plenty of training objects. Codes such as Le PHARE, which use new observed templates perform best in the lower redshift bins. All codes produce reasonable photometric redshifts, the 1-sigma scatters ranging from 0.057 to 0.097 if averaged over the entire redshift range.

Tuesday
11:54am

Galaxy shapes in Weak Lensing Surveys (GREAT08)

L. Voigt (UCL), Sarah Bridle and the GREAT08 team

Cosmologists are challenging the world to solve a compelling statistical problem, to bring us closer to understanding the nature of dark matter and energy which makes up 95 per cent of the "missing" universe. The GRavitational lEnsing Accuracy Testing 2008 (GREAT08) PASCAL Challenge is being set by 38 scientists across 19 international institutions, with the aim of enticing other researchers to crack it by 30 April 2009.

The method with the greatest potential to discover the nature of dark energy is gravitational lensing, in which the shapes of distant galaxies are distorted by the gravity of the intervening dark matter. The observed galaxy images appear distorted and their shapes must be precisely disentangled from observational effects of sampling, convolution and noise. The problem being set, to measure these image distortions, involves image analysis and is ideally matched to experts in statistical inference, inverse problems and computational learning, amongst other scientific fields.

The GREAT08 Challenge contains 200 GB of simulated images, containing 30 million galaxy images. For the main competition, participants are asked to extract 5400 numbers from 170 GB of data. The competition can be accessed via the website www.great08challenge.info.

U-P01

On the Detection of Periodic Components in Observational Data

R. Baluev (Saint Petersburg State University)

On the detection of periodic components in observational data The Lomb-Scargle periodogram and its various extensions is widely used in astronomy for searching periodicities in observational data or splitting the observational time series into a set of sinusoidal (or non-sinusoidal) periodicities. This work reviews the author's results obtained recently in the problem of rapid determination of the statistical significance of periodogram peaks. A new rigorous method for analytic estimation of the statistical significance of periodogram peaks is developed. This method is based on the theory of extreme values of stochastic processes. It allows us to construct closed and efficient analytic estimations of the false alarm probability, associated with the maximum peaks for the Lomb-Scargle and multiharmonic periodograms and their normalizations. These results can be useful in a wide variety of astronomical applications, for instance in the searches of variable stars or extrasolar planets.

U-P02 Does Environment Affect the Star Formation Histories of Elliptical Galaxies?

B. Rogers (King's College London), Ignacio Ferreras and Ofer Lahav

Elliptical galaxies provide one of the best test beds to study the standard paradigm of galaxy formation via hierarchical build-up. One key observable is the effect of environment on the star formation history of galaxies (SFH), providing a potentially powerful way to constrain the baryonic physics behind this theory. Using the process of Principal Component Analysis on a 7,000-strong sample of early type galaxies from SDSS, we derive two model independent parameters to investigate their star formation histories. One of these two parameters is found to be mostly sensitive to average stellar age, the other sensitive to small amounts of recent star formation. This result was confirmed using GALEX NUV photometry. We investigate the effect of environment in two ways: I. Dark Matter Halo masses of galaxy groups from the catalogue of Yang et al. II. Close pairs involving only early-type galaxies (i.e. a prototypical dry merger precursor). We find that while environment plays a secondary role to stellar mass it has a measurable effect on the SFH of elliptical galaxies, with close pair interactions a possible cause for the recent star formation seen in these systems.

U-P03 Statistical Algorithms for Identification of Astronomical X-Ray Sources

H. Ziaeepour (MSSL-UCL), Simon Rosen

We use Chandra Multi-Wavelength (Champ) public data to investigate a number of statistical algorithms for classification of X-ray sources with optical imaging follow-up. We show that up to statistical uncertainties, each class of X-ray sources has specific photometric characteristics that can be used for its classification. We assess the relative and absolute performance of classification methods and measured features by comparing the behaviour of physical quantities for statistically classified objects with what is obtained from spectroscopy. We find that among methods we have studied,multi-dimensional probability distribution is the best for both classifying source type and redshift, but it needs a sufficiently large input (learning) data set. In absence of such data, a mixture of various methods can give a better final result. We discuss some of potential applications of the statistical classification and the enhancement of information obtained in this way. We also assess the effect of classification methods and input data set on the astronomical conclusions such as distribution and properties of X-ray selected sources.

Tuesday
11:00am

Amateur Contributions to the Study of the Atmospheric Dynamics of Jupiter and Saturn

D. Arditti (BAA Jupiter & Saturn Sections), John Rogers, Mike Foulkes

The last two decades have witnessed a revolution in the possibilities for the imaging of the bright planets using small telescopes (<0.5m aperture) coupled to fast frame-rate CCD cameras, using fast PCs and image processing-software. Amateurs have developed these techniques to a level where they are capable of providing much information on the development of the atmospheric features of Jupiter and Saturn that is complementary to the information gathered by probes and large professional telescopes. The particular value of the amateur contribution lies in the long-term and complete nature of the coverage, with observers stationed all over the globe. Organisations such as the British Astronomical Association (BAA) can collate the results from these observers to create a record of the longer-term large-scale developments of these atmospheres which is not available from any other source.

This presentation explains briefly the methods commonly used by amateurs working in this field and assesses the resolution obtainable, the reliability of the results and influence of personal factors in the way the images are processed. The work of the BAA Jupiter and Saturn sections and the international JUPOS (Database for Object Positions on Jupiter) project on analysing the feature drift-rates on Jupiter and Saturn is outlined, demonstrating the form in which the data is produced, and mentioning some recent results from published and unpublished work on Jupiter and Saturn.

Tuesday
11:20am

Pro-am Collaboration in CCD Photometry of Cataclysmic Variable Stars

D. Boyd (British Astronomical Association)

Observing cataclysmic variable (CV) stars is one area where amateurs can complement and assist the work of professional astronomers. Detecting and observing outbursts and superoutbursts using CCD photometry enables important CV parameters to be measured and the GCVS classification of variables to be confirmed, or in some cases determined for the first time. During the past 4 years, 19 refereed papers on CVs have been published in the Journal of the British Astronomical Association describing and analysing observations carried out by amateurs. Examples of these will be given in the talk.

Through their greater numbers and wider geographical distribution, amateurs astronomers have the potential to achieve more intensive coverage than is possible with professional telescopes. This enables them, by collaborating with professional astronomers, to address open research issues. A good example is the recent 4-week observing campaign on the eclipsing dwarf nova DW Ursa Majoris. Many interacting binaries containing accretion disks exhibit superhumps in their light curves suggesting that their accretion disks are elliptical and precessing on time scales of a few days due to tidal interactions with the companion star. The changing geometry may cause the depth of eclipses to be modulated on the accretion disk precession period.

The aim of the campaign was to provide for the first time sufficient continuous photometric coverage of an eclipsing superhumper to test this hypothesis. The target, DW UMa, belongs to the group of SW Sextantis stars, novalike variables exhibiting permanent superhumps. The talk will present preliminary results of the campaign including unambiguous confirmation that the superhump signal is the beat between the orbital and precession periods and evidence that the timing, width and depth of the eclipses are all modulated on the disk precession period. These results should provide insight into the nature of accretion disks in SW Sex stars.

Tuesday
11:35am

Precision Timing of Occultations, Eclipses, and Transits by Dedicated Amateur Astronomers

A. Elliott (BAA Asteroids and Remote Planets Section (ARPS))

Accurate timing and photometry of occultations of stars by solar system bodies, mutual occultations and eclipses of planetary satellites, and eclipses and transits, can yield scientifically valid data. This can be used to determine or refine the size, shape, and orbital parameters of the bodies, the characteristics of planetary and satellite atmospheres, the detection and orbital characterisation of close double stars, and the sizes of stars. The ready availability of large telescopes, extremely sensitive video cameras, precision timing technology, prediction and reduction software, and internet coordination, mean that the world body of amateur astronomers is well placed to make a significant contribution to science in these areas. Large groups of dedicated amateurs in most continents have been contributing for over two decades. This Paper briefly illustrates the state-of-the-art methods and contributions of amateurs.

Tuesday
11:50am

Increased Pro-Am Cooperation in Spectroscopy Delivers Results

R. Leadbeater (British Astronomical Association)

Despite spectroscopy being a vital tool for the professional, amateur spectroscopists are relatively uncommon. Their numbers are increasing however, due in part to the work of a couple of amateur groups in Europe. They have, under the guidance of professional astronomers, developed the techniques and instrumentation needed for amateurs to undertake useful work in this field. This includes the development of a spectrograph capable of resolutions up to 17000, significantly higher than previously available to the amateur commercially.

Some examples of current amateur spectroscopic work in support of professional projects are discussed, including: Long term monitoring of Be Star activity and H alpha line profiles, which led to the creation of a Pro-Am database of Be Star Spectra (BeSS). Daily spectroscopic measurements of the WR140 colliding wind binary system over 3 months covering periastron 2008/9.

Tuesday
12:05pm

The BAA VSS and Pro-Am Collaboration

R. Pickard (British Aastronomical Association)

Examples will be given of existing collaboration between professional and amateur variable star observers.

V-P01 Modelling Light Pollution for Sky-Luminance Reduction Based Lighting Standards

C. Baddiley (BAA CfDS)

In the UK, Skyglow from the towns illuminates the sky right into the rural environment. Most young people have never seen the Milky Way.

A mathematical model has been written by the author that reads industry standard photometry files of streetlight designs and calculates reflections and scattering off surfaces into the sky and then the downward scattering, as Skyglow. It gives results dependent on atmospheric visibility, view distance, view elevation and azimuth angle. Reflection off surrounds including verges is included in the calculations.

Different luminaires have been compared in similar circumstances and conclusions drawn about the benefit of certain designs. Studies include tilted Low Pressure Sodium SOX, Cut Off High Pressure Sodium SON in both polycarbonate and curved tempered glass types, Full cutoff flat glass SON, and the effect of changing to white light sources. At rural distances, different designs produce large differences in sky luminance.

With careful adherence to the design principles, there could be a return of dark skies in rural areas.

The UK Highways Agency has incorporated these ideas into their new standards. A Guidance note "Towards Understanding Skyglow" based on this work, was published by the Institution of Lighting Engineers in 2007, at their conference. The International Darksky Association and the North American lighting industry IESNA have used some of the findings in their model lighting ordinance.

The work presented here summarises the physics of this and some of the modelling results and the possible adoption of external lighting distribution cutoff angles by the UK lighting industry.

V-P02 The MARIACHI Project: Mixed Apparatus for Radio Investigation of Atmospheric Cosmic Rays of High Ionization

M. Inglis (SUNY), H. Takai (Brookhaven National Laboratory), M. Marx (Stony Brook University)

Extreme Energy Cosmic Rays are nuclei that have been accelerated to kinetic energies in excess of 1020 eV. Where do they come from? How are they produced? Are they survivors of the early universe? Are they remnants of supernovas? MARIACHI, a unique collaboration between scientists, physics teachers and students, is an innovative technique that allows us to detect and study them.

The Experiment MARIACHI is a unique research experiment that seeks the detection of extreme energy cosmic rays (EECRs), with E >1020 eV. It is an exciting project with many aspects:

Research: It investigates an unconventional way of detecting EECRs based upon a method successfully used to detect meteors entering the upper atmosphere. The method was developed by planetary astronomers listening to radio signals reflected off the ionization trail. MARIACHI seeks to listen to TV signals reflected off the ionization trail of an EECR. The unique experiment topology will also permit the study of meteors, exotic forms of lightning, and atmospheric science.

Computing and Technology: It uses radio detection stations, along with mini shower arrays hooked up to GPS clocks. Teachers and students build the arrays. It implements the Internet and the GRID as means of communication, data transfer, data processing, and for hosting a public educational outreach web site.

Outreach and Education: It is an open research project with the active participation of a wide audience of astronomers, physicists, college professors, high school teachers and students. Groups representing high schools, community colleges and universities all collaborate in the project. The excitement of a real experiment motivates the science and technology classroom, and incorporates several high school physical science topics along with material from other disciplines such as astronomy, electronics, radio, optics.

V-P03 Preliminary Results from a Five Year VS Study in Cygnus

S. Waterman (BAA, Variable Star Section), R. S. Stratford

A five square degree area of sky in Cygnus has been intensively recorded over a 6 year period. The results analysis of some 1,000 new variable stars is ongoing and this talk is a progress report which will outline the results to date. The talk will address the following topics: a) A very brief outline of the data collection and analysis b) A summary of the types, numbers and distribution of variable stars found. c) A brief discussion of the achievable precision. d) A descriptive summary of a few of the more unusual and interesting objrcts found.

(W1) ALMA: status, science capabilities and the path towards science operations

Tuesday
11:00am

ALMA Project: Science and Status

R. Laing (ESO)

ALMA, the Atacama Large Millimeter/submillimeter Array, is currently under construction at a high-altitude (5000m) site at Llano de Chajnantor in Chile. It is an aperture-synthesis array with unprecedented angular resolution and sensitivity, covering the frequency range 30 - 950GHz. ALMA is the largest new project in ground-based astronomy, and has global participation.

I will describe the main science drivers for ALMA, outline its design and anticipated performance and give a progress report on its construction.

Tuesday
11:40am

ALMA Science Operations

P. Andreani (European Southern Observatory), Lars-Ake Nyman, John Hibbard, Ken Tatematsu

The prime goal of the ALMA operations is to facilitate the scientifically efficient use of the Joint ALMA Observatory (JAO), consistent with operating safely at a high altitude (5000m) site in a cost effective manner and with as small as possible impact on the unique environment in and around the ALMA sites in northern Chile. To this end, operations modes will be developed and implemented that allow the antennas, instruments, and data flow to work together in a fully coordinated fashion and to adapt quickly to the prevailing atmospheric conditions. Operations shall be designed to minimize the global overhead for target selection, antenna pointing, target acquisition, instrument set-up, data acquisition & storage, and quick-look quality control of data. Taking into account all this it means to develop a very specific operations model whose basic concepts and paradigms are presented in this talk.

Tuesday
12:00pm

ALMA Regional Support Centre

T. Muxlow (JBCA)

User support will be provided to the ALMA community via three ALMA Regional Centres (ARCs), one in East Asia (serving Japan and Taiwan), North America (USA and Canada) and Europe. The latter will be the point of contact for european ALMA users throughout the lifetime of the project. The ARC will consist of a network of nodes spread across Europe plus a central node at ESO in Garching. Currently, six nodes are envisaged with the UK node being located in the Jodrell Bank Centre for Astrophysics on the University of Manchester campus. Each node will provide comprehensive face-to-face support for ALMA users from the preparation of proposals through to data processing and detailed imaging.

Tuesday
2:00pm

E-ELT Project

R. Gilmozzi (European Southern Observatory)

The EELT is a project led by ESO on behalf of its 14 member states. The project is midway through Phase B (detailed design), an activity that will result in a Proposal for Construction by end 2010. The requirements for the basic reference design, starting point for the current phase, were defined through a community process that led to the convergence of earlier concepts into a single European project: a 42m adaptive telescope based on a novel 5-mirror design that is scheduled to have first light in 2018. I will report on the status of the Phase B activities, on the basic reference design development, and on future plans.

Tuesday
2:30pm

Science with the European Extremely Large Telescope

I. Hook (U. Oxford and INAF-Rome)

I will describe the science case for the European ELT, including some recent results from development of the Design Reference Mission. I will also discuss ways for the community to provide input through the Design Reference Science Plan.

Tuesday
3:00pm

E-ELT Instrumentation

M. Casali (ESO)

ESO has begun a series of conceptual design studies for E-ELT instrumentation, which is expected to lead to an instrumentation plan at the end of 2010. The studies, involving more than 30 European institutes, explore the parameter space of possibilities, from high resolution diffraction limited imagers, to large-field multi-object spectrographs. This talk will report on progress with the studies, and discuss some of the technical issues which have come up during their design.

Tuesday
4:00pm

Overview of the End-To-End Cycle of an ESO Observing Programme

F. Comeron (ESO)

Whereas ESO works in many respects like other observatories in terms of proposal submission, time allocation and scheduling, there are many particularities that are worth knowing at the time of designing an ESO observing proposal and preparing ESO observations. Many of these are motivated by the implementation of large-scale Service Mode observing, the intricacies of the scheduling process, the existence of well-defined calibration plans, the distribution of pipeline-processed data products, and the storage of the data obtained in the ESO archive. This presentation reviews the aspects of the ESO end-to-end operations model that can be most relevant to potential users of ESO telescopes. The available tools and policies to optimize the chances of success of proposals and their scientific return of the observations are also reviewed.

Tuesday
4:18pm

OPC - behind the scenes

E. Brinks (University of Hertfordshire)

The ESO Observing Programmes Committee is tasked with recommending which proposals are worthy of being executed at ESO's ever expanding suite of telescopes and instruments. Oversubscription rates on all telescope/instrument combinations is high, sometimes discouragingly so. The purpose of this contribution is to shed light on how the OPC goes about the difficult task of selecting what are deemed the best proposals and I will touch upon the difficult task of translating the recommendation into a workable observing schedule. I will also provide background information on the selection process and reasoning behind it, talk about special modes such as Large and ESO/GTC proposals, and list some of the dos and don'ts when preparing a proposal.

Tuesday
4:36pm

Spotlight on Paranal Operations: How are Your Observations Made?

C. Dumas (European Southern Observatory)

This talk will present insightful information regarding the day and night-time work done by the astronomers and technicians working at Paranal Observatory, covering the preparation of the observing night at the Very Large Telescope, how the observations are made, what factors (science priorities, meteo conditions, etc.) impact the observational strategy, how is the data quality assessed in real-time, how to best plan your service mode observations to increase the chances of having your program completed. In summary, an overview of the whole science operation process, up to the delivery of the data to the archive, will be presented.

Tuesday
4:52pm

Data Products in the ESO Archive

M. Romaniello (European Southern Observatory)

With more than 100 refereed papers resulting from it every year, the ESO Science Archive Facility is a scientific tools in its own right (in this context, an archive paper is defined as a publication in which none of the authors was part in the original observing proposal). In this presentation, I will describe the current holdings of the ESO Archive and their future evolution. In particular, I will concentrate on the Archive's content in terms of data products at different levels of processing and science readiness and on the different ways to access them.

Tuesday
5:10pm

You and Your Observatory: The ESO Users Committee

J. van Loon (Keele University)

The ESO Users Committee plays an important and effective role in serving both observers and the observatory. It works together with the ESO organisation to address the needs and wishes of the ESO users community, and to maximise the scientific exploitation of the ESO facilities. I will briefly explain the mechanisms through which the Users Committee operates, and how you can enhance the effectiveness of your input in the running and planning of ESO facilities. Some examples will be given of recent successes resulting from the ESO-Users collaboration, but also of key outstanding issues which require the attention and effort from both the ESO users and organisation. I will be available for discussion and shall be happy to collect your thoughts for consideration at the next ESO Users Committee meeting - which takes place in the week immediately following the JENAM.

Monday
11:00am

The ASTRONET Science Vision and Joint Call

F. Molster (NWO/NOVA)

ASTRONET is an FP6 ERA-NET which combines 24 national research organizations in Europe as well as the European Southern Observatory and the European Space Agency. The aim of ASTRONET is to establish a long term strategy for European astronomy and to execute this plan.

The first step in this process was the production of "A Science Vision for European Astronomy", a document containing the important astronomical questions of today and a pathway how to solve them in the future. Based on this document the ASTRONET Infrastructure Roadmap was developed (see the talk of M. Bode in this session) and a subject was chosen for the ASTRONET Joint Call. This talk will provide an overview of the activities leading to and the results from the Science Vision and the Joint Call.

Monday
11:23am

The ASTRONET Infrastructure Roadmap

M. Bode (Liverpool JMU)

Published in November 2008, the ASTRONET Roadmap provides a prioritised plan regarding the infrastructures required over the next 10-20 years for Europe to deliver the science set out in the ASTRONET Science Vision. In addition, it contains recommendations for the furtherance of public engagement and education, plus the enhancement of links to European Industry. This talk will provide an overview of the process and main recommendations of the Roadmap, as well as giving an update on its implementation.

Monday
11:45am

The ASPERA Roadmap

S. Katsanevas (CNRS/IN2P3)

The European Strategy for Astroparticle Physics roadmap document, published in October 2008, gives the priorities and timeline of Astroparticle Physics in Europe, for the next decade. This talk will review the updfated information concerning this roadmap, as well as the steps taken or about to be taken for its implementation, including: a common for the R&D in view of design studies of the priority infrastructures, the launch of a worldwide coordination effort in the context of OECD and the effort to link a posteriori existing infrastructures as for instance underground labs.

Monday
12:08pm

ERC - The New Opportunity for Fundamental Research in Europe

T. Lago (University of Porto)

The talk will focus on the European Research Council (ERC), its strategy and operation as set up by its scientific council - to stimulate investigator-initiated frontier research across all fields of research, on the basis of excellence. The ERC grants scheme will be presented

- ERC Starting Grants - with the objective to provide critical and adequate support to the independent careers of excellent researchers who are at the stage of starting or consolidating their own independent research programme.

- ERC Advanced Grants with the objective to encourage and support excellent, innovative investigator-initiated research projects by leading advanced investigators across the Member States and Associated countries as well as their simple operating procedures, budget and statistics of the two years of ERC activity.

Wednesday
11:00am

The Planck Mission

J. Tauber (European Space Agency)

Planck {http://www.rssd.esa.int/Planck} is an astronomical satellite part of the Scientific Programme of the European Space Agency, due to be launched in April of 2009. It is designed to image the anisotropies of the Cosmic Microwave Background (CMB) over the whole sky, with unprecedented sensitivity (DeltaT/T ~ 2E-6) and angular resolution (~5 arcminutes). Planck will provide a major source of information relevant to several cosmological and astrophysical issues, such as testing theories of the early universe and the origin of cosmic structure.

The ability to measure to high accuracy the angular power spectrum of the CMB fluctuations will allow the determination of fundamental cosmological parameters with an uncertainty better than a few percent. In addition to the main cosmological goals of the mission, the Planck sky survey will be used to study in detail the very sources of emission which "contaminate" the signal due to the CMB, and will result in a wealth of information on the properties of extragalactic sources, and on the dust and gas in our own galaxy. The ability of Planck to measure polarization across a wide frequency range (30-350 GHz), with high precision and accuracy, and over the whole sky, will provide unique insight into specific cosmological questions, but also into the properties of the interstellar medium.

At the time of the JENAM, Planck should be a week from launch. I will present an overview of the Planck mission, its scientific objectives, the key elements of its technical design, and its current status.

Wednesday
11:25am

The Promise of Herschel

G. Pilbratt (European Space Agency)

The Herschel Space Observatory is the next observatory mission in the European Space Agency (ESA) science programme. Herschel will carry a 3.5 metre diameter passively cooled telescope. The science payload complement - two cameras/medium resolution spectrometers (PACS and SPIRE) and a very high resolution heterodyne spectrometer (HIFI) - will be housed in a superfluid helium cryostat.

Herschel is the first large aperture space infrared observatory, it will build on previous infrared space missions, offering a larger telescope and push towards longer wavelengths. It will perform imaging photometry and spectroscopy in the far infrared and submillimetre part of the spectrum, covering approximately the 55-672 micron range. I will describe the science capabilities of Herschel putting it into perspective. Herschel is designed to observe the 'cool universe'; the key science objectives include star and galaxy formation and evolution, and in particular the physics, dynamics, and chemistry of the interstellar medium and its molecular clouds, the wombs of the stars and planets. Herschel will open a new window to study how the universe has evolved to become the universe we see today, and how our star the sun, our planet the earth, and we ourselves fit in.

Once operational in orbit around L2, following an early operations period of 6 months, Herschel will offer a minimum of 3 years of routine science observations. Nominally ~20,000 hours will be available for astronomy, 32\% is guaranteed time and the remainder is open to the general astronomical community through a standard competitive proposal procedure. The time allocation for both GT and OT Key Programmes has been concluded. I will summarise the accepted Key Programmes, I will mention future observing opportunities and report on the launch status.

Wednesday
11:50am

Gaia's Science Programme

T. Prusti (European Space Agency)

Gaia is a space astrometry mission, a broad survey project following the measurement and operational principles of Hipparcos. It will help solving one of the most difficult yet deeply fundamental challenges in modern astronomy: to create an extraordinarily precise three-dimensional map of about one billion stars throughout our Galaxy and beyond. In the process, it will map their three-dimensional motions, which encode the origin and subsequent evolution of the Galaxy. Through comprehensive photometric and spectroscopic classification, it will provide the detailed physical properties of each star observed: characterising their luminosity, temperature, gravity, and elemental composition. This massive stellar census will provide the basic observational data to tackle an enormous range of important problems related to the origin, structure, and evolutionary history of our Galaxy. In addition, by measuring celestial objects in an unbiased manner, Gaia will provide fundamental data on solar system objects, general relativity and extragalactic objects. The presentation will summarise the mission, scientific capabilities, payload, science case, data processing and current status.

Wednesday
12:15pm

JWST's Science Programme

S. Carpano (European Space Agency)

The James Webb Space Telescope (JWST) is a cooperative mission between NASA, ESA and the Canadian Space Agency due to be launched in 2013. The key features of the JWST observatory and its instruments will be summarised, and the science expected of the mission will be outlined.

Index

Authors Index:

Index

Authors Index (continued):

Authors Index (continued):

Authors Index (continued):

Authors Index (continued):

Authors Index (continued):

Authors Index (continued):