A General Search for Rare Objects in the UKIDSS LAS

Author: Nathalie Skrzypek

Imperial College London

Co-Authors: S.J.Warren (Imperial College London); D.Mortlock (Imperial College London)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

The YJHK near-infrared bands of the UKIDSS Large Area Survey (LAS) are ideal for finding rare classes of object including high-redshift quasars, cool brown dwarfs, and cool white dwarfs. Here we present the results of a more general search for rare objects, by identifying sources with unusual colours from throughout the YJHK colour space. Unusual stellar sources are identified through chi^2 comparison against a wide set of colour templates, including stars, brown dwarfs, white dwarfs and quasars. Objects that do not match any of the templates are flagged as interesting. A small number of unusual sources merit further investigation.

Clustering analysis of high-redshift Luminous Red Galaxies in Stripe 82

Author: Nikolaos Nikoloudakis

University of Durham

Co-Authors: T. Shanks (University of Durham); U. Sawangwit (University of Durham)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

We have measured the clustering for ~130000 colour selected Luminous Red Galaxies via the angular correlation function in Stripe 82 exploiting SDSS DR7 iz and UKIDSS LAS K photometry. We use the cross-correlation technique of Newman (2008) to establish that the average redshift of the LRGs is z~1. We have established that a sample with ~700deg^-2 has a comparable space density to the z~0.68 SDSS AAOmega LRG sample of Sawangwit et al. (2011) Compared to the AAOmega LRG w(θ) scaled to the depth of the Stripe 82 LRGs, the Stripe 82 w(θ) is higher at all scales. Thus at intermediate scales, the z~1 LRGs are not only more clustered than predicted by the long-lived evolutionary model, they are also more clustered than the comoving model. w(θ) shows a very flat slope at large scales which means that the ΛCDM linear model has become a poorer fit than at lower redshift. We present arguments that this is not caused by systematics. HOD models are fitted with best fit parameters : M_ min =2.2x10^13 M_sun, M_1 = 22x10^13 M_sun, F_sat=3.2%, bias=3.1 The flat slope in w(θ) cannot be explained on the basis of the HOD model. If the w(θ) excess proves reliable, we have made a significant detection of non-Gaussianity in the z~1 LRG distribution with an estimated local non-Gaussianity parameter estimate of f_=90+-20 which is a 4σ detection at a level comparable to the present upper limit from WMAP CMB measurements of f_<60.

Galaxy-scale gravitational lenses in large surveys: finding them, and what to do with them

Author: Neal Jackson

University of Manchester

Co-Authors:

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

30 years after the discovery of the first gravitational lens system, we are at the beginning of the period in which new lens systems can be discovered on industrial scales by wide-field surveys at multiple wavelengths. I describe some surveys for lenses from existing surveys such as NVSS, GB6 and UKIDSS and some efforts to find lenses in other surveys. Large numbers of such lenses can be important for understanding the structure of galaxies at different redshifts. I describe the aims and early results of an e-Merlin Legacy Programme aimed at followup of lenses already discovered.

Gravitational Lens Statistics with Herschel-ATLAS

Author: Jo Short

Cardiff University

Co-Authors:

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

Whilst lens identification has traditionally been a rather timely exercise, early data from the Herschel-ATLAS survey demonstrated how efficiently lenses

can be identified at submillimeter wavelengths using a simple flux criteria. Five lens candidates were identified in the H-ATLAS Science Demonstration Phase (SDP), however the full data set is expected to yield many more numbering in the hundreds. This has led us to consider how to utilise the statistical properties of the lenses. In this work we take a preliminary look at the different assumptions in analytical models for the redshift and magnification distributions of strong gravitational lenses, which include the cosmological parameters, the mass function and the lens density profile (for which we consider singular isothermal sphere and Navarro-Frenk-White approximations). We demonstrate how the SDP data compares to these models and consider about what could be done with the larger data set.

Large-Scale Structure Surveys and Violations of Statistical Isotropy

Author: Dr. Yashar Akrami

Institute of Theoretical Astrophysics, University of Oslo

Co-Authors: H. K. Eriksen (Institute of Theoretical Astrophysics, University of Oslo)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

The principles of isotropy and homogeneity of the Universe on large scales are two cornerstones of the cosmological concordance model. Despite the fact that these assumptions have so far been in good agreement with most cosmological observations of both cosmic microwave background (CMB) anisotropies and the large scale structure (LSS) of the Universe, subtle hints of the contrary have been claimed by some studies of the CMB and LSS data. Any violation of these cosmological principles may have strong impacts on our current understanding of the Universe, and therefore, it is of crucial importance to verify whether such claims hold against the tide of various high-quality data or they are only the results of systematic errors or statistical flukes. Here, we give an update on a previous analysis of the photometric luminous red galaxies (LRG) provided by the Sloan Digital Sky Survey (SDSS) to constrain the parameters of a quadrupolar anisotropic model of the primordial power spectrum. Our analysis is based on the construction of a quadratic estimator of the anisotropy coefficients and we use the latest SDSS-III photometric data (Data Release 8). We also present a more sophisticated technique based on a Gibbs sampling algorithm that can give a more flexible, accurate and computationally efficient way of searching for signatures of violations of statistical isotropy in the LSS data. We show that this method can provide a significantly more powerful tool for the statistical analysis of cosmological data from existing and forthcoming ground-based and space galaxy surveys.

Measuring the Cosmic Star Formation Rate Using Deep, Wide-Area, Narrow-Band Imaging

Author: Alyssa Drake

Astrophysics Research Institute, LJMU

Co-Authors: C.Simpson, I.K.Baldry, C.A.Collins, P.A.James (Astrophysics Research Institute, Liverpool John Moores University)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

The advent of wide-field narrow-band surveys allows for the first time the analysis of large statistical samples of star-forming galaxies, reaching lower stellar masses and star formation rates (SFRs) than ever before. Using ultra deep data from the SXDF-UDS Field, we construct a sample of >7000 narrowband-selected emission-line galaxies, in 12 redshift slices ranging from z=0.14 out to z=1.46. We use broad-band photometry across 11 filters from CFHT u band through to Spitzer IRAC, to determine accurate photometric redshifts, and confirm their reliability using ~250 spectra from the Magellan Telescopes. We trace the evolution of the SFR as a function of stellar mass to <108 Msun (and SFRs <<1 Msun yr-1) across ~10 Gyr.

The WIRCam Deep Survey

Author: Rich Bielby

Durham University

Co-Authors: O. Ilbert (LAM), P. Hudelot (IAP), H. J. McCracken (IAP), E. Daddi (CEA Saclay), J. P. Kneib (LAM), Y. Mellier (IAP), C. Willott (NRC-CNRC)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

We present a new near-infrared imaging survey in the four CFHTLS deep fields: the WIRCam Deep Survey (WIRDS). WIRDS comprises extremely deep, high quality J, H and Ks imaging covering a total effective area of 2.1 sq. deg. and reaching AB 50% completeness limits of ~ 24.5. We combine our images with the CFHTLS to create a unique set of eight-band ugrizJHK photometric catalogues in the four CFHTLS deep fields; these four separate fields allow us to make a robust estimate of the effect of cosmic variance for all our measurements. We use these catalogues in combination with 9,800 spectroscopic redshifts to estimate precise photometric redshifts, galaxy types, star-formation rates and stellar masses for a unique sample of 1.8 million galaxies. We present an overview of the latest results based on the WIRDS data in the CFHTLS fields, including the evolution of the galaxy stellar mass function and mass-selected galaxy clustering to z~2, the identification of high redshift (z>1) clusters and the luminosity function of z=6 LBGs.

Ultra-strong UV FeII Emission in a Large Quasar Group

Author: Kathryn Harris

UCLan

Co-Authors: R.G.Clowes(University of Central Lancashire); L.Haberzettl (University of Louisville); S.Mitchell(University of Louisville); M.J.Graham (California Institute of Technology); L.E.Campusano (Observatorio Astronomico Cerro Calan, Chile); G.M.Williger(Lab. Fizeau, University de Nice);I.K.Sochting (University of Oxford)

Session: COS1: Cosmology and Structure Evolution with Wide-Field Optical and NIR Imaging Surveys

Displayed during: Poster Session B

Summary:

I would like to present a region containing an excess of strong and Ultra-strong UV FeII emitting quasars, twice the number of previously published similar objects. These 16 quasars are spread over a redshift range 1.1

Improving the Spectroscopic Atomic Line Database

Author: Dr Matthew Ruffoni

Imperial College London

Co-Authors: Dr J.C.Pickering (Imperial College London)

Session: COS2: Future wide-field massive spectroscopic surveys with 4m-telescopes

Displayed during: Poster Session B

Summary:

High-resolution, high-quality spectra from both ground- and space-based spectrographs are vital in many fields of astronomy. However, they also highlight the inadequacies of the existing atomic database. Such inadequacies will be further exposed by future spectrographs, such as those on Gaia and E-ELT. For Gaia, follow-up measurements with a ground-based MOS on a 4-m class telescope will be crucial in extracting the most from the satellite's spectra. Yet neither the substantial investment in Gaia, nor the resources expended on such a follow-up, will be fully exploited so long as spectral analyses are limited by the quality of the atomic database. An investment must, therefore, also be made in improving the accuracy and reliability of parameters associated with important atomic lines. In many cases, order of magnitude improvements are needed and are achievable using Fourier transform spectroscopy, where wavelengths are accurate to at least 1:10^7 (30 ms^–1, 0.15 mÅ at 1500 Å), and f-values to a few percent. We present an overview of current needs for accurate atomic data, particularly f-values for iron group element spectra in the IR, optical, UV, and VUV spectral regions. Examples of current work for SDSS-III/APOGEE will be shown, which could be extended to support Gaia.

Mass Calibration of the South Pole Telescope Galaxy Clusters

Author: Bazin

Ludwig Maximilian Universitaet Muenchen

Co-Authors: Bazin (Ludwig Maximilian Universitaet Muenchen)

Session: COS2: Future wide-field massive spectroscopic surveys with 4m-telescopes

Displayed during: Poster Session B

Summary:

The South Pole Telescope, a 10-m telescope observing the CMB in 3 mm-wave bands, is a great machine to detect galaxy clusters using the Sunyaev Zeldovich Effect. The SPT cluster survey is now finished and it covers 2,500 sqdeg of the south hemisphere sky. I will present the SPT galaxy cluster sample and followups in optical, NIR and X-ray. I will summarize the cosmological analyses, and mainly focus on the SZ mass-observable calibration efforts that the collaboration is pursuing. In particular, I will present our calibration method based on dynamical masses using spectroscopic follow-up, a comparison with X-ray mass calibration, and limitations.

WEAVE - a new wide-field multi-object spectrograph for the William Herschel Telescope

Author: Chris Benn

ING, La Palma

Co-Authors: M. Balcells (ING), D. Abrams (ING), G. Dalton (Oxford/RAL), S. Trager (Groningen), D. Carter (LJMU), C. Evans (ATC, Edinburgh)

Session: COS2: Future wide-field massive spectroscopic surveys with 4m-telescopes

Displayed during: Poster Session B

Summary:

WEAVE is a new multi object spectrograph (1000 fibres 2-deg field) planned for the 4.2-m William Herschel Telescope on La Palma. First light is expected in 2017.

Are z~5 QSOs found in the most massive high redshift halos?

Author: Kate Husband

University of Bristol

Co-Authors: M. Bremer (University of Bristol, UK), L. Douglas (University of Bristol, UK), L. Davis (University of Bristol, UK), E. Stanway (University of Warwick, UK)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Luminous high redshift quasars are thought to exist within the most massive dark matter halos (M > 10^13 Msun) in the young universe, where simulations suggest the strongest evolution is expected to have occurred in the relatively brief time since the Big Bang. Given the expected halo clustering behaviour, the quasars may trace volumes containing an overdensity of other high redshift galaxies (i.e. Lyman Break Galaxies, LBGs). To test this hypothesis we searched three ~3' (~1Mpc at z~5) z=5 quasar fields for strongly star forming LBGs at the quasar redshift. We compared the numbers of spectroscopically-confirmed LBGs in these fields to those found through an identical procedure in blank sky fields (ESO Remote Galaxy Survey, ERGS; Douglas et al.'09,'10). We find no evidence for significant overdensities in the quasar fields; they appear typical of those found in ERGS. The lack of LBG clustering around high redshift quasars suggests that either high redshift quasars do not trace the peaks in the mass density at high redshift, or if they do, that LBGs are poor tracers of galaxy evolution in such high-redshift environments. Either way, this indicates our understanding of early galaxy formation is incorrect.

EAGLE: Producing Realistic SPH Simulation Data

Author: Michelle Furlong

Institute for Computational Cosmology, Durham University

Co-Authors: R. G. Bower(Institue for Computational Cosmology), T. Theuns(Institute for Computational Cosmolgy), Y. Rosas-Guevara(Institue for Computational Cosmology), J. Schaye(Leiden University), R. A. Crain(Leiden University), C.M.Booth(Kavli Institute for Cosmological Physics), C. Dalla Vecchia (Max Planck Institut fur Extraterrestrische Physik)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Understanding the combination of ingredients required in galaxy formation, to produce the observed galaxy population, remains one of the challenges of Cosmology. Although the background cosmology is well understood, the properties of galaxies depend sensitively on the star formation model, stellar feedback, the effects of metallicity and the formation of black holes and their associated feedback. Using sub-grid physics for these processes introduces further parameters to simulations, which then need to be constrained by observations. A key aspect of the Eagle project is to reproduce the observed stellar mass function, through tuning the sub-grid parameters, focusing on the Type II SN feedback and AGN feedback. The completed data will consist of a 100Mpc^3 N-body SPH simulation with gas particle resolution of ~10^6 solar masses, providing sufficient resolution to study Milky Way size galaxies, with 10^5 particles. This size of simulation at such a high resolution puts Eagle as one of the largest SPH simulations to be carried out, with an added challenge of reproducing observable data. While the full volume is still in the preparatory stages, results for smaller volumes and zoomed simulations, constraining parameters are currently available. These tests also outline how the parameter selection can be carried out.

Halo Statistics and Substructure at High Redshift

Author: William Watson

University of Sussex

Co-Authors: I. T. Iliev (University of Sussex)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Using a suite of large N-Body Dark Matter Simulations (with 28bn - 216bn particles) the halo mass function is probed at high redshifts (z > 6) and compared to existing analytic functions from the literature. Two spherical overdensity (SO) halo finders and one Friends-Of-Friends (FOF) halo finder were used in the analysis. In addition, a presentation of the substructure of the most massive halos from the simulations is given, found using the AMIGA Halo Finder (AHF) and SUBFIND.

Non-Gaussianity in Large Scale Structure and Minkowski Functionals

Author: Geraint Pratten

Cardiff University

Co-Authors: D. Munshi (Cardiff University)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Minkowski Functionals (MFs) are topological statistics that have become one of many standard tools used in investigating statistical properties of cosmological random fields.To lowest order, the MFs depend on three generalised skewness parameters that can be shown to probe the bispectrum with differing weights. Recent studies have advocated the use of a power spectrum associated with the bispectrum, called the skew-spectrum, that has more power to distinguish between various contributions to the bispectrum than the conventional formalism adopted when using the Minkowski Functionals. In this talk we will review the motivations for studying non-Gaussianity and emphasise the importance of the momentum dependence of higher order correlators in investigating inflationary models before introducing the skew-spectra, applied to galaxy surveys, as a tool for investigating primordial and gravitationally induced non-Gaussianity.

Numerical simulations with GPUs

Author: Martin Zintl

USM

Co-Authors: A.M. Burkert (University Observatory Munich)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Many astrophysical problems are limited by the computational power of the machines running those simulations. Therefore, additional hardware to assist the CPU of a computer have been used in the past (Grape boards, FPGAs), to speed up simulations. Graphics processing units (GPUs) provide a novel way to gain massive performance speedups in certain situations due to their highly parallel nature. We will talk about the opportunities, but also the challenges of running simulations on a GPU. Since the raw floating point performance of a GPU exceeds the performance of a CPU by far, there is the potential for significant speedups. Early tests show that our SPH simulation code on one consumer GPU is approximately 60 times faster than the standard cosmological code "Gadget-3" running on a Core i7 Quadcore processor. We will also present a few results of simulations run with this code: The collision of two cold gas clouds with high mach numbers in an isothermal three-dimensional simulation, and the problems of standard SPH regarding the growth rate of the Kelvin-Helmholtz-instability in two dimensions, with and without various SPH modifications.

Particle-by-Particle M2M Galaxy Simulations

Author: Jason Hunt

MSSL (UCL)

Co-Authors:

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

The next European Space Agency (ESA)’s cornerstone mission, Gaia, is expected to be launched in 2013. We are developing a made-to-measure (M2M) Galaxy model to reconstruct the mass distribution and stellar kinematics of each component of the Milky Way, such as the thin and thick discs, bar/bulge and halo, from the data from Gaia and related surveys. M2M was originally suggested by Syer & Tremaine (1996), which adapts an existing model to better fit ‘observables’ by altering the particle weights of an N-body model. As the Gaia data will be in the form of individual stars, we have newly developed a particle-to-particle M2M (ppM2M), where the target observables are compared with the model observables at the position of target particles, i.e. stars. We demonstrate that ppM2M is capable of reproducing the target N-body models, including Hernquist (1990) models and disc galaxies simulated with N-body code.

The Influence of Gas Physics on SZ Pressure Profiles

Author: Simon Pike

Co-Authors: Scot Kay - University of Manchester

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

The Sunyaev-Zel'dovich or SZ effect is caused by CMB photons being scattered off free electrons via Compton scattering, creating a predictable distortion in the CMB. The intracluster medium or ICM is a heated plasma in approximately hydrostatic equilibrium at the centre of clusters that forms the major contribution to the SZ effect. The SZ effect can be used to investigate the scaling relation between the Y parameter, which is a volume integral over the pressure of the gas, and cluster mass. It is therefore important to investigate how gas physics within the cluster might affect the pressure profile, and therefore its Y parameter. In my poster I will show preliminary results of a new set of 30 hydrodynamical simulations, spanning a mass range of 1e14 to 1e15 M_sun/h. These simulations will be used to see how the gas physics, including cooling, star formation and feedback will effect the pressure profiles and the SZ Y parameter.

The predicted UV colours of galaxies at z>3

Author: Violeta Gonzalez-Perez

Durham University

Co-Authors: C. Lacey (Durham), C. Baugh (Durham), S. Wilkins (Oxford), C. Frenk (Durham), T. Theuns (Durham)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

The rest frame ultra-violet (UV) colours of galaxies are a powerful tool to select galaxies at z>3, in fact, the new Hubble Space Telescope has recently revealed several candidates at z=10. The UV continuum slope is widely used to estimate the dust content of galaxies and it can give us information about the end of the reionisation epoch. In this talk I will present a theoretical study of the UV colours of galaxies at z>3. Using GALFORM, a semi-analytical model of galaxy evolution, I will present results on how UV colour change with changing quantities from the physical distribution of dust with respect to stars to the dust extinction curve adopted, and how these affect the knowledge that we can extract from analysing the UV continuum slope.

The role of the AGN in the evolution of Eagle galaxy groups.

Author: Yetli Rosas-Guevara

Durham University

Co-Authors: R.G. Bower(ICC Durham University), C. Booth(University of Chicago), J. Schaye (Leiden Observatory Leiden University), Adrian Jenkins(ICC Durham University), R.Crain (Leiden Observatory Leiden University), T.Theuns (ICC Durham University and University of Antwerp), C.S. Frenk(ICC Durham University) , M. Furlong (ICC Durham University)

Session: COS3: Simulations of the formation of galaxies and larger structures

Displayed during: Poster Session A

Summary:

Previous studies have shown that the AGN plays a key role in the shaping of the high end of stellar mass function and in the evolution systems such as groups and clusters. Motivated by this,, we study the evolution of the galaxy groups focusing on the variations in AGNs physics implemented in Evolution and Assembly of Galaxies and their Environments (EAGLE) project. In order to efficiently study the formation of galaxies in high mass haloes, we perform a set of hydrodynamical resimulations of galaxy groups of 10^13-14 h^-1 Msun at a resolution of 10^6 h^-1 Msun per gas particle. We explore some parameters of the AGN prescription. We focus mainly on follow the evolution of the Central Brightest Galaxy (CBG) and its star formation history as well as the Black Hole (BH) Mass -Bulge Mass relation. We explore the impact of several parameters such as the threshold amount of energy released by the BH to its surrounding gas and halo mass at which we inject BH seeds.

Discrimination between cosmological constant, quintessence, and modified gravity

Author: Houri Ziaeepour

Max Planck Institute fur Extratresstrische Physik (MPE)

Co-Authors:

Session: COS4: Modelling Dark Energy and Modified Gravity

Displayed during: Poster Session B

Summary:

In what concerns dark energy, the ultimate goal of space and ground based surveys is discriminating between various candidate models and a cosmological constant. Here we report results of a work on finding the best set of parameters and measurables for this purpose. In particular we show that independent measurements of cosmological parameters of homogeneous component - the background cosmology - and anisotropies are necessary, notably for distinguishing between interacting quintessence models and modified gravity. This put in evidence for the advantage of surveys able to observe Large Scale Structures as well as a large number of supernovae. The role of CMB measurements for improving discrimination will be mentioned too. We also propose quantities that determine the discrimination power of a survey independent of observed proxy. (based on arXive:1112.6025, submitted)

String Quintessence and the Formulation of Advanced Quantum Gravity

Author: Andrew Worsley

KCL

Co-Authors:

Session: COS4: Modelling Dark Energy and Modified Gravity

Displayed during: Poster Session B

Summary:

Since the publication of the general theory of relativity (GTR), gravity has been described by classical field equations. However, mathematically GTR results in the formation of infinite density singularities in black holes, it challenges simultaneity and causality, and it is generally incompatible with quantum mechanics. A separate problem is the presence of “dark energy”, the energy inherent in space-time. GTR helps explain this energy by the addition of a separate cosmological constant. However, what is required are formulae which treat the energy in space-time as an integral part of quantum gravity. This space-time energy is treated as integral in the quintessence model, and may be resolvable by the use of a minimum energy scale. In this paper we use the standard minimal energy scale, Planck’s constant, and in turn define a new quintessence. Using this string quintessence, we obtain advanced

quantum gravity (AQG), which technically agrees exactly with GTR, in the range where GTR has been widely tested. Additionally, the principle of relativity is also maintained, and advanced in order to restore simultaneity and causality. Moreover, using string quintessence, AQG resolves the difficulties related to singularities, and in turn explains the apparent presence of dark energy. The separate presence of “dark energy” can also be explained. Overall, in this paper gravitation is taken to the next level, black holes and in turn dark matter are explained and “dark energy” the presence of space-time energy, becomes integral to the equations of advanced quantum gravity (AQG).

Testing modified gravity in the Solar System using LISA-pathfinder

Author: Pasquale Galianni

School of Physics & Astronomy, the University of St Andrews

Co-Authors: A.Martin Feix (Department of Physics, Technion - Israel Institute of Technology); B.Hongsheng Zhao;B.Keith Horne (SUPA, School of Physics and Astronomy, the University of St Andrews)

Session: COS4: Modelling Dark Energy and Modified Gravity

Displayed during: Poster Session B

Summary:

There are many points in the Solar System where the total gravitational pull exerted by the Sun the planets and the galaxy cancels out exactly. These points, which do not coincide with the Lagrangian points, are embedded into low acceleration regions where paradigms a` la MOND predict significant deviations from Newtonian mechanics. Two of these bubbles are close enough to Earth to be visited by spacecrafts, providing a unique occasion to test the laws of gravity into extremely low gravitational acceleration regimes. I will discuss the possibility of testing MOND and QMOND using the instruments on-board the LISA-pathfinder spacecraft, which has been scheduled for launch in 2013.

An SPMHD Mean Field Dynamo

Author: Federico Stasyszyn

Universitäts-Sternwarte München (USM)

Co-Authors: D. Elstner (AIP);

Session: CP1: Current Developments in Numerical astrophysics

Displayed during: Poster Session A

Summary:

Following the developments in SPMHD we implemented the turbulent transport terms in the induction equation for the evolution of the magnetic field in , with the aim to perform realistic modelling of dynamo action in global galaxy simulations. Besides the spatial dependent turbulent diffusion η also the α-tensor is included. For a disk setup we could verify our numerical results with a known analytical model of Meinel 1990. Further comparisons with grid based numerical simulations for disks with a galactic rotation law and an anisotropic α-effect are shown. This allow us to perform global galaxy simulations with a subgrid model for dynamo action, which can be linked to upcoming and present day radio observations

Simulations of Cosmological Magnetic Fields using GCMHD+

Author: David Barnes

MSSL

Co-Authors:

Session: CP1: Current Developments in Numerical astrophysics

Displayed during: Poster Session A

Summary:

Observations show that a range of galaxy clusters are permeated by cosmological magnetic fields of micro gauss strength. The origin of these fields is uncertain and several processes have been suggested to generate them. Numerical simulations are required to show how the strength and profile of a cosmological magnetic field from a generation mechanism changes in a range of systems. We simulate the formation of ten different galaxy clusters with a range of final virial masses using GCMHD+, where the gas particles are embedded with a homogeneous primordial magnetic field. The merging of protoclusters and infall of material lead to an amplification of the magnetic field in the cluster and the emergence of a radial profile for the magnetic field. We show how the magnetic field and the amplification of the field changes with the mass of the system. The effect of the resolution of the simulation on the strength and profile of the cosmological field is also shown for one system.

Updated GCD+: A new Galactic Chemo-Dynamical evolution code

Author: Awat Rahimi

UCL - MSSL

Co-Authors: D.Kawata (UCL-MSSL)

Session: CP1: Current Developments in Numerical astrophysics

Displayed during: Poster Session A

Summary:

We have made several important enhancements to our original Chemo-Dynamical galaxy evolution code: GCD+. GCD+ is a N-body/SPH code which takes into account self-gravity, hydrodynamics, radiative cooling, star formation, SNe feedback and chemical enrichment. The new code incorporates new schemes for gravitational N-body dynamics and SPH. We implement a novel star formation and feedback recipe. We describe these new schemes and outline their effects on numerical simulations of galaxy evolution. The new schemes lead to a significant improvement in the ability of TreeSPH codes, such as GCD+, to capture strong shocks and model Kelvin-Helmholtz instabilities.

A Multi-Wavelength View of the ISM in Nearby Galaxies

Author: Ioannis Bagetakos

University of Hertfordshire

Co-Authors: E.Brinks (University of Hertfordshire)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We are developing an objective, automated method to compare multi-wavelength images based on 2–D pixel-by-pixel cross-correlations. We introduced a measure for the degree of correlation, Ccoef, which takes values from 1 (perfect correlation) to −1 (perfect anti-correlation). This we subsequently applied to NGC 2403, in a pilot project. We produce spatially resolved cross-correlation maps, on scales of 250 pc to 1000 pc and radial profiles of the cross-correlation coefficients. We find that 1.) all dust tracers, 8μm–70μm, are well correlated (Ccoef > 0.7) at all scales; 2.) all the star formation tracers are well correlated at scales larger than 500 pc (Ccoef > 0.6); 3.) at 250 pc scale, FUV correlates poorly (Ccoef ~ 0.3) with any the dust tracer, a direct consequence of the absorption of FUV photons by dust; and 4.) neutral atomic hydrogen is tightly correlated with the 8μm emission (Ccoef ~ 0.6), illustrating the fact that HI is mixed with PAH's.

Concurrant star formation and black hole growth in the most massive galaxies

Author: Jason Rawlings

MSSL-UCL

Co-Authors: N.Seymour (CSIRO Astronomy & Space Science) M.J.Page (MSSL-UCL) M.Symeonidis (MSSL-UCL)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

High redshift radio galaxies (HzRGs) are extremely powerful, rare, radio-loud AGN whose hosts are known to be among the most massive galaxies in the Universe. While it is expected that the AGN has a strong contribution to the bolometric output, about a third of HzRGs have sub-mm detections which implies considerable star formation in the host galaxy. While observations at these wavelengths inform us of the cold dust associated with the galactic star forming regions, they reveal little about the AGN buried deep within. At mid-infrared (MIR) wavelengths however, both components can play an important role in terms of the energy output of such objects. In order to disentangle the contributions from AGN activity and star formation, we obtained MIR spectra of a sample of HzRGs ($1 < z < 3.2$) using the Infrared Spectrograph on-board the Spitzer Space Telescope. About a third of the MIR spectra in our sample show polycyclic aromatic hydrocarbon features indicative of considerable star formation and most show relatively weak silicate absorption, implying a more clumpy and extended dust structure surrounds the central engine. With the aid of a library of AGN and starburst models, we examine the properties of HzRGs such as star formation rates, AGN unobscured luminosities and extinction. Our aim is to gain a better understanding of the connection between star formation and the radio-loud phase of powerful obscured AGN.

Deep Radio Continuum Imaging Of The Dwarf Irregular Galaxy IC 10: Tracing Star Formation And Magneti

Author: Volker Heesen

U Hertfordshire

Co-Authors: U. Rau (NRAO); M. Rupen (NRAO); E. Brinks (U Hertfordshire); D. Hunter (Lowell)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We exploit the vastly increased sensitivity of the Expanded Very Large Array (EVLA) to study the radio continuum and polarisation properties of the post-starburst, dwarf irregular galaxy IC10 at 6 cm, at a linear resolution of ~50 pc. We find close agreement between radio continuum and Halpha emission, from the brightest HII regions to the weaker emission in the disk. A quantitative analysis shows a strictly linear correlation, where the thermal component contributes 50% to the total radio emission, the remainder being due to a non-thermal component with a surprisingly steep radio spectral index of between -0.7 and -1.0 suggesting substantial radiation losses of the cosmic-ray electrons. We confirm and clearly resolve polarised emission at the 10-20% level associated with a non-thermal superbubble, where the ordered magnetic field is possibly enhanced due to the compression of the expanding bubble. A fraction of the cosmic-ray electrons has likely escaped because the measured radio emission is a factor of 3 lower than what is suggested by the Halpha-inferred SFR

Halpha-inferred SFR.

Dust heating in nearby galaxies from the Herschel Reference Survey

Author: Lingjie Kong

University of Manchester

Co-Authors: George J. Bendo (University of Manchester), Herschel Reference Survey, Herschel Virgo Cluster Survey

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Recent research with Herschel Space Observatory data has shown that dust emission at >250 microns appears to be heated by the total stellar population rather than just star forming regions. This has implications for using dust to measure star formation and for modelling dust emission. However, these results have been based on observations of a relatively small number of galaxies. We expand this analysis using data for a subset of galaxies observed by the Herschel Reference Survey. We will compare variations in the surface brightness ratios to tracer of total stellar emission and star formation to identify the dust heating sources, and then we will compare our results with prior observational results for other galaxies and prior modelling results.

Flux density variations of radio sources in M82

Author: Melanie Gendre

JBCA

Co-Authors: D. Fenech (UCL); R. Beswick (JBCA); T. Muxlow (JBCA)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

M82 is one of the closest (d = 3.2 Mpc) starburst galaxies known, producing a large population of massive, rapidly evolving stars, and an equally large number of supernovae. In the past 30 years, M82 has been subject to frequent radio monitoring at centimetre wavelengths with the VLA and MERLIN. With detection of over 50 discrete objects, including over 30 SNRs, these regular observation programmes have the advantage of tracking the evolution of supernova remnants as their shells expand, which provide a way to investigate properties of the Inter-Stellar Medium. Regular observation programmes also allow for the monitoring of flux variability in sources such as 41.95+57.5, which has shown a continued decrease in flux density since its first observation in 1965. We present the results of the 2009-2010 monitoring sessions of the starburst galaxy M82, obtained with MERLIN)at 5-GHz and e-MERLIN at 6-GHz. Combining the 5-GHz MERLIN epochs to form a map with 11.8 uJy/beam noise level, 52 discrete sources, mostly supernova remnants and HII regions, are identified. These include 3 objects which were not detected in the 2002 5-GHz MERLIN monitoring session: supernova 2008iz, the transient source 43.78+59.3, and a new supernova remnant shell. Flux density variations, both in the long (1981 to 2010), medium (2002 to 2010) and short (2009 to 2010) term, are investigated. We find that flux densities of SNR in M82 stay relatively constant in most of the sample (~90-95%). In addition, aside from SN2008iz and the well-known variable source 41.95+57.5, 4 sources display long term variations over the period 1981-2010, three of which have measured sizes among the most compact in M82. These variations could be explained by changes in the mediums in which the shocks travel.

Galaxy-wide outflows in z~1.5-3.5 infrared-luminous galaxies

Author: Christoper Harrison

Durham University

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Leading models of galaxy evolution predict an active period, peaking around z~2, of supermassive black hole (BH) and stellar growth. These processes are thought to be self-regulating through powerful active galactic nuclei (AGN) driven outflows; however, direct observational evidence of this at high redshift remains very limited. I present integral field spectroscopy observations, covering the [OIII] emission line, of eight submillimetre-luminous galaxies (SMGs) that host radio-quiet AGN activity. These SMGs display extremely broad (FWHM~1000-2000 km/s) [OIII] emission across 4-15 kpc, a signature of vigorous outflows over galaxy-wide scales. These outflows are dumping considerable amounts of energy into their host galaxies which is likely to disrupt star formation. For example, we identify a spectacular, two-sided, high velocity (v~830 km/s) AGN-driven outflow in a galaxy that is also undergoing a merger and intense star formation activity. We speculate that we are observing galaxies in a transition phase from obscured star formation and AGN activity to an unobscured quasar, potentially a key evolutionary stage in the formation of local massive galaxies.

H-ATLAS/GAMA: The star formation history of H-ATLAS galaxies and its correlation to the environmen

Author: Ali Dariush

Imperial College London

Co-Authors: S. Eales (Cardiff University); S. Dib (Imperial College London)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

The aim of this work is to see how star-formation-histories (SFH) correlate with the environmental density and/or dust properties of low-redshift galaxies detected by H-ATLAS. We use multi-band photometric data (e.g. UV, optical, and NIR) in order to measure the SFH of galaxies from their spectral energy distributions (SEDs). To do so, we will consider all galaxies with submillimetre detections and measure their SFHs against a control sample. We analyse differences between the SFHs as well as dust mass/temperature of low-mass and high-mass systems and investigate the effect of environment (density) on such properties.

H-ATLAS: The FIR Properties of BAL Quasars

Author: Jose Manuel Cao Orjales

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Co-Authors: J. A. Stevens (University of Hertfordshire); M. J. Jarvis (University of Hertfordshire, University of the Western Cape); D. J. B. Smith (University of Hertfordshire); M.J. Hardcastle (University of Hertfordshire); R. Auld (Cardiff University); M. Baes (Universiteit Gent); A. Cava (Universidad Complutense de Madrid); D. L. Clements (Imperial College London); K. Coppin (McGill University); A. Dariush (Imperial College London); L. Dunne (University of Nottingham); S. Dye (University of Nottingham); S. Eales (Cardiff University); C. Hoyos (University of Nottingham); E. Ibar (UKATC); R. J. Ivison (UKATC and University of Edinburgh); R. Hopwood (Imperial College London); S. J. Maddox (University of Nottingham); M. J. Page (MSSL, University College London); E. Valiante (Universiteit Gent)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We have used data from the Herschel-ATLAS at 250, 350 and 500 microns to determine the far-infrared (FIR) properties of Broad Absorption Line Quasars (BAL QSOs). Our sample contains 49 high-ionization BAL QSOs (HiBALs) and 1 low-ionization BAL QSO (LoBAL) which are compared against a matched sample of 329 non-BAL QSOs. We calculate star-formation rates (SFR) for our individually detected HiBAL QSOs and solitary LoBAL QSO as well as average SFRs for the BAL and non-BAL QSO samples based on stacking the Herschel data. We find no difference between the HiBAL and non-BAL QSO samples in the FIR, even when separated based on differing BAL QSO classifications. Despite tentative claims in the literature, we are unable to show a decisive dependence of CIV equivalent width on FIR emission, suggesting that the strength of any outflow in these objects is not linked to their FIR output. These results suggest strongly that BAL QSOs (more specifically HiBALs) can be accommodated within a simple AGN unified scheme in which our line-of-sight to the nucleus intersects outflowing material. Our results do not support evolutionary models.

Herschel

Author: Chris Fuller

Cardiff University

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Using the superb resolution and sensitivity of Herschel we have measured the FIR (100, 160, 250, 350, 500u) fluxes of an optically selected sample of Coma cluster galaxies. Using these data we fit spectral energy distributions to derive dust temperature and masses. We cover both the cluster core which is dominated by early type galaxies and also the extended outer regions of the cluster. We make comparisons of the FIR properties of these galaxies with those of a similar sample detected and measured in the Virgo cluster.

Probing the star formation and AGN connection using NMF analysis of IRS spectra

Author: Peter Hurley

University of Sussex

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Understanding the star formation and AGN connection in infrared galaxies still poses an interesting problem for astronomers. The infrared spectra obtained from the Spitzer IRS spectrograph, has provided a unique probe, but difficulties remain in utilising the spectra due to the limited modelling tools available for the mid-infrared. Blind source separation techniques such as principal component analysis (PCA), provide an alternative tool to modelling. PCA has already successfully decomposed the IRS spectra of local ULIRGs into 5 unique components. However, due to the nature of PCA, the components do not have an obvious physical interpretation. Non negative matrix factorisation (NMF) is similar to PCA, but constrains both weights and derived templates to be non-negative. This more closely resembles the physics of emission in the mid-infrared and as a result the derived components are

derived templates to be non-negative. This more closely resembles the physics of emission in the mid-infrared and as a result the derived components are more physically intuitive. We have applied the NMF technique to the IRS spectra of galaxies from the CASSIS database (Lebouteiller et al. 2011). Our derived NMF components/templates can be used to quantify the contributions from different physical environments and are therefore an ideal classification tool for constraining properties such as the star formation and AGN contribution for galaxies with IRS data.

Radio to infrared spectra of late-type galaxies with Planck and WMAP data

Author: Michael Peel

Jodrell Bank Centre for Astrophysics, University of Manchest

Co-Authors: M. W. Peel [1], C. Dickinson [1], R. D. Davies [1], D. L. Clements [2], R. J. Beswick [1] [1] Jodrell Bank Centre for Astrophysics, University of Manchester [2] Astrophysics group, Imperial College London

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Using the Planck ERCSC, WMAP and other archival measurements, we construct continuum spectra of the nearby late-type galaxies Messier 82, NGC 253 and NGC 4945. We find that their spectra are consistent with steep spectrum synchrotron emission, a substantial amount of free-free emission, and cold thermal dust. The higher levels of free-free emission than previously found bring the star formation rate calculated from it into better agreement with that from non-thermal emission. We place limits on the amount of anomalous microwave emission from the galaxies, finding that it is lower than expectations from our own Galaxy. (MNRAS Letters, 416, 99, arXiv:1105.6336)

Spectral Aging In The Lobes of FR-II Radio Galaxies

Author: J Harwood

University of Hertfordshire

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

It has become increasingly apparent in recent times that radio-loud active galaxies play an important role in the evolution of galactic populations. Understanding their dynamics and energetics is therefore vital if we are to build a true picture of galaxies came to be the way they are today. Determining the spectral shape of a population can often give key insights in to the underlying physics of a radio source, specifically, the ability to derive information about age of emission and the rate and which energy is being transferred to the local environment. In principle, since higher-energy electrons lose energy faster by synchrotron radiation, we expect to see steeper, more strongly curved spectra in older regions of plasma. Models describing this curvature (‘spectral ageing’), fitted to narrow-band observations of a radio source at several frequencies have been a standard tool in this field for many years. The poor sampling in frequency space has traditionally meant that determining which of these models (if any) are correct has been hard to achieve; however, the capability of the upgraded EVLA to observe at widely spaced frequencies and broad-bandwidths allows this problem to be overcome. Here I present the latest results in using these capabilities to provide high resolution spectral maps to answer the long standing question of possible spectral ageing in the lobes of FRII radio galaxies.

Spectroscopic Followup of Radio-loud AGN Sources in the South Pole Telescope Survey

Author: Kate Husband

University of Bristol

Co-Authors: S. Chapman (Institute of Astronomy, UK), J. Vieira (California Institute of Technology, USA)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

A study of radio loud AGN sources in ~1500 square degrees of the South Pole Telescope point-source survey has revealed three classes of sources: radio-loud quasars whose radio to sub-mm SED is a flat power law, radio-loud quasars whose spectrum turns over due to self-absorption and sources with an upturning spectrum in the far-infrared (FIR). The upturning spectrum has an excess 'upturn' flux of 5-84 mJy at 1.4mm thought to be due to thermal emission from dust. If the upturn is thermal emission from dust the implied far-infrared luminosities are huge and the sources are ultraluminous infrared galaxies (ULIRG: L>10^12). Despite this none of the upturning sources are detected by Plank or IRAS. Follow-up spectroscopy of a sub-sample of upturns with VLT-ISAAC indicates that these ATCA-identified radio sources are typically broad line radio-QSOs at z=1.0-2.3. Possible scenarios are discussed to explain these observations.

Spying on the neighbour - Mapping the ISM and star formation in Andromeda

Author: George Ford

Cardiff University

Co-Authors: Walter Gear (Cardiff University); Steve Eales (Cardiff University); Matt Smith (Cardiff University)

Co-Authors: Walter Gear (Cardiff University); Steve Eales (Cardiff University); Matt Smith (Cardiff University)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Here we explore how the star formation rate relates to density of gas in M31, and hence test the Schmidt law on smaller scales than was previously possible. We use two methods of calculating the star formation. FUV + 24μm emission probes the embedded and unobscured star formation separately. We use a modified version of the prescription found in Leroy et al (2008) combining Galex and MIPs data, corrected for the old stellar population. Total infrared luminosity probes dust heating only and is calculated using recently acquired data from the Herschel Space Observatory. We compare the two methods, and discuss the limitations of both. We further look at possible means to calibrate one or both maps to reach an agreement. Gas mass is traced by summing the total HI and H2 (from CO). We calculate gas-to-dust ratios at every pixel (dust mass found from Herschel data) and find a variation with radius. This is used to create a second gas map, using dust as the tracer. The Schmidt law is tested in several elliptical annuli. It appears the dust tracer gives the most consistent results throughout the galaxy, but gives an index much lower than values previously found.

Star Formation and AGN Activity in Interacting Galaxies: A Near-UV Perspective

Author: Caroline Scott

Imperial College

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Galaxy interactions produce intense star formation episodes, driving the build-up of stellar mass and black holes and alter the morphological mix of the universe. While they are routinely included in galaxy formation models, the evolution of star formation and AGN activity is only now being investigated from a purely observational perspective. SDSS and GALEX data is employed to analyse our close pairs catalogue. UV and optical colours are used to approximate recent star formation in close pair systems as a function of separation, galaxy properties (eg. morphology and luminosity) and local environment, and NUV-derived luminosities provide specific star formation rates. Our large homogeneous dataset allows us to study the interplay between star formation and AGN activity. Using SDSS spectra, we probe the AGN fraction and its evolution as mergers advance. The results provide constraints on our current theoretical infrastructure and provide a picture of how merging affects galaxy evolution from an observational perspective using state-of-the-art spectro-photometric data from current large-scale observational surveys.

Submillimetre and X-ray observations of star-forming AGN in the epoch of galaxy formation.

Author: Mat Page

MSSL-UCL

Co-Authors:

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

The present day black hole / bulge mass correlation tells us that star formation and the growth of black holes by accretion must be intimately linked. In the years prior to Herschel, ground based submillimetre observations combined with X-ray surveys identified a subset of luminous QSOs, those with significant X-ray absorption as embedded in powerful star-forming submillimetre galaxies. I will present evidence that the X-ray absorbers in these objects are highly-ionised winds, and discuss the evolutionary-sequence suggested by these observations. I will move on to describe the results obtained from the Herschel Multi-tiered Extragalactic Survey (HerMES) observations of the Chandra Deep Fields, which pairs the deepest submillimetre images ever obtained with the deepest X-ray surveys. The Herschel data provide the first sensitive glimpse into the far-infrared and star formation properties of a large part of the AGN population at cosmological distances. With Herschel SPIRE we identify star formation in a much greater fraction of AGN than in pre-Herschel observations. The association of X-ray absorption with star-forming QSO host galaxies is found to extend well below the break in the luminosity function of AGN. We discuss the implications of these findings with respect to the co-evolution of galaxies and the black holes that reside in their centres.

Sweeping up the Dust in the Low Redshift Universe by Stacking in the Herschel ATLAS

Author: Nathan Bourne

University of Nottingham

Co-Authors: S.J.Maddox (Canterbury, NZ); L.Dunne (Canterbury, NZ); and the H-ATLAS and GAMA teams.

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

The Herschel-ATLAS survey provides the largest ever map of the sub-millimetre sky. We have used over 100 square degrees of this revolutionary data set, with multi-wavelength photometry and redshifts from GAMA, to conduct an unbiased census of the dust mass in optically selected galaxies up to

set, with multi-wavelength photometry and redshifts from GAMA, to conduct an unbiased census of the dust mass in optically selected galaxies up to z=0.35, using stacking techniques to recover emission from sources well below the noise and confusion limits of H-ATLAS. I will summarise the results and discuss the relationship between the typical dust and stellar content of galaxies, and how this depends on optical colour, stellar mass and redshift.

The AGN-Starburst Connection in 1 < z < 4 Quasars

Author: Ashley K Hyde

Imperial College London

Co-Authors: D.L.Clements (Imperial College London), H.Patel (Imperial College London), HerMES Collaboration

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We model the optical-to-IR SEDs of 38 SWIRE quasars with optical spectroscopic redshifts. Our key results are: 1) All these quasars are experiencing starbursts. 2) 21 of our quasars are detected by the Herschel SPIRE instrument. By fitting and integrating an M82 starburst SED, we find that all 21 host galaxies are HLIRGs with log(L,8-1000um/L,sun)=13-14, and they are experiencing very high star formation rates of ~10,000Msun/yr where they harbour non X-ray detected quasars, but ~7,000Msun/yr if their AGN is X-ray bright (L[2-8keV]>10^37W). This suggests that in the latter group the AGN may be suppressing star formation in the host galaxy, as predicted by the quenching paradigm. 3) We estimate black hole masses from the CIV or MgII broad line and we find a range of 8.06

The Distribution of Star Formation in a Representative Sample of 69 Barred Galaxies.

Author: Richard Taylor

Co-Authors: W.X. Maciejewski (Liverpool John Moores University)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We study the distribution of H-alpha emission in barred spiral galaxies from the H-alpha Galaxy Survey, a survey that is representative of a wide range of galaxy luminosities. Of the 69 galaxies in our sample, about half exhibit emission from the main body of the bar, whilst only 13% show emission from the leading edge of the bar. Emission from the nucleus is present in 75% of galaxies, with extended nuclei preferred by strongly barred galaxies, while in weak bars, extended and compact nuclei are both equally common. Nuclear rings are extremely rare in H-alpha emission (6% of the sample). Our findings challenge the generic picture of gas flow in barred galaxies and of the evolution of barred galaxies.

The host galaxies and black-hole:galaxy mass ratios of luminous quasars at z~4

Author: Thomas Targett

IfA, Edinburgh

Co-Authors: J.S. Dunlop (IfA, Edinburgh) R.J. McLure (IfA, Edinburgh)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We present and analyse the deepest, high-quality Ks-band images ever obtained of luminous quasars at z~4, in an attempt to determine the basic properties of their host galaxies less than 1 Gyr after the first recorded appearance of black holes with Mbh > 10^9 Msol. Via carefully-controlled separation of host-galaxy and nuclear light, we estimate the luminosities and stellar masses of the host galaxies, and set constraints on their half-light radii. The quasar host galaxies have K-band luminosities similar to radio galaxies at comparable redshifts, suggesting that these quasar hosts are also among the most massive galaxies in existence at this epoch. However, the quasar hosts are a factor ~5 smaller than the host galaxies of luminous low-redshift quasars. We estimate the stellar masses of the z~4 host galaxies to lie in the range 2-10x10^11 Msol, and use the CIV emission line to estimate the masses of their black holes. The results imply a black-hole:host-galaxy mass ratio Mbh:Mgal~0.01-0.05. This is an order of magnitude higher than typically seen in the low-redshift Universe, and is consistent with existing evidence for a systematic growth in this mass ratio with increasing redshift, at least for objects selected as powerful AGN.

The influence of star formation and nuclear activity on the molecular gas in nearby active galaxies

Author: Stefanie Muehle

Argelander-Institut fuer Astronomie

Co-Authors: C. Henkel (Max-Planck-Institut fuer Radioastronomie) M. Rodriguez (Instituto de Astrofisica de Andalucia) T. de Maio (University of Colorado) S. Aalto (Onsala Space Observatory) E.R. Seaquist (University of Toronto)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Star formation processes and nuclear activity play a crucial role in the evolution of galaxies, locally as well as at high redshifts. The question whether or not the initial mass function (IMF) is universal is subject to intense debate. A number of recent observations have been interpreted as evidence for a non-standard IMF in a variety of environments. Hydrodynamical simulations suggest that the kinetic temperature of the collapsing molecular gas is a key factor for the shape of the resulting IMF. In active environments like the cores of starburst galaxies or near AGN, the dense molecular gas may be much warmer than the dense cores in the Milky Way disk, but unfortunately, the kinetic temperature of the molecular gas in external galaxies is rarely well constrained. We demonstrate the diagnostic power of a selected set of paraformaldehyde lines, in particular in the ALMA era, as tracers of the kinetic temperature as well as of the gas density in external galaxies using our non-LTE radiative transfer model. The first results of our survey of nearby starburst galaxies and AGN using this new tool support the notion of a significant warm molecular gas phase in at least some of these environments.

The LITTLE THINGS Survey

Author: Elias Brinks

University of Hertfordshire

Co-Authors: and the LITTLE THINGS Team

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

We present the LITTLE THINGS project, a multi-wavelength dataset consisting of 41 relatively normal, nearby (<10 Mpc) gas-rich dwarf irregular galaxies. LITTLE stands for Local Irregulars That Trace Luminosity Extremes, and is the low-mass, low-metallicity extension of THINGS, The HI Nearby Galaxy Survey. Our data include GALEX UV images, ground-based UBV and Halpha images, some ground-based JHK images, Spitzer archival mid-IR images, and HI-line maps. The HI maps, obtained with the VLA, go deep (12/6/2 hrs in B/C/D arrays) and are characterised by high spectral resolution (<2.6 km/s) and high angular resolution (typically 6", which is 110 pc at the average distance of our sample). Our datasets trace the stellar populations, gas content and structure, dynamics, and star formation indicators in the galaxies, and are being used to answer questions about star formation in dwarf galaxies. All data have now been made publicly available. We give here an overview of the data and the project's aims.

The search for cool baryons at z~5

Author: Luke Davies

University of Bristol

Co-Authors: M.N.Bremer (University of Bristol); E.R.Stanway (University of Warwick); M.Birkinshaw (University of Bristol); M.N.Lehnert (Observatoire de Paris, Meudon); A.Omont (Institut dAstrophysique de Paris); E. J.Mannering (University of Bristol)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

Lyman Break Galaxies (LBGs) form a substantial fraction of the known high-z (z~5) galaxy population. While these systems have been extensively studied at rest-frame UV/optical wavelengths (probing the bulk of their stellar mass), little work has been undertaken to explore their cool dust and interstellar gas content. In order to fully understand star-formation activity at high-z and the subsequent evolution of early star-forming galaxies, we must observe their complete baryonic budget. Until recently studies of the dust and molecular gas content of the highest-z galaxies has been limited to massive/rare systems which maybe atypical of the general star-forming population at z~5. To this end we have carried out a pilot study, targeting molecular gas and dust emission from regions which are over-dense in LBGs at z~5. We place constrains on the UV-dark baryonic content of high-z galaxies, indicating that these systems are likely to be small, independent galaxies and not super-starburst regions embedded in a much larger obscured system (for reasonable assumptions of T_dust and `X-factor'). Though this study we have pushed the limits of current instrumentation but discuss how the detection cool material at high-z will become routine with the fully operational ALMA.

The star formation history of the Galactic Bulge

Author: Albert Zijlstra

University of Manchester

Co-Authors: K. Gesicki (University of Torun, Poland), B. Rees (University of Machester, UK)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

The star formation history of the Galactic Bulge is an important constraint on its origin - either as a separate entity of the Galaxy or as a pseudo-bulge. We derive the star formation history using HST and VLT observations of compact planetary nebulae. Stellar ages are derived from the mass distribution of the central stars. There is evidence for a range of ages, estimated at 10-8 Gyr, with a significant peak for the youngest ages. We derive an approximate star formation rate of 4 solar masses per yr over these 2 Gyr (for a Bulge mass of 10^10 solar masses), with a peak of 8 solar masses per yr during the last 0.5 Gyr. A possible explanation is that the Bulge formed 8 Gyr ago, from an event which scattered stars and gas into the central regions. The structures of the planetary nebulae indicate that the star formation in the Bulge took place under a strong and well-ordered magnetic field.

The X-ray/infrared connection in star-forming galaxies

Author: Myrto Symeonidis

MSSL-UCL

Co-Authors: the HerMES consortium

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

I will present results from our recent study of the X-ray/infrared correlation, carried out as part of the Herschel Multi-tiered Extragalactic Survey (HerMES) guaranteed-time key programme, with data from the field of GOODS-North. Combining X-ray data from the 2Ms Chandra survey and infrared data from Herschel's sub-millimeter bolometer array, SPIRE, we are able to investigate the X-ray/infrared correlation in the high star formation rate (SFR), starburst-mode regime for galaxies at cosmologically significant redshifts. Once obvious AGN are excluded, the X-ray/infrared properties of our sample of luminous and ultraluminous infrared galaxies (LIRGs and ULIRGs) at ~1, are compared to those of local ($z<0.1$) and intermediate redshift ($z\sim0.6$) samples of equivalently infrared-luminous sources. We conclude that there is no evidence for evolution in the X-ray/IR correlation with redshift, however, we note that in contrast to normal star-forming galaxies, LIRGs and ULIRGs are X-ray deficient relative to their infrared output. This suggests fundamental differences in the origin of X-ray emission in systems undergoing starburst episodes and has implications on the use of the X-ray/infrared correlation, both as a star-formation tracer and as a means of separating AGN from star-forming galaxies in extragalactic surveys.

X-Ray properties of star-forming BzK galaxies

Author: Cyprian Rangel

Imperial College London

Co-Authors: K. Nandra (Max Planck Institut fur Extraterrestrische Physik); E. S. Laird (Imperial College London); S. J. Warren (Imperial College London)

Session: GAL1: 12 billion years of star formation and nuclear activity in galaxies - the submillimetre view

Displayed during: Poster Session A

Summary:

X-Ray background models predict a large population of heavily obscured (Compton thick) AGN at $z>1$ that to date remains undiscovered. These heavily obscured AGN are too faint to be directly detected in even the deepest x-ray surveys, hence we search for this population using multi-wavelength techniques. We present x-ray stacking of a sample of BzK galaxies binned according to the ratio of their Infrared and dereddened UV star formation rates (SFRs) in Chandra Deep Field South (CDFS) 4Ms and Chandra Deep Field North (CDFN) 2Ms. Galaxies with IR SFR greater than their dereddened UV SFR (IR Excess) are deemed to be strong Compton thick AGN candidates, based upon previous stacking analyses using CDFS 1Ms data, while the remaining BzK galaxies (IR Non-Excess) are thought to be purely star forming. A greater proportion of the BzKs have now been directly x-ray detected in the CDFS 4Ms data, ranging from heavily obscured AGN to faint and unobscured AGN. From stacking we conclude the IR Excess galaxies are a mixture of obscured and unobscured AGN and star forming galaxies. The IR Non-Excess galaxies have an almost identical x-ray emission profile but are less x-ray bright.

Automated Measurement of Interacting Galaxies in the Sloan Digital Sky Survey

Author: Alex Lockey

University of Bristol

Co-Authors:

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

We investigated an approach to quantifying the morphological effects of galactic mergers. A main sample of visually- and spectroscopically-identified merging galaxies was selected from SDSS DR4, and a control sample of galaxies corresponding to the main sample was selected by matching morphological classification, mass, luminosity and environmental density. The merging and control sample galaxies were modelled using single-Sèrsic model fits to SDSS r-band images, and the model error used to calculate a disruption value. The disruption value is found to be substantially dependent on morphological type, but to also vary between merging galaxies and control galaxies. The disruption value is shown to vary with the projected separation of interacting galaxies.

Building the galactic halo through the evolution and dissolution of star clusters.

Author: Poul Alexander

Institute of Astronomy

Co-Authors:

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

An unknown portion of galactic halo stars originate in globular clusters. The evolution of such clusters therefore represents an ideal means through which we can explore their contribution to the formation and evolution of the halo, and allows us to link the halo's cosmological origins to it's current stellar kinematics and population. We have developed a computationally fast yet physically motivated code to efficiently explore the long term evolution of star clusters. We find that this code is able to reproduce N-body simulations to ~10% accuracy, over a wide range of initial conditions. Using this code, we are able to rapidly explore an extremely large parameter space expressing the distribution and nature of star cluster formation, and hence place constraints on the nature and origin of the stars that comprise the galactic halo.

Diagnostics of Dusty vs Non-Dusty Early-Type Galaxies

Author: Nicola Agius

University of Central Lancashire

Co-Authors: A.E.Sansom (UCLan)

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

Early-type galaxies are known for being generally smooth, passive, red objects with no spiral arms. With the aid of recent results from Herschel-ATLAS and GAMA, a sample of 508 morphologically selected ETGs detected in the sub-mm has been created. By comparing and contrasting this sample with an optically selected sample of ETGs undetected in the sub-mm, we explore their relative properties. We examine the environmental densities of these two samples and find no significant difference in their environments. The dusty ETG data are fit with a modified Planck function, giving us specific dust masses which increase with decreasing stellar mass. Statistical testing shows that other host galaxy properties are also shown to have different distributions for the two samples.

On the optical+NIR color gradients in the external regions of early-type galaxies

Author: Francesco La Barbera

INAF-OAC

Co-Authors: I. Ferreras (UCL-MSSL); R.R. de Carvalho (INPE-DAS); A. Pasquali (ARI-ZAH); E. Merlin (INAF-OAP)

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

We stack the optical+NIR colour profiles, out to a large galactocentric distance of eight Re's, for a sample of ~1000 nearby (z~0.05), massive (M*~10^10-10^11Msun), early-type galaxies (ETGs), with grizYJHK photometry available from SDSS and UKIDSS-LAS. ETGs are split according to the environment where they reside, into field and group galaxies. Combining g-r through g-K colours allows us to constrain stellar population properties (i.e. age and metallicity) from the central regions to the outskirts of ETGs. I will present how age and metallicity profiles depend on stellar mass, environment, and galactocentric distance, providing new constraints to the formation and evolution scenario of massive galaxies.

Quantifying the stellar assembly in early-type galaxies using spatially-resolved spectro-photometry

Author: Sugata Kaviraj

Imperial College London and the University of Oxford

Co-Authors: R. W. O'Connell (Virginia); B. C. Whitmore (Space Telescope Science Institute); J. Silk (IAP and Johns Hopkins); M. Cappellari (Oxford); R. M. Crockett (Oxford)

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

Traditionally considered to be old and passively-evolving, I show how recent rest-frame UV studies have demonstrated (and quantified) widespread recent star formation in early-type galaxies (ETGs). Together with the past literature these studies show that, while the bulk of the stellar mass in ETGs is old, ~20% forms after z~1, via minor mergers between ETGs and gas-rich dwarfs. While our traditional understanding of galaxy evolution is largely based on integrated spectro-photometry, I demonstrate how spatially-resolved studies, using high-resolution UV/optical imaging and integral-field spectroscopy (IFS), is a uniquely powerful tool to quantify the formation of individual ETGs. Combining new HST/WFC3 UV-optical imaging and IFS from the SAURON project, I present a case study of the ETG NGC 4150, showing (empirically) that this galaxy experienced a minor merger with mass ratio ~1:20 around ~0.9 Gyr ago, which formed 3% of its stellar mass and a young kinematically-decoupled core. A UV/optical analysis of its globular cluster system then shows that the bulk of the stars in this galaxy formed ~6-8 Gyrs in the past. I introduce a new HST/WFC3 programme (PI: Kaviraj), that will extend this spatially-resolved analysis to a representative sample of ETGs and serve as a prototype for work using the extremely large telescopes, that will routinely provide high-resolution imaging at the end of this decade.

Structure and Dynamics of Hot Stellar Systems

Author: Mark Norris

University of North Carolina at Chapel Hill

Co-Authors: Sheila J Kannappan (UNC - Chapel Hill)

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

I will present results from two studies: (1) Determining the dynamical mass of galaxies like S0s, where cold gas emission is weak or absent, and where neither stellar dispersion or stellar rotational support dominates has traditionally been extremely difficult. In order to produce a more reliable mass estimator for S0s we have therefore examined the relations between central stellar velocity dispersion, and the maximum rotation velocity of both stars and cold gas for more than 60 S0 galaxies drawn from the RESOLVE survey (http://resolve.astro.unc.edu/). In doing so we are determining a dynamical mass estimator for S0s which improves on standard practice. (2) The second project is an HST archival survey designed to investigate the nature and origins of massive globular clusters, ultra compact dwarfs, and compact elliptical galaxies. We are finding many of these previously understudied objects in a range of environments from the field to galaxies clusters. We find that some massive GCs/UCDs are created in periods of intense in-situ star formation, while others are created during later accretion events. We will discuss how the objects discovered to date put constraints on the two-phase build up of galaxy halos.

Testing Theoretical Element Response Functions with an Empirical Stellar Spectral Library.

Author: Dr. Anne E. Sansom

University of Central Lancashire

Co-Authors:

Session: GAL2: Diving into the outer halos of elliptical galaxies: clues to galaxy formation and evolution

Displayed during: Poster Session A&B

Summary:

Element abundance ratios hold important clues to understanding the evolution of stellar populations, through the varying timescales of different nucleosynthetic contributors(including SNII, SNIa, stellar winds and mass loss). Newly measured and compiled [Mg/Fe] ratios in the MILES stellar library are used to confront models of different star spectra. Such models have been used in recent years to provide estimates of differential changes in spectral line strengths of stellar populations, due to enhancements in [alpha/Fe]. This talk presents tests of the most widely used sets of theoretical element response functions. Using magnesium as a proxy for all alpha elements the reliability of these theoretical response functions are tested against empirical observations. This study probes the reliability of current methods of measuring element abundance ratios in stellar populations.

Kinematic analysis of the M31 halo globular clusters

Author: Jovan Veljanoski

Institute for Astronomy, University of Edinburgh

Co-Authors: A.M.N. Ferguson (Institute for Astronomy, University of Edinburgh); D.A.Mackey (Research School of Astronomy & Astrophysics, Australian National Observatory, Mt. Stromlo Observatory); M.J.Irwin (Institute of Astronomy, University of Cambridge); A.P.Huxor (Astronomisches Rechen-Institut, Zentrum fur Astronomie der Universit¨at Heidelberg);

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

The halo of M31 hosts nearly 90 globular clusters. Using low resolution spectra, we present kinematic and chemical analysis for a significant sample of these objects. Many of the M31 outer halo globular clusters lie along stellar streams, suggesting that they have been accreted along with their host dwarf galaxies. We discuss evidence for this via velocity and metallicity correlations of globular clusters which lie along particular debris features.

On the star formation history of IKN dSph

Author: Tudorica Alexandru

Argelander Institute for Astronomy

Co-Authors: Iskren Georgiev (Argelander Institute for Astronomy); Ana Chies Santos (Nottingham University)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

I will present an optical-NIR photometric investigation of the age and metallicity of globular clusters in the ultra-faint IKN dwarf spheroidal galaxy in the M81 group. Age and metallicity distributions of GCs in a galaxy can provide valuable information about the physical conditions of major starburst

M81 group. Age and metallicity distributions of GCs in a galaxy can provide valuable information about the physical conditions of major starburst episodes during which these GCs were formed. With the highly sensitive to age and metallicity VIKs color indices we find a large spread in age (1-15Gyr) and metallicity (-1.6

Scaling relation of dwarf galaxies in the core of Coma cluster

Author: Habib Khosroshahi

IPM

Co-Authors: E. Kourkchi (IPM); Habib Khosroshahi (IPM); D Carter (ARI); B. Mobasher (UCR)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

Rich environment of Coma galaxy cluster offers a unique environment to study many galaxy properties including dwarf galaxy scaling relations, such as the Fundamental Plane (FP) and Photometric Plane. We present a study of scaling relations for a large sample of dwarf galaxies in the core of Coma cluster down to -15 mag, for the first time, taking advantage of high resolution DEIMOS spectrograph on Keck II for measuring the internal velocity dispersion of galaxies and high resolution imaging of HST/ACS, which allows an accurate surface brightness modeling. We find that the faint end galaxies in the sample show significantly higher velocity dispersion, for their optical luminosity, than expected from their more luminous counterparts thus resulting in a higher M/L. We also find that, the scatter about the FP depends on the faint-end luminosity cutoff, such that the scatter increases for fainter galaxies. The residual from the FP correlates with the galaxy colour, with bluer galaxies showing larger residuals from FP. We find that less massive dwarf ellipticals are bluer than their brighter counterparts, possibly indicating ongoing star formation activity. Although tidal encounters and harassment can play a part in removing stars and dark matter from the galaxy, we believe that the dominant effect will be the stellar wind associated with the star formation, which will remove material from the galaxy resulting in larger M/L ratios. We attribute the deviation of a number of faint blue dwarfs from the FP of brighter ellipticals to this effect. We explore the scatter around the Photometric Plane of the sample galaxies and show that, compared to the FP, the scatter about the photometric plane is smaller at the faint end.

Structure of the Intermediate and High Velocity Clouds towards the LMC and SMC

Author: Jonathan Smoker

European Southern Observatory, Chile

Co-Authors: A.J. Fox STSci F.P. Keenan Queen's University Belfast

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

We present interstellar absorption-line spectroscopy of early-type stars in CaK and NaD towards the Large and Small Magellanic Clouds to investigate the large- and small-scale structure in foreground Intermediate and High Velocity Clouds (IHVCs). The data include FLAMES-GIRAFFE observations of 403 stars in four open clusters plus FEROS spectra of 52 in the LMC and 8 in the SMC. From the FLAMES data we find that, within a 0.5 degree field-of-view, the CaII K equivalent width in the IHVC components varies by factors exceeding 10. A number of lines-of-sight toward NGC 1761 and NGC 2004 in the LMC show velocity structure in the IHVC gas, indicating multiple clouds are present along each sightline, possible fragmentation of the clouds, or a two-phase medium. There are detections of molecular gas in LMC absorption towards a handful of sightlines, although no molecular detections are made in either IHVC or Galactic gas. From the FEROS data we find CaII K IHVC absorption in around 60 per cent of sightlines. No NaI D is found at non-Magellanic HVC velocities aside from a tentative detection towards the star LHA 120-S 93. The lower limits on the CaII/NaI ratio in IHVCs are large, with a maximum value exceeding +1.5 dex, illustrating the Routly-Spitzer effect. In four sightlines with previous OI measurements,we find CaII/OI ratios in the LMC gas ranging from 0.23 to 1.3 dex below the solar value, indicating either dust or ionisation effects. Both CaII and HI data are available for three sightlines, with HVCs showing (a) similar CaII/HI ratios to the general IHVC population,and (b) identical CaII and HI velocities (within the errors), implying that at least in these sightlines the two elements form part of the same structure.

The carbon star phase in the Sagittarius Dwarf Spheroidal

Author: Iain McDonald

University of Manchester

Co-Authors: J.R.White (University of Manchester) A.A.Zijlstra (University of Manchester) J.Th.van Loon (Keele University) G.C.Sloan (Cornell University) E.Lagadec (ESO)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

Carbon stars are an important source in the enrichment of heavy elements in galaxies. They help control the balance of carbon and oxygen in the interstellar medium and subsequent generations of stars, as well as changing the observed properties (colours, spectrum) of their host galaxies. Whether a star becomes carbon rich depends on its mass and metallicity, thus a galaxy's C/O ratio changes with time. We have recently carried out a spectral survey of over 1000 stars in the Sgr dSph, whose population is close to the limit of carbon star production. I will discuss the carbon star population and its impact on the galaxy, and present the Sgr dSph in context with other local dwarf galaxies.

The mass function of dwarf galaxies: Going beyond the Local Group with gravitational lensing

Author: John McKean

ASTRON

Co-Authors: S. Vegetti (MIT); D. J. Lagattuta (Uni. Melbourne); M. W. Auger (Uni. Cambridge); C. D. Fassnacht (Uni. California, Davis); L. V. E. Koopmans (Uni. Groningen)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

Gravitational lensing provides an opportunity to measure the mass-fraction and the mass-function of low-mass substructure in massive galaxies well beyond the Local Group. I will review the gravitational lensing method of detecting substructures, which is independent of whether the substructure is luminous or not, from lensed quasar flux-ratio and astrometric anomalies. I will present new results from the ongoing SHARP project, which aims to image lensed quasar systems to search for luminous and dark substructures by searching for surface brightness anomalies in extended lensed images. The first major result from this survey is the detection of a low mass (2 x 10^8 M_sol) dark dwarf galaxy that is a companion of a massive early-type galaxy at redshift 0.881. I will also present the first constraints on the substructure mass-function for massive elliptical galaxies beyond the Local Group by combining this result with a previous detection.

The nature of stars in the nucleus of M32

Author: Olivia Jones

JBCA, University of Manchester

Co-Authors: C. Kemper (ASIAA, Taiwan) M. Rich (UCLA)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

We investigate the infrared properties of cool, evolved stars in the local group dwarf elliptical galaxy M32 (NGC 221), using IRAC observations from the Spitzer Space Telescope. Our images resolve the dust-producing asymptotic giant branch population of M32 at 8 microns. These objects are highly enshrouded and have no apparent counterparts in the 1 micron WFPC2 HST images. Using IRAC colour information we can determine the nature of these dusty sources and through the comparisons of the 8 micron luminosity function with globular clusters the number of oxygen rich and carbon rich sources can be estimated giving clues to the global dust injection rate and the life cycle of matter on a galaxy wide scale. Here, we describe the program and present some first results.

The Structure of the Sagittarius Stellar Stream as Traced by Blue Horizontal Branch Stars

Author: Christine Ruhland

University of Hertfordshire

Co-Authors: E. F. Bell (University of Michigan); H.-W. Rix (Max Planck Institute for Astronomy); X.-X. Xue (Max Planck Institute for Astronomy)

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

Summary:

We use a sample of blue horizontal branch (BHB) stars from the Sloan Digital Sky Survey Data Release 7 to explore the structure of the tidal tails from the Sagittarius Dwarf Galaxy. We use a method yielding BHB star candidates with up to ~70% purity from photometry alone. The resulting sample has a distance precision of roughly 5% and can probe distances in excess of 100 kpc. Using this sample, we identify a possible extension to the trailing arm at distances of 60-80 kpc from the Sun with an estimated significance of at least 3.8σ. Current models predict that a distant "returning" segment of the debris stream should exist, but place it substantially closer to the Sun where no debris is observed in our data. Exploiting the distance precision of our tracers, we estimate the mean line-of-sight thickness of the leading arm to be ~3 kpc, and show that the two "bifurcated" branches of the debris stream differ by only 1-2 kpc in distance. With a spectroscopic very pure BHB star subsample, we estimate the velocity dispersion in the leading arm, 37 km s-1, which is in reasonable agreement with models of Sgr disruption.

Towards a complete stellar mass function of the Hyades with PanSTARRS1

Author: Bertrand Goldman

MPIA

Co-Authors: S.Roeser(ARI); E. Schilbach (ARI); E.A. Magnier (IfA); C. Olczak (ARI,MPIA,NAOC/CAS); T. Henning (MPIA); M. Juric (CfA); and the PanSTARRS1 Science Consortium

Session: GAL3: The nature of satellite and dwarf galaxies

Displayed during: Poster Session B

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Summary:

The Hyades cluster is an ideal target to study the dynamical evolution of a star cluster over the entire mass range due to its intermediate age and proximity to the Sun. We want to extend the Hyades mass function towards lower masses down to 0.1M_sol and to use the full three-dimensional spatial information to characterize the dynamical evolution of the cluster. We perform a kinematic and photometric selection using the PPMXL and Pan-STARRS1 sky surveys, to search for cluster members up to 30 pc from the cluster centre. We determine our detection efficiency and field star contamination rate to derive the cluster luminosity and mass functions down to masses of 0.1 M_sol. A minimum spanning tree algorithm was used to quantify the mass segregation. We discover more than 50 new Hyades member candidates with mass estimates between 0.48 and 0.085 M_sol, and double the number of low-mass member candidates. The cluster is significantly mass segregated. The extension of the mass function towards lower masses provided an even clearer signature than estimated before.

A conservation law formulation of nonlinear elasticity in relativity for NS crust shattering

Author: Stephanie J. Erickson

University of Southampton

Co-Authors: C. Gundlach (University of Southampton); I. Hawke (University of Southampton)

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Tidal shattering of neutron star crusts is expected to play a role in the dynamics of binary neutron star mergers, giving rise phenomena such as energetic gamma-ray bursts. For this reason, we have developed a general relativistic conservation-law formalism for nonlinear elasticity; this allows us to use high-resolution shock-capturing methods to resolve strong shocks. We hope to use this formalism to simulate the evolution of discontinuities in the crust of a neutron star caused by shattering and refreezing of the crust, thus illuminating the role this process may play in the evolution of a binary neutron star system.

A New Method to Reduce Eccentricity in Numerical-Relativity Simulations of Black-hole-Binary Inspira

Author: Michael Puerrer

School of Physics & Astronomy, Cardiff University

Co-Authors: S.Husa (Departament de Fisica, Universitat de les Illes Balears, Palma, Spain) M.Hannam (School of Physics & Astronomy, Cardiff University, UK)

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

We present a new iteration method for producing low-eccentricity of black-hole-binary simulations. Given reasonably low eccentricity starting momenta for puncture initial data we evolve these data numerically for 3-4 orbits and construct improved initial parameters by comparing numerical relativity with post-Newtonian quantities. We can reach eccentricities below ~0.001 in one or two iteration steps. We also comment on the difference between the eccentricities calculated from the orbital motion and the GW signal.

Black hole binaries galactic and intergalactic globular clusters

Author: Jonathan Michael Blake Downing

ARI, Zentrum für Astronomie der Universität Heidelberg

Co-Authors:

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Mergers of black hole binaries are one of the most promising sources for the next generation of ground-based gravitational wave detectors. Black hole binaries are a rare outcome of stellar evolution but can be produced efficiently by dynamical interactions in globular clusters. I will present a summary of a large set of Monte Carlo globular cluster simulations that show that black hole binary detection rates will be dominated by binaries produced in star clusters. I will also present first results for the black hole binary population in intergalactic globular clusters, such as those recently found in Coma, that have not been taken into account in previous black hole binary population synthesis studies.

Genuine field theory needed to support Gravitational Waves

Author: Max K Wallis

BCAB, Buckingham University

Co-Authors: T.W.Marshall

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Our theme is that gravitational waves necessitate the gravitational field having material status, like the electromagnetic field of Faraday-Maxwell, which motivated the gravity mass/energy term in Einstein's field equation. To properly formulate gravitational theory as a field theory, we need a real (not pseudo-) tensor for gravitational energy-momentum, as recognised by Hilbert and accomplished by Weinberg. Implicit in Einstein's derivation of quadrupole radiation was that the gravitational field is carried by the Minkowski space of 'special' relativity. Babak & Grishchuk etc. have developed this field interpretation of gravity to explicitly include the Minkowski metric in the field equations. Field theorists commonly demand covariance, gauge invariance and the Principle of Equivalence - we argue for maintaining the first, abandoning the second, and accepting only the weakest form of the third (Eötvös Principle). Gravitational waves being real rather than a metric fluctuation followed from the orbit decay of the Hulse-Taylor double pulsar, at the rate predicted by Einstein's quadrupole formula. Yet few challenge the view of gravity as only geometry and the catch-phrase "Space tells matter how to move" coupled to "matter tells space how to curve" persists. The material nature of gravitational energy and gravitational waves shows instead that "fields tell matter how to move".

Optical rigidity concepts at the Glasgow 10m prototype interferometer

Author: John Macarthur

University of Glasgow

Co-Authors: J. Macarthur (University of Glasgow), B.W. Barr (University of Glasgow), M.P. Edgar (University of Glasgow), S. Hild (University of Glasgow), S. Huttner (University of Glasgow), B. Sorazu (University of Glasgow) and K. A. Strain (University of Glasgow)

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Ground based gravitational wave detectors are currently undergoing a major upgrade expected to improve sensitivity in their detection band by a factor of 10. As a result quantum noise, made of shot noise and radiation pressure noise, will become the dominant noise source across most of the frequency band. The obvious improvement consists of increasing laser power to reduce shot noise at high frequency, which in turn inescapably gives rise to a larger radiation pressure effect at low frequency. However, using innovative interferometer topologies, this effect can be used to our advantage by creating coupling of the cavity mirrors via the pendulum restoring force to the radiation pressure force, also known as the Optical Spring effect. This and other optical rigidity schemes can significantly surpass the Standard quantum limit and are going to become vital for future gravitational wave detectors. We will give an overview on the experimental testing of optical rigidity concepts at the Glasgow 10m prototype interferometer.

Optimal use of astrophysical priors for electromagnetic follow-ups of gravitational wave candidates

Author: Will Vousden

University of Birmingham

Co-Authors: I. Mandel (University of Birmingham)

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Current methods for locating EM counterparts to GW events generated by neutron star binary mergers rely on several optimistic assumptions regarding their distribution and genesis. However, due to the rarity of detectable GW events that will yield observable counterparts, it is important that the preciseness of sky location priors is commensurate with our confidence in their correctness. I will present an analysis of the effects on EM follow-up success rates of the choice of astrophysical priors, tested against simulated distributions of candidate events under a range of corresponding astrophysical models. It is expected that successful follow-ups will deliver rich insight into the underlying astrophysics of compact binary mergers.

Searching for Gravitational waves associated with Gamma-ray bursts

Author: Thomas Adams

Cardiff University

Co-Authors: Thomas Adams for the LIGO collaboration and VIRGO collaboration

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Gravitational waves (GWs) are oscillations in the gravitational field which propagate at the speed of light and are emitted by accelerated masses. Gamma-ray bursts (GRBs) are intense flashes of gamma rays which can be grouped into two classes by their duration and spectral hardness. The progenitors for short-hard GRBs (duration < 2s) are thought to be neutron star binaries or neutron star black hole binaries, while long-soft GRBs (duration > 2s) are associated with core-collapse supernovae. These objects are compact, asymmetric, relativistic and emit large amounts of energy in a short period of time which makes them likely sources for GWs. Using data from the LIGO, VIRGO and GEO detectors an unmodelled "burst" search for GWs associated with GRBs observed by the SWIFT, FERMI and IPN satellites was performed. We give the status of this search and look at prospective searches for the

GRBs observed by the SWIFT, HETE-II and IPN satellites was performed. We give the status of this search and look at prospective searches for the advanced detector era.

Status of the ground based interferometric gravitational wave detector GEO 600

Author: Borja Sorazu

University of Glasgow

Co-Authors: GEO team.

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

GEO 600 is the German-British contribution to the first world network of ground based, large scale, interferometric gravitational wave detectors in operation during the last decade. In 2009 this detector initiated an upgrade program, called GEO-HF, which targeted an improvement of around one order of magnitude in its measurement sensitivity at the high frequencies where the limiting factor is photon shot-noise. We present a review of the current status of this upgrade, focusing on the main techniques being implemented; homodyne readout and output mode cleaner (OMC) installation, transition to tuned signal recycling, laser power increase and injection of squeeze vacuum states. We also report on our efforts on detector commissioning and characterisation.

The status of galactic neutron star searches using gravitational waves

Author: Matthew Pitkin

University of Glasgow

Co-Authors: The LIGO Scientific Collaboration; The Virgo Collaboration

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Rotating neutron stars are expected to be weak emitters of quasi-monochromatic gravitational waves. Data from the initial generation of interferometric gravitational wave detectors, LIGO and Virgo, have been used to search for such sources. We present a status report on these, including searches for specific targets, such as known pulsars and supernova remnants, and blind all-sky searches for unknown sources. We will also examine the prospects for future searches using the Advanced LIGO and Virgo detectors.

Transient gravitational waves at r-mode frequencies associated with pulsar glitches

Author: Ignacio Santiago-Prieto

University of Glasgow

Co-Authors: Ik Siong Heng (University of Glasgow); D.I. Jones (University of Southampton); James Clark (University of Massachusetts, Amherst)

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Pulsar glitches can cause oscillations in the fluid interior of the pulsar which lead to gravitational wave emissions at the r-modes frequencies of the neutron star. The emitted gravitational waves can have long damping time scales, ranging from minutes to days. We estimate the strength of the emitted gravitational waves from potential sources and demonstrate their detectability for future detectors through simulated data, using parameters derived from radio and X-ray observations.

What we (don't) know about gravitational waveforms from black-hole binaries

Author: Frank Ohme

Albert Einstein Institute

Co-Authors:

Session: GW1: Dawn of Gravitational Astronomy

Displayed during: Poster Session A

Summary:

Accurately predicting the complete gravitational-wave signal of coalescing black-hole binaries is of fundamental importance in the efforts to detect and correctly interpret these signatures in the data of current and future detectors. The best waveform models today combine information from both analytical and numerical calculations into complete inspiral-merger-ringdown waveforms, and I will review the current status of such models. I will particularly focus on the question of how reliable these models are and which statistical and systematic bias we have to expect when using these template waveforms to estimate the source parameters of the signal.

A black hole transient, and other X-ray binaries in Cen A

Author: Mark Burke

University of Birmingham

Co-Authors: Somak Raychaudhury (University of Birminham), Ralph Kraft (Harvard-Smithsonian Center for Astrophysics), + Cen A VLP collaboration

Session: HE1: Extragalactic Transients

Displayed during: Poster Session A

Summary:

We model the X-ray spectra of point sources in the nearby early-type galaxy NGC 5128 (Cen A), focussing on the discovery of a bright X-ray transient, CXOU J132527.6-430023. The source was first detected over the course of six 100 ks Chandra observations in 2007, reaching an unabsorbed outburst luminosity of 1-2*10^38 erg/s in the 0.5-7.0 keV band before returning to quiescence. Such luminosities are possible for both stellar-mass black hole and neutron star X-ray binary transients. The brightness of the source after a >100 fold increase in flux, coupled with the results from spectral fitting appear to lend weight to the view that this is a black hole transient observed in the thermally dominant state. We discuss this result in the context of our work modelling all of the bright X-ray binaries in Cen A that were observed in deep Chandra pointings. The proximity of the galaxy combined with the depth of the data will lead to this being the largest spectral investigation of X-ray binaries outside of the Local Group, while correlation with the large globular cluster population will provide new insights into binary formation and evolution.

A Stacked Analysis of Cluster-centre AGN with Fermi-LAT Data

Author: Kate Dutson

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Session: HE1: Extragalactic Transients

Displayed during: Poster Session A

Summary:

Radio-synchrotron and hard X-ray emission establish clusters of galaxies as hosts to significant populations of non-thermal particles, and it is believed that feedback from the central active galactic nucleus (AGN) plays a crucial, cluster-scale role in accelerating these particles, and counteracting the observed cooling flow; driving weak shocks through the intracluster medium and inflating bubbles of relativistic plasma tens of kiloparsecs in extent. Observational evidence for variable high-energy (HE) γ-ray emission associated with the central engine of a number of clusters supports this view. Motivated by Fermi-LAT detections of active galaxies such as NGC 1275 and M87 (the dominant members of the Perseus and Virgo clusters, respectively), we present a radio-selected sample of 63 such Brightest Cluster Galaxies (BCGs) within cooling-core clusters, treating each as a candidate source of ~GeV γ rays. The standard Fermi-LAT analysis procedure is augmented by a source-specific normalisation of the diffuse γ-ray background, and following a maximum likelihood fitting of the data, the distribution of Test Statistic values across the sample is studied. The counts and model maps for candidate sources below an appropriate critical statistical significance are stacked: imitating a deeper observation of the BCG class than is currently achievable in HE γ rays.

CLASP (Create Lightcurves with Alignment, Subtraction and Photometry)

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Session: HE1: Extragalactic Transients

Displayed during: Poster Session A

Summary:

CLASP (Create Lightcurves with Alignment, Subtraction and Photometry) comprises two pipelines developed to automate data reduction and lightcurve creation from SNe imaging through template subtraction. Images are cleaned, then accurate alignment is achieved between a science image containing the SNe and a template image. Subtraction of the template light from the science image, after seeing and flux matching, is performed utilising a version of the ISIS routine of Alard (2000). The subtracted image permits accurate photometry of faint SNe, whose significant host galaxy light would compromise photometry otherwise. Photometry is performed on the subtracted image and calibrated using the science and template images, allowing lightcurves to be created with minimal user interaction required. The pipelines have been extensively tested on Liverpool Telescope data for instruments with FOVs ranging from 5 arcminutes to 1 degree, performing well in the vast majority of cases; other telescope data are also accepted. With huge amounts of observational follow-up being performed for surveys such as PTF, as well as the intense monitoring of individual SNe that is feasible presently, the quick and automated nature of these pipelines make them equally invaluable to both large data sets and individual objects. A catalogue of multi-colour, pseudo-bolometric lightcurves of Liverpool Telescope observations of PTF CCSNe is being created using these pipelines. These lightcurves allow analytical extraction of the physical parameters (ejected mass, mass of nickel-56 and kinetic energy) of the explosions for a sample of CCSNe of unprecedented size. This will allow investigation into trends of these parameters across CCSNe subtype and host properties, thereby probing the progenitor systems of CCSNe in combination with further constraints from environment measures.

Long-term X-ray variability of Swift J1644+57

Author: Roberto Soria

ICRAR

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Co-Authors: C.J. Saxton (MSSL), K. Wu (MSSL), N.P.M. Kuin (MSSL)

Session: HE1: Extragalactic Transients

Displayed during: Poster Session A

Summary:

Exactly 1 year ago, the nuclear black hole in a galaxy at redshift 0.35 went into outburst, blazing a jet along our line of sight; this increased activity was interpreted as the result of a tidal disruption event. We studied the decline of the X-ray flux over the following months, and noticed a series of dips recurring on characteristic timescales (eg 4.5E5 s) and their harmonics. We show that the dips have a softer X-ray spectrum but no additional absorption; this rules out obscuration from orbiting clouds. We propose that the dips are caused by temporary, partial loss of alignment with the (wobbling) jet axis, so that sometimes we only see emission from a slower, less collimated part of the outflow. The existence of a pattern of characteristic timescales in the dipping behaviour may be due to a combination of jet precession and nutation.

FR dichotomy, accretion modes and environmental factors in the local Universe

Author: Melanie Gendre

JBCA

Co-Authors: P. N. Best (IfA Edinburgh); J. V. Wall (UBC)

Session: HE2: The Gamma-ray/radio connection

Displayed during: Poster Session A

Summary:

Active galactic nuclei (AGN) comprise the majority of currently observed radio galaxies, and the Fanaroff-Riley (FR) categorisation provides a classification of extended AGN. The FRI objects have the highest surface brightness along the jets near the core, while FRII sources show the highest surface brightness at the lobe extremities, as well as more collimated jets. This FR dichotomy is based purely on the appearance of the radio objects, and the mechanisms differentiating the two populations are still unknown. Two main streams of models exist to explain these differences in morphology. Extrinsic models are purely based on the source environment, where inter-galactic medium density is the differentiating factor: jets of sources in higher/lower density mediums experience a higher/lower degree of resistance, yielding sources with FRI/FRII structures respectively. Intrinsic models, on the other hand, suggest that the dichotomy arises from differences in the properties of the central black hole. In these scenarios, low-excitation galaxies (LEG) have jets produced by low accretion-flow rate which are generally weak and mostly display FRI-type structure, whereas high-excitation galaxies (HEG) have higher accretion flow rates giving rise to stronger, mainly FRII-type jets. If the FR dichotomy was fully dependent on the jet properties, FRI/II sources would be systematically associated with LEG/HEG respectively. However, in several cases, small subsets of FRIs were found in HEG samples, as well as some FRIIs being associated with LEGs. The presented work is based on the CoNFIG catalogue, a sample of radio sources at 1.4-GHz, including FRI/FRII/Compact morphology classifications, optical identifications and redshift estimates. High/low excitation classification and environmental richness factor of a subsample of local (z<0.3) CoNFIG extended galaxies were compiled to investigate the possible FR morphology-accretion mode-environment relations. The sub-sample contains 208 sources, including 75 FRIs and 108 FRIIs, 76% of which have available spectra, mostly from SDSS. We found that there is a broad overlap of properties, although FRIs generally reside in denser environments that FRIIs. More interestingly, a source found in a rich environment has a very high probability of being both LEG and FRI, fitting with scenarios in which cooling occurs from the X-ray halo. In addition, FRIs broadly show the same RLF shape in all 4 classes (poor/rich HEG/LEG), while FRIIs show more evidence for a switch between HEGs at high luminosities to LEGs at low luminosities.

Radio observations of unidentified Fermi LAT sources

Author: Ewan Barr

MPIfR

Co-Authors: L. Guillemot, D. Champion, M. Kramer and R. Eatough (MPIfR)

Session: HE2: The Gamma-ray/radio connection

Displayed during: Poster Session A

Summary:

In the 4 years since its launch, the Large Area Telescope (LAT) aboard Fermi has revolutionised gamma-ray astronomy. However, due to a low number of incident gamma-ray photons, it is not possible to identify many of the sources discovered by the LAT. This is especially true for binary pulsars, where orbital motion may obfuscate periodicities. Our solution is to perform sensitive pulsar searches at radio wavelengths at the position of the gamma-ray source, a technique which has, to date, found 36 new millisecond pulsars (MSP). Here we present an overview of the current efforts to further understand the population of radio selected LAT pulsars, with particular focus on a 1.4 GHz targeted search in LAT error boxes performed with the 100-m Effelsberg telescope. This search, the largest of its type, covered 289 unidentified sources with > 200 hours of telescope time. In addition to the discovery of the "Black Widow" MSP, PSR J1745+1017, this survey has provided strong luminosity and spectral index limits on several newly detected radio and gamma-ray pulsars. Furthermore, with the large number of sources covered in this work we have performed a statistical analysis of the population distribution of radio selected LAT pulsars.

Radio variability of Fermi gamma-ray loud AGNs and S_gamma - S_radio correlations

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Co-Authors: L. Fuhrmann(1), V. Pavlidou(1), I. Nestoras(1), R. Schmidt(1), J. A. Zensus(1), T. P. Krichbaum(1), H. Ungerechts(2), A. Sievers(2), D. Riquelme(2), L. Foschini(3) 1: Max-Planck-Institut für Radioastronomie, Bonn, DE 2: Instituto de Radio Astronomía Milimétrica, Granada, Spain 3: INAF - Osservatorio Astronomico di Brera, Merate, Italy

Session: HE2: The Gamma-ray/radio connection

Displayed during: Poster Session A

Summary:

It has always been thought that two types of Active Galactic Nuclei, namely Blazars and Radio Galaxies, are strong gamma-ray emitters. The recent discovery of gamma-ray emission from Narrow Line Seyfert 1 galaxies by Fermi/LAT, revolutionises , among others, the belief that jet emission is exclusively associated with old elliptical galaxies. The F-GAMMA program with its unprecedented radio frequency coverage, fast observing cadence, and long time baselines, allows us the detailed study of the variability characteristics and properties of their radio jet emission. Here we present the most recent results of the F-GAMMA monitoring and compare their variability characteristics with the rest of the targeted Fermi blazars. Among the most debated topics, on the other hand, in AGN research is the correlation between the radio and the gamma-ray emission. Several claims have been made with respect to possible connections between radio to gamma-ray fluxes and luminosities, relations which are know to be subject to severe biases influences. Here, a statistically robust method for the evaluation of the significance of such a correlation between F-GAMMA radio and Fermi/LAT gamma-ray 1FGL flux is presented and it is argued that, in certain cases, such correlations hold; indicating that a possible intrinsic connection in the production of radio and gamma-ray photons, may be at play.

Recent Galactic Results from the VERITAS Collaboration

Author: Gareth Hughes

DESY Zeuthen

Co-Authors: VERITAS Collaboration

Session: HE2: The Gamma-ray/radio connection

Displayed during: Poster Session A

Summary:

The Very Energetic Radiation Imaging Telescope Array System (VERITAS) is a ground-based gamma-ray observatory, located in southern Arizona, sensitive to energies from 100GeV up to 30TeV. VERITAS has been fully operational since 2007 and the current sensitivity enables the detection of a 1% Crab Nebula flux at 5 sigma in under 30 hours. The scientific observations include a strong galactic program. Objects observed comprise of pulsars, PWNe, HMXB and sources with unknown counterparts in other wavelengths. This talk will review the status of the current galactic science results.

LOFT - Large Observatory for X-ray Timing

Author: Dr Silvia Zane

MSSL-UCL

Co-Authors: Jan-Willem den Herder, Marco Feroci, Enrico Bozzo, Luigi Stella, Michiel van der Klis on behalf of the LOFT Team Silvia Zane, Roberto Mignani, Dave Walton, Tom Kennedy, on behalf of the MSSL-LAD team

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

LOFT is one of the four M3 missions that have been selected by ESA for an Assessment Phase with launch in 2020-2022. LOFT is specifically designed to study the very rapid X-ray flux and spectral variability that directly probe the motion of matter down to distances very close to black holes and neutron stars. A 10 m2-class instrument in combination with good spectral resolution (<260 eV around 6 keV) is required to exploit the relevant diagnostics and holds the potential to revolutionise the study of collapsed objects in our galaxy and of the brightest supermassive black holes in active galactic nuclei. High-time-resolution X-ray observations of compact objects are unique in providing direct access to strong-field gravity, black hole masses and spins, and the equation of state of ultra-dense matter. LOFT will carry two main instruments: a Large Area Detector (LAD, to be built at MSSL with the collaboration of Leicester for the collimator) and a Wide Field Monitor (WFM). The ground-breaking characteristic of the LAD (that will work in the energy range 2-50keV) is a mass per unit surface in the range of ~10 kg/m2, enabling an effective area of ~10 m2 (@10 keV) at a reasonable weight and improving by a factor of ~20 over all predecessors. This will allow timing measurements of unprecedented sensitivity, allowing for instance the capability to measure the mass and radius of neutron stars with ~5% accuracy, or to reveal blobs orbiting close to the marginally stable orbit in active galactic nuclei. The LOFT scientific payload is completed by the coded-mask WFM, for monitoring a large fraction of the sky potentially accessible to LAD, to provide the history and context for the sources observed by LAD and trigger its observations on their most interesting and extreme states. In this poster, we will illustrate the scientific goals and the unique potential of the mission and the major role played by MSSL and UK scientists in the LOFT team.

Magnetars are super hot and super cool

Author: Wynn C.G. Ho

University of Southampton

Co-Authors: K.Glampedakis (Universidad de Murcia); N.Andersson (University of Southampton)

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

We examine to what extent the inferred surface temperature of magnetars in quiescence can constrain the presence of a superfluid in the neutron star core and the role of magnetic field decay in the core. By performing detailed simulations of neutron star cooling, we show that extremely strong heating from field decay in the core cannot produce the high observed surface temperatures nor delay the onset of neutron superfluidity in the core. We find that it is not possible to conclude that magnetar cores are in a non-superfluid state purely from high surface temperatures, and we find that neutron superfluidity in the core occurs less than a few hundred years after neutron star formation for core fields < 10^16 G. Thus all known neutron stars, including magnetars, without a core containing exotic particles, should have a core of superfluid neutrons and superconducting protons.

Optical Monitoring of the Black Hole X-Ray Binaries, XTE J1118+480 and GX 339-4

Author: Fraser Lewis

Faulkes Telescope Project

Co-Authors: D.M. Russell (Amsterdam, IAC)

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

We present results from the long-term optical monitoring of these two black hole X-Ray Binaries using the Faulkes Telescopes North and South. These two 2-metre facilities (in Hawai'i and Australia) have allowed us to undertake regular monitoring of these sources in V, R and i' bands. The flexibility of our monitoring campaign allows us to alter the cadence of our observations in response to outbursts or state transitions within these systems. We show that the long-term (~ 5 years) variability of XTE J1118+480 can be accounted for by just the variability of its (orbital) ellipsoidal modulation. We also show that the system is bluer when brighter comensurate with emission from an accretion disc. We discuss results from short-term variability studies of GX 339-4 in outburst and during its fades towards quiescence and show that the rms variability in the optical is state dependent as seen at X-ray wavelengths.

Short period variables in the Kepler field

Author: Adam Brooks

Armagh Observatory/UCL

Co-Authors: Gavin Ramsay (Armagh Observatory); Thomas Barclay (NASA-Ames Research centre); Pasi Hakala (FINCA, Tuorla Observatory, Finland)

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

In the summer of 2011 we commenced a deep, high cadence, photometric survey of the Kepler field using the Isaac Newton Telescope (INT) on La Palma. We take a series of 20 sec exposures in the g band lasting one hour. Light curves are obtained for all sources in the field and those which are variable, identified. We are sensitive to objects in the range 13.5

The Proper Motion of the Central Compact Object RX J0822-4300 in the Supernova Remnant Puppis-A

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Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

Using the High Resolution Camera (HRC) aboard the Chandra X-ray satellite we have re-examined the proper motion of the central compact object RX J0822-4300 in the supernova remnant Puppis A. New data taken in summer 2010 along with three additional archival data sets, of which the oldest dates back to December 1999, provide a baseline of 3886 days (more than 10 1/2 years) to perform the measurement. Correlating the four positions of RX J0822-4300 as measured in each data set implies a projected proper motion of m_u ~69 mas/yr (preliminary). For a distance of 2 kpc this proper motion is equivalent to a recoil velocity of ~ 650 km/s. The position angle is found to be 242.5±7.0 degrees. Both the magnitude and direction of the proper motion are in agreement with the birth place of RX J0822-4300 being near to the optical expansion center of the supernova remnant. For a displacement of 371 ± 8 arcsec between its birth place and today's position we deduce an age of 5170 ± 650 yrs for RX J0822-4300 and hence for the supernova remnant Puppis A.

Understanding X-ray Reflection in AGN

Author: Dan Wilkins

Institute of Astronomy, University of Cambridge

Co-Authors: A.C. Fabian (Institute of Astronomy, University of Cambridge)

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

High quality X-ray observations of AGN reveal a number of spectral features resulting from the reflection of X-ray continuum emission from a source in a corona surrounding the central black hole off the accretion disc. These features include the prominent iron K emission line at 6.4keV, broadened by relativistic effects close to the black hole and can probe right down to the event horizon. Detailed analysis of the emission line profile reveals the illumination pattern of the accretion flow by the X-ray source (the emissivity profile), which depends on a number of factors including the location and geometry of the primary X-ray source. Observed emissivity profiles are naturally explained by general relativistic effects on the rays and the accretion disc. Comparing observed emissivity profiles to systematic, high performance GPU-based ray tracing simulations relates the emissivity profile to the properties of the X-ray source. When combined with measurements of reverberation time lags, constraints can be placed on the location and geometry of the coronal X-ray sources in AGN from observed emissivity profiles. Such analysis has been completed for the narrow line Seyfert 1 galaxy 1H 0707-495 and other sources, revealing the location and extent of the primary X-ray source.

What is feeding the intermediate-mass BH candidate HLX1?

Author: Roberto Soria

ICRAR

Co-Authors: P.J. Hakala (FINCA), G.K.T Hau (ESO), J.C. Gladstone (Alberta), A.K.H. Kong (NTHU), G Dubus (Grenoble)

Session: HE3: Multi-wavelength observations of compact objects

Displayed during: Poster Session B

Summary:

HLX1 is the strongest candidate proposed to date for an intermediate-mass black hole. It showed 3 FRED-like X-ray outbursts in the last 3 years, almost exactly one year apart. The peak X-ray luminosity of all 3 outbursts is about 1E42 erg/s, decreasing to about 3E40 erg/s between outbursts. We observed the optical counterpart with the VLT, during the decline from the 2010 and 2011 outbursts, and compared it with the HST observations of Dr Sean Farrell & collaborators, obtained closer to outburst peak. We argue that the optical luminosity declines along with the X-ray luminosity. Hence, we suggest that at least the blue/UV optical emission is mostly due to the accretion disk rather than a massive cluster of young stars around the BH. We propose that the BH is fed by a long-period pulsating star, as an alternative to the eccentric orbit scenario.

Interference Mitigation schemes for LOFAR dynamic spectra

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Co-Authors: R.A. Fallows (ASTRON, the Netherlands Institute for Radio Astronomy, & Institute of Mathematics and Physics, Aberystwyth University, Penglais Campus, Aberystwyth, SY23 3BZ, Wales, UK); S. ter Veen (Department of Astrophysics, University of Nijmegen, P.O. Box 9010, 6500 GL Nijmegen, The Netherlands)

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

Summary:

We present details of LOw Frequency ARray (LOFAR) dynamic spectrum data pipeline, focussing on the mitigation of Radio Frequency Interference (RFI) in the data sets. RFI can be categorised in two forms: persistent interference where entire frequency channels can be regarded as contaminated, and brief pulses where single spikes of RFI can exist at more random times and frequencies. The worst-affected frequency channels are identified using median filters. Most of the persistent interference can be identified in this way, allowing the median of each frequency channel to be interpolated in frequency across the 'bad' channels. This creates an estimate of the telescope response across the pass-band, which is used to 'flatten' the data. Two-dimensional (2-D) median filters are then employed to locate the remaining (more random) spikes of RFI. We also describe a method of "random substitution" to obtain 'clean' time-frequency data after RFI identification and mitigation. This may allow the calculation of bi-spectra and the development of novel ways to study interplanetary scintillation (IPS) and solar wind micro structure.

Lightning at Saturn and Jupiter radiation belts emission seen by LOFAR

Author: Julien Girard

LESIA - Observatoire de Paris, France

Co-Authors: Griessmeier J.-M. (LPC2E - Université d'Orléans, France); Hess S. (LATMOS/IPSL, France); Majid W. (JPL Caltech, USA); Tasse C. (GEPI - Observatoire de Paris, France); Zarka P. (LESIA - Observatoire de Paris, France)

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

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Summary:

The Planetary Working Group of the LOFAR Transient Key Project: "Planets & exoplanets" currently works with the LOFAR radiotelescope time-frequency data taken in phased array mode and interferometer mode. Commissionning observations were performed on Saturn lighting and on Jupiter emissions in meter-decameter range. Along with the detection of Saturn lightning (Saturn Electrostatic Discharges - SED) in the LBA band (30-90 MHz) at high time resolution, the characterization of SED (burst duration, power spectrum, etc.) will deepen our understanding of these events as compared to their terrestrial counterparts (Farrell et al., 2007 and ref. therein). In addition, Jupiter was observed in the HBA band (110-250 MHz) in interferometer mode. The exploitation of these interferometric data leads to the first high resolution images of Jupiter's synchrotron emission from its radiation belts that will reveal the spatial structure of this emission at low frequencies (see also de Pater, 2004). An update on current work will be presented.

LOFAR Imaging of Cygnus A

Author: John McKean

ASTRON

Co-Authors: the LOFAR collaboration

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

Summary:

The nearby radio galaxy Cygnus A is the brightest source in the low frequency sky that will be observed with LOFAR. Therefore, Cygnus A provides an excellent commissioning target to test the LOFAR system and also to produce the first science results. I will present new imaging of Cygnus A with LOFAR between 30 and 240 MHz, with baselines of up to ~100 km. These data provide the highest angular resolution images of Cygnus A at low frequencies to date. I will present a preliminary spectral analysis of the source, including the properties of the lobes, hot-spots and their interaction with the intergalactic medium surrounding the galaxy.

LOFAR, Weather and the implications for EISCAT_3D and the SKA.

Author: Derek McKay-Bukowski

Rutherford Appleton Laboratory

Co-Authors:

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

Summary:

The LOFAR (Low-Frequency Array) system makes use of mass-produced, relatively-cheap antennas deployed in a wide variety of different site environments. Apart from the challenges of varying local geology, layout and infrastructure, each presents its own unique weather conditions. With several years of experience (and some failures and damage), we are now in a position to assess the physical performance of the design and look at the implications of our findings on long-term LOFAR operations as well as other planned phased-array systems such as EISCAT_3D and the Square Kilometre Array (SKA).

Solar Observations with LOFAR

Author: Christian Vocks

Leibniz-Institut für Astrophysik Potsdam

Co-Authors: F. Breitling; G. Mann

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

Summary:

During the first commissioning phase of the LOw Frequency ARray (LOFAR), the Key Science Project "Solar Physics and Space Weather with LOFAR" has developed a pipeline for solar imaging. Solar radio radiation in the LOFAR frequency range of 30 - 240 MHz emanates from the outer layers of the Sun's hot atmosphere, the corona. Strong scattering of radio waves due to coronal turbulence limits the angular resolution of any radio image to a few 10s of acrseconds. This corresponds to baselines between the core and the nearest remote stations of LOFAR. Solar imaging is largely based on the standard imaging pipeline, but the Sun as a bright, extended, and temporally variable source poses special challenges for the calibration of LOFAR data. Different calibration strategies, e.g. using only the shortest baselines or solution transfer from external calibration sources, will be discussed. Radio images of the Sun will be shown, both for LOFAR's low and high frequency band, that were taken during commissioning runs in the year 2011. This includes the first LOFAR observation of a solar radio burst. Observation plans for LOFAR's first operational phase will be presented.

The First Detection of a Coronal Mass Ejection (CME) with LOFAR

Author: M.M. Bisi

Institute of Mathematics and Physics, Aberystwyth University

Co-Authors: P.A. Fallows (Institute of Mathematics and Physics, Aberystwyth University/ASTRON, the Netherlands Institute for Radio Astronomy), and

Co-Authors: K.A. Fallows (Institute of Mathematics and Physics, Aberystwyth University/ASTRON, the Netherlands Institute for Radio Astronomy), and A. Asgekar (ASTRON, the Netherlands Institute for Radio Astronomy).

Session: INS4: LOFAR, the LOw Frequency ARray: Ongoing Developments and Early Results

Displayed during: Poster Session B

Summary:

Interplanetary scintillation (IPS) is a powerful means of observing the Sun's extended atmosphere – the solar wind – through remote sensing. IPS – the twinkling of radio waves from a distant, compact, astronomical natural radio source – results from density inhomogeneities traversing the interplanetary medium moving outward from the Sun. Using the newly-developed IPS experiment on the novel European-based radio telescope, the LOw Frequency ARray (LOFAR), we have our first detection of a coronal mass ejection (CME) passing through one of our preliminary observations of IPS during the ongoing commissioning phase of the LOFAR system. Here, we identify the CME in white-light imagery, and briefly discuss and compare its characteristics/properties with other sources of data where available. We also note how such work will be taken forward with on-going test observations of IPS using LOFAR, and look to the future to fully combine LOFAR observations of IPS with those taken using other systems worldwide, including the European Incoherent SCATter (EISCAT) radar and the Multi-Element Radio-Linked Interferometer Network (MERLIN) which are also located within Europe along with LOFAR.

A 19-pixel L-band receiver array for FAST.

Author: Bruno Maffei

Jodrell Bank Centre for Astrophysics

Co-Authors: Rendong Nan (NOAC), Jin Chengjin (NAOC), Graeme Carrad (CSIRO) and the FAST collaboration.

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

The FAST (Five hundred meter Aperture Spherical Telescope) project is being developed by China. This approved mega-science currently under construction will be the largest single dish telescope ever built. This facility, planned to be commissioned in 2016, will largely surpass the capabilities of the famous Arecibo telescope leading to a formidable tool for the study of pulsars, HI regions and more generally Cosmology. Several receivers will be installed at its focus on a common platform. A consortium of three institutes (JBCA-UK, NAOC-China and CSIRO- Australia) has been formed in order to develop the first set of receivers for this world leading facility. This 19-pixel L-Band receiver array (0.95 – 1.45 GHz), which will be ready for the telescope commissioning, will give the first light of this facility which is expected to be a new milestone for the pulsar search and pulsar timing study. We present the design of the telescope together with the expected performance of the L-Band receiver array.

Generation of vortex beams in the W-band: design and testing of a dielectric q-plate.

Author: Stefania Maccalli

JBCA

Co-Authors: G. Pisano (JBCA); R. Ng (JBCA)

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

It has been discovered recently that light can carry not only the usual Spin Angular Momentum (SAM), associated with circular polarization states of the field, but also Orbital Angular Momentum (OAM): light beams carrying quantized values lħ of OAM are called optical vortices. This kind of radiation has a wide range of applications: from quantum encryption and telecommunications to non-contact manipulation of matter and astrophysics. The goal of our project is to develop instrumentation able to discern different OAM states in the laboratory, at millimetre wavelengths (W-band). This can be achieved by designing devices such as q-plates: artificial birefringent plates designed for production/detection of particular OAM states. Here we present the RF characterisation of one prototype of dielectric q-plate that has been designed to produce/detect POAM beams with charge l=+/-2. All the measurements were carried out using a Vector Network Analyser (VNA). The measured beam pattern resulted in very good agreement with the finite-element analysis predictions (HFSS) showing both the expected intensity annular shape and the phase change of 4pi across a close loop around the propagation axis.

Instrumental systematic effects of quasi-optical components for astronomical instruments

Author: Ho-Ting Fung

JBCA, The University of Manchester

Co-Authors: H.Fung(JBCA, The University of Manchester); F.Ozturk(JBCA, The University of Manchester); B.Maffei(JBCA, The University of Manchester); G.Pisano(JBCA, The University of Manchester)

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

Astrophysical experiments dedicated to millimetre-wave polarimetry, in particular COrE and QUBIC, are in need of well defined antenna beam shapes.

Such beams not only have to be modelled with care, but they must also be characterised accurately. Some of the quasi-optical components within these instruments (such as interference filters and half wave plates) can modify the shape of the antenna beams. We present here, the measurements and simulations of such effects (co- and cross- polarisation radiation patterns) on a corrugated horn antenna beam, using a Vector Network Analyser at W–band (75 – 110 GHz).

Investigation of Optimised Horns for use in Future Arrays, as an Alternative to Corrugated Horns

Author: Darragh McCarthy

National University of Ireland, Maynooth

Co-Authors: N.Trappe(National University of Ireland, Maynooth); B.Maffei(University of Manchester)

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

At present, space and ground based sub-millimetre systems are based on a single pixel model, utilising a corrugated horn at the front end of the instrument to couple the incident radiation to the optics. While these systems function very well, the natural progression is to extend them to multiple pixels to allow more efficient observations to be made. This becomes critical for space based missions in which the instrument has a finite lifetime. Such instruments would require arrays of horns, one for each pixel. Corrugated horns are time and cost intensive to produce, which makes them less ideal for arrays containing potentially hundreds of horns, particularly if the technology is to be introduced in a commercial sense (security and medical imaging, for example). The goal therefore, is to produce a feed horn with similar performance to that of a corrugated horn, but with a limited number of corrugations, or ideally none. We investigate the performance of a Pickett-Potter horn when its design is optimised subject to a number of degrees of freedom, in order to achieve specified levels of performance similar to those of a corrugated horn, under specific headings such as cross polar power, gaussicity and mode content. We also investigate using smooth walled Gaussian profiled horns for this purpose.

Lens antenna system study for future CMB polarisation projects.

Author: Fahri Ozturk

The University of Manchester, JBCA

Co-Authors: B. MAFFEI (1) G. PISANO (1) H.T. FUNG (1) M.W. NG (1) V. HAYNES (1) (1) JBCA, School of Physics and Astronomy, The University of Manchester, UK

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

The next generation of instruments dedicated to the Cosmic Microwave Background Radiation (CMBR) polarisation measurement will require large focal planes including several thousand of pixels. Future lens-based telescope configurations (such as LSPE, SPIDER) might be a strong alternative to the reflector based ones (Planck, WMAP). However, their readiness level is deemed low in term of RF performance knowledge and hence they are being studied in order to understand their systematic effects such as aberrations and cross-polarisation. The work presented here introduces RF simulations using different optical models such as Method of Moments (MOM) and Finite Element Method (FEM). These simulations are also compared to experimental data gathered on a representative lens system (lens and feed-horn) for which the co- and cross-polarisation beam pattern has been measured.

The Manchester University Student Telescope (MUST)

Author: Monika Obrocka

Jodrell Bank Centre for Astrophysics

Co-Authors: P. Wilkinson; B. Stappers; MUST Collaboration

Session: INS5: Radio to sub-millimeter technology developments for receiver arrays

Displayed during: Poster Session B

Summary:

The first phase of a low cost radio telescope known as the Manchester University Student Telescope (MUST) is under construction. The design requirement and science goals, such as pulsar searches and fast radio transients, are presented in this poster. MUST is a phased array system that will be able to survey the radio sky due to its multi-beaming capabilities. The Phase 1 prototype will consist of one tile of 20 m^2 and operate at a centre frequency of 590 MHz with 5 to 10 MHz bandwidth.

A New Method to Determine Star Cluster Distances?

Author: Anne Buckner

Univeristy of Kent

Co-Authors: D.Froebrich (University of Kent)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Determining cluster distances is essential to analyse their properties and distribution throughout the Galaxy. In particular it is desirable to have a reliable, purely photometric method for large samples of newly discovered (candidate) clusters (e.g. from 2MASS, UKIDSS-GPS, VISTA-VVV). This would allow us to estimate distances independent of isochrone fits and cluster properties (age and reddening). Here we present our attempt to 'calibrate' such a method, based on a set of about 100 star clusters with known distances. Our method relies on the photometric decontamination of cluster and field stars, based on the colour and position of a star relative to the cluster, to determine cluster membership probabilities. We then estimate the total number of foreground stars to the cluster (per unit area) based on the colours of low probability cluster members. These are then compared to predictions from the Besancon Galaxy Model by Robin et al. to estimate the cluster distance. The poster will show our preliminary results on the accuracy of such distance calculations. We will discuss which parameters of the photometric decontamination are required to achieve the best calibration, and if the accuracy depends on e.g. the age of the cluster or its position in the Galaxy.

An analysis of the Herschel data of the star-forming regions Mon R1 and Mon R2

Author: Thomas Rayner

Cardiff University

Co-Authors: M. Griffin (Cardiff University) D. Ward-Thompson (Cardiff University) J. Kirk (Cardiff University) The SPIRE SAG-3 Team

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Reflection nebulae are usually good indicators of sites of current or recent star formation, as they are formed when the output from a star or stars opens up the parent cloud. In many cases, the clouds will contain yet younger stars and protostars, which are even more valuable to star formation studies. These, however, cannot be observed in visible light, and so must be studied in the infrared part of the spectrum. Using data from both the Herschel PACS and SPIRE instruments and SCUBA-2 on the JCMT, we study two star-forming regions; the reasonably quiet Mon R1 (part of the Mon OB1 association), and the much denser, brighter Mon R2. We identify the locations and properties of dense clumps in the clouds and characterise these clumps via a mass-size plot, which is used to determine what proportion of them are likely to become stars. We also study the structure of the regions, including that of the filaments in which star formation occurs, and the cores themselves.

Direct Observation of the Transition to Coherence and Isothermal Filaments in a Dense Core

Author: Jaime E Pineda

JBCA, University of Manchester and ESO

Co-Authors: A. Goodman (Harvard-Smithsonian CfA), H. Arce (Yale University), P. Caselli (University of Leeds), J. Foster (Boston University), P.C Myers (Harvard-Smithsonian CfA), E. Rosolowsky (University of British Columbia at Okanagan), S. Longmore (ESO), S. Corder (NRAO)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

We present NH3 observations of the B5 region in Perseus obtained with the GBT and EVLA. The GBT map covers a region large enough (11'×14') that it contains the entire dense core observed in previous dust continuum surveys. The dense gas traced by NH3(1,1) covers a much larger area than the dust continuum features found in bolometer observations. The velocity dispersion in the central region of the core is small, presenting subsonic non-thermal motions which are independent of scale. However, it is thanks to the coverage and high sensitivity of the observations that we present the detection, **for the first time**, of the transition between the coherent core and the dense but more turbulent gas surrounding it. This transition is sharp, increasing the velocity dispersion by a factor of 2 in less than 0.04 pc (the 31" beam size at the distance of Perseus, 250 pc).The change in velocity dispersion at the transition is ~3 km s−1 pc−1. The existence of the transition provides a natural definition of dense core: the region with nearly-constant subsonic non-thermal velocity dispersion. The EVLA observations (27 pointing mosaic) are combined with the GBT map to achieve a 6" beam. This map (~6.8'x8') covers the region of subsonic non-thermal velocity dispersion observed with the GBT. These observations reveal, for the first time, the presence of striking filamentary structure (20" wide or 5,000 AU at the distance of Perseus) in this low-mass star forming region. The integrated intensity profile of this structure is consistent with models of an isothermal filament in hydrostatic equilibrium. Also, the observed separation between the B5–IRS1 young stellar object (YSO), in the central region of the core, and the northern starless condensation matches the Jeans length of the dense gas. This suggests that the dense gas in the coherent region is fragmenting. The region observed displays a narrow velocity dispersion, where most of the gas shows evidence for subsonic turbulence, and where little spatial variations are present. It is only close to the YSO where an increase in the velocity dispersion is found, but still displaying subsonic non-thermal motions. Finally, we'll discuss the implications of these results on the "core" identification/definition and the importance of the region of subsonic turbulence in the formation process of low-mass stars.

Feedback Regulated Star Formation: From Star Clusters to Galaxies

Author: Sami Dib

Imperial College London

Co-Authors:

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Displayed during: Poster Session A

Summary:

I will summarise results from a model which describes star formation in protocluster clumps of different metallicities. In this model, gravitationally bound cores form uniformly in the clump following a prescribed core formation efficiency per unit time. After a contraction timescale which is equal to a few times their free-fall times, the cores collapse into stars and populate the IMF. Winds from the newly formed OB stars remove gas from the clump until core and star formation are quenched. The power of the radiation driven winds has a strong dependence on metallicity and increases with increasing metallicity. Thus, winds from stars in the high metallicity models lead to a rapid evacuation of the gas from the protocluster clump and to a reduced star formation efficiency, SFE_exp, as compared to their low metallicity counterparts. By combining SFE_exp with the timescales on which gas expulsion occurs, we derive the metallicity dependent star formation rate per unit time in this model as a function of the gas surface density Sigma_g. This is combined with the molecular gas fraction in order to derive the dependence of the surface density of star formation Sigma_SFR on Sigma_g in galactic disks. This feedback regulated model of star formation reproduces very well the observed star formation laws extending from low gas surface densities up to the starburst regime. Furthermore, the results show a dependence of Sigma_SFR on metallicity over the entire range of gas surface densities.

Herschel HIFI water observations of low-mass protostellar envelopes in the WISH survey

Author: Joseph Mottram

Leiden Observatory

Co-Authors: Lars Kristensen (Leiden Observatory), Ewine van Dishoeck (Leiden Observatory)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Herschel observations are revolutionising our understanding of water, a key probe of the temperature, density and kinematics of the warm gas in star formation regions. Recent results from the ``Water in Star-forming regions with Herschel'' (WISH) HIFI Guaranteed Time Key Programme have revealed that embedded YSOs have diverse, rich and complex water line profiles, often containing multiple components tracing different physical processes within a single beam. These different components can be placed in a tentative evolutionary scenario, such that the relative importance of different processes can be explored with time. A specific example is that inverse P-Cygni profiles are much more common in water in deeply embedded low-mass protostars than other chemical species previously studied. 1-D multi-transition radiative transfer modelling of WISH HIFI water observations towards these Class 0 protostars is used to quantify the infall velocities and envelope physical properties in a self-consistent manner. This example will be used to show that water is uniquely sensitive to the dynamics of material around YSOs. The WISH survey is thus providing a valuable legacy, which will shape our understanding of star formation for decades to come.

How stars grow massive despite radiation pressure, triggering star-bursts; insights from gravitation

Author: Miles F Osmaston

Woking, UK (retired)

Co-Authors:

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Although high-mass stars range up to >100Msun they are evidently shedding up to 90% of their mass at very high rates. This has been attributed to radiation pressure, the only mechanism apparently available. But thermonuclear light-up occurs at well below one solar mass, so why doesn't radiation pressure inhibit accretionary growth to that high mass in the first place? New work on the physics of the gravitation mechanism [1], outlined on this poster, has revealed an expectation that the Newtonian force of any gravitationally-retained assemblage is inescapably accompanied by a radial positive-body-repelling electric field, the Gravity-Electric (G-E field). So this may be responsible for much of the mass loss, primarily of highly ionized material, with radiation pressure playing a smaller rôle. In that case, accretionary infall of very dust-opaque materials will not be opposed by the G-E field until stellar heat evaporates the dust and ionizes it, very close-in. The Newtonian force will prevail and the star will grow. So the ability to build a high-mass star now depends upon the source cloud's opacity. But the rapid evolution and mass loss of those stars will further increase that opacity - a positive feedback mechanism that could be the trigger for the starburst phenomenon. [1] Osmaston MF. (2006) GCA 70(18S), A465:- — (2009a) EPSC Abstr. 4, EPSC2009-264:- — (2009b) Geophys.Res. Abstr. 11, EGU2009-12204:- — (2010) In JENAM 2010 (ed. A. Moitinho et al) Abstract Book (Version 2.0) 159-160. — PSS (submitted).

Large Scale Infrared Dark Filaments

Author: Clare Lenfestey

University of Manchester

Co-Authors:

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

The galactic plane contains long strings of IRDCs with very high aspect ratios, for example the 'Nessie' nebula (Jackson et al. 2010) is 80pc long with an aspect ratio of 150:1. The formation of such filaments is poorly understood; their size implies that it is unlikely that such filaments are formed by turbulence alone, but that cloud-cloud collisions or the interaction of shocks with molecular clouds play an important role. In order to investigate the possible processes behind the formation of such large-scale filaments and the role they play in star formation, a systematic search of the galactic plane has been undertaken. Using the Spitzer IRDC catalogue and minimum spanning trees, 102 candidate filamentary structures have been identified and further investigated using the Herschel HIGAL data to look at their thermal dust emission. This not only provides additional support that the structures detected are indeed coherent, spatially connected filaments, but also allows us to look in greater detail at the fragmentation of the filaments, allowing us to further understand the processes that initiate star formation. The morphologies of infrared dark filaments are varied, ranging from hub-filaments to bubble-like features, but the majority of the structures are long and narrow, similar to Nessie. One of the most intriguing characteristics of the filaments is that the do not appear to be randomly aligned with respect to the galactic plane; they are instead aligned so that they lie parallel to the disc. This could provide evidence that the passage of the spiral arms through the ISM compresses the gas, causing infrared dark filaments to condense and fragment, triggering star formation along the leading edge of the spiral arms.

Lonely Cores Observed In Molecular Lines

Author: Ciara Quinn

Cardiff University

Co-Authors: T. Bourke (Harvard-Smithsonian Centre for Astrophysics); D. Ward-Thompson (Cardiff University)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Isolated star-forming cores are the ideal laboratory for the study of the low-mass star formation process. They have a relatively simple nature and are free from the confusing effects experienced in larger, more crowded molecular clouds and clusters, where multiple star formation events lead to a more complicated picture that is harder to interpret. The Spitzer legacy program "From Molecular Clouds to Planet-Forming Disks" and its follow-up program "Lonely Cores" mapped more than 100 nearby, isolated cores across a range of evolutionary stages. To study the cores in detail, however, complementary high-resolution spectral-line mapping is needed. Using the ATNF Mopra Telescope, a 22-m radio telescope, situated in NSW, Australia, we have mapped the 12CO(J=1-0), 13CO(J=1-0) and C18O(J=1-0) emission from ~40 southern cores from the Lonely Cores sample, primarily targeting low density starless cores that may or may not be gravitationally bound, to study possibly the youngest cores . By conducting an LTE analysis, we have calculated excitation temperatures, optical depths, column densities and masses of the most isolated subset of these cores. By comparing our column density maps with mid-infrared extinction maps, we find that 13CO and C18O are excellent tracers of extinction conditions within these dense cores.

Molecular cloud disruption and chemical enrichment of the ISM caused by massive star feedback

Author: Katharina Fierlinger

University Observatory Munich

Co-Authors: A.M. Burkert (University Observatory Munich); R. Diehl (Max Planck Institute for Extraterrestrial Physics); C. Dobbs (University of Exeter); D.H. Hartmann (Clemson University); M. Krause (Max Planck Institute for Extraterrestrial Physics); E. Ntormousi (University Observatory Munich); R. Voss (Radboud University Nijmegen)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Massive stars shape the interstellar medium and enrich it with freshly-produced heavy elements by means of Wolf-Rayet winds and supernovae explosions. In this work we focus on the feedback efficiency in homogeneous GMCs, turbulent GMCs, as well as irregularly-structured GMCs taken from global disc simulations. Also the enrichment of the ISM with 26Al, a radioactive trace element that decays with an average lifetime of 1 Myr after being ejected from the stars, is studied. For our hydrodynamic simulations we use the RAMSES code and the Geneva grids of stellar evolution models. In all our simulations, a superbubble is formed after break-out from the MC, and then the massive-star outputs rather rapidly disrupt the molecular cloud. The feedback is most disruptive for a homogeneous molecular cloud, whereas the clouds with an irregular density structure have longer lifetimes, since more of the energy from the feedback is channelled into low density surroundings. We find that for structured clouds, the stellar feedback naturally reproduces cavities with asymmetric morphologies, similar to the Orion-Eridanus bubble. Finally we use our calculations to predict the distribution of 26Al, thus providing an important constraint on the timescales for the propagation of stellar winds and supernovae in the ISM.

Numerical simulations of a shock interacting with multiple clouds

Author: Robertas Aluzas

University of Leeds

Co-Authors: J.M.Pittard (University of Leeds) T.W.Hartquist (University of Leeds) S.A.E.G. Falle (University of Leeds)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

In self-propagating star formation feedback from massive stars induces further star formation in the galaxy. However, flows and shocks created by the

massive stars can also destroy surrounding clouds. In order for a shock front to provide positive feedback in star formation the shock needs to evolve considerably, perhaps as a result of destroying some "sacrificial" clouds on its way. I will present the insights gained from numerical simulations where a

shock encounters systems of clouds. As the clouds evolve they affect the flow and are mixed into it. Clouds further downstream then evolve differently as they interact with the shock and mass-loaded flow. I investigate the role of different cloud geometries and number densities and use a sub-grid turbulence model.

Radio continuum observations of low mass young stars driving outflows

Author: Rachael E. Ainsworth

Dublin Institute for Advanced Studies

Co-Authors: A. M. M. Scaife (University of Southampton); T. P. Ray (Dublin Institute for Advanced Studies)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

We present 16 GHz deep radio continuum observations of a sample of classic low-mass young stars driving jets with the Arcminute Microkelvin Imager Large Array (AMI-LA). We compile and examine spectral energy distributions (SEDs) for each source using data from an extensive literature search and calculate both radio and sub-mm spectral indices in two different scenarios: (1) fixing the dust temperature according to evolutionary class; (2) allowing the dust temperature to vary. We use these derived spectral indices to place constraints on the physical mechanisms responsible for the radio emission and find that 80% of the objects in this sample have spectral indices consistent with free-free emission from a partially ionized outflow. We examine correlations between the radio luminosity and bolometric luminosity, envelope mass, and outflow momentum force and investigate the error contributions of different spectral parameters to constraining the radio luminosity of these objects. Based on AMI Consortium: Ainsworth et al. 2012, in prep

Spitzer characterisation of dust in an anomalous emission region: the Perseus Cloud - IRAC and MIPS

Author: Christopher Tibbs

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Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Anomalous microwave emission is known to exist in the Perseus Molecular Cloud, as recently observed by the Planck satellite, and one of the most promising candidates to explain this excess emission is that of electric dipole radiation from rapidly rotating very small dust grains, commonly referred to as spinning dust. Photometric data observed with the Spitzer Space Telescope have been completely reprocessed and used in conjunction with the dust emission model DUSTEM to characterise the properties of the dust within the cloud. This analysis allowed us to constrain spatial variations in the strength of the interstellar radiation field, the abundances of the PAHs and VSGs relative to the BGs, the column density of hydrogen and the equilibrium dust temperature. These parameter maps were used to investigate the dust properties in regions both with, and without, anomalous emission, and we find that in regions of anomalous emission, the abundances of the PAHs, the strength of the interstellar radiation field and the equilibrium dust temperatures are enhanced, while the column density of hydrogen is decreased. This type of analysis opens a new perspective in the field of anomalous emission studies, and represents a powerful new tool for constraining spinning dust models.

Stability of self-gravitating discs under irradiation

Author: Ken Rice

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Co-Authors: P.J. Armitage (University of Colorado, Boulder) G.R. Mamatsashvili (Observatorio Astronomico di Torino) G. Lodato (Universita degli Studi di Milano) C.J. Clarke (Institute of Astronomy, Cambridge)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Self-gravity becomes competitive as an angular momentum transport process in accretion discs at large radii, where the temperature is low enough that external irradiation likely contributes to the thermal balance. Irradiation is known to weaken the strength of disc self-gravity, and can suppress it entirely if the disc is maintained above the threshold for linear instability. However, its impact on the susceptibility of the disc to fragmentation is less clear. We use two-dimensional numerical simulations to investigate the evolution of self-gravitating discs as a function of the local cooling time and strength of irradiation. Fragmentation requires short cooling times and is found to be a weak function of the level of irradiation. We find that the cooling time boundary increases by approximately a factor of two, as irradiation is increased from zero up to the level where instability is almost quenched. The numerical results imply that irradiation cannot generally avert fragmentation of self-gravitating discs at large radii; if other angular momentum transport sources are weak mass will build up until self-gravity sets in, and fragmentation will ensue.

Template fitting of WMAP 7-year data: anomalous dust or flattening synchrotron emission?

Author: Michael Peel

Jodrell Bank Centre for Astrophysics, University of Manchest

Co-Authors: M. W. Peel [1], C. Dickinson [1], R. D. Davies [1], A. J. Banday [2], T. R. Jaffe [2], J. L. Jonas [3] [1] Jodrell Bank Centre for Astrophysics, University of Manchester [2] Centre d'Etude Spatiale des Rayonnements, Toulouse [3] Department of Physics and Electronics, Rhodes University

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

Anomalous microwave emission at 20-40GHz has been detected across our Galactic sky. It is highly correlated with thermal dust emission and hence it is thought to be due to spinning dust grains. Alternatively, this emission could be due to synchrotron radiation with a flattening (hard) spectral index. We cross-correlate synchrotron, free-free and thermal dust templates with the WMAP 7-year maps using synchrotron templates at both 408MHz and 2.3GHz to assess the amount of flat synchrotron emission that is present, and the impact that this has on the correlations with the other components. We find that there is only a small amount of flattening visible in the synchrotron spectral indices by 2.3GHz, of around \Delta \approx 0.05, and that the significant level of dust-correlated emission in the lowest WMAP bands is largely unaffected by the choice of synchrotron template, particularly at high latitudes (it decreases by only ~7 per cent when using 2.3 GHz rather than 408 MHz). This agrees with expectation if the bulk of the anomalous emission is generated by spinning dust grains. (MNRAS, submitted; arXiv:1112.0432)

Testing the universality of star formation - the 73% solution?

Author: Robert King

University of Exeter

Co-Authors: R. J. Parker (ETH, Zurich); J. Patience (Exeter); S. P. Goodwin (Sheffield)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

One of the major unsolved problems in star formation is the universality of the process: is the difference between small, local star-forming regions such as Taurus, and massive starburst clusters like 30 Doradus merely one of the level of star formation, or is there something fundamentally different between these two extremes? Binary star populations provide an important probe of the star formation process. I will present our recent comparison of multiplicity data for five nearby star-forming regions (Taurus, Chamaeleon I, Ophiuchus, IC348, and the ONC) in which we impose identical sensitivity criteria. Within this carefully controlled study, we find no significant trend of decreasing binary fraction with increasing cluster density. Only Taurus is distinct from the remaining regions which span a factor of nearly 20 in density. Through a comparison with N-body simulations tailored to the size, density and morphology of our target clusters, we find that the only possible universal initial condition capable of reproducing all of the observations is an initially clumpy (fractal) distribution with a total binary fraction of ~73%. I will also discuss our ongoing comparison of the separation distributions of these regions.

The ISM in distant star-forming galaxies: going after extreme turbulence at z=2

Author: Padelis P. Papadopoulos

Max Planck Institute for Radioastronomy

Co-Authors: Mark Swinbank (Durham) - Pierre Cox (IRAM) -- Ian Smail (Durham) et al.

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

I will describe how a combination of strong gravitational lensing and sensitive mm and cm interferometric imaging of molecular lines allowed a detailed glimpse into the molecular ISM of a distant star-forming galaxy at z=2.2. The effects of high turbulent pressure, the cloud scaling relations, and a dramatic resetting of the star formation initial conditions come into an unexpectedly sharp focus, opening the gates for such investigations across cosmic epoch, with ALMA and the EVLA

The Milky Way Project

Author: Robert Simpson

Oxford University

Co-Authors: M.S.Povich (Pennsylvania State University); S.Kendrew (Max Planck Institute for Astronomy); C.J.Lintott (Oxford University); E.Bressert (ESO, Exeter); K.Arvidsson (University of Chiacgo); C.Cyganowski (Harvard CfA); S.Maddison (Swinburne); K.Schawinski (Yale University); R.Sherman (University of Chicago); A.M.Smith (Adler Planetarium); G.Wolf-Chase (Adler Planetarium)

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

We present the first results of the online citizen science website 'The Milky Way Project. Principally we describe a new catalogue of 5,106 infrared bubbles created through visual classification via the site. Bubbles in the new catalogue have been independently measured by at least 5 individuals, producing consensus parameters for their position, radius, thickness, eccentricity and position angle. Citizen scientists - volunteers recruited online and taking part in this research - have independently rediscovered the locations of at least 86% of three widely-used catalogues of bubbles and H II regions whilst finding an order of magnitude more objects. Also outlined is the creation of a 'heat map' of star-formation activity in the Galactic plane. This online resource provides a crowd-sourced map of bubbles and arcs in the Milky Way, and will enable better statistical analysis of Galactic star-formation sites. The project has also been collecting data on the locations and sizes of other objects, including star clusters, galaxies and compact H II regions.

The Structure and Kinematics of NGC 2068 in Orion B

Author: Samantha Walker-Smith

University of Cambridge

Co-Authors: J. S. Richer, J. V. Buckle, J. S. Greaves, I. A. Bonnell

Session: ISM1: Interstellar medium and star formation

Displayed during: Poster Session A

Summary:

We have carried out a survey on the NGC 2068 region in the Orion B molecular cloud with HARP on the JCMT, using 13CO and C18O (J=3-2) and H13CO+ (J=4-3). We used 13CO to map the outflows in the region, and have attempted to match them up with previously defined SCUBA cores. Using the gaussclumps algorithm, we have broken down the C18O and H13CO+ into clumps, finding 29 and 18 clumps respectively. The average deconvolved radii of these clumps is 5400+/-2100AU and 2800+/-900AU for C18O and H13CO+ respectively. We have also obtained virial and gas masses for these clumps, and hence determined how bound they appear. We find that the C18O clumps appear to be more bound than the H13CO+ clumps (average gas-virial ratio of 2.6 compared to 1.1). This can be explained by C18O contributions from gas in the infalling envelope, compared to H13CO+ which traces only the denser core. We have obtained core-to-core velocity dispersions for the clumps of 0.43 +/- 0.17 km/s and 0.71 +/- 0.11 km/s for C18O and H13CO+ respectively. We use these values to investigate the kinematics of fragmentation of prestellar cores.

CARMA observations of methanol in NGC2264

Author: Jane Buckle

University of Cambridge

Co-Authors: J.S. Richer (University of Cambridge) G.A. Fuller (University of Manchester), N. Peretto (SAp CEA-Saclay)

Session: ISM2: Cosmic carbon

Displayed during: Poster Session A

Summary:

The NGC2264 star forming region is an ideal astrochemical laboratory for clustered star formation. The NGC2264 protoclusters contain embedded sources with masses ranging from 1 to 50 solar masses. The physical parameters of the embedded sources have been well-characterized at high resolution. Since the system is young, with the potential still gas-dominated, we have used CARMA observations of methanol to probe the physical characteristics of the gas. Methanol is known to trace a clumpy, turbulent medium. The high number of transitions, and the volatility of methanol make the molecule a versatile tracer of star forming regions. We present results from CARMA observations of several methanol transitions, tracing a range of physical conditions, temperatures of 7 K to 430 K, and densities of 10^4 to 10^6 per cubic cm.

Desorption of O2, CO and N2 from Astronomically Relevant Surfaces

Author: Dr Jerome Lasne

Heriot-Watt University

Co-Authors: V.L. Frankland; M.P. Collings; M.R.S. McCoustra

Session: ISM2: Cosmic carbon

Displayed during: Poster Session A

Summary:

In the interstellar medium, a range of molecules have been observed in the gas phase or condensed on the icy surface of dust grains. Oxygen (O2), carbon monoxide (CO) and nitrogen (N2) are predicted to be among the most abundant small molecules in dense cores. Although the concentrations of most species, such as CO, agree well with the observed molecular abundance using gas-phase chemistry, the models are unable to explain the formation and abundance of several molecules, including O2 and N2. Then, the models need to include the adsorption and desorption processes of these species from the icy grains to match the observed abundances. To this aim, we performed Temperature-Programmed Desorption (TPD) experiments to study the desorption kinetics of O2, CO and N2 sub-monolayers and multilayers from amorphous silica. The desorption of O2 from compact and porous amorphous solid water is also reported. Our results show that the morphology of the underlying silica surface affects the desorption kinetics of O2, CO and N2.

Nonlinear surface chemistry analysed with XUV pump - XUV probe at FLASH

Nonlinear surface chemistry analysed with XUV pump - XUV probe at FLASH

Author: Björn Siemer

Physikalisches Institut Westfälische Wilhelms-Universität Ms

Co-Authors: R. Frigge, H. Zacharias (Westfälische Wilhelms-Universität Münster); R. Mitzner (Helmholtz Zentrum Berlin); Stefan Düsterer (Hasylab, DESY, Hamburg)

Session: ISM2: Cosmic carbon

Displayed during: Poster Session A

Summary:

For a better understanding of the formation of interstellar molecules a D_2O ice covered highly-oriented pyrolytic graphite (HOPG) surface is investigated. This analog of interstellar ice covered dust grains, is irradiated with XUV radiation (hν = 38 eV), provided by the free electron laser at Hamburg (FLASH). In a so far unknown reaction cascade O_2^+ ions are formed and emitted with a highly nonlinear dependence on the FLASH intensity proportional to I^3. To investigate the formation process of the desorbing molecular oxygen ions a non-linear XUV pump - XUV probe measurement with a beamsplitter and delay-line device for the energy range of 24 – 200 eV is used. A two-pulse autocorrelation curve of desorbing O_2^+ ions is measured. The time constants for the fitted asymmetric Gaussian points to an electronic process initiating the reaction and long decay time of the O_2^+ - signal suggests a motion of molecular constituents during the reaction.

Small TiC molecular clusters as precursors of dust grains in extended atmospheres of AGB stars

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Co-Authors: Ch. Chang; D. Suelzle (Zentrum für Astronomie und Astrophysik, TU Berlin)

Session: ISM2: Cosmic carbon

Displayed during: Poster Session A

Summary:

In circumstellar environments around cool, late-type stars on the asymptotic giant branch (AGB) dust particles are effectively formed via the formation and subsequent growth of small molecular clusters in the gas phase. The details of the dust formation process and the nature of the condensed material depend decisively on the chemical composition as determined by the elemental mixtures of the circumstellar envelopes. As verified by many studies of pre-solar grains enclosed in meteorites dust grains formed in circumstellar outflows of carbon-rich AGB stars are a mixture of several chemical elements such as silicon or titanium in addition to the main component carbon. In this contribution we focus on the investigation of the properties of small molecular titanium carbide clusters, which have been estimated within density functional theory (DFT) approaches. The molecular properties, thus obtained, are necessary prerequisites for the study of dust nucleation in circumstellar environments of AGB stars, to determine the required data of the mircophysical processes involved. Implications regarding the formation of dust particles especially in view of the 'condensation sequence' under carbon-rich conditions are discussed.

Thermal desorption spectroscopy of small molecules on interstellar interesting surfaces

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Session: ISM2: Cosmic carbon

Displayed during: Poster Session A

Summary:

Chemical surface reactions on dust grains are a possible way of molecule formation in the Interstellar Medium (ISM). These grains typically consists of graphitic and silicate particles embedded in icy mantels which are formed by molecules like CO, CO_2, H_2O or CH_4. Temperature programmed desorption (TPD) is used to investigate the binding energy and reaction order of several interstellar interesting molecules like D_2, CO, CO_2, CH_4, and D_2O on different interstellar silicate analogues like Forsterit (Mg2SiO4) and Olivine (Mg

HARP 12CO J=3-2 Submillimeter Observations of the Cygnus X Giant Molecular Cloud

Author: David Carretero

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Co-Authors: J.Richer (University of Cambridge); E.Curtis (University of Cambridge); J.Buckle (University of Cambridge); N. Schneider (Universite Paris Diderot); S.Bontemps (Universite Bordeaux); T.Csengeri (Universite Paris Diderot)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

We present results from a large submillimeter survey of the J=3-2 rotational transition of 12CO, covering a 10 square degree area of the Cygnus X Giant Molecular Cloud (GMC) using HARP on the James Clerk Maxwell Telescope. The data were reduced using the ORAC-DR data reduction pipeline and

analyzed using Starlink software. We searched for outflows in the region originating from the millimeter continuum cores detected in the 1.2 mm continuum survey by Motte et al. (2007), which identifies high mass protostellar candidates. Of the 42 possible protostellar cores identified in Motte et al., we did not have data towards 3 of the cores and have detected outflows and calculated outflow masses, momentums and energetics for 29 of the remaining 39 and an additional outflow attributed to a previously unknown protostellar core. In addition, we compare our data with Spitzer Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE) 4.5 micron emission to test whether extended 4.5 micron emission (Extended Green Objects, or EGOs) trace outflows specifically from massive protostars.

Infall and Outflows in Massive Star Forming Regions.

Author: Catherine McGuire

University of Manchester

Co-Authors: G. A. Fuller (University of Manchester); N. Peretto (CEA, Saclay)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

The exact mechanism by which high mass stars form is not fully understood. One of the main questions concerning the formation of high-mass stars is whether or not they gain their mass through accretion in a similar way to their low-mass counterparts. Recent surveys towards high mass protostellar objects (HMPOs) have found signatures of infall in the form of excess blue asymmetric molecular line profiles in dense gas tracers. However this evidence, based on observations towards single positions, is not sufficient to confirm the presence of infall on its own, since such profiles can also be associated with rotation and outflow motions.Fuller, Williams and Sridharan (2005) identified 22 infall candidates in a molecular line survey of 77 HMPOs. I will present the current results of work to investigate the presence of infall in these objects using a) maps of the spatial distribution of the blue asymmetry and the outflows associated with the sources and b) models of the infall to determine its physical properties.

IRDCs in the Herschel HiGAL Survey in the range l=300-330

Author: Derek Ward-Thompson

Cardiff University

Co-Authors: Lucy Wilcock (Cardiff University) and the HiGAL Team

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

We have observed over 3000 infrared dark cloud (IRDC) candidates in the Herschel HiGAL survey, in the range l=300-330. We find that only around 1200 of them are Herschel-bright in the far-infrared and less than 1000 of these contain distinct cores that are visible in emission at 250 microns. Based on the statistics of those cores that contain sources at 8 and 24 microns respectively, we are able to postulate an evolutionary sequence, with associated timescales, for cores within IRDCs.

Modelling CO bandhead emission in massive young stellar objects

Author: John Ilee

University of Leeds

Co-Authors: R. D. Oudmaijer (University of Leeds) H. E. Wheelwright (MPIfR, Bonn)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

High resolution spectra over the CO first overtone bandhead of twenty massive young stellar objects (MYSOs) are presented. The MYSOs are drawn from the Red MSX source (RMS) survey which represents the most complete population of such objects to date. CO bandhead emission traces hot, dense gas, exactly the conditions expected in circumstellar disks. Therefore, our observations of a relatively large sample of MYSOs allows the scenario of massive star formation featuring accretion disks to be tested. Furthermore, we fit the high spectral resolution data with models of accretion disks to determine the MYSOs' accretion rates, which are currently unknown. Therefore these observations provide a unique view of massive star formation.

MOLECULAR OUTFLOWS TOWARD METHANOL MASERS: Detection methods and calculations of their properties

Author: Lientjie (H.M.) de Villiers

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Co-Authors: M.A.Thompson (University of Hertfordshire); A.Chrysostomou (Joint Astronomy Centre); D.B. van der Walt (North West University)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

Interstellar methanol exhibits maser emission toward star-forming regions. There exist two types of methanol masers: Class I methanol masers, which trace distant parts of molecular outflows from young stellar objects (YSO's) and Class II methanol masers (MMII), which are in the vicinity of massive YSO's, uniquely associated with high mass star formation regions. MMII's exhibit strong emission at 6.7 and 12.1 GHz, and since the Galaxy is transparent at 6.7 GHz, they are ideal tracers of massive star formation sites. These MMII's occupy probably a brief phase in the development of a massive YSO (~10^4 years) – the stage immediately before the ultracompact HII region, a stage where molecular outflows are expected to occur. MMII's could therefore also be useful tracers of molecular outflows. A subset of the MMB Survey's maser coordinates were observed as position-position-velocity (p-p-v) cubes in 13CO and C18O and matched with 12CO images from the JCMT HARP 12CO Galactic Plane Survey. These images were initially used to examine CO line spectrum profiles in a search for broadened line wings, indication of possible CO outflows. Different 1D outflow detection techniques are expanded by investigating three dimensional isosurface representations of the p-p-v cubes, in search for extended velocity features. Once outflows were selected, their physical parameters were calculated. Future work involves a broad search for these outflows by developing automated 3D detection methods. This could cast some light on the association between MMII's and molecular outflows associated with YSO's.

Peering into the Heart of Massive Star formation with the Herschel EPoS survey

Author: Sarah Ragan

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Co-Authors: H. Beuther (MPIA); T. Henning (MPIA); J. Pitann (MPIA); J. Tackenberg (MPIA); H. Linz (MPIA)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

The centerpiece of decades of star formation studies has been the characterization of the earliest phases, known to reside deeply embedded in molecular cloud complexes. This has been a particular challenge for the high-mass regime, because such regions are more distant than their low-mass brethren. Because of its high angular resolution in the far-infrared wavelength regime, Herschel has enabled us to peer into the dense regions of infrared-dark clouds (IRDCs), the birthplaces of high-mass stars and clusters. The Earliest Phases of Star Formation (EPoS) Herschel key program has surveyed 45 IRDCs, and we find that IRDCs harbor a population of point sources ($r < 0.2$pc) along the cold filaments, about half of which are detected at 70 micron for the first time. These deeply embedded objects are pre- and proto-stellar cores which link the cold filaments to the clusters which ultimately will form there. We characterize these sources based on blackbody fits to their spectral energy distributions (SEDs) in the far-infrared, which give estimates of the core temperature, luminosity, and mass. These results provide a more complete census of star formation within our sample and allow us to probe the efficiency with which IRDCs form (massive) stars.

Radio Continuum Sources associated with 6.7GHz methanol masers.

Author: Dr Adam Avison

UK ARC Node, Jodrell Bank Centre for Astrophysics

Co-Authors: The MMB Survey.

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

We present the results of 8.64 GHz continuum observations made toward class II methanol masers in regions of massive star formation. Made simultaneously Methanol Multibeam Survey (MMB) observations for high accuracy maser positioning these observations were conducted at the Australia Telescope Compact Array (ATCA). The target sources in the sample are 6.7GHz maser sources newly discovered during MMB Survey. The resulting HII region sample have been categorised based on their size (e.g. Hyper-compact or Ultra-compact HII regions). Evolutionary traits such as the size of the HII region compared with the maser/HII region separation have been investigated. For the more spatially separated HII regions we investigate their GLIMPSE colours, finding that our HII region sample inhabits a distinct region of GLIMPSE colour space from the region inhabited by class II methanol masers.

The G305 star-forming complex: Embedded Massive Star Formation Discovered by Herschel Hi-GAL

Author: Alessandro Faimali

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Co-Authors: M. A. Thompson (University of Hertfordshire); L. Hindson (University of Hertfordshire; ATNF, CSIRO Astronomy and Space Science); J. S. Urquhart (ATNF, CSIRO Astronomy and Space Science; Max Planck Institut fu ¨r Radioastronomie); M. Pestalozzi (INAF-Istituto Fisica Spazio Interplanetario); S. Molinari (INAF-Istituto Fisica Spazio Interplanetario); S. Carey (Spitzer Science Center, California Institute of Technology); S. Shenoy (Space Science Division, NASA Ames Research Center); and J. S. Clark (The Open University).

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

The G305 complex is one of the nearest, and most massive star forming sites within the Galactic plane at l=305°, b=0°, providing an excellent opportunity to study the nature of massive star formation. Here we present a far-IR study towards the complex, utilising PACS 70, 160 μm and SPIRE 250, 350, and 500 μm observations from the Herschel Hi-GAL survey. The focus of this study is to identify the sites of embedded massive star formation within G305, by combining our far-IR data with ATCA radio continuum, ATNF Mopra H2O maser, MMB methanol maser, Spitzer MIPSGAL, and RMS data. From these associations we identify some 16 candidate embedded massive star-forming regions, and derive a far-IR selection criterion from this sample, to identify a further 31 embedded massive star forming candidates with no associated emission. Using this result we can build a picture of the present day star-formation of the complex, and by using a Salpeter IMF, find a SFR of 0.01-0.02 M⊙ yr−1. Comparing to the Galactic SFR, we find that a few tens to hundreds of G305 complexes are analogous to the entire star formation rate of the Milky Way. This resolved Galactic SFR is contrasted to more extragalactic SFR indicators to test whether the two regimes are consistent with one another. We find the star formation activity is underestimated by a factor of > 2 in total when using typical extragalactic SFR tracers, suggesting fundamental differences in the way both regimes are measured.

The W51 Main/South SFR complex seen through 6-GHz OH and methanol masers

Author: Sandra Etoka

JBCA - The University of Manchester

Co-Authors: Malcolm Gray (JBCA - The University of Manchester); Gary Fuller (JBCA - The University of Manchester)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

W51 Main/South is one of the brightest and richest high-mass star-forming regions (SFR) in the complex W51. It is known to host many ultra-compact HII (UCHII) regions thought to be the site of massive young stellar objects. Maser emission from various species is also found in the region. We have performed MERLIN astrometric observations of excited-OH maser emission at 6.035 GHz and Class II methanol maser emission at 6.668 GHz towards W51 to investigate the relationship between the maser emission and the compact continuum sources in this SFR complex. Here we present the astrometric distributions of both 6.668-GHz methanol and 6.035-GHz excited-OH maser emission in the W51 Main/South region. The location of maser emission in the two lines are compared with that of previously published OH ground-state emission. The interesting coherent velocity and spatial structure of the masers and their relationship to infall or outflow in the region will be discussed. It appears that the masers are excited by multiple objects potentially at different stages of evolution.

Tracing the Mass Distribution in Star-Forming Cores Using Ammonia

Author: Lawrence Morgan

ARI

Co-Authors: T.J.T.Moore (ARI), James Alsopp (ARI), David Eden (ARI)

Session: ISM3: Massive Star Formation in the Milky Way

Displayed during: Poster Session B

Summary:

Through the assumption of a slowly varying partition function for ammonia in the temperature regime typically found in star forming regions, we have mapped the mass distribution around a number of cores in W3. This assumption allows us to determine the column density of ammonia using only the (1,1) inversion transition rather than the typical combination of the (1,1) and (2,2) transitions. We present the resulting column density maps along with a comparison to the corresponding maps created using the established method. We suggest that this method is a useful tool in studying the distribution of mass around YSOs, particularly in the outskirts of the envelope where the (2,2) ammonia line is not always detectable on the short timescales necessary for large area mapping.

Conjugate observations of Saturn

Author: Calum J Meredith

University of Leicester

Co-Authors: S.W.H. Cowley (University of Leicester), J.D. Nichols (University of Leicester)

Session: MAG1: Magnetospheres throughout the Universe

Displayed during: Poster Session A

Summary:

We present an analysis of a unique dataset of Hubble Space Telescope images of Saturn's UV auroras obtained close to equinox in 2009, such that both northern and southern dayside auroras were observed simultaneously. Here we focus on the north-south conjugacy, or otherwise, of propagating and transient auroral features, and discuss the implications of the findings for the physical mechanisms involved.

Laboratory investigation of background plasma effects on cyclotron radiation emission

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Session: MAG1: Magnetospheres throughout the Universe

Displayed during: Poster Session A

Summary:

The auroral density cavity (a region of partial plasma depletion at an altitude of ~3200km at the Earth's pole) has a background plasma density ~10^6m^-3, and plasma frequency ~9kHz. Auroral Kilometric Radiation (AKR) is produced when particles descend through this region and are magnetically compressed as they approach the Earth's magnetosphere and through conservation of the magnetic moment, a horseshoe shaped velocity distribution is formed as the particles sacrifice axial for rotational momentum. Theory has shown this type of distribution to be unstable to cyclotron emissions in the X-mode [1]. Satellites have observed that the AKR is emitted at frequencies that extend down to the local electron cyclotron frequency with a spectral peak at ~300kHz, powers ~109W and emission efficiency ~1% of the total precipitated electron kinetic energy. Scaled laboratory experiments [2] have allowed investigation of the naturally occurring process of AKR to take place. Addition of a Penning trap [3] allowed generation of a background plasma, enhancing the comparison between experimental and theoretical/numerical results [DC Speirs and KM Gillespie at these proceedings] and magnetospheric data. Plasma diagnostics gave fpe ~150-300MHz, ne ~10^14-10^15m^-3, Te ~10^5K and a corresponding ratio of fce/fpe~19-40. The plasma background affected the microwave generation, characterised by lower-level intermittent radiation emission compared to the stable emission observed in the absence of plasma. 1. Gurnett DA et al, 1974, J. Geophys. Res., 79, 4227-4238 2. Ronald et al 2011, Plasma Phys. Control. Fusion, 53, 074015 3. McConville SL et al 2011, Plasma Phys. Control. Fusion, 53, 124020

Numerical and laboratory studies of auroral cyclotron emission processes

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Session: MAG1: Magnetospheres throughout the Universe

Displayed during: Poster Session A

Summary:

Electron cyclotron radio emissions, known as Auroral Kilometric Radiation (AKR) originate in the X-mode from regions of locally depleted plasma in the terrestrial polar magnetosphere. A laboratory experiment was constructed to study the emission mechanism of AKR scaled to microwave frequencies [1-2]. 3D PiC simulations of the experiment were conducted to study resonant energy transfer with non-azimuthally symmetric modes of the bounding radiation structure. These 3D simulations show the backward-wave resonance to be resilient to Doppler broadening of the beam-wave coupling [3]. It would suggest that the auroral process may emit with backward-wave coupling giving a spectral downshift and thus avoiding the upper hybrid stop-band [4]. Simulations have shown the influence of electron beam current and cyclotron-wave detuning on mode excitation within the interaction region and the saturated rf output power. The results also demonstrate that cyclotron-wave coupling becomes weaker as the resonant wave moves away from near transverse propagation (kz□> 0). Experiments have tested these results and the potential for relatively efficient emission into an R-X mode at close to the cyclotron frequency. This may be particularly interesting where ducting of the radiation signal is relevant, e.g. chorus. [1] McConville S.L et al, Plasma Physics And Controlled Fusion, 50, Art: 074010, 2008. [2] Ronald K et al, Plasma Physics and Controlled Fusion, 53, Art: 074015, 2011. [3] K. M. Gillespie et al, Plasma Phys. Control. Fusion, 50, 12403, 2008. [4] A.V. Savilov et al, Phys. Plasmas, 14, 113104, 2007.

X-ray activity and rotation of the young stars in IC 348

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Co-Authors: Thomas Preibisch (Universitäts-Sternwarte München)

Session: MAG2: Structure and Dynamics of Solar and Stellar Magnetic Fields

Displayed during: Poster Session A

Summary:

The physical origin of the strong magnetic activity in T Tauri stars and its relation to stellar rotation is not yet well-understood. We investigate the relation between the X-ray activity, rotation, and Rossby number for a sample of 82 young stars in the ~3 Myr old cluster IC 348. We use the data of four Chandra observations of IC 348 to derive the X-ray luminosities of the young stars. We compare the dispersion of fractional X-ray luminosities of the stars in the saturated rotation regime in IC 348 to that seen in younger and older stellar populations. The scatter seen in the ~3 Myr old IC 348 is considerably smaller than for the ~1 Myr old ONC, but, at the same time, considerably larger than the dispersion seen in the ~30 Myr old cluster NGC 2547 and in main-sequence stars. Our results suggest that the scatter of X-ray activity levels shown by the rapidly rotating members of young clusters decreases with the age of the stellar population. We interpret this as a signature of the changing interior structure of PMS stars and the consequent changes in the dynamo mechanisms that are responsible for the magnetic field generation.

Bluesky Solutions to the Magnetohydrodynamic Trigger Problem

Author: Dr Wayne Arter

United Kingdom Atomic Energy Authority

Co-Authors:

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

The trigger problem in magnetohydrodynamics~(MHD) concerns the timescale for the release of a significant fraction of the energy in a magnetic field. The problem is to explain how the timescale of field evolution can change suddenly from months to twenty minutes or less in the case of Solar Coronal Mass Ejections (a factor of at least 2000). Even larger factors, millions plus, approximately the ratio of thermal diffusion timescale to the Alfven timescale, are sometimes seen in tokamak laboratory experiments. As in the case of some Solar flares, repeats of abrupt events are observed, resulting in the sawtooth oscillation. It has long been realised that the likeliest mathematical explanation of the abrupt change in growth rate is to be found in catastrophe theory. The novelty of this work is in starting to tie the generic mathematics to a specific model of an ideal MHD instability (fast timescale) coupled to a slow dissipative background evolution. The specific ANAET model considered (Axisymmetric-NonAxisymmetric ExTended) exploits the symmetries to be expected in a near MHD-equilibrium situation to generate a low order dynamical system. For a wide range of parameters, ANAET exhibits a blue-sky catastrophe, and for a smaller range, numerical results suggest the existence of a blue-sky bifurcation, implying periodic or quasi-periodic catastrophes. Unfortunately for more detailed work, the results indicate that accurate numerical modelling may be very challenging.
Acknowledgement: Work funded by UK EPSRC.

Collisionless distribution function for the relativistic force-free Harris sheet

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Co-Authors: C.R. Stark (Mathematics & Statistics, University of St. Andrews)

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

A self-consistent collisionless distribution function for the relativistic analogue of the force-free Harris sheet is presented. This distribution function is the relativistic generalization of the distribution function for the non-relativistic collisionless force-free Harris sheet recently found by Harrison and Neukirch [Phys. Rev. Lett. 102, 135003 (2009)] as it has the same dependence on the particle energy and canonical momenta. We present a detailed calculation which shows that the proposed distribution function generates the required current density profile (and thus magnetic field profile) in a frame of reference in which the electric potential vanishes identically. The connection between the parameters of the distribution function and the macroscopic parameters such as the current sheet thickness is discussed.

High latitude observations of magnetotail plasma-sheet plasma in conjunction with a transpolar arc

Author: Robert Fear

University of Leicester

Co-Authors: S. E. Milan (University of Leicester) & R. Maggiolo (Belgian Institute for Space Aeronomy)

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

Transpolar arcs (TPAs) are auroral features which extend into the polar cap from the night side of the main auroral oval. A major candidate mechanism for TPA formation invokes the closure of lobe flux in a twisted magnetotail, where the closed flux is prevented from returning to the dayside as the twist causes the northern and southern hemisphere footprints of the closed field lines to straddle the midnight meridian. In this mechanism, closed flux builds up on the night side, so plasma similar to typical plasma sheet distributions should be observed at high latitudes embedded within the lobe. We present preliminary observations of three cases where the Cluster spacecraft observes plasma-sheet plasma embedded within the lobes, and at much higher latitudes than those at which the plasma sheet is usually observed. The locations of the spacecraft map to points on the TPA that are significantly poleward of the main auroral oval. These observations are consistent with TPAs being formed by the proposed reconnection/twisted magnetotail mechanism.

Magnetopause Reconnection Across Wide Local Time.

Author: Malcolm Dunlop

RAL

Co-Authors: Q.-H Zhang (PRIC), Y. Bogdanova (MSSL), Z. Pu (PKU), H. Hasegawa (ISAS), K-H. Trattner (Lockheed Martin), M. Lockwood (Reading U), M. G. G. T. Taylor (ESA), J. Berchem (IGPP), D. Constantinescu (TU-BS), B. Lavraud (IRAP), J. Eastwood (ICL), H. Frey (SSL), J Wild (Lancaster U), C. Shen (NSSC), J-K Shi (NSSC), M. Volwerk (SRI), A. N. Fazakerley (MSSL), D. Sibeck (GSFC), P. Escoubet (ESA).

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

The operation and extent of magnetic reconnection (MR) across the Earth's magnetopause has recently benefitted from an unprecedented growth in complexity of multi-point, in situ measurements, on the small and meso-scale, from Earth-bound space missions. Recent findings in active sites of MR have increased the theoretical understanding of the detailed structure within the ion diffusion region surrounding the magnetic X-line or null field, nevertheless, direct measurements of this small region in space are still relatively rare, owing to the time variable nature of the near-Earth space environment. During April to July 2007 a combination of 10 spacecraft (Cluster, THEMIS and TC-1) provided simultaneous monitoring of the dayside magnetopause across a wide range of local times. Here, we report direct evidence, taken from a conjunction of the THEMIS-A spacecraft and the Double Star, TC-1 spacecraft, of the X-line structure resulting from the operation of MR at two widely (~9 RE) separated locations along the expected sub-solar merging line (line of maximum current) on the Earth's magnetopause. The near simultaneous conjunctions of all 10 spacecraft also identify an extended magnetic reconnection X-line, tilted in the low latitude, sub-solar region, which extends to (anti-parallel) locations on the dawn-side flank. The observed global pattern of FTE's is consistent with the initially strong, but changing, IMF By conditions and supports the result that reconnection activity may occur simultaneously across the sub-solar and flank magnetopause, linked to the (large-scale) extended configuration of the merging line. The occurrence of MR is therefore consistent with a 'component' driven scenario and independent of guide field conditions.

Simulations of Magnetic Reconnection in the Turbulent Solar Wind

Author: Christopher Haynes

Queen Mary University of London

Co-Authors:

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

Magnetic reconnection is a universal process which can play a controlling role in large-scale interactions such as at the magnetopause. Recently interesting questions have arisen on the role of reconnection in turbulence, motivated by MHD simulations and observations of possible reconnection in large amplitude turbulence behind the Earth's quasi-parallel shock. We analyze previous PIC simulation work (Camporeale et al 2010) for signatures of magnetic reconnection, and find electron scale reconnection is occurring in the turbulent plasma simulation. We also analyze plasma temperature in more detail revealing many localised temperature variations, indicating particle acceleration events are occurring at scales near the electron gyroradius. We present new results from 2D fully-kinetic Particle-in-Cell (PIC) simulations of decaying electromagnetic fluctuations, with the guide magnetic field out of the simulation plane. The computational box is such that wavelengths ranging from the electron to ion gyroradius are resolved. The parameters used are typical for the solar wind, with realistic ion to electron mass ratio. We investigate the role of these reconnection events in the turbulent cascade. The work demonstrates that, in contrast to dissipation mechanisms based on linear modes, non-linear magnetic reconnection may be an important energy dissipation mechanism in turbulent solar wind plasma.

Spine-Fan Reconnection: The Influence of Temporal and Spatial Variation in the Driver

Author: Peter Wyper

Sheffield University

Co-Authors: R.Jain

Session: MST1: Magnetic Reconnection in Space and Astrophysical Plasmas

Displayed during: Poster Session B

Summary:

Three dimensional (3D) neutral points are important locations in the solar corona for energy release and magnetic topology change through magnetic reconnection. Recent theoretical studies of the reconnection process at 3D null points suggests that the most common scenario of current sheet formation is a collapsed region between the Spine and Fan known as Spine-Fan reconnection. Previous studies of the Spine-Fan reconnection process use temporally symmetric driving of a fixed spatial extent. However, from observations the atmosphere of the Sun has been shown to be highly dynamic with perturbations of the magnetic field often lacking temporal or spatial symmetry. We present here results from numerical simulations of the Spine-Fan reconnection process driven by more generic perturbations with temporal asymmetry and varying spatial extent. The qualitative and quantitative effects on current sheet growth and reconnection rate are discussed. Our results demonstrate the many degrees of freedom available in interpreting observational signatures of reconnection in three dimensions. We find that additional knowledge of the surrounding flows is essential for a clear interpretation of the reconnection process.

A new methodology to improve modelling of the internal magnetic field

Author: Virginie Penquerc'h

University of Liverpool

Co-Authors: R. Holme (University of Liverpool)

Session: MST2: New exploration of the geomagnetic field: opportunities with the ESA SWARM mission

Displayed during: Poster Session A&B

Summary:

The geomagnetic field is generated by several sources, involving various temporal and spatial scales which overlap each other. It is difficult to separate the different contributions, and models of the internal field often suffer from contamination of the external fields. With the upcoming Swarm mission, it is necessary to understand how this contamination contributes to uncertainties and to develop new methods to minimise it in order to improve the resolution of models of the internal field. We propose here a new methodology. For every orbital track of CHAMP data, the residuals (correlated mainly according to the geometry of the mismodelled external field) between vector measurements and a model are calculated. An external field model is estimated from these residuals, which provides an estimate of the dominant data uncertainty. Data are decimated to calculate a new model, but where a covariant error weighting is applied which gives lesser weight to the data component in the direction of the contamination. This methodology follows past methods, for example to take account of the effect of the spacecraft attitude uncertainty in the Ørsted satellite (Holme, Earth Planets Space, 52, 1187-1197, 2000). We will here discuss preliminary results and possible implications for the Swarm mission.

Coordinated operations between Swarm and Cluster: scientific potential

Author: Andrew Fazakerley

MSSL-UCL

Co-Authors: M.W.Dunlop (Rutherford Appleton Laboratory) M.G.G.T.Taylor (ESA-ESTEC) R. Haagmans (ESA-ESTEC)

Session: MST2: New exploration of the geomagnetic field: opportunities with the ESA SWARM mission

Displayed during: Poster Session A&B

Summary:

The four spacecraft Cluster mission has been studying the Earth's magnetosphere and the solar wind since 2001. The initial polar orbit, which had a perigee height of order 20,000 km, has evolved during the mission. Today the orbit plane has tilted over and the perigee height has fallen, reaching a minimum value below 1500 km at latitudes below 50 degrees. In the coming years the perigee height will rise and the orbit plane will become increasingly tilted, so that the spacecraft cross the auroral regions at the altitudes associated with the auroral acceleration region in 2013 and 2014. The SWARM mission which will be launched shortly will provide information about current systems and electric fields from a near-polar orbit at low altitudes of a few hundred km. We will report on a preliminary examination of the kinds of magnetic conjunction between Cluster and SWARM that are likely to occur over the nominal 4 year lifetime of the SWARM mission, and consider their scientific potential.

Solar cycle trends in ground activity indices

Author: Philip Hush

CFSA, PUniversity of Warwick

Co-Authors: S. C. Chapman (CFSA, Physics Department, University of Warwick), M. W. Dunlop (RAL-Space)

Session: MST2: New exploration of the geomagnetic field: opportunities with the ESA SWARM mission

Displayed during: Poster Session A&B

Summary:

Geomagnetic indices provide a measure of geomagnetic activity over several solar cycles, allowing long term trends to be analysed. SuperMAG is a recent worldwide collaboration of organizations and national agencies that currently operate over a hundred ground based magnetometers. These can be used to create geomagnetic indices in the same manner as the ‘traditional’ geomagnetic indices AE AU AL, but with an order of magnitude greater number of stations. [1] We have performed a statistical analysis of trends in these indices over the solar cycle, with particular focus on comparing SME with AE etc. We find that activity is correlated, but are not in phase, with solar cycle activity as measured by sunspot number or other indicators. We further investigate the correspondence with the source of the ground indices such as the MLT and latitude locations of the SML and SMU ground stations. Comparisons are made between AE and SME to investigate the geographic pattern of activity, and thresholds on activity levels are used to separate large scale and small scale processes. Work is in progress to investigate Dst trends and to compare results to solar wind key parameters. We would like to acknowledge SuperMAG, the World Data Center for Geomagnetism, Kyoto and STFC for their support.

The role of neutral atmospheric dynamics in cusp density and ionospheric patch formation

Author: Anasuya Aruliah

University College London

Co-Authors: Amy Ronksley (UCL); Herbert Carlson (Utah State University, USA); Ian McWhirter (UCL); Tim Spain (UCL); Jøran Moen (University of Oslo, Norway); Kjellmar Oksavik (University of Bergen, Norway); John Meriwether (Clemson University, USA)

Session: MST2: New exploration of the geomagnetic field: opportunities with the ESA SWARM mission

Displayed during: Poster Session A&B

Summary:

The prediction of satellite orbits relies on the quality of models of the upper atmosphere. Until recently it has been assumed that the neutral gas is a slowly and smoothly varying medium, with scale sizes of hours and several hundred to thousands of kilometres. Then in 2004 Lühr et al. reported that the CHAMP satellite observed large increases (doubling) in thermospheric density over small distances of only a few hundred kilometres, seen nearly every time the satellite crossed the cusp. Since then it has become a challenge for the scientific community to determine a mechanism to account for this localised upwelling phenomenon. Critically it has become a challenge for the modellers who need to reconsider thermospheric scale sizes and, in particular, the role of the so-called “passive” thermosphere in the magnetosphere-ionosphere-thermosphere system. From a recent set of experiments on Svalbard in January 2012, EISCAT radar measurements of the ionosphere provide measurements of the heating effect, which are compared with direct measurements of the response of the thermosphere using a combination of a narrow field-of-view Fabry-Perot Interferometer and all-sky Scanning Doppler Imager. An important further bonus with these experiments is to make a quantitative test of the Carlson (2007) theory which proposes a polar patch formation mechanism caused by these density bulges that invokes an important thermospheric role for the first time. The presence of ionospheric patches is of interest to the study of signal propagation. The observations will be used to constrain and test existing models, and will inevitably lead to significant improvements that will benefit the satellite and satellite communications industry.

What the Swarm mission may tell us about the South Atlantic Anomaly

Author: Susan Macmillan

British Geological Survey

Co-Authors: S. Casadio (IDEAS, SERCO, Frascati)

Session: MST2: New exploration of the geomagnetic field: opportunities with the ESA SWARM mission

Displayed during: Poster Session A&B

Summary:

The South Atlantic Anomaly (SAA) is often simply mapped using total intensity values taken from spherical harmonic models of the Earth’s magnetic field. These models are derived from magnetic field observations taken by satellites and observatories and it is expected that data from the forthcoming Swarm mission will make a significant contribution to them. However, the location of the SAA as it affects Low Earth Orbiting (LEO) satellites is more completely determined by considering charged particle trajectories in the Earth’s magnetic field. To include the effects of solar wind variations and magnetic storms dynamic radiation belt models are used, and they generally assume that the Earth’s magnetic field is like that from a dipole. In order to quantify the effect of the omission of the non-dipolar terms and how it is changing with time, we calculate loss cones for trapped particles in the SAA region at typical LEO altitudes using full spherical harmonic models and simplified models comprising only degree 1 and 2 spherical harmonic terms. We also compare the results with SAA peak locations through time as derived from the along-track scanning radiometer series of instruments on board the ERS-1, ERS-2 and ENVISAT satellites.

Antarctic access to the Middle Atmosphere

Author: Andrew J. Kavanagh

British Antarctic Survey

Co-Authors: M. J. Jarvis (British Antarctic Survey)

Session: MST3: Vertical Coupling through planetary atmospheres and ionospheres

Displayed during: Poster Session B

Summary:

The British Antarctic Survey is a leading environmental research centre with a remit to address fundamental questions best answered by studies in the Polar Regions. BAS has a wide-ranging research portfolio which includes atmospheric science ranging from the surface through the middle atmosphere into the geospace region. The Middle Atmosphere Dynamics work-package at BAS uses long-term observations and modelling to determine the global scale dynamical links between the polar middle atmosphere and surface climate. This includes determining how these links are influenced both from above and below. To support this work BAS (sometimes in partnership with other institutions) operates a number of key instruments at its stations at Halley and Rothera, including middle atmosphere radars, airglow imagers, spectrometers and radiosondes. In this poster we provide details of some of the instrumentation available for middle atmosphere research at BAS.

Digital Radio Camera

Author: Martin Fullekrug

University of Bath

Co-Authors: Andrew Mezentsev (University of Bath)

Session: MST3: Vertical Coupling through planetary atmospheres and ionospheres

Displayed during: Poster Session B

Summary:

This contribution reports the design, realization and operation of a novel digital low frequency radio camera towards an exploration of the Earth's

This contribution reports the design, realization and operation of a novel digital low frequency radio camera towards an exploration of the Earth's electromagnetic environment with particular emphasis on lightning discharges and subsequent atmospheric effects such as transient luminous events. The design of the digital low frequency radio camera is based on the idea of radio interferometry with a network of radio receivers which are separated by spatial baselines comparable to the wavelength of the observed radio waves, i.e., ~1-100 km which corresponds to a frequency range from ~3-300 kHz. The key parameter towards the realization of the radio interferometer is the frequency dependent slowness of the radio waves within the Earth's atmosphere with respect to the speed of light in vacuum. This slowness is measured with the radio interferometer by using well documented radio transmitters. The first application of the digital low frequency radio camera is to characterize the electromagnetic energy emanating from sprite producing lightning discharges, but it is expected that it can also be used to identify and investigate numerous other radio sources of the Earth's electromagnetic environment.

Sensitivity studies of mesospheric metal layers using a whole atmosphere community climate model

Author: WUHU FENG

UNIVERSITY OF LEEDS

Co-Authors: John Plane(School of Chemistry, University of Leeds, UK); Martyn Chipperfield (School of Earth and Environment, University of Leeds, UK); Dan Marsh (Atmospheric Chemistry Division, NCAR, USA); Diego Janches (GSFC/NASA, USA); Chester Garner (University of Illinois at Urbana-Champaign, USA); Josef Hoeffner(Leibniz-Institute of Atmospheric Physics, Germany); Anne Smith (Atmospheric Chemistry Division, NCAR, USA)

Session: MST3: Vertical Coupling through planetary atmospheres and ionospheres

Displayed during: Poster Session B

Summary:

The mesosphere / lower themosphere (MLT) region (~80-120 km) connects the atmosphere below with space above, and is a region of increasing scientific and practical interest. For instance, recent studies show that weather forecasts are significantly improved by extending Numerical Weather Prediction models from the stratosphere to the upper mesosphere. The ablation of interplanetary dust particles entering the atmosphere provides a source of metal atoms in the MLT, and the resulting layers of metal atoms and ions offer a unique way to understand the coupling of atmospheric chemistry and dynamical processes, as well as testing the accuracy of climate models in the MLT. Recently we have successfully incorporated the chemistry of Na, Fe and Mg into the NCAR Whole Atmosphere Community Climate Model (WACCM). This model has detailed dynamics/physics and chemical processes from the surface to ~140 km, and also includes parameterisations for other key processes (e.g., ion chemistry, solar cycle and solar proton events). A series of six long-term model runs were conducted to investigate the sensitivity of the simulated Fe layer to the meteoric input function (MIF) and the presence of polar mesospheric clouds. Here we will evaluate: WACCM temperature and ozone against TIMED/SABER measurements; the electron density against the International Reference Ionosphere; and the Fe and Na layers against lidar and satellite measurements.

A Comparison of Geomagnetic Storm and Quiet Time Periods Seen in Superposed SuperDARN Data

Author: James Hutchinson

University of Leicester

Co-Authors: D. M. Wright (University of Leicester); S. E. Milan (University of Leicester); A. Grocott (University of Leicester)

Session: MST4: Recent results in MIST science

Displayed during: Poster Session B

Summary:

Geomagnetic storms cause large global disturbances in the Earth’s magnetosphere, during which large amounts of energy are deposited in the magnetotail and inner magnetosphere, producing an enhanced ring current and energising plasma to relativistic levels by poorly-understood excitation mechanisms. A previous study by Hutchinson et al. [2011a] identified 143 geomagnetic storms over the last solar cycle (1997-2008) from the global SYM-H index and associated solar wind (SW) data from the Advanced Composition Explorer (ACE) spacecraft. Current work continues to use this dataset to investigate the characteristic ionospheric convection during both magnetic storms and quiet time periods via radar backscatter observed by the Super Dual Auroral Radar Network (SuperDARN). A superposed epoch analysis is completed using the map potential technique of Ruohoniemi and Baker [1998]. Complementary analysis is completed on both storm and quiet time auroral images from the IMAGE and POLAR spacecraft missions, with superposed auroral keograms presented along with the cross-cap potential derived from the superposed SuperDARN results to better constrain the storm time coupling between the solar wind and magnetosphere. Here we use the Latitude-Time-Velocity plot technique previously presented (Hutchinson et al. [2011b]) to demonstrate statistical differences in the location and characteristics of storm time and quiet time convection. Initial results are compared to those of Kane & Makarevich [2009] and Gillies et al. [2011] who have undertaken similar studies using different superposition methods. Also presented is a comparison of the results of the superposition with recent geomagnetic storms seen in specific radars; done to investigate the validity of using the statistically average radar scatter as an indication of what individual radars would see during different sized storms, phase progression and varying MLT onsets.

A critical examination of accelerated particle spectra in the auroral acceleration region

Author: Colin Forsyth

UCL/MSSL

Co-Authors: A.N.Fazakerley (UCL/MSSL); A.P.Walsh (UCL/MSSL); C.J.Owen (UCL/MSSL)

Session: MST4: Recent results in MIST science

Displayed during: Poster Session B

Summary:

Quasi-static magnetic-field-aligned electric potential drops at altitudes between 1000 and 12000 km are able to accelerate charged particles into and out of the ionosphere above the aurora. Since 2008, Cluster has made regular passes through this so-called auroral acceleration region (AAR), facilitating studies

of both the temporal evolution and spatial structure of these regions. Whilst the spacecraft can pass over this region with their foot-points separated by only fractions of a degree, this still translates to 10s km in the ionosphere, and this is comparable to the scale size of some auroral arcs. Consequently, the validity of assumptions made concerning magnetic conjugacy, or that the spacecraft are passing through the same acceleration region at different times, may be severely tested and must be closely examined. In this study, we examine a number of AAR crossings by the 4 Cluster spacecraft and compare the accelerated particle spectra recorded by the different spacecraft in order to determine the likelihood of their being conjugate or passing through the same feature at different times. From this, we attempt to understand the uncertainty in determining the temporal evolution and spatial structure of quasi-static potential drops in the AAR.

Spatial fine-structure in trapped and precipitating medium-energy electrons in the noon sector

Author: Martin Birch

University of Central Lancashire

Co-Authors: J.K.Hargreaves(1,2) & M.J. Birch(2) (1) Department of Physics, Lancaster University, UK. (2) Jeremiah Horrocks Institute, University of Central Lancashire, UK.

Session: MST4: Recent results in MIST science

Displayed during: Poster Session B

Summary:

Data from Polar Orbiting Environmental Satellites (POES) during auroral zone overpasses in the noon sector have been studied in order to investigate the relationships between the trapped and precipitating components of the electron flux at 10 km resolution. Three classes of behaviour have been identified, two of which are consistent with strong and weak diffusion. In the third class the precipitating flux shows variations up to 2 orders of magnitude while the trapped flux is almost constant. These properties are compared for electron energies exceeding 30 keV and 100 keV, which are relevant to the phenomena of auroral radio absorption.

Statistical study of EMIC waves using Cluster satellites

Author: Ivan Pakhotin

The University of Sheffield

Co-Authors: S.N. Walker (The University of Sheffield), M. A. Balikhin (The University of Sheffield)

Session: MST4: Recent results in MIST science

Displayed during: Poster Session B

Summary:

Electromagnetic Ion Cyclotron(EMIC) waves play an important role in the dynamics of energetic electrons within the inner magnetosphere. 11 years of Cluster data enable a multipoint, statistical study of EMIC waves, their polarization and propagation properties. The results of this study are presented.

ULF Waves Generated By Energetic Particle Injection

Author: Matthew James

University of Leicester

Co-Authors: T.K.Yeoman (University of Leicester)

Session: MST4: Recent results in MIST science

Displayed during: Poster Session B

Summary:

A previous case study (Yeoman et al., 2010) observed a ULF wave with an eastward and equatorward phase propagation (an azimuthal wave number of m~13) generated during the expansion phase of a substorm. The eastward phase propagation of the wave suggested that eastward drifting energetic electrons were responsible for driving this particular wave. In this study a population of 44 similar ULF wave events also thought to have been driven by substorm-injected particles have been identified using the Hankasalmi SuperDARN radar in Finland between August 2000 and December 2002. The wave events identified in this study exhibit azimuthal wave numbers ranging in magnitude from 3 to 44, with both westward and eastward propagation. The drift resonance mechanism implies this population of waves may be generated by either eastward drifting electrons or westward drifting protons, with predictions of the associated particle energies ranging from ~1 – 120 keV.

A classification scheme for stochastic acceleration

Author: Nicolas Bian

glasgow university

Co-Authors: Eduard Kontar (Univeristy of Glasgow); Gordon Emslie (University of West Kentucky)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

A classification of stochastic acceleration models for solar flares is presented. The scheme takes into account both the nature of the force accelerating the particles and the nature of their transport inside the acceleration region. These models are called resonant or non-resonant depending whether the particle trajectories are regular or chaotic.

Effect of Langmuir wave diffusion on flare-accelerated electrons in the inhomogeneous coronal plasma

Author: Heather Ratcliffe

University of Glasgow

Co-Authors: E.P.Kontar (University of Glasgow); N.Bian (University of Glasgow)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

Beams of electrons accelerated by solar flares produce Langmuir waves as they propagate through the inhomogeneous solar corona. The interaction between these Langmuir waves and density fluctuations, in the limit of fluctuations with spatial scale much larger than the Langmuir wavelength, can be described by a diffusion equation. The case of elastic scattering has been extensively treated, and leads to purely angular diffusion in k-space, while relaxing this assumption introduces diffusion in the magnitude of k. We evaluate this diffusion coefficient for various spectra of density fluctuations, considering both those due to waves with a defined dispersion relation, and those with arbitrary frequency and wavenumber spectra. Simulations for the case of a 1-dimensional electron beam generating Langmuir waves which then diffuse, showed a reacceleration effect on the electrons, increasing the number at high energies in the time-integrated distribution. The magnitude and form of the diffusion coefficient may therefore be important for the interpretation of HXR observations of non-thermal electrons, as the increased number of electrons at high energies could lead to an overestimate of the total number and energy of the originally accelerated electrons.

Influence of binary collisions on fast electrons in solar flares

Author: Alec MacKinnon

University of Glasgow

Co-Authors: C Burge (University of Glasgow); P Petkaki (University of Cambridge)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

Test particle studies in prescribed electromagnetic fields yield insight into flare particle aceleration. Depending on ambient density, binary collisions may modify particle trajectories. We describe a code that follows test electrons in the presence of both Lorentz (deterministic) and binary collision (stochastic) forces. As a first application we study collision-driven cross-field mobility of fast electrons. We also show how electron trajectories in model reconnection fields are modified by collisional energy loss and pitch-angle scattering.

Modelling Solar Energetic Particle Propagation for the COMESEP Alert System

Author: Michael Marsh

University of Central Lancashire

Co-Authors: S. Dalla; J. Kelly; T. Laitinen

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

Forecasting the arrival of Solar Energetic Particles (SEPs) and their intensities at a given location in space is a key objective of a space weather alert system. We model SEP propagation within the interplanetary magnetic field, with the eventual aim of a rapid and reliable warning system for SEP events. This will be implemented within the FP7 COMESEP (Coronal Mass Ejections and Solar Energetic Particles: Forecasting the Space Weather Impact) Alert System. We present simulations of particle propagation obtained via a full-orbit test particle numerical code, including the effects of cross-field transport, for various configurations of the large-scale interplanetary magnetic field and additional perturbations across multiple scales. We study a variety of particle injection functions and investigate their effect on SEP intensities measured e.g. near Earth. This work will lead to the development of an optimised rapid-response modelling system of SEP events, crucial for space weather impact warnings. This work has received funding from the European Commission FP7 Project COMESEP (263252).

Spatial properties of hard X-ray (HXR) coronal sources due to magnetic diffusion

Author: Natasha Jeffrey

University of Glasgow

Co-Authors: E.P.Kontar (University of Glasgow)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

During solar flare events, high energy electrons (> 10 keV) are produced in the Sun's corona. Accelerated electrons interact with the surrounding plasma, producing hard X-ray (HXR) bremsstrahlung emission. Most HXR emission is produced by electrons travelling into denser chromospheric layers, but HXR's are also emitted from high density coronal regions and hot thermal loops. Using instruments such as the Ramaty High Energy Solar Spectrometer Imager (RHESSI), we can measure properties such as position and size of HXR coronal sources. RHESSI observations show increases in coronal source size with time and energy, in both the directions parallel and perpendicular to the magnetic field. While electron transport along the magnetic field can account for the parallel source size increase, the perpendicular expansion is harder to explain, since electrons are unable to cross magnetic field lines easily. Recently, magnetic diffusion has been suggested to account for the perpendicular growth, a property thought to be important for coronal acceleration and transport. Using Monte Carlo simulations, we model the transport and acceleration of electrons in the solar corona and hence the resulting HXR emission. As with previous simulations, we model energy changes and pitch angle scatterings due to Coulomb collisions and magnetic trapping, but also include magnetic diffusion. The properties of our simulated HXR coronal sources will be compared with RHESSI results, allowing us to determine the role of magnetic diffusion within the corona.

The effect of turbulent density fluctuations on solar flare X-ray spectrum

Author: Iain Hannah

University of Glasgow

Co-Authors: E.P. Kontar (University of Glasgow); H.A.S. Reid (Observatoire de Paris)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

The unprecedented RHESSI observations of solar flare hard X-rays (HXR) has forced us to consider mechanisms in addition to the traditional collisional view of coronal electron transport. The self-consistent generation of Langmuir waves by the electron beam is one such process, thought to be the source of the reverse drift decimetric radio emission seen in some flares. We have previously shown that the inclusion of Langmuir waves flattens the electron spectrum and produces a spectral index difference between the coronal and footpoint sources closer to observations. However the wave growth also results in fainter HXR emission requiring a higher flux of electrons to be accelerated, compounding the “number” problem. In this work we show that the addition of the interaction of the Langmuir waves with turbulent density fluctuations in the background plasma greatly alleviates this problem. We demonstrate the consequences of this self-consistent treatment in the context of the observable HXR spectrum for a variety of forms of the density fluctuations.

the role of electron beam pitch angles and density gradients in solar Type III radio bursts

Author: Roman Pechhacker

Queen Mary, University of London

Co-Authors: D.Tsiklauri (Queen Mary, University of London)

Session: MST5: Particle acceleration and transport at the Sun and in the heliosphere

Displayed during: Poster Session B

Summary:

Accelerated particles are the driving force for solar type III bursts, generating (electromagnetic) emission via the bump-in-tail instability, which refers to a 'bump' in the electron distribution function in phase space. We are presenting results of PIC-simulated injection of mildly relativistic electron beams into magnetised plasma for solar parameters, commensurate with type III bursts. Varying the injection angle with respect to the background magnetic field and the background plasma density profile, we investigate the role of both pitch angle and density gradient on the resulting emission. Special focus is put on the case where the pitch angle reaches 90 degrees, for which we obtain the highest emission intensity, suggesting a link between the perpendicular component of the beam injection momentum and radiation intensity. We establish that (i) the existence of a density gradient enables the EM emission generation, (ii) different initial pitch angles only affect the strength of the EM emission (keeping its time evolution un-altered), (iii) the EM emission is elliptically polarised, (iv) the distribution function at time zero appears similar to that of Dory-Guest-Harris (DGH) [Dory et al., 1965], (v) Plots of the perpendicular components of the electron distribution function for different times show an oscillation at the relativistic electron cyclotron frequency, while the emission itself is near the electron plasma frequency.

A study of particle energisation in kinematic MHD models of CMTs in the relativistic regime

Author: Solmaz Eradat Oskoui

University of St Andrews

Co-Authors: T. Neukirch & K. Grady

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

We present the results of a detailed investigation of particle energisation in the Collapsing Magnetic Trap (CMT) model of Giuliani et al.(2005) using for the first time relativistic guiding centre test particle orbits. The results are compared with the non-relativistic calculations previously under taken by Grady et al.(2012).

24-160 micron images of nearby galaxies from the Spitzer archive

Author: George J. Bendo

Jodrell Bank Centre for Astrophysics, Univeristy of Manchest

Co-Authors: F. Galliano (Laboratoire AIM, CEA, Universite Paris Diderot, IRFU/Service d'Astrophysique, Bat. 709, 91191 Gif-sur-Yvette, France); S. C. Madden (Laboratoire AIM, CEA, Universite Paris Diderot, IRFU/Service d'Astrophysique, Bat. 709, 91191 Gif-sur-Yvette, France)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

We have reprocessed Spitzer Space Telescope 24, 70, and 160 micron images of galaxies covered in several Herschel Space Observatory surveys. Although high-quality versions of some of these Spitzer images have been published before, most Spitzer data have only been available in the form of lower-quality images from the Spitzer archive. We are currently in the process of publishing global photometric for these data, and we will also be distributing our reprocessed images to the general public.

A Possible Astronomically Aligned Monolith at Gardom's Edge

Author: Dr. Daniel Brown

Nottingham Trent University

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

Gardom's Edge forms part of the Peak District National Park, close to Manchester. This region has ancient remains including a Neolithic enclosure, rock art, and standing stone. A singular standing stones is rare and is ideal to study its setting in its original orientation. Results of a survey analysing the orientation of the stone are presented. The stone was found to be triangular in shape and supported by packing stones at its base. The stone has been selected for its flat side that is slanted up towards geographic south. The orientation and inclination of the slope is aligned to the altitude of the Sun at mid-summer. During the winter half-year the slanted side of the stone would remain in permanent shadow; during most of the summer half-year it would only be illuminated during the morning and afternoon; close to midsummer it would be illuminated all day. The striking seasonal illumination is used to enhance its meaning and importance. This standing stone may predate the surrounding settlements and would have been a focus point for seasonal gatherings of a widely dispersed community. It is proposed to interpret the wider Gardom's Edge landscape with astronomy and Dark Sky Discovery in mind.

ACAM - A New Imager / Spectrograph at the William Herschel Telescope

Author: Chris Benn

Isaac Newton Group, La Plma

Co-Authors: K. Dee (Engineering and Project Solutions), Tibor Agocs (ASTRON), Lilian Dominguez (Isaac Newton Group)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

ACAM is a highly-versatile wide-field imager/spectrograph mounted permanently at a folded-Cassegrain focus of the 4.2-m William Herschel Telescope. The field of view in imaging mode is 8.3 arcmin. In spectroscopic mode, the resolution is R ~ 600 in the red. ACAM is ideal for programmes requiring high throughput (up to twice that of ISIS), unusual (e g custom) filters, rapid response (e g supernovae), or observations over several nights (e g exoplanet transits) During the first two years of operation ACAM has proved popular with observers, and has been used for imaging or spectroscopy of a broad range of objects from comets and exoplanets to supernovae and gamma-ray bursts.

Are the constant Kepler A-stars chemically peculiar?

Author: Simon Murphy

University of Central Lancashire

Co-Authors: D.W.Kurtz (University of Central Lancashire); K.Uytterhoeven (Instituto de Astrofisica de Canarias)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

The delta Scuti instability strip lies at the junction between the classical Cepheid instability strip and the main sequence. Amongst the delta Scuti stars in this region lie the metallic-lined (Am) stars, which are less prone to pulsation. Am stars represent a significant fraction of A-stars: up to 50% at A8 (Smalley et al. 2011). Of the ten known Am stars in the Kepler field, six are known to pulsate (Balona et al. 2011). Now that it is known that some Am stars do not pulsate, we must question whether the constant A-stars all have Am spectra. Given that 70% of non-chemically peculiar stars are delta Scuti stars and are therefore variable (based on pre-Kepler sensitivity levels; Turcotte et al. 2000), we might expect almost all of the non-variable A-stars in the Kepler field of view to be chemically peculiar. The unprecedented precision of the Kepler spacecraft allows stars to be studied photometrically at the micro-magnitude variability level. Stars that are constant at this level are unusual indeed. Pulsation, spots and activity all contribute to the total variability, hence these A-stars are probably the only stars in the HR-diagram that are truly constant.

CO Excitation Temperatures in the Winds of Betelgeuse

Author: Sarah Kennelly

Astrophysics Research Group, Trinity College Dublin

Co-Authors: Graham Harper (Astrophysics Research Group, Trinity College Dublin), Nils Ryde (Lund Observatory, Sweden)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

Spatial variations of the 4.6 μm CO fundamental lines in the winds of Betelgeuse are investigated. Excitation temperatures are estimated from line ratios in the Phoenix spectra obtained on the 8 metre Gemini-S (Smith et al, 2009). These spectra map the circumstellar shell via wind scattered ro-vibrational lines of CO and were obtained at distances of 0.5″ and 1″ from the star. Excitation temperatures estimated from these measurements are compared to those obtained in the classic 1979 Bernat et al study, and to Phoenix/Kitt Peak results reported by Ryde et al(1999), which are spatially resolved and were obtained at the greater projected distance of 4″ from the star.

Cosmology and Galactic Foregrounds at 11-30 GHz with the Q-U-I JOint Tenerife Experiment

Author: Stuart Harper

University of Manchester

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

The Q-U-I JOint Tenerife Experiment (QUIJOTE) is currently a two instrument experiment in the northern hemisphere based on Mount Teide, Tenerife. The first instrument is a galactic foreground experiment with five pixels in the range of 11 to 30GHz which will survey a 10000 sq. degree region in polarised and total intensity emission. The current objectives of the first instrument is to allow for effective component separation of the foregrounds from cosmological signals with a specific focus on measuring spinning dust emission. The second instrument is a 31 pixel cosmological experiment at 30GHz. Using the first instruments data, along side PLANCK and other survey results, it will measure the upper limit on the scalar-tensor ratio of cosmic microwave background (CMB) primordial B mode emission to about 0.1. This poster intends to show via simulations what can be expected from QUIJOTE in terms of both cosmological science and galactic microwave foregrounds. Also the advantages of a potential third future QUIJOTE instrument at a higher frequency will be discussed and how this will contribute to measuring the CMB B mode emission with greater sensitivity.

Enhancements to AF2/WYFFOS on the WHT

Author: Ian Skillen

Isaac Newton Group

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

Multiplexed spectrographs on 4m-class telescopes, with their large fields-of-view, excel in complementing and playing a supporting role to the 10m-class telescopes such as GTC. We describe a programme of enhancements to AF2/WYFFOS on the WHT which will allow it to remain competitive until the proposed new wide-field fibre spectrograph, WEAVE, begins operations on the WHT in 2017

Hubble Deep Field observations with e-MERLIN

Author: Nick Wrigley

Jodrell Bank Centre for Astrophysics

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

The Hubble Deep Field North region was originally surveyed by the Hubble Space Telescope in the mid 1990s and is regarded as an iconic image revealing thousands of galaxies across cosmic timescales. It has since been observed extensively at multiple wavelengths in what became known as the Great Observatories Origins Deep Survey North. A combination of two types of emission mechanisms appeared to be present in galaxy populations in varying proportions; accretion mechanisms giving rise to the observed Active Galactic Nuclei type galaxies (quasars), or more diffuse emissions characteristic of star formation processes - which became known as 'starbursts'. The UK's newly upgraded e-MERLIN radio telescope array, based at Jodrell Bank, probes ever deeper into these populations of starburst and AGN galaxies captured within the field. New detailed observations are presented for selected objects illustrating the instrument's unique combination of sensitivity and high angular resolution. e-MERLIN generates essentially unimpeded views of these ancient sources given the property that radio waves have of penetrating intervening gas and dust. Furthermore the high resolution imaging derived from the array's wide bandwidth permits spectral features to be examined in combination with their morphology. These early results mark the beginning of an unprecedented view into the structures of starburst and AGN galaxies, essential for assembling the evolutionary history of galaxies in the Universe.

Integral field spectroscopy on small aperture telescopes

Author: Samuel Richards

University of Hertfordshire

Co-Authors: M.E.Martin (University of Hertfordshire) H.R.Jones (University of Hertfordshire) M.Gallaway (University of Hertfordshire) D.Campbell (University of Hertfordshire) E.Brinks (University of Hertfordshire) M.Sarzi (University of Hertfordshire) D.J.B.Smith (University of Hertfordshire) J.Bland-Hawthorn (University of Sydney) S.G.Leon-Saval (University of Sydney) J.J.Bryant (University of Sydney) L.Fogarty (University of Sydney) J.Lawrence (Australian Astronomical Observatory) M.Goodwin (Australian Astronomical Observatory)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

The art of integral field spectroscopy is one that has come on in leaps and bounds over the last decade, and is really pushing our understanding of galaxy formation and evolution. Of the of the 30 such instruments around the world, all but one are on 2+metre class telescopes. It is now possible to exploit recent advancements in small aperture telescopes (<0.5m) to enable an integral field spectrograph with a performance that allows taxonomy via optical emission line analysis (Hβ to SII). An integral field spectrograph on this class of telescope warrants its use for teaching, though its ability to obtain data on 10^2–10^3 nearby galaxies in 100 nights enables it to probe a new parameter space to aid our understanding of galaxies.

Mysteries of the North Star: Stellar Evolution Modelling, Period Change and Mass Loss˜

Author: Hilding Neilson

Argelander Institute for Astronomy

Co-Authors: S.G. Engle (Villanova U.); E. Guinan (Villanova U.); N. Langer (AIfA); R. Wasatonic (Villanova U.); D. Williams (AAVSO)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

Polaris is one of the most observed stars in the night sky, with recorded observations spanning more than 150 years. From these observations, one can study the real-time evolution of Polaris via the secular rate of change of the pulsation period. However, the measurements of the rate of period change do not agree with predictions from state-of-the-art stellar evolution models. We show that this may imply that Polaris is currently losing mass at a rate of about 10^ solar masses per year based on the difference between modeled and observed rates of period change, consistent with pulsation-enhanced Cepheid mass loss. A relation between the rate of period change and mass loss has important implications for understanding stellar evolution and pulsation, and provides insight into the current Cepheid mass discrepancy.

Optimizing future dark energy surveys for model selection goals (ArXiV: 1111.1870)

Author: Catherine Watkinson

Imperial College London

Co-Authors: A.R.Liddle (University of Sussex), P.Mukherjee(University of Sussex), D.Parkinson (University of Queensland)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

My poster will be about a paper written with the above co-authors, in which we demonstrate a methodology for optimizing the ability of future dark energy surveys to answer model selection questions, e.g. 'Is acceleration due to a cosmological constant or a dynamical dark energy model?'. Model selection Figures of Merit are defined, exploiting the Bayes factor, and surveys optimized over their design parameter space via a Monte Carlo method.

We present implementations based on the Savage–Dickey Density Ratio that are both accurate and practical for use in optimization. It is shown that whilst the optimal surveys using model selection agree with those found using the Dark Energy Task Force (DETF) Figure of Merit, they provide better informed flexibility of survey configuration and an absolute scale for performance; e.g. we find survey configurations with close to optimal model selection performance despite their corresponding DETF Figure of Merit being at only 50% of its maximum. This Bayes factor approach allows us to interpret survey configurations that will be good enough for the task at hand, vital especially when wanting to add extra science goals and in dealing with time restrictions or multiple probes within the same project.

Remote observing with the ING telescopes

Author: Ian Skillen

Isaac Newton Group

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

The advent of high-bandwidth, low-latency networks allows the possibility of observing remotely from an observatory's sea-level base, or indeed from farther afield. We describe our experiences of intrument setup and troubleshooting, astronomer training, and remote observing from the ING sea-level offices, using a VNC client to operate the telescope and instrument control systems, and a high-quality, two-way audiovisual link for communicating with mountain staff.

Science with APEX-SZ

Author: Sandra Burkutean

Argelander Institute for Astronomy

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

The APEX-SZ experiment is a collaboration between Berkeley, University of Bonn, MPIfR, Onsala and ESO, which operated a 280 element bolometer camera at the APEX telescope in Chile at an altitude of 5100 meters during 2007-2010. Targeted observations of over 40 X-ray selected galaxy clusters were made via the Sunyaev-Zel'dovich (SZ) effect. The APEX-SZ group in Bonn has focused its research on non-parametric cluster modeling with APEX-SZ data and its combination with X-ray and weak-lensing results. A joint SZ/X-ray analysis has already been made for individual clusters and a combined analysis with the full APEX-SZ sample is currently under way. In addition, we are developing and optimizing techniques for combining high resolution interferometric measurements with APEX-SZ data to extract information on the thermodynamic state of the intracluster gas at a wide range of spatial scales.

Size differences in red and blue globular clusters

Author: Jonathan M. B. Downing

Astronomisches Rechen-Institut, ZAH

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

Observations show that metal-poor (blue) globular clusters have larger half-light radii than metal-rich (red) globular clusters. It is not clear as to weather this difference truly represents the sizes of blue and red clusters or weather it is simply a product of mass segregation and stellar evolution. I present a set of simulations which confirm that blue and red globular clusters do indeed have different sizes but also show that the half-light radii of globular clusters do not have a simple relationship with their sizes as measured by their half-mass radii.

Student training at the telescope in the 10-m era

Author: Chris Benn

ING, La Palma

Co-Authors: L. Dominguez (ING), R. Karjalainen (ING)

Session: OTH1: Other Topics - Posters ONLY

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

The ING studentship programme has for more than 10 years now offered European astronomy students the opportunity to train as an observer on a medium-sized ground-based optical telescope. This is particularly important in the era of very large telescopes and their queue-scheduled observing. This limits direct access by young astronomers, and is giving rise to a generation of astronomers with much reduced experience of observing.

The First Public Data Releases from the VISTA Science Archive.

Author: Nicholas Cross

Institute for Astronomy, Edinburgh)

Co-Authors: R.S. Collins (IfA, Edinburgh); M.A. Read (IfA, Edinburgh); E.T.W. Sutorius (IfA, Edinburgh); R.P. Blake (IfA, Edinburgh); M.S. Holliman (IfA, Edinburgh); N.C. Hambly (IfA, Edinburgh); R.G. Mann (IfA ,Edinburgh)

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session B

Summary:

VISTA is the fastest near-infrared survey telescope and has been surveying the Southern hemisphere in 6 Public Surveys - VHS, VVV, VMC, VIKING, VIDEO and Ultra-VISTA - since the beginning of 2010. These surveys vary from wide, shallow surveys, to very deep pointed surveys and many have a multi-epoch component. These will shortly become the largest near-infrared surveys of the sky in terms of data volume. The VISTA Science Archive (VSA) uses a sophisticated relational database to store and serve out the data to scientists across the world. Images, catalogue and advanced science products: such as cross matches with other public survey source catalogues, including SDSS, 2MASS, XMM, Galex; and variability tables are available to the whole community for the first time, having been limited to the survey science teams beforehand. The user interface allows complex queries to be created allowing the selection of different types of objects and contains quality control information to aid in this selection. In this presentation, we describe which data are being released, describe the main products available in the VSA and show how users can query the VSA to do some quite sophisticated science. The VSA is derived from the WFCAM Science Archive that has been the main repository for the UKIDSS data.

Using data from the GAIA-ESO survey to advance knowledge of young star-forming regions.

Author: Amy Dobson

Keele University

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

The GAIA-ESO public spectroscopic survey is a ground-based project, aiming to study approximately 100 clusters in the Milky Way, along with the thick and thin disks, halo and bulge. The project uses the FLAMES multi-object spectrograph on the VLT, to retrieve large amounts of data, covering components of the Milky Way including young star forming regions. With this data, the understanding of early stellar evolution can be improved, hence the timescale in which stellar and planetary systems are formed can be more accurately estimated. The data will be used to study the pre-main sequence stellar population in the Milky Way, and particularly to estimate age spreads of young star forming regions. The Thorium-Argon calibration spectra allows very accurate radial velocity measurements, which are used to determine age spreads of stellar populations. Here, an overview has been presented of the GAIA-ESO survey, focusing on potential areas of research concerning young star-forming regions, and methods that have been used to improve the accuracy of the data reduction.

Virialised galaxy groups and optical substructure

Author: Richard Pearson

University of Birmingham

Co-Authors:

Session: OTH1: Other Topics - Posters ONLY

Displayed during: Poster Session A

Summary:

Most X-ray studies of galaxy groups and clusters are subject to significant selection effects whereby only the most X-ray luminous systems tend to be studied. This results in poor knowledge about the properties of low mass, low luminosity systems, and also makes it impossible to get an unbiased estimate of the distribution of gas entropy in groups, which is a key indicator of cosmic feedback. With the use of large optical surveys it is possible to select groups and clusters without prior knowledge of their x-ray properties, however this may result in the inclusion of groups that are not fully virialised. Since we would like to establish the properties of an unbiased sample of virialised groups, we have been investigating the ability of substructure tests, applied to the distribution of group galaxies, to discriminate systems which are in virial equilibrium. Our substructure analyses have been calibrated on mock data provided by the GAMA consortium, and applied to select targets for X-ray observation with Chandra. We discuss our methods and present some initial results from our X-ray observations.

Asteroid search and follow-up in German schools

Author: Lothar Kurtze

Technische Universität Darmstadt

Co-Authors: C.Liefke (Haus der Astronomie, Heidelberg, Germany), M.Metzendorf (Lessing-Gymnasium Lampertheim, Germany), J.Schnepf (Lessing-Gymnasium Lampertheim, Germany), P.Roche (Faulkes Telescope Project), P.Miller (IASC, USA)

Session: OUT1: Public Astronomy

Displayed during: Poster Session A

Summary:

Since October 2010, German school classes and student groups supervised by the Haus der Astronomie in Heidelberg successfully participate in the Pan-STARRS asteroid search campaigns of the International Astronomical Search Collaboration (IASC). During such a campaign, each school discovers up to 30 previously unknown asteroids. On average, for each group one of their discoveries can be confirmed by independent observations and thus gets designated by the Minor Planet Center. Within the framework of a pilot project with Faulkes Telescopes (FT), one of these teams, the Lessing-Gymnasium in Lampertheim, planned and conducted follow-up observations of their Pan-STARRS discoveries during the fall 2011 campaign in order to improve their orbital elements. The students will continue to observe these asteroids with the aim to get them numbered and named within the next few years.

Mapping things out: the RAS outreach survey

Author: Robert Massey

Royal Astronomical Society

Co-Authors: Q. Stanley (HPS Research); S. McWhinnie (Oxford Research and Policy); C. E. Barclay (Marlborough College)

Session: OUT1: Public Astronomy

Displayed during: Poster Session A

Summary:

The Royal Astronmical Society commissioned a short survey of UK-based public engagement work in astronomy and geophysics that closed in January 2012. We have used these data to analyse the needs of practitioners so that the Society can support them through for example our Education Committee. We have also created a map of this provision to allow teachers and others to find and contact their nearest practitioner. In this paper we present the initial results of the survey and the map and discuss the consequences for the work of the RAS.

Outreach at UCLan and its Effects

Author: Kathryn Harris

UCLan

Co-Authors: Kathryn A. Harris

Session: OUT1: Public Astronomy

Displayed during: Poster Session A

Summary:

The University of Central Lancashire (UCLan) in Preston has been active in outreach for many years, using competitions, Observatory trips and talks to inspire a wide range of people from areas across Lancashire. UCLan is part of an Ogden Trust School Partnership working with a fantastic group of teachers from various different schools, running competitions and events between them and with the University. The different schools work together with the university to encourage primary school children in Physics and Astronomy, as well as other sciences. UCLan's Alston Observatory is a small teaching observatory in Longridge, Preston, which is having a large impact on the children in Preston. Also used for undergraduate teaching, this small observatory hosts a planetarium in the main building giving shows to all age groups and abilities. Though small, this facility is opening the eyes of children from under-privileged backgrounds across Preston and Lancashire.

The Jodcast

Author: Christina Smith

University of Manchester

Co-Authors: The Jodcast Team

Session: OUT1: Public Astronomy

Displayed during: Poster Session A

Summary:

The Jodcast is a twice-monthly astronomy podcast produced by staff and students at Jodrell Bank since 2006. Here we report a summary of our activities over the past six years, including our listening/viewing statistics, feedback and our latest foray into videocasting.

over the past six years, including our listening/viewing statistics, feedback and our latest foray into videocasting.

Dual High Speed Photometer for Detecting Edgeworth Kuiper Belt Objects by Occultation

Author: Eamonn Ansbro

Open University

Co-Authors: Eamonn Ansbro (Open University)

Session: PL1: Small bodies in Our Solar System

Displayed during: Poster Session A

Summary:

We present the design of a high speed dual photometer to detect Edgeworth Kuiper Belt Objects. The current limitation in occultation surveys is course time resolution and poor sensitivity. We need high precision, high reliability photometry. High time resolution photometry is the only way to search for small scale variability within a star and this provides orders of magnitude more resolution than even the NGST. This time resolution allows us to be sensitive to detecting the unexplored sub-kilometer regime of EKBOs. Discovering and constraining the size distribution of EKBOs is crucial to understand solar system formation.

Mapping The Density Distribution In Saturn's F Ring During An Encounter By Prometheus

Author: Phil Sutton

Loughborough University

Co-Authors:

Session: PL1: Small bodies in Our Solar System

Displayed during: Poster Session A

Summary:

Saturn's F-ring is one of the most dynamic places in the solar system with interactions between particles and its Sheppard moons taking place over short time periods. CASSINI then offers a unique opportunity to observe such a dynamic system as it evolves. Previous numerical modelling has shown that Prometheus is responsible for generating some structures seen in the F-ring. Moonlets have been known to exist in the F-ring for many years however only recently a connection between Moonlets and Prometheus has been discovered. Here we model a multi strand F ring that is realistic in shape and size taken from CASSINI observations. For the first time we show how density in the F-ring evolves as Prometheus encounters the F-ring creating the well-known streamer – channels. We found that when the F-ring and Prometheus were at minimum separation the highest densities occurred during the first encounter. This happens when the velocity kick given to inner strand particles is large enough to move it into the central F-ring core. Moonlets formed can persist for long periods if their density overcomes the critical Roche density for ice in the F-ring. We can therefore use our models to predict that Moonlets formed solely by perturbations of Prometheus on the F-ring mostly originate in the central strand.

Searching for asteroid collisions with Pan-STARRS 1

Author: Ev McLoughlin

Queen

Co-Authors: E. McLoughlin (Queen's University Belfast), A. Fitzsimmons (Queen's University Belfast), L. Denneau (Queen's University Belfast and Institute for Astronomy, University of Hawaii), R. Jedicke (Institute for Astronomy, University of Hawaii)

Session: PL1: Small bodies in Our Solar System

Displayed during: Poster Session A

Summary:

The Pan-STARRS 1 (PS1) telescope in Hawaii has been surveying large areas of the sky since 2010 and the quality of astrometry and photometry together with repeated coverage of the same areas of the sky enables discovery of various interesting objects and events down to magnitude 22.5 brightness. The Main Asteroid Belt is collisionally dominated with asteroids' shapes, sizes and surface geology dominated by impacts. The brightness of impacted asteroids will temporarily increase due to material being ejected off their surface. Two collisions observed recently have sparked interest in the phenomenon: asteroid P/2010 A2 in 2009 and asteroid (596) Scheila in 2010. Studying these events can provide insights in asteroid structure and evolution. I am using PS1 data to search for possible collision events as it is expected that there may be one observable collision per year. Both existing and current data will be analysed to look for anomalous increases in brightness of known asteroids that might be indicative of a collision. Initial results and sample data will be shown.

The Sodium Tails of Near-Sun Comets

Author: Geraint Jones

MSSL, UCL & Centre for Planetary Sciences at UCL/Birkbeck

Co-Authors: H. Osborn (Dept. of Earth Sciences, UCL), Y. Ramanjooloo (MSSL, UCL & Centre for Planetary Sciences at UCL/Birkbeck)

Session: PL1: Small bodies in Our Solar System

Displayed during: Poster Session A

Summary:

In 1997, comet C/1995 O1 (Hale-Bopp) was found to possess a tail composed of sodium atoms accelerated anti-sunward by radiation pressure. Although sodium had long been known to exist in comets, a distinct tail had only been reported in one other comet, in 1957. Sodium is a very strong contributor to the emission spectra of sungrazing comets. Although it is known that there are at least two sodium sources, one near the nucleus, and the other in the extended dust tail, the ultimate sources of the sodium have not been identified. We present results of our survey of several sodium tails observed by the ESA/NASA Solar and Heliospheric Observatory spacecraft's LASCO coronagraph, reporting on their morphologies and brightness. We present our initial simulations of the tails; their modelling is complicated by the fact that the acceleration of sodium atoms is a strong function of the atoms' radial velocity, due to the dependence of the acceleration on the strength of the Doppler-shifted Fraunhofer sodium absorption lines in the atoms' frame of reference. We discuss the implications our results for our understanding of near-Sun comets' composition and origins.

The unusual comet P/2010 TO20 LINEAR-Grauer

Author: Pedro Lacerda

Queen

Co-Authors:

Session: PL1: Small bodies in Our Solar System

Displayed during: Poster Session A

Summary:

I will briefly describe an observational and dynamical study of the unusual comet P/2010 TO20 LINEAR-Grauer. Discovered in late 2010 by LINEAR, this object was first classified as a Jupiter Trojan. Subsequent observations obtained in late October 2011 revealed 2010 TO20 to be a Jupiter-family comet. LINEAR-Grauer has one of the largest perihelia (q=5.1 AU) and lowest eccentricities (e=0.09) among Jupiter-family comets. I will present optical broadband observations of this object taken on 29-31 October 2011 as well as pre-covered images taken in October 2010 as part of the Pan-STARRS survey. The latter show that LINEAR-Grauer was clearly active at the time of discovery by LINEAR. Dynamical simulations indicate the LINEAR-Grauer is in a very unstable orbit and probably originated in the trans-Neptunian region of the solar system.

Accurate parameters of WASP planet host stars

Author: Amanda Doyle

Keele University

Co-Authors: B. Smalley (Keele University)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

A careful and detailed spectral analysis of several WASP planet host stars will be presented. A line by line differential analysis was performed relative to the Sun and the mid-F star Procyon. Spectra were obtained using the HARPS spectrograph (resolution of 115,000), and the importance of high quality spectra is investigated by comparing the results with the original discovery analyses, which mainly used the CORALIE spectrograph (resolution of 60,000). A line list was carefully constructed by selecting as many clean, unblended lines in the solar spectrum as possible, and rejecting unresolved blends. It is shown that lines should be selected with caution from the VALD database, and properly supplemented with additional data. The importance of synthesis in addition to equivalent width measurements is also shown.

Adaptation of the Met Office Unified Model to modelling exoplanets.

Author: David Acreman

University of Exeter

Co-Authors: N. J. Mayne (University of Exeter); I. Baraffe (University of Exeter); D. S. Amundsen (University of Exeter); G. Chabrier (Ecole Normale Superieure de Lyon/University of Exeter)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

We are adapting the UK Met Office Unified Model (used for weather forecasting and climate modelling) to model exoplanets. The Unified Model solves the full Navier-Stokes equations, without making the standard approximations used in most Global Circulation Models (GCMs). The global circulation on exoplanets can be very different to that on Earth, hence the model needs to operate well outside its normal regime. We present results from our model developement which uses benchmark cases to test the performance of the model in exoplanet-like circulation regimes.

An integrated payload design for the EChO Exoplanet Characterisation Observatory

Author: Neil Bowles

University of Oxford

Co-Authors: B. Swinyard (RAL/UCL);G.Tinetti (UCL);M. Ferlet (RAL);E. Pascale (Cardiff Univ.);L. Fletcher (Univ. Oxford);M. Tecza (Univ. Oxford);A. Adriani (IFSI);J. Beaulieu (IAP);T. Belenguer Davila (INTA);I. Bryson (UKATC);J. Cho (QMUL);V. Coudé de Foresto (LESIA);A.

Coustenis (LEISA);M. Focardi (Univ. Florence);P. Hartogh (Max Planck Institute for Solar System Research);P. Lagage (CEA−Saclay);M. López−Morales (Institut de Ciencies de l'Espai);G. Micela (Osservatorio Astronomico di Palermo);G. Morgante (IASF Bologna);H. U. Nørgaard−Nielsen (DTU Space, Copenhagen);M. Ollivier (IAS);E. Pace (Univ. of Florence);G. Ramos Zapata (INTA);J. Reess (LESIA);I. Ribas (Institut de Ciències de l'Espai);B. Winter (MSSL);G. Wright (UKATC);M. Zapetero Osorio (CAB);

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The Exoplanet Characterisation Observatory (EChO) is a space mission dedicated to undertaking spectroscopy of transiting exoplanets over the widest wavelength range practicable. It is based around a highly stable space platform with a 1.2 m class telescope. The mission is currently being studied by ESA in the context of a medium class mission within the Cosmic Vision programme for launch post 2020. The payload suite is required to provide simultaneous coverage from the visible to the mid− infrared and must be highly stable and effectively operate as a single instrument. In this paper we describe the approach being studied by the EChO instrument consortium to meet these demanding requirements whilst remaining within the mission's operating constraints. In particular, we will give an overview of the work being carried out in the UK to support system and mechanical design, spectral channel division, infrared detector characterisation and long wave (11-16 micron) infrared channel as part of a larger multi-national instrument payload consortium.

Analysing exoplanetary data using unsupervised machine-learning

Author: Ingo Waldmann

UCL

Co-Authors:

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The field of transiting extrasolar planets and especially the study of their atmospheres is one of the youngest and most dynamic subjects in current astrophysics. Permanently at the edge of technical feasibility, we are successfully discovering and characterising smaller and smaller planets. To study exoplanetary atmospheres, we typically require a 10e-4 to 10e-5 level of accuracy in flux. Achieving such a precision has become the central challenge to exoplanetary research and is often impeded by systematic (nongaussian) noise from either the instrument, stellar activity or both. Dedicated missions, such as Kepler, feature an a priori instrument calibration plan to the required accuracy but nonetheless remain limited by stellar systematics. More generic instruments often lack a sufficiently defined instrument response function, making it very hard to calibrate. In these cases, it becomes interesting to know how well we can calibrate the data without any additional or prior knowledge of the instrument or star. In this conference, we present a non-parametric machine-learning algorithm, based on the concept of independent component analysis, to de-convolve the systematic noise and all non-Gaussian signals from the desired astrophysical signal. Such a 'blind' signal de-mixing is commonly known as the 'Cocktail Party problem' in signal-processing. We showcase the importance and broad applicability of unsupervised machine learning in exoplanetary data analysis by discussing: 1) the removal of instrument systematics in a re-analysis of an HD189733b transmission spectrum obtained with Hubble/NICMOS; 2) the removal of time-correlated stellar noise in individual lightcurves observed by the Kepler mission.

Characterising Super Earths with the ECHO spacemission concept

Author: Marcell Tessenyi

UCL

Co-Authors: M. Ollivier (IAS Paris Sud, CNRS), G. Tinetti (UCL), B. Swinyard (UCL/RAL), and the EChO simulation team

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

Transiting Super-Earths orbiting M-dwarfs are excellent targets for studying potentially habitable exoplanets. While most of the currently known exoplanets are Hot Jupiters and Neptunes, attention is now turning to these Super-Earths. (e.g., Cancri 55e, found by Winn et al. in 2011). These candidates offer the opportunity of obtaining spectral signatures of their atmospheres in transiting scenarios, via data obtained by ground based and space observatories, compared to simulated climate scenarios. With the recent selection of the Exoplanet Characterisation Observatory mission by ESA for further studies, I present observational strategies and time requirements for the characterisation of atmospheres of a range of targets with EChO, with a study of detectability of molecular spectral features, from Habitable Zone Super-Earth to Hot Jupiter atmospheres.

Close-in exoplanets, but none of ours: Guidance from Triton

Author: Miles F Osmaston

Retired (Woking, UK)

Co-Authors

Co-Authors:

Session: PL2: Exoplanets

Displayed during: Poster Session B
Summary:

Some 23% of all orbitally-determined exoplanets orbit their star within 12 Rsun, with a clear concentration centred on 10 Rsun. The proportion has changed little as numbers grew. Not a matter of detectability but of why they are there at all (Mercury is at 83). Triton's retrograde orbit invites a reconsideration of the main mechanism of planetary construction. Its immersion in the (56 body) prograde satellite population of the Giant Planets implies [1] that tidal capture had been the mechanism of central body accretion until the arrival of their gas-ice envelopes liquefied their interiors, destroying their tidal attribute and halting Triton's inward motion. Efficient tidal capture required nebular gas-drag during planetary growth, confirmed by the preserved low eccentricities of all except Mercury (so it alone suffered a late giant impact). The second problem of planetary construction, of long standing [2], is to equip their growth materials with their very high (orbitally prescribed) specific angular momenta relative to that of their rotating star/Sun. Nebular action is the only conceivable agent for doing this. New insight on the physical mechanism of gravitation [3] leads to the expectation that the Newtonian field of any gravity-retained assemblage is inescapably accompanied by a radial Gravity-Electric (G-E) field, providing a potentially over-riding repulsive force on sufficiently charged nebular ions. The tangential velocity pattern is then not Keplerian and we show that, in the solar system example, outward G-E field action yields an adequate a.m. growth mechanism within the frame of our new scenario for planetary system formation [3]. Its key feature is that solar/stellar passage through a second cloud gathers cold protoplanetary material whose high opacity permits protoplanetary nuclei to form very close to the star and then be pushed out successively in a G-E driven nebular disc wind, growing by tidal capture of passing objects. Apparently we see close-in exoplanets soon after their star has left the high-opacity second cloud, exposing them to us and to their star. Now, with no disc wind to drive them outward, they accumulate in number until they vanish by evaporation. [1] McCord TB. (1968) JGR 73, 1497:- Counselman CC., III. (1973) Ap.J. 180, 307. [2] Jeans JH. (1919) Adams Prize Essay, Clarendon Press. 293pp. [3] Osmaston MF. (2006) GCA 70(18S), A465:- — (2009a) EPSC Abstr. 4, EPSC2009-264:- — (2009b) Geophys. Res. Abstr. 11, EGU2009-12204:- — (2010) In JENAM 2010 (ed. A. Moitinho et al) Abstract Book (Version 2.0) 159-160.

Debris from giant impacts: signposts of terrestrial planet formation

Author: Alan Jackson

Institute of Astronomy

Co-Authors: M.C. Wyatt (Institute of Astronomy)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The final stage in assembling terrestrial planets is thought to be driven by giant impacts between planetary scale bodies. In addition to building terrestrial planets such impacts produce large quantities of debris. Here we present a model of the evolution of debris from the Moon forming collision as an example. This shows that the debris would be bright and detectable in the mid-infrared on Myr timescales after the impact. It is thus expected that young stars hosting systems undergoing terrestrial planet formation will have detectable mid-infrared excesses for much of the final stage of formation. Indeed, the dust produced during formation of the planets would likely be substantially easier to detect than the terrestrial planets themselves. We use current searches for warm dust around young stars to provide constraints on the fraction of stars that form terrestrial planets and conclude that terrestrial planet formation is not common.

EChO detectability analysis using the NEMESIS radiative transfer and retrieval tool

Author: Jo Barstow

University of Oxford

Co-Authors: S. Aigrain (University of Oxford; P. G. J. Irwin (University of Oxford); J-M. Lee (University of Oxford)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The proposed EChO (Exoplanet Characterisation Observatory) space telescope is projected to significantly improve understanding of planets outside our solar system, and in particular their atmospheric structure and composition. We utilise the NEMESIS radiative transfer and retrieval algorithm (Irwin et al. 2008) to investigate the detectability of extrasolar planet phenomena with the proposed EChO telescope design. We build on the work of Lee et al. (2012) and begin the study of a range of hypothetical extrasolar planets, with different sizes, temperature structures and atmospheric compositions, orbiting stars of different spectral types. Giant planets, small Neptunes and super-Earths are considered. We include HD189733b and HD209458b, the two best-studied hot Jupiters, in order to determine how far EChO will extend our retrieval capability beyond that of the instruments currently available. We hope to use these results to make recommendations about the minimum spectral range, resolution and signal to noise ratio necessary to break degeneracies in the retrieval problem.

Exploring the treasure trove: PIRATE as a remotely operated exoplanets winnower

Author: Jakub J Bochinski

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Co-Authors: R.Busuttil (Open University); S.Holmes (Open University); U.C.Kolb (Open University); C.A.Haswell (Open University)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The SuperWASP consortium has to date identified several thousand exoplanetary candidates worthy of follow-up. Based on current statistics, most of these will prove to be mimics, many of which could be interesting in their own right. To deal with the large quantities of candidates, a cost effective follow-up procedure is required, to both broadly categorise all objects and identify the most interesting ones for further follow-up on high-demand telescopes. In this context, we present PIRATE Mk II (Physics Innovations Robotic Astronomical Telescope Explorer) in its current role as a second stage exoplanetary candidate winnower. Our pipeline data reduction methods are explained as well as the rationale behind the current site, instrument set-up and mode of observations. With the present rate of data acquisition it should be possible to cover several hundred targets per year, or a quarter of all "A-grade", northern hemisphere, SWASP photometric follow-up candidates. Finally, we present and discuss example light curves and results, including typical mimic and exoplanetary signals.

Ground-based secondary eclipse observations of CoRoT-1b

Author: Hannah Ruth Wakeford

University of Exeter

Co-Authors:

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

I present ground-based z'-band secondary eclipse observations from CFHT of CoRoT-1b, in an effort to constrain emission spectra, albedo, and temperature redistribution in its atmosphere. The observations are part of a project to measure the brightness temperature of hot jupiters around and apparent 1800K temperature regime, where hotter planets show a very strong day to night flux contrast.

Microlensing planets in spiral arms

Author: Markus Hundertmark

University of St Andrews

Co-Authors:

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

In recent years, gravitational microlensing has impressively proven its capability to detect low-mass planets and free-floating planetary-mass objects. The characterisation of these events often requires an underlying Galactic model, but none of the Galactic models used for inferring planetary parameters includes the spiral arm structure. Reviewing the properties of detected microlensing planets reveals a remarkable spatial distribution and motivates studying the impact of a Galactic model. Depending on the assumed location of source and lens, the planet mass changes and thus the results for all reported planetary-mass objects can be reviewed based on such an extended model. The prominent rocky 5.5 Earth-mass planet, for instance, would differ noticeably if the lens position is located in the Centaurus arm and thus at a distance of 3 kpc from Earth. In addition to changing the lens distance, the lens-source proper motion needs to be revised as well, as the lens originates from a different stellar population.

Modeling Exoplanet Transmission Spectra

Author: Alexander Pettitt

University of Exeter

Co-Authors: F. Pont (University of Exeter); D. K. Sing (University of Exeter)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

The field of transmission spectroscopy is a key area of exoplanetary science as it enables the identification of molecular species in planetary atmospheres. We present an ongoing study to model the transmission spectrum for exoplanets, with the aim of comparing this to measured spectra from such instruments as those aboard Hubble and Spitzer. Of particular interest is the IR region where the molecules H2O, CH4, CO and NA3 are believed to produce the dominant spectral features. We present our current progress as well as the necessary steps required to build a transmission spectrum from the raw constituents that are widely available.

New measures for the detection of habitable planets

Author: Ulrike Lemke

Durham University

Co-Authors: S. Schaefer A. Reiners

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

Since the first exoplanet discovery 20 years ago, detection methods have largely improved and lead to ever finer provisions on the strive towards the required accuracies. New instrumentation utilizing the radial velocity approach is aiming at 1ms^-1 precision in order to detect Earth-like planets in the habitable zone. Current efforts at the University of Göttingen include the implementation of a Fabry-Pérot-Interferometer as a mean to produce a reliable wavelength standard and furthermore investigate the incomplete scrambling phenomenon and viable mitigation strategies to ensure the required spectrograph performance.

Opacity and spectra in hot Jupiters

Author: Nawal Husnoo

University of Exeter

Co-Authors: F. Pont (Exeter), D. Sing (Exeter), K. Heng (Zurich), S. Aigrain (Oxford), L. Fletcher (Oxford), J. Lee (Oxford), T. Evans (Oxford)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

We are developing a set of tools for generating shortwave opacities for hot Jupiter atmospheres. We focus on the visible spectrum, where we plan to use the routines for generating "frst guess" models for the upcoming transmission spectra of hot Jupiters (HST program in progress, PI: Sing). We also plan to study the atmospheric temperature-pressure profle of hot Jupiters (Heng et al. 2011), with a focus on the effects of various types of clouds.

Selection effects of the SuperWASP project

Author: Simon Walker

University of Warwick

Co-Authors: P. J. Wheatley (University of Warwick); R. West (University of Leicester)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

SuperWASP is the most successful ground based survey for transiting extrasolar planets, with over 70 discoveries announced. The project is most sensitive to hot Jupiters, but the sample is limited by selection effects. In order to determine the underlying distribution, it is necessary to quantify these selection effects. We have simulated synthetic lightcurves with planetary transits with different physical parameters, and inserted into observed data. The resulting lightcurves are analysed with the SuperWASP analysis tools to determine how many would be detected, if they contained a genuine transit. The fraction of synthetic lightcurves maps the underlying detection sensitivity of the project and how this relates to both physical and observational parameters of the system.

The atmospheric structure of the hot Jupiters

Author: Alexis Smith

Keele University

Co-Authors: D. R. Anderson (Keele); N. Madhusudhan (Yale); and the SuperWASP team

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

When a transiting planet is occulted by its host star, we can detect the emergent flux from the planet. Near-infrared measurements of the occultation depth yield the brightness temperature of the system at a particular wavelength, which can provide an estimate of the efficiency of the heat redistribution to the night-side of the planet. Measurements of the occultation depth at several wavelengths allow the construction of a spectral energy distribution for the planet and enable the atmospheric composition and structure (for instance whether or not the atmosphere has a thermal inversion or stratosphere) to be inferred. In addition to using the Spitzer Space Telescope to obtain occultations redwards of 3.6 microns, we have an ongoing programme using several ground-based telescopes at shorter wavelengths. These observations are often vital to limit the range of models which can describe the atmospheric structure and composition. Of particular interest is what determines whether a particular planet's atmosphere exhibits a thermal inversion. Various parameters have been proposed as key to this question, including insolation, stellar activity and stellar metallicity. By characterising the atmospheres of hot Jupiters occupying a range of parameter space, we aim to resolve this question. Here I present our latest results.

The Sun's radial velocity jitter

Author: Raphaelle D. Haywood

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Co-Authors: A. C. Cameron (University of St Andrews), D. Queloz (Observatoire Astronomique de l'Universite de Geneve), R. Fares (University of St Andrews), J. Llama (University of St Andrews), M. Gillon (Institut d'Astrophysique et de Geophysique, Universite de Liege,), A. Hatzes (Thueringer Landessternwarte Tautenburg), M. Deleuil (Laboratoire d'Astrophysique de Marseille), A. Lanza (INAF - Osservatorio Astronomico di Catania), C. Lovis (Observatoire Astronomique de l'Universite de Geneve), C. Moutou (Laboratoire d'Astrophysique de Marseille), F. Pepe (Observatoire Astronomique de l'Universite de Geneve), D. Pollacco (Astrophysics Research Centre, Department of Physics and Astronomy, Queen's University Belfast), D. Ségransan (Observatoire Astronomique de l'Universite de Geneve), Y. Unruh (Astrophysics Group, Blackett Laboratory, Imperial College of Science, Technology and Medicine)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

One of the most common methods used to discover extra-solar planets is to monitor a star's radial velocity (RV) in order to detect the reflex orbital motion caused by one or more planets orbiting the star. When looking for "small" planets (Neptune or Earth mass), the RV signals induced by these planets are entangled with the jitter arising from the star's magnetic activity. The Sun's activity is well known and it is possible to remove all RV components induced by all other bodies of the solar system. We have obtained its activity-driven RV variations over two solar rotations using HARPS by observing sunlight reflected off the bright asteroid Vesta. We aim to model the solar RV jitter in terms of the continuum lightcurve, the chromospheric Ca II H&K emission, and the line-profile distortions produced by spots drifting across the face of the Sun. By using the "ground truth" of solar observations in this way, we will identify photometric and spectroscopic proxies that will make it possible to model and remove the stellar activity RV contribution from exoplanet RV curves.

Things that go bump in the transit: Using Kepler lightcurves to determine stellar spot-belt drifts.

Author: Joe Llama

University of St Andrews

Co-Authors: M. Jardine, (St Andrews); D. H. Mackay (St Andrews); R. Fares (St Andrews)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

Planetary transits provide a unique opportunity to investigate the surface distributions of star spots. Using stellar evolution simulations we predict transit lightcurves of a planet whose orbital axis is misaligned with the stellar rotation axis. Such a planet could occult spots at a range of latitudes. From these lightcurves we determine if missions such as Kepler, which provide continuous observations, can be used to measure spot belt drift over time providing a further test for dynamo theory.

Transmission Spectroscopy on a Blotchy Canvas: Star Spot Corrections Using Gaussian Processes

Author: Tom Evans

University of Oxford

Co-Authors: S. Aigrain (University of Oxford), F. Pont (University of Exeter), N. Gibson (University of Oxford)

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

Absorbing materials in a transiting exoplanet's atmosphere can be inferred by measuring how the apparent size of the planet varies as a function of wavelength. However, the application of this technique, known as transmission spectroscopy, is complicated by the presence of dark star spots and bright faculae on the stellar surface. In order to obtain an accurate transmission spectrum, it is necessary to correct for the effect that these active regions have on the measured transit depth. This poses a challenge, as the spot/faculae coverage cannot be observed directly. In this talk I will describe a new approach for dealing with this problem, which makes use of Gaussian process regression onto long-term photometric monitoring data of the host star. We plan to apply this technique when calibrating high precision optical transmission spectra for eight hot Jupiters that are to be observed over the next year or so using the STIS instrument on board HST (GO12473, P.I. Sing).

What a high-accurate light curve could tell us about an exoplanet ?

Author: Dimitris Mislis

Institute of Astronomy - Cambridge University

Co-Authors: S. Hodgkin (IoA)

Session: PL2: Exoplanets

Session: PL2: Exoplanets

Displayed during: Poster Session B

Summary:

We present a new approach to determine the parameters of transiting extrasolar planetary systems using photometric light curves (LCs). An analysis that combines a treatment of various phenomena in high-accuracy LCs allows a derivation of orbital and physical parameters. Our method considers the primary transit, the secondary eclipses, and the overall phase shape of a LC between the occultations. Phase variations are induced by reflected and thermally emitted light from the planet. Moreover, the ellipsoidal shape of the star due to the gravitational pull from the planet induce phase variations. Using the approach above, we are able to characterise transiting systems only from the LC, but also to discover many non-Transiting exoplanets (new or in known planetary systems). The technique has many applications to current mission (e.g. Kepler) or future missions (such as PLATO)

A self-similar expansion model for use in solar wind transient propagation studies

Author: Dr Jackie Davies

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Co-Authors: R.A. Harrison (RALSpace, UK), C.H. Perry (RALSpace, UK), C. Möstl (University of Graz, Austria; Austrian Academy of Sciences, Austria; University of California, USA), N. Lugaz (University of Hawaii, USA), T. Rollett (University of Graz, Austria), C.J. Davis (RALSpace, UK; University of Reading, UK), S.R. Crothers (RALSpace, UK), M. Temmer (University of Graz, Austria), C.J. Eyles (RALSpace, UK; University of Valencia, Spain), N.P. Savani (Nagoya University, Japan; Naval Research Laboratory, USA)

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

Since the advent of wide-angle heliospheric imaging, a number of techniques have been developed to investigate the 3D structure and kinematics of solar transients from their signatures in single- and multi-spacecraft imaging observations. In the analysis of single-spacecraft imaging observations, much use has been made of the Fixed-φ Fitting (FPF) and Harmonic Mean Fitting (HMF) techniques, in which the transient is considered a radially-propagating point source (Fixed-φ, FP, model) and a radially-expanding circle anchored at Sun-centre (Harmonic Mean, HM, model), respectively. Initially, we compare radial speeds and propagation directions derived from applying these techniques to a large set of STEREO/Heliospheric Imager (HI) observations. As the geometries on which these two techniques are founded constitute extreme descriptions of solar transients in terms of their cross sectional extent, we describe a single-spacecraft fitting technique based on a more generalised model for which the FP and HM geometries form the limiting cases. In addition to providing transient speed and propagation direction, Self-Similar Expansion Fitting (SSEF) provides, in theory, the capability to estimate a transient's angular extent in the plane orthogonal to the field of view. Using HI observations, and a Monte-Carlo simulation, we assess the potential of the SSEF technique.

An analysis of the origin and propagation of the multiple coronal mass ejections of 1 August 2010

Author: Richard Harrison

Rutherford Appleton Laboratory

Co-Authors: J.A. Davies (Rutherford Appleton Laboratory), C. Möstl (University of California, Berkeley, USA), Y. Liu (University of California, Berkeley, USA), M. Temmer (University of Graz, Austria), M.M. Bisi (Aberystwyth University), J.P. Eastwood (Imperial College London), C.A. de Koning (Space Weather Prediction Center, Bouder, USA), N. Nitta (Lockheed Martin Advanced Technology Centre, Palo Alto, California), T. Rollett (University of Graz, Austria), C.J. Farrugia (University of New Hampshire, USA), R.J. Forsyth (Imperial College London), B.V. Jackson (University of California, San Diego, USA), E.A. Jensen (Planetary Science Institute, Tucson, USA), E.K.J. Kilpua (University of Helsinki, Finland), D. Odstrcil (NASA/Goddard Space Flight Center, Maryland, USA), D.F. Webb (Boston College, USA)

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

On 1 August 21010, a complex of active regions and adjacent filament channels in the northern solar hemisphere was the source of a four major coronal mass ejections (CMEs), the effects of which were detected at Earth and other solar system bodies. A wealth of spacecraft-borne instrumentation allowed an unprecedented capability to explore methods for CME identification and tracking, and to assess issues regarding onset and planetary impact from these events. This has generated a series of research papers and workshops focused in particular on the observations from the STEREO spacecraft. The principal results from the interpretation and analysis of the observations, in particular from the Heliospheric Imagers, is given. The consistency of the results, derived from the wide variety of methods applied to such an extraordinarily complete dataset, has allowed us to converge on robust interpretations of the CME onsets and their arrivals at 1 AU. This work provides a valuable case study for space environment applications efforts.

Characteristics of the Solar Wind Electron Distribution at 10AU

Author: Andrew Walsh

MSSL/UCL

Co-Authors: C.S. Arridge (MSSL/UCL, Centre for Planetary Sciences at UCL/Birkbeck); A.N. Fazakerley (MSSL/UCL); A. Masters (MSSL/UCL, Centre for Planetary Sciences at UCL/Birkbeck), G.R. Lewis (MSSL/UCL, Centre for Planetary Sciences at UCL/Birkbeck), A.J. Coates (MSSL/UCL, Centre for Planetary Sciences at UCL/Birkbeck)

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

The electron distribution in the solar wind has 3 components – a Maxwellian or thermal core, which generally isotropic, a isotropic suprathermal “halo” population existing at higher energy, which can be described by a kappa distribution, and the strahl - a beam of higher-still energy electrons that travels away from the Sun along the interplanetary magnetic field. The strahl can also be described by a kappa distribution. Current theories suggest the halo population is formed through pitch angle scattering of the strahl, so the presence or otherwise of each of these three populations can provide information about the evolution of the solar wind as it propagates through the heliosphere. To date there have been few observations of the solar wind electron distribution that include the higher energy, suprathermal, components made outside the orbit of Jupiter. Here we use data from CAPS-ELS, flying on Cassini, to characterise the electron distribution that was measured upstream of Saturn while the Cassini was on approach to the planet. We find that the measured distribution does contain one or more suprathermal components measurable above instrument background levels, with a higher phase space density in the direction one would expect the strahl to be observed, although it cannot yet be confirmed that this distribution conforms to the core-halo-strahl structure observed closer to the Sun.

CME expansion in the inner heliosphere - STEREO/SECCHI observations

Author: Volker Bothmer

University of Goettingen

Co-Authors: Eckhard Bosman, Malte Venzmer, Jonas Hesemann

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

The Sun Earth Connection Coronal and Heliospheric Investigation suite comprises two sets of five dedicated telescopes suitable for imaging coronal mass ejections (CMEs) from Sun to beyond Earth orbit. With the Heliospheric Imagers on board the two STEREO satellites, for the first time CMEs can be tracked directly all the way from Sun to beyond Earth. This presentation summarises results inferred from the analysis of CME events identified in the HI observation in order to derive basic parameters describing the dimensions and topology of CMEs at Earth's orbit for improving space weather forecasting. The analysis is carried out in the framework of the EU FP7 project AFFECTS (Advanced Forecast For Ensuring Communications Through Space).

Inclusion of Real-Time in-situ Measurements into the UCSD Time-Dependent Tomography...

Author: M.M. Bisi

Institute of Mathematics and Physics, Aberystwyth University

Co-Authors: B.V. Jackson (Center for Astrophysics and Space Sciences, University of California, San Diego), P.P. Hick (Center for Astrophysics and Space Sciences, University of California, San Diego/San Diego Supercomputer Center, University of California, San Diego), J.M. Clover (Center for Astrophysics and Space Sciences, University of California, San Diego), A. Buffington (Center for Astrophysics and Space Sciences, University of California, San Diego), and M. Tokumaru (Solar-Terrestrial Environment Laboratory, Nagoya University).

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

...and its Resultant Space-Weather Forecast and Science Improvements The University of California, San Diego (UCSD) three-dimensional (3-D) time-dependent tomography programme has been used for well over a decade to reconstruct and forecast coronal mass ejections (CMEs) from observations of interplanetary scintillation (IPS) taken using the Solar-Terrestrial Environment Laboratory (STELab) IPS arrays. Here, we demonstrate how the inclusion of in-situ data (velocity and density) from space-borne instrumentation can be used in addition to observations of IPS to better-constrain a time-dependent tomographic reconstruction solution. We also consider the forecasting of both velocity and density in the near-Earth space environment using this incorporated method. Supplementing observations of IPS with in-situ measurements results in the largest changes within the 3-D volume around the radial direction that incorporates these in-situ measurements; their inclusion greatly reduces the uncertainty in extending the 3-D reconstructions globally which are then distant in space and time from the spacecraft. Near the Earth, this analysis provides a finely-tuned real-time result up to the latest time for which in-situ measurements are available (when using real-time data), and enables more-accurate forecasting beyond this than observations of IPS alone allow. We show examples of this new algorithm and our real-time STELab IPS data, and provide a prescription to determine the forecasting accuracy.

Multi-spacecraft Study of the Heliosphere using HELIO

Author: R.D. Bentley

University College London (MSSL)

Co-Authors: M. Hapgood (STFC), J. Brooke (Univerity of Manchester), K. Benson (UCL-MSSL), S. Zharkov (UCL-MSSL), C.H. PErry (STFC), P. Richards (STFC), A. Le Blanc (Univerity of Manchester)

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

HELIO, the Heliophysics Integrated Observatory, provides a collaborative environment where scientists can discover, understand and model the connection between solar phenomena, interplanetary disturbances and their effects on the planets. The project is designed around a service-oriented architecture with resources established as services that support metadata curation and search, data location and retrieval, and data processing and storage. HELIO provides integrated access to the data and metadata from the domains that constitute heliophysics - solar, heliospheric, geophysics and planetary.

More than 50 event catalogues can be used in the search; data from more than 150 instruments from nearly 50 observatories can be accessed. A comprehensive user interface is available and the serves can be used individually or accessed through IDL/SolarSoft; a workflow tool provides the ability to combine services together and it is possible to execute programmes on demand including propagation models. We will report on the status of HELIO and the services that are available and show how these resources can be used to address use cases involving multiple spacecraft and modelling related to the solar wind and propagating phenomena in the heliosphere. HELIO is a research infrastructure funded under Capacities programme of the EC's 7th Framework Programme (FP7).

Observations of a sequence of events on the sun and their effects on the inner planets

Author: Ailsa Prise

MSSL/UCL

Co-Authors: L.K.Harra (MSSL/UCL) A.Aylward (UCL) S.A. Matthews (MSSL/UCL)

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

On 3rd November 2011 an X1.9 flare from NOAA 11339 was observed by STEREO-B/EUVI and SDO/AIA. It was followed by a large CME erupting, with a speed of roughly 1500km/s, from a second active region on the backside of the sun. This was observed in STEREO-A and B. An EIT wave is seen propagating from the first CME on the sun, at speed of 200km/s. It extends to a third active region in the middle of the disk visible from STEREO-B, which later produces another CME. These events are investigated in detail and observed as they propagate in various directions out into the solar system. A solar energetic particle event of accelerated electrons is seen by both STEREO spacecraft and by ACE at the Earth, after the first CME. The CME itself travels towards Mercury and Venus. With this study we aim to track these events into the solar system and compare the multiple effects of these events at the different planets that they encounter.

Observations of kinetic plasma turbulence in the Slow Solar wind

Author: Owen Roberts

Institute of Mathematics and Physics, Aberystwyth University

Co-Authors: X. Li

Session: SP1: Interplanetary observations of the solar wind

Displayed during: Poster Session A

Summary:

Using the k-filtering (aka wave telescope) method and data from Cluster's fluxgate magnetometer (FGM), kinetic plasma turbulence in quiet slow solar wind is investigated. The cluster spacecraft are able to give us a unique view into the solar wind, and enable us to differentiate between spatial and temporal variations in the magnetic field. Using the four satellites and the three time series' from each craft, the wavevectors that make up the time series' can be recovered, even when the frequencies of numerous waves are similar. Using a filter this is done for several frequency intervals in the spacecraft frame, and the dispersion relation of the waves is found by Doppler shifting the frequency into the plasma frame. Using this approach and data from 2004 (where the spacecraft separations are around 200km), two distinct cases are found. Both data sets indicate the presence of Kinetic Alfven waves propagating in directions nearly perpendicular to the background magnetic field. One case shows that only these quasi-perpendicular kinetic Alfven waves exist. Whereas there is also another, rarer case which shows a population of waves propagating at less oblique angles $\theta \sim 50^{\circ}$ (the angle between the wave vector k and mean magnetic field B) in the solar wind frame and the wave power of the two populations are similar. We will discuss the sources of the two wave populations.

Build-up of coronal magnetic gradients from observed photospheric flows

Author: Anthony Yeates

Durham University

Co-Authors: G. Hornig (University of Dundee); B.T. Welsch (University of California, Berkeley)

Session: SP2: Solar coronal magnetic fields

Displayed during: Poster Session B

Summary:

We use a sequence of high-resolution photospheric flows derived from Hinode/SOT magnetograms to study the build-up of magnetic gradients in the Sun's corona, without recourse to magnetic field extrapolation. By integrating trajectories of the flow field, we can derive the magnetic field line mapping that would result from the observed footpoint motions, assuming an ideal evolution in the corona. We map the quasi-separatrix layers (QSLs) in the mapping, and show that these correspond to Lagrangian coherent structures in the photospheric flow field. Their spatial pattern may be interpreted with the help of a simple analytical model of photospheric convection; we also use the model to predict how the magnetic structure might change given even higher-resolution observations.

Influence of an atmospheric layer with non-negligible pressure on MHS equilibria

Author: Thomas Neukirch

Mathematics & Statistics, University of St. Andrews

Co-Authors: J.D.B.Hodgson (Mathematics & Statistics, University of St. Andrews); E.R.Priest (Mathematics & Statistics, University of St. Andrews)

Session: SP2: Solar coronal magnetic fields

Displayed during: Poster Session B

Summary:

Solar magnetic fields models are often based on potential fields for reasons of simplicity. In the present paper, we investigate the influence of a lower atmospheric layer with non-negligible plasma pressure on the result of magnetic field calculations and compare this with potential fields, using translationally and rotationally invariant magnetohydrostatic models of a single flux source. To solve the magnetohydrostatic equations a numerical continuation method is used, which is capable of calculating sequences of equilibria. The plasma pressure function is determined by assuming approximate horizontal pressure balance along the lower boundary in the non-potential field limit and a simple stratified hydrostatic atmosphere in the potential field case. We show some illustrative examples of the differences between potential field and non-potential field calculations with the same boundary conditions.

Nonlinear force-free coronal magnetic field modelling with SDO

Author: Thomas Wiegelmann

Max-Planck Institut fuer Sonnensystemforschung

Co-Authors: J.K. Thalmann; B. Inhester; T. Tadesse; X. Sun; J.T. Hoeksema

Session: SP2: Solar coronal magnetic fields

Displayed during: Poster Session B

Summary:

The SDO/HMI instrument provides photospheric vector magnetograms with a high spatial and temporal resolution. We extrapolate these measurements into the solar corona, assuming a force-free state. We use an updated version of our nonlinear force-free optimization code, which allows to incorporate measurement errors in the photospheric magnetic field vector. We evaluate the resulting 3D equilibria by means of how well the force-freeness and solenoidal conditions are fulfilled, the angle between the magnetic field and the electric current and by comparing projections of magnetic field lines with loops visible in coronal images from SDO/AIA.

Observations of apparent solar tornados

Author: Xing Li

Aberystwyth University

Co-Authors: H. Morgan, D. Leonard

Session: SP2: Solar coronal magnetic fields

Displayed during: Poster Session B

Summary:

We present observations of apparent rotational structures (solar tornados) above the limb of the Sun using SDO/AIA data. The phenomenon is observed mainly at coronal temperatures but the presence of cold material at chromospheric temperatures cannot be ruled out. The high resolution data of SDO/AIA allow us to reveal the vivid details of apparent motions presumably along magnetic field lines. Apparent motions are found to originate from the root of the observed structures and describe clear helical paths. The shape and position of the overall structures experience dramatic changes indicating the instability of the magnetic structure as a result of such apparent motions. A local correlation technique is used to compute the plane-of-sky velocity field of the events and a speed as high as 50~70 km/s is typically observed, which is significantly smaller than the coronal sound speed. Hence the apparent motions are most likely due to the ejection of material along a long arcade of winding magnetic field. Although faint, the ejections are seen to eventually drop back to the surface through the long helical field. It is speculated that rotational magnetic structures previously observed on the solar disc by SDO/AIA may be physically similar to the solar tornados studied here but this is not a definite conclusion. A density model of such events is presented in another paper (by Morgan, Li & Leonard).

The onset of outflows in NOAA 11117 using SDO

Author: David Shelton

MSSL/UCL

Co-Authors: L.K.Harra (MSSL/UCL) L.M.Green (MSSL/UCL)

Session: SP2: Solar coronal magnetic fields

Displayed during: Poster Session B

Summary:

Coronal outflows have been observed using EUV imaging on TRACE (Winebarger et al. 2001). However, it has only been since the launch of Hinode that direct spectroscopic detection of persistent outflows have been made using the EUV Imaging Spectrometer (EIS, Culhane et al. 2007). These persistent

outflows have larger speeds in spectral lines that are formed at T > 1 MK (Del Zanna (2007,2008b), they are found at the edges of active regions and are unchanged over a long period of time. It has been suggested that these persistent outflows could be caused by chromospheric evaporation flow magnetic reconnection (Del Zanna 2008b) and that the outflows could be related to the origin of the slow solar wind (Sakao et al. 2007; Marsch et al. 2008). EIS observations show that these outflows are associated with “open” coronal magnetic field lines (Harra et al. 2008; Doschek et al. 2008). It has recently been shown that emerging flux into an active region can produce new and enhanced outflows (Harra et al. 2010) which have been shown through simulations to be caused by a mixture of compression and magnetic reconnection (Harra et al. 2011). In this work, we choose an example of a region that emerged into quiet Sun and not into a pre-existing active region. We present the results of a study using the Solar Dynamics Observatory (SDO) of the emergence of active region NOAA 11117 which was present on the solar disk between 21st October and 31st October 2010.By using the high spatial resolution and high temporal cadence of SDO, we are able to determine when in the formation of the active region that the onset of these persistent outflows started. The outflows were delayed by 3 and a half days from the region’s first emergence. By comparing the AIA 171Å data with the HMI magnetogram data for this period, we see that the persistent outflows only start to appear after the leading polarity starts to coalesce.

SPARK: Solar Particle Acceleration, Radiation and Kinetics

Author: Sarah Matthews

UCL Mullard Space Science Lab.

Co-Authors: The SPARK consortium

Session: SP3: UKSP/MIST Missions Forum 2012

Displayed during: Poster Session A

Summary:

Energetic particles are critical components of plasma populations found throughout the universe. The proximity of the Sun and the range of high-resolution diagnostics available within the solar atmosphere offers unique opportunities to study the processes involved in particle acceleration through the use of remote sensing observations of the radiative signatures of accelerated particles, and of their plasma and magnetic environment. We outline a mission concept designed to target the broad range of energy, spatial and temporal scales over which particle acceleration occurs in the solar atmosphere, in order to determine how and where energetic particles are accelerated. The SPARK concept combines highly complementary imaging and spectroscopic observations of radiation from energetic electrons, protons and ions set in their plasma and magnetic context. The payload comprises focusing-optics X-ray imaging covering the range from 1 - 60 keV; indirect HXR imaging and spectroscopy from 5 to 200 keV, γ-ray spectroscopic imaging with high-resolution LaBr3 scintillators, and photometry and source localisation at far-infrared wavelengths in addition to soft X-ray imaging of the corona and vector magnetography of the photosphere and chromosphere. SPARK will additionally provide exciting new insights into the origin of particle acceleration in other regimes, including terrestrial gamma-ray flashes (TGF), the origin of γ-ray bursts, and the possible existence of axions.

The SDO data hub at UCLan

Author: S. Regnier

University of Central Lancashire

Co-Authors: D. S. Brown, S. A. Chapman, S. Dalla, C. Kay, M. S. Marsh, R. W. Walsh

Session: SP3: UKSP/MIST Missions Forum 2012

Displayed during: Poster Session A

Summary:

In the advent of the Solar Dynamics Observatory (SDO), a data pipeline for the distribution of data and associated data products has been developed throughout the world (US, Europe and Asia). The UK node within this pipeline is located at the University of Central Lancashire (UCLan), where a data centre has been established to host a rolling SDO/AIA and SDO/HMI archive for about five consecutive months: the archive currently contains all SDO/AIA level 1 data for all wavelengths and at the full cadence, and the SDO/HMI line-of-sight magnetic field, Dopplershift and intensity maps. The data centre is providing SDO data to the large UK solar scientific community through the commonly used SolarSoft package and also through the Virtual Solar Observatory (VSO) web interface. We describe the architecture of the archive, focusing on the many ways in which everybody can retrieve the data. We also discuss the download speeds to retrieve data from the UCLan hub compared to overseas archives.

The SWARM mission opportunity

Author: malcolm Dunlop

RAL

Co-Authors: H Luehr (GFZ) and M. Dunlop (RAL)

Session: SP3: UKSP/MIST Missions Forum 2012

Displayed during: Poster Session A

Summary:

The ESA SWARM mission is a three-spacecraft mission designed to explore both external and internal influences on the Earth's magnetic field in

unprecedented detail. It is due for launch in the summer of 2012 and is the subject of a dedicated session (MST2) within NAM 2012. As both an Earth Explorer mission and an important resource for space weather science, the mission has attracted interest from the geomagnetic and MIST communities. A number of UK proposals have been submitted to an ESA call for science and mission support projects (SSVO), exploring: exploitation and data use, data verification and modelling. These form parallel (proposed) activities to the more formal forum of the German SWARM project office. Thus, these UK

plans, reflected in both Germany and the UK, highlight the crucial role of science in supporting SWARM operations, including the possible coordination with data from other spacecraft and with ground-based sensors. This presentation to the missions forum will provide a short overview of the dedicated session and will list UK plans for related projects which have been submitted to the ESA SSVO call. We will outline the relevance of the mission to a range of RAS science.

Can we learn something new about solar prominence eruptions with Solar Orbiter?

Author: Nicolas Labrosse

University of Glasgow

Co-Authors: L. Harra (MSSL)

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

EUI (Extreme Ultraviolet Imager) will monitor the low atmosphere counterparts of large-scale solar eruptive events such as CMEs. As such it will ideally be suited to study prominence eruptions. Here we are primarily interested in investigating what we may learn from data returned by the High Resolution Imagers (HRI) in the Lyman-alpha channel, and the Full-Sun Imager (FSI) working at the 304 A EUV passband. In Labrosse & McGlinchey (2012) we showed how it is possible to exploit data at 304 A from SDO/AIA to make a diagnostic of the prominence plasma by comparing AIA observations with non-LTE radiative transfer calculations. These calculations take into account the strong Doppler dimming effect on the He II line induced by the outwards radial motion of the structure. Previous calculations have shown that the Ly-alpha line is also sensitive to the Doppler dimming effect. EUI offers a good opportunity to use both lines simultaneously at high-resolution and out of the ecliptic plane to study - among other phenomena - prominence eruptions. This paper will present new radiative transfer calculations combining results on both hydrogen and helium resonance lines, addressing the question of what we can learn from these observations.

Coronal Jet, Magnetic Topology, and the Production of an Interplanetary Electron Stream

Author: Sarah Matthews

UCL Mullard Space Science Lab.

Co-Authors: Chuan Li, Lidia van Driel-Gesztelyi, Jian Sun and Chris Owen

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

Combining the in situ electron measurements and remote-sensing solar observations, as well as the calculated magnetic fields obtained from a potential-field source-surface model, we investigate the acceleration source of the impulsive solar energetic particle (SEP) events on 2007 January 24. We demonstrate that the jets associated with the hard X-ray flares and type-III radio bursts, rather than the slow and partial coronal mass ejections, are closely related to the production of interplanetary electron streams. The jets, originated from the well-connected active region (AR 10939) whose magnetic polarity structure favours the eruption, are observed to be forming in a coronal site, extending to a few solar radii, and having a good temporal correlation with the electron solar release. Our analysis enables us to propose a coronal magnetic topology relating the impulsive SEP events to their solar source. We discuss future extensions of this work with a view towards Solar Orbiter.

Magnetic topology of Active Regions and Coronal Holes: Coronal Outflows and the Solar Wind

Author: Lidia van Driel-Gesztelyi

UCL MSSL

Co-Authors: J.L. Culhane (UCL, MSSL), D. Baker ((UCL, MSSL, UK), Demoulin, P. (Paris Obs., France), Mandrini, C.H. (IAFE, Buenos Aires, Argentina), De Rosa, M.L. (Lockheed Martin Lab., USA), Rouillard, A.P. (Univ. Toulouse, France), Opitz, A. (Univ. Toulouse, France), Stenborg, G. (George Mason Univ., USA), Vourlidas, A. (NRL, USA), Brooks, D.H. (NRL, USA)

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

When active regions are adjacent to coronal holes, interchange reconnection may lead to significant evolution of coronal hole boundaries. Reconnection can also take place between closed fields having a large connectivity gradient. Outcomes may include hot plasma outflows from active regions (ARs) with likely implications for solar wind (SW) plasma escaping along open magnetic field lines. During 2-18 January 2008 a pair of low-latitude opposite polarity coronal holes were observed on the Sun with two ARs and the heliospheric plasma sheet located between them. We use the Hinode/ EIS to locate AR-related outflows and measure their velocities. STEREO imaging is also employed as are the ACE in-situ observations, to assess the resulting impacts on the interplanetary SW properties. Magnetic field extrapolations of the two ARs confirm that AR plasma outflows observed with EIS are co-spatial with quasi-separatrix layer locations, including the separatrix of a null point. Global potential field source-surface modeling indicates that field lines in the

quasi-separatrix layer locations, including the separatrix of a null point. Global potential field source surface modeling indicates that field lines in the vicinity of the null point extend up to the source-surface, enabling a part of the EIS plasma upflows access to the SW. We find that similar upflow properties are also observed within closed field regions that do not reach the source surface. We conclude that some of plasma upflows observed with EIS remain confined along closed coronal loops, but that a fraction of the plasma may be released in the slow SW. This suggests that ARs bordering coronal holes can contribute to the slow SW. Analyzing the in-situ data, we conclude that the type of SW present (composition, temperature, speed and first

ionization potential bias) depends on the type whether the AR is fully or partially enclosed by an overlying streamer. The analysis of remote sensing and in situ data in close combination is performed in preparation for the Solar Orbiter mission.

Observation of kinetic plasma turbulence in the solar wind

Author: XING LI

Aberystwyth University

Co-Authors: S.Y. Huang (Wuhan University), O.W. Roberts (Aberystwyth University)

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

Using Cluster data, the k-filtering technique is adopted to investigate the property of plasma turbulence at the scale of the ion gyroradius in the undisturbed solar wind conditions where the plasma beta is in the order of unity. We are able to determine the direction of wave propagation and the wave dispersion relation. Waves are found mainly propagating in directions quasi-perpendicular to the background magnetic field. We found tentative evidence that quasi-perpendicular kinetic Alfven waves, fast waves and Bernstein waves at the harmonic frequencies of alpha particles may all co-exist, although kinetic Alfven waves carry more power than the quasi-perpendicular fast waves. The study suggests that ion cyclotron resonance and Landau resonance are both operating during the period that the solar wind data in this study were taken. We will discuss the potential implications of the study to the question of the solar wind the acceleration in the near sun region where the plasma beta may be much smaller than unity.

Science Goals of SPICE EUV Spectrometer for Solar Orbiter

Author: Andrzej Fludra

STFC Rutherford Appleton Laboratory

Co-Authors: D. Griffin (STFC RAL); M. Caldwell (STFC RAL); P. Eccleston (STFC RAL); S. Beardsley (STFC RAL); N. Waltham (STFC RAL); and the SPICE team

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

SPICE is an European-lead high-resolution imaging spectrometer with contributions from ESA member states (UK, Germany, France, Switzerland and Norway) and ESA. It is being considered by ESA as a facility instrument on the Solar Orbiter mission. SPICE will record spectra in two EUV wavelength bands, observing more than 70 emission lines over a wide range of temperatures from the chromosphere to the corona. SPICE will address the key science goals of the Solar Orbiter mission and investigate the links between the solar surface, corona and inner heliosphere. SPICE will measure plasma density and temperature, flow velocities, the presence of plasma turbulence and composition of solar plasmas. It will be observing, at all latitudes, the energetics, dynamics and fine-scale structure of the Sun's magnetized atmosphere. The SPICE instrument design, science goals and measurement capabilities are presented in this poster.

Solar Orbiter magnetometer: overview, science goals and status

Author: Tim Horbury

Imperial College London

Co-Authors: Helen O'Brien, Lee Matthews, Emanuele Cupido, Patrick Brown, Tim Oddy, Heather Lewtas (Imperial College London)

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

The magnetic field experiment on Solar Orbiter is central to all the science goals of the mission. There are 9 Co-Investigators of the instrument within the UK, at 7 institutions. It is a conventional fluxgate instrument with two sensors on a boom, in shadow, behind the spacecraft. The magnetometer was the first of the ten instruments to undergo Preliminary Design Review, which it passed in January 2012. We discuss the science goals of the instrument and how these feed into technical requirements. We present the instrument design including technical developments specific for this mission, and its current status.

Solar Orbiter: The Solar Wind Analysers (SWA) Experiment

Author: Prof Christopher Owen

UCL/Mullard Space Science Laboratory

Co-Authors: C.J. Owen D.O. Kataria, B.K. Hancock, A.N. Fazakerley, C. Brockley-Blatt,(all UCL/Mullard Space Science Laboratory); P. Louarn (IRAP, Toulouse); S. Livi (Southwest Research Inc., Texas); R. Bruno (IFSI, Rome)

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

In order to achieve the Solar Orbiter mission science goals, we need high-cadence measurements of 3D velocity distribution functions of the solar wind electron, proton and aplha particles populations, abundant heavy ions such as O6+ and low iron charge states such as Fe9+ or Fe10+. These measurements are among those that will be made by the Solar Wind Analyser (SWA) suite on Solar Orbiter. This investigation is a major international hardware collaboration, led by the UK (P.I. institute: UCL/Mullard Space Science Laboratory). In addition to the overall leadership of the suite, UCL/MSSL will provide the bulk of the hardware for the Electron Analyser System, one of 3 sensor systems within the suite. The Proton-Alpha Sensor and the Heavy Ion Sensor are led by partners in France and the USA respectively, while a central data processing unit, to be built in Italy, serves all 3 sensors and completes the suite. In this poster we briefly present the science goals related to the in situ exploration of the inner heliosphere, in particular addressing the SWA sensor designs required to meet these goals under Solar Orbiters challenging measurement environment and present the progress to date on building the SWA sensors.

Spectral diagnostics with SPICE

Author: Giulio Del Zanna

University of Cambridge

Co-Authors: H.E.Mason

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

We present a few spectral diagnostics available within the SPICE spectrometer on-board the Solar Orbiter mission and briefly review some aspects about the relevant atomic data. We also present a few science cases where we explore the possibility to link the remote-sensing observations of the source regions with the local in-situ measurements of the solar wind plasma parameters.

The EUV Imager (EUI) for Solar Orbiter

Author: Louise Harra

UCL-MSSL

Co-Authors: and EUI team

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

EUI will provide image sequences of the solar atmospheric layers above the photosphere, thereby providing an indispensable link between the solar surface and outer corona that ultimately shapes the characteristics of the interplanetary medium. Scientific topics to be addressed include monitoring the low atmosphere counterparts of large-scale solar eruptive events such as CMEs and the study of fine-scale processes in the solar atmosphere. EUI will also provide the first-ever images of the Sun from an out-of-ecliptic viewpoint (up to 34° of solar latitude during the extended mission phase). The EUI instrument suite is composed of two High Resolution Imagers (HRI), one at Lyman-α and one in the extreme UV at 174 Å, and one dual band Full-Sun Imager (FSI) working alternatively at the 174 and 304 Å EUV passbands.

The Spectrometer/Telescope for Imaging X-rays (STIX)

Author: Marina Battaglia

University of Applied Sciences Northwestern Switzerland

Co-Authors: The STIX team

Session: SP4: Solar Orbiter mission - How does the Sun createand control the heliosphere?

Displayed during: Poster Session A

Summary:

One of Solar Orbiter's main science goals is to address how solar eruptions produce energetic particles that fill the heliosphere. X-rays are an important diagnostic of the properties of accelerated electrons near the Sun. STIX will measure the timing, intensity, location and spectrum of thermal and non-thermal X-rays by means of imaging-spectroscopy over a wide energy range of 4 to 150 keV, with energy resolution ranging from 1 to 15 keV. With a 2 degree field of view capable of viewing the full Sun from 0.28 A.U., a spatial resolution of 7 arcseconds, and statistics-limited time resolution as short as 0.1 seconds, STIX will be able to locate and image the sites of solar flares and determine the spectrum of flare accelerated electrons. This will be particularly valuable in conjuncton with in-situ measurements of accelerated particles on Solar Orbiter. We present a short overview of the STIX instrument followed by a more detailed description of the science with a focus on collaborative studies between the different Solar Orbiter instruments.

A Study of an M Class Flare Observed by ROSA and SDO

Author: Peter Keys

Queen

Co-Authors: M.Mathioudakis (Queen's University Belfast); D.Kuridze (Queen's University Belfast); D.B.Jess (Queen's University Belfast); A.F.Kowalski (University of Washington); F.P.Keenan (Queen's University Belfast)

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

Using the Rapid Oscillations in the Solar Atmosphere (ROSA) instrument based at the Dunn Solar Telescope, we observed a M5.4 class flare that erupted from AR11121 on the 6th of November 2010 at 15:27UT for approximately one hour. The flare was observed with six synchronized cameras in the ROSA instrument using filters to produce data sets in G band (430.5nm), the continuum (417nm and 351nm), Halpha (656.2nm) and, left and right-hand circularly polarised light in FeI (630.2nm). The Interferometric BIdimensional Spectrometer (IBIS) was employed as well to sample the NaI DI line across 25 wavelength steps. Each data set obtained with ROSA and IBIS were speckle reconstructed to remove the effects of atmospheric seeing. Here we present some initial results regarding the on-set of flare related intensity enhancements across G band, the 417nm continuum and the 351nm continuum lines. We present results on the velocities of chromospheric flows, which are witnessed from an eruptive event associated with the flare. We also show a comparison of this flare as observed by the Solar Dynamic observatory (SDO) to highlight the capacity for ROSA to do fine-scale analysis of flaring active regions.

Geometry of acoustic wavefronts generated by a point source in the Sun: effects of cut-off frequency

Author: S. Zharkov

MSSL/UCL

Co-Authors:

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

Acoustic waves generated by a point source in stratified plasma are considered based on Geometric Asymptotics approach. Analytical parametric solution for monochromatic source is derived for plane-parallel model of the solar interior and is used to gain insight into the properties of the generated wavefronts as function of excitation frequency and depth. A slowly varying pressure perturbation moving in upper layers of solar photosphere with supersonic speed is also considered, showing that it can excite acoustic waves putting certain restrictions upon their geometry of the generated wavefront. The results are discussed in relation to observations of flare generated sun-quakes.

Stability of Current Sheets in the Solar Corona

Author: Zimovets Ivan

Space Research Institute (IKI) of RAS, Moscow, Russia

Co-Authors: A.Artemyev (Space Research Institute (IKI) of RAS, Moscow, Russia)

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

This work aims at investigating unstable modes of oscillation of quasi-vertical two-dimensional current sheets with sheared magnetic fields under physical conditions typical for the solar corona. We use linear magnetohydrodynamic equations to obtain sets of unstable modes related to the longitudinal inhomogeneity of the current sheet. It is shown that these modes of current sheet oscillations can modulate the current sheet thickness along the polarity inversion line. Based on the obtained results, we propose a scenario which can naturally explain both the quasi-periodic pulsations of hard X-ray emission and parallel movement of their double footpoint-like sources along the polarity inversion line observed in some eruptive two-ribbon solar flares.

The Coronal Pulse Identification and Tracking Algorithm (CorPITA)

Author: David Long

MSSL/UCL

Co-Authors: D. Shaun Bloomfield (Trinity College Dublin) David Perez-Suarez (Trinity College Dublin) Peter Gallagher (Trinity College Dublin)

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

The Coronal Pulse Identification and Tracking Algorithm (CorPITA) is an automated algorithm designed to systematically detect and analyse "EIT Waves" in data from the Solar Dynamics Observatory (SDO) spacecraft. CorPITA will operate as the automated coronal pulse detection system for the Heliophysics Event Knowledgebase (HEK), providing near–real–time identification of coronal pulses. Once triggered by the start of a solar flare, the algorithm uses an intensity profile technique radiating from the flare to examine the entire Sun. If a pulse is identified, the algorithm determines the

kinematics and morphological variation of the pulse in all directions along the solar surface. CorPITA therefore provides a systematic and unbiased method to identify "EIT Waves" and examine their physical properties. This will allow the true nature of "EIT Waves" and their relationship to coronal mass ejections to be determined, and as a result has potential implications for space–weather forecasting.

The Source of Three-minute Magneto-acoustic Oscillations in Coronal Fans

Author: David Jess

Queen

Co-Authors: M. Mathioudakis (Queen's University Belfast); I. De Moortel (University of St Andrews); D.J. Christian (California State University Northridge); K.P. Reardon (Osservatorio Astrofisico di Arcetri); P.H. Keys (Queen's University Belfast); F.P. Keenan (Queen's University Belfast)

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

We use images of high spatial, spectral, and temporal resolution, obtained using both ground- and space-based instrumentation, to investigate the coupling between wave phenomena observed at numerous heights in the solar atmosphere. Analysis of continuum images reveals small-scale umbral intensity enhancements, with diameters ~0.6", lasting in excess of 30 min. Intensity oscillations of ~3 min are observed surrounding these photospheric structures. Simultaneous chromospheric velocity and intensity time series reveal an out-of-phase behaviour, implying the presence of (magneto)acoustic oscillations. An average blue-shifted Doppler velocity of ~1.5 km/s confirms the presence of upwardly-propagating slow-mode waves in the lower solar atmosphere. Propagating oscillations in EUV intensity are detected in simultaneous coronal fan structures, with a periodicity of 172 ± 17 s, and a propagation velocity equal to 45 ± 7 km/s . The coronal fans are seen to anchor into the photosphere in locations where large-amplitude umbral dot oscillations manifest. Derived kinetic temperature and emission measure time series display prominent out-of-phase characteristics, and when combined with the previously established sub-sonic wave speeds, we conclude that the observed EUV waves are the coronal counterparts of the upwardly-propagating (magneto)acoustic slow-modes detected in photospheric umbral dots.

Transversal oscillations in emerging flux tubes

Author: Istvan Ballai

University of Sheffield

Co-Authors: I. Ballai, B. Orza

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

High resolution space observations revealed a very high degree of dynamicity of the solar atmospheric plasma where the dynamics is controlled by the magnetic field. Dynamical processes, such as waves, oscillations, turbulences, instabilities, allowed us to indirectly diagnose the magnetic field and plasma. As observations show (see, e.g. EUV observation by TRACE, HiNODE, SDO), magnetic structures, such as coronal loops or prominences, oscillate even in their emerging phase, most probably after encountering large-scale blast waves propagating in the chromosphere/low corona. Here we study the oscillation patterns of kink oscillations in coronal loops whose length varies with time and draw conclusions on the evolution of plasma parameters within the coronal loop. Theoretical results will be compared to EUV observations.

Transverse oscillations in chromospheric mottles

Author: David Kuridze

Queen

Co-Authors: D. Kuridze(1), R. J. Morton(2), R. Erd\'elyi(2), G. D. Dorrian(3), M. Mathioudakis(1), D. B. Jess(1), and F. P. Keenan(1) (1) Astrophysics Research Centre, School of Mathematics and Physics, Queen's University Belfast. (2) Solar Physics and Space Plasma Research Centre (SP^2RC), University of Sheffield. (3) Institute of Astronomy and Astrophysics, National Observatory of Athens.

Session: SP5: Waves in the solar atmosphere

Displayed during: Poster Session A

Summary:

We investigate long-lived, quiet Sun, on-disk features such as chromospheric mottles (jet-like features located at the boundaries of supergranular cells) and their transverse motions. The observations were obtained with the Rapid Oscillations in the Solar Atmosphere (ROSA) instrument at the Dunn Solar Telescope. The dataset comprises simultaneous imaging in the Halpha core, Ca II K, and G band of an on-disk quiet Sun region. We detect over 40 transverse oscillations in both bright and dark mottles, with periods ranging from 70 to 280 s, with the most frequent occurrence at ~ 165 s. Neighbouring mottles oscillating in-phase are also observed. The transverse oscillations of individual mottles are interpreted in terms of magnetohydrodynamic kink waves. Their estimated periods and damping times are consistent with phase mixing and resonant mode conversion.

Downward-moving Thick Target Flare Emission Driven by Hardening in Nonthermal Electron Spectrum

Author: Aidan O'Flannagain

Trinity College, Dublin

Co-Authors: P.G. Gallagher (Trinity College, Dublin) R.O. Milligan (Queens University, Belfast) J.C. Brown (University of Glasgow) G.D. Holman (Goddard Space Flight Centre)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

The thick-target model has made several accurate predictions of the behaviour and evolution of nonthermal x-ray emission produced during solar flares. The emergence of new theories however brings into question a key part of the flare process - the transport of energy from the corona into the chromosphere prior to the major production of X-rays. In order to investigate this portion of the mechanism, we must study a unique subset of solar flares which show nonthermal emission prior to the peak in X-rays, called 'early impulsive' events. This work details the rigorous investigation of one such event, and by interpreting the X-ray images and spectra produced by RHESSI, sheds light on some of the remaining questions of the theory behind solar flare initiation.

A method for analysing the temperature structure of the solar corona

Author: Andrew Leonard

Aberystwyth University

Co-Authors: H. Morgan (Aberystwyth University)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

Many studies which look at the temperature of the solar corona fail to account for the various multi-thermal structures along the line of sight (LOS). The high-quality multi-channel observations of AIA/SDO are used to estimate temperature across large off-limb regions. Preliminary results are shown which are broadly consistent with other published results. Coronal hole temperatures are at a maximum near the Sun, at 0.25MK at a height of 1.06Rs, dropping gradually to 0.15MK at a height of 1.24Rs. Quiet Sun temperatures are higher, starting at 1.5MK at 1.06Rs and dropping to 0.2MK at 1.24Rs. Estimating the temperature of active regions forces the introduction of multiple temperatures into our fitting routines which distinguishes the contribution of other structures along the LOS. This preliminary work lays the foundation for a more comprehensive tomographical approach which will accurately resolve the LOS in the next few years.

CME-related changes in line-of-sight magnetic field strength in dimming regions observed by Hinode

Author: Ehsan Pedram

MSSL

Co-Authors: Sarah A. Matthews (MSSL) Lidia van Driel-Gesztelyi (MSSL, Observatoire de Paris)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

Following many coronal mass ejections (CMEs), dark areas referred to as coronal dimming regions have been observed to form within and around the erupting active region. We probe the nature of coronal dimmings in relation to the expanding CME through the analysis of the associated photospheric magnetic field in the flare and CME event of 14 December 2006, using data from Hinode's SOT. We have systematically analysed the variation of the line-of-sight magnetic field strength in a large region surrounding AR 10930 using Hinode SOT Stokes V data. Our analysis, for the first time, shows that at the site of the dimmings there is a decrease in the magnetic field strength at the onset of the dimming in the dominant polarity of the plage regions surrounding the Active Region (AR), persisting during the dimming and recovering at the onset of the intensity recovery reported in Attrill et al. (2010). Using simple geometric arguments we show that the decrease in the dominant polarity flux is consistent with an ≈35 degrees change in the inclination angle of the photospheric magnetic fields in the plage regions, from horizontal to vertical. We further observe a close correlation between the site of plasma outflow with velocities of ≈30 km/s and one of the plage regions showing change in magnetic field strength. Our findings indicate a reconfiguration and opening of the magnetic field lines resulting in a change in their inclination angle in the dominant polarity of the plage regions surrounding the erupting active region. This then leads to a decrease in the plasma density observed as coronal dimming.

Flare ribbons in the early phase of an SDO flare: emission measure and energetics

Author: Lyndsay Fletcher

University of Glasgow

Co-Authors: Iain G. Hannah (University of Glasgow); Hugh S. Hudson (U. C. Berkeley & University of Glasgow); D. E. Innes (Max Planck Institute fuer Sonnensystemforschung)

Session: SP6: Solar Physics General session

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

We report on the M1.0 flare of 7th August 2010, which displayed extended early phase chromospheric ribbons well observed by SDO/AIA and RHESSI. Most large flares saturate rapidly in the high-temperature AIA channels, however this event could be followed in unsaturated AIA images for ten minutes in the build-up to and first few minutes of the impulsive phase. Analysis of GOES, RHESSI and SDO/AIA demonstrates the presence of high temperature (~10MK), compact plasma volumes in the chromospheric flare ribbons, with a column emission measure of on average 3-7 x 10^28 cm^-5. We construct a time-resolved energy budget for the ribbon plasma, including also SDO/EVE data, and discuss the implications of the observed ribbon properties for flare energisation and electron acceleration.

Impulsive Phase Footpoint DEMs

Author: David Graham

University of Glasgow

Co-Authors: I.G. Hannah (University of Glasgow), L. Fletcher (University of Glasgow), R.O. Milligan (Queen's University Belfast)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

The differential emission measure is an important tool in understanding the properties of flaring plasma. However, determining the DEM of impulsive phase footpoints has been difficult in the past without sufficient spatial resolution to resolve footpoints from loop structures, and a lack of spectral and temporal coverage. We use the capabilities of Hinode/EIS to present the first DEMs from the impulsive phase of a number of flare footpoints. Observations were chosen from a period when EIS telemetry was at its best and analysed using a new regularised inversion method (Hannah & Kontar 2012). We find a peak temperature in the DEM of around 7 MK with emission measures peaking between 10^28 and 10^29 cm-5, indicating a substantial presence of plasma at 'coronal' temperatures within the footpoint.

Influence of a variation of the fine structure constant on the sun and the habitability of earth

Author: Bjoern Soergel

University Observatory Munich (USM), LMU Munich

Co-Authors: D. Boneberg (USM,LMU), H. Lesch (USM,LMU)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

We develop a model of a one solar mass star with variable fine structure constant. For this purpose, we calculate the reaction rate and energy generation of the pp-chain depending on α. Based on the analytic model of stellar structure by D.D.Clayton (1986), we obtain a fine structure constant dependent solar model with one fudge factor. By equating the predicted luminosity for not varied α with the one of the sun, the fudge factor can be calculated. Thus a solar radius of R=6.95·10^10 cm is determined from the model, which is in good agreement with the actual value. We are also able to estimate the change in the solar luminosity when varying α. This is used to obtain an expression for the inner and outer border of the habitable zone, where the change of the melting and boiling point of water depending on α are as well taken into account. The model only allows an increase of α by 0.2% to prevent the earth from freezing. Assuming a linear change over the past 4.5 Gyrs, this gives an upper limit for the rate of change of 4·10^(-13) per year. Finally, the question is addressed whether the obtained results indicate a fine tuning of α. (Comment: This has been written as a bachelor thesis by B.Soergel and D.Boneberg under supervision of Prof. Dr. H.Lesch at USM/LMU in 2011)

Invisible Active Region emergences in line-of-sight magnetogram data

Author: Silvia Dalla

University of Central Lancashire

Co-Authors: L. Fletcher (University of Glasgow), D.H. Mackay (University of St. Andrews), F. Watson (University of Glasgow)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

The emergence of a new solar Active Region (AR) is typically detected using full-disk continuum images or line-of-sight magnetograms. It produces modifications in the structure and connections of the coronal magnetic field, and can trigger activity such as flares and Coronal Mass Ejections. It is generally assumed that current instrumentation allows good visibility of the emergence process. We present the results of a statistical analysis of AR emergences and disappearances in line-of-sight magnetogram data over a 20-year time range. We developed an automated detection technique identifying AR emergence by means of morphological methods applied to difference images. The technique is used on the NSO Kitt Peak 512-channel magnetograph dataset, spanning the time range between 1974 and 1993. We obtain the distribution of locations of new emergences on the solar disk, and show that it has a strong asymmetry in longitude. There is an 11:1 ratio between the number of new regions seen to emerge in the [-60,-40] longitude bin and in the

[+40,+60] longitude bin. As a result, a very large fraction of new ARs emerging in the West of the Sun go undetected in line-of-sight magnetograms. We discuss the causes of this phenomenon and its implications.

Mass estimates of rapidly-moving prominence material from high-cadence EUV images

Author: David Williams
UCL Mullard Space Science Laboratory

Co-Authors: D. Baker (UCL MSSL), L. van Driel-Gesztelyi (UCL MSSL, Observatoire de Paris (Meudon), Konkoly Observatory)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

Much of the work on filament/prominence structure can be divided between studies that use a polychromatic approach with targeted campaign observations, and those that use synoptic observations, frequently in only one or two wavelengths. The superior time resolution, sensitivity and near-synchronicity of data from the Solar Dynamics Observatory's Advanced Imaging Assembly allow us to combine these two techniques using photo-ionisation continuum opacity to determine the spatial distribution of hydrogen in filament material. We apply the combined techniques to SDO AIA observations of a filament which erupted during the spectacular coronal mass ejection on 2011 June 07. The resulting "polychromatic opacity imaging" method offers a powerful way to track partially ionised gas as it erupts through the solar atmosphere on a regular basis, without the need for co-ordinated observations, thereby readily offering regular, realistic mass distribution estimates for models of these erupting structures.

Observations of Low Frequency Solar Radio Bursts from the Rosse Solar-Terrestrial Observatory.

Author: Pietro Zucca

Trinity College Dublin

Co-Authors: E. P. Carley (School of Physics, Trinity College Dublin, Dublin 2,Ireland) J. McCauley (School of Physics, Trinity College Dublin, Dublin 2,Ireland) P.T. Gallagher (School of Physics, Trinity College Dublin, Dublin 2,Ireland) C. Monstein (ETH-Zentrum, Zurich,Switzerland) R. T. J. McAteer (Department of Astronomy, New Mexico State University)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

The Rosse Solar-Terrestrial Observatory (RSTO) was established at Birr Castle, Co. Offaly, Ireland (53°05'38.9", 7°55'12.7") in September 2010, to study solar radio bursts and the response of the Earth's ionosphere and geomag- netic field. To date, three Compound Astronomical Low-Cost Low Frequency (Callisto) spectrometers have been installed with the capability of observing in the frequency range 10-870 MHz. The receivers are fed simultaneously by a bicone and a log-periodic antenna. Nominally, frequency spectra in the range 10-400 MHz are obtained with 4 sweeps per second over 600 channels. Here, we describe the RSTO solar radio spectrometer setup, and present first-light spectra of a sample of Type II, III and IV radio bursts. In particular, we describe fine-scale structure observed in Type II bursts, including band splitting and rapidly varying herringbone features. RSTO was established under the auspices of International Heliophysical Year 2007 and the International Space Weather Initiative, supported by the United Nations Basic Space Science Initiative.

Predicting space climate change.

Author: Luke Barnard

Department of Meteorology, University of Reading

Co-Authors: M. Lockwood (University of Reading) M.A. Hapgood (RAL Space, Rutherford Appleton Laboratory) M.J. Owens (University of Reading) C.J. Davis (University of Reading) F. Steinhilber (EAWAG, Swiss Federal Institute of Aquatic Science and Technology)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

The recent decline in the open magnetic flux of the Sun heralds the end of the Grand Solar Maximum (GSM) that has persisted throughout the space age, during which the largest−fluence Solar Energetic Particle (SEP) events have been rare and Galactic Cosmic Ray (GCR) fluxes have been relatively low. In the absence of a predictive model of the solar dynamo, we here make analogue forecasts by studying past variations of solar activity in order to evaluate how long−term change in space climate may influence the hazardous energetic particle environment of the Earth in the future. We predict the probable future variations in GCR flux, near−Earth interplanetary magnetic field (IMF), sunspot number, and the probability of large SEP events, all deduced from cosmogenic isotope abundance changes following 24 GSMs in a 9300−year record.

SDO observations and modeling of flaring loops.

Author: Dr Panagiota Petkaki

University of Cambridge

Co-Authors: G. Del Zanna (Univ. Cambridge), H.E. Mason (Univ. Cambridge), S.J. Bradshaw(Rice University)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

We present multi-wavelength observations of a C1 class Solar flare using the AIA and EVE instruments onboard the Solar Dynamic Observatory. We obtained temperatures and densities of the flaring loops using both instruments. We found good agreement, which confirms the AIA calibration and opens up the possibility to use AIA for flare diagnostics. We used the self-consistent 1-d hydrodynamic code HYDRAD to perform various time-dependent simulations of the thermal evolution of a flaring loop, by varying the location and amount of heating to match the observations. We find good overall agreement for the gradual phase.

Stellar Variability in the Kepler Q1 Data

Author: Amy McQuillan

University of Oxford

Co-Authors: S. Aigrain (Department of Astrophysics, University of Oxford); S. Roberts (Department of Engineering Science, University of Oxford)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

We investigate the variability properties of main sequence stars in Kepler Q1 data, using a new astrophysically robust correction for systematics (ARC), and find that 60% of stars appear more active than the Sun. We define low and high variability samples and compare the properties of the stars belonging to each sample, showing tentative evidence that more active stars have lower proper motions. We also investigate the frequency content of the variability, finding clear evidence for periodic or quasi-periodic behaviour in 16% of stars, and showing that there exist significant differences in the nature of variability between spectral types. Of the periodic objects, most A and F stars have short periods (<2 days) and highly sinusoidal variability, suggestive of pulsations, whilst G, K and M stars tend to have longer periods (>5 days, with a trend towards longer periods at later spectral types) and show a mixture of periodic and stochastic variability, indicative of activity. Finally, we use auto-regressive models to characterise the stochastic component of the variability, and show that its typical amplitude and time-scale both increase towards later spectral types, which we interpret as a corresponding increase in the characteristic size and life-time of active regions.

The influence of coronal emission lines on prominence plasma.

Author: Gerrard Brown

University of Glasgow

Co-Authors: N.Labrosse (University of Glasgow); L.Fletcher (University of Glasgow)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

Prominences are cool, high density structures located in the corona; the surrounding corona can influence the processes which go on inside the prominence via the effect of coronal radiation illuminating the prominence. This can affect the ionisation degree of the plasma inside the prominence. Several strong emission lines are found in the coronal spectrum, and the impact that these lines in the coronal spectrum has on the radiative transfer processes of the prominence is examined. A one dimensional model is used to model the radiative transfer processes of the prominence. Previous modelling did not include the coronal lines. In this study coronal lines are added to the code's incident radiation; we present the influence of this additional coronal radiation on the state of the prominence plasma.

Treasures at RAS: Analysis of Schwabe

Author: R.Arlt

Leibniz Institute for Asstrophysics Potsdam

Co-Authors: R.Leussu (Univ. Oulu), K.Mursula (Univ. Oulu)

Session: SP6: Solar Physics General session

Displayed during: Poster Session B

Summary:

Samuel Heinrich Schwabe made about 8500 detailed drawings of sunspots on the solar disk from 1825 to 1867. The original observations are stored in the library of the Royal Astronomical Society, London, and are perfectly preserved. The drawings were digitized and are now being measured. We compiled a preliminary database of 128,000 heliographic positions and sizes of individual sunspots. The measurements are about 90 per cent complete. We show a solar butterfly diagram of the period of 1825-1867 which adds details about four more cycles to our knowledge of the solar cycle.

LBV nebulae in the Local Group

Author: Kerstin Weis

Astronomical Institute Ruhr-University Bochum

Co-Authors:

Session: STA1: Massive stars: From the Milky Way to beyond the Local Group

Displayed during: Poster Session A

Summary:

The LBV phase marks an active evolved phase in which massive stars undergo photometric and spectroscopic variations. Enhanced mass loss by stellar winds and possibly giant eruptions indicate the stars proximity to an instable state. As a consequence of both winds and eruption a fraction of LBVs form LBV nebulae. Analysis of the properties of the nebulae provide further insight about the underlying mechanism of the instability. With typical sizes below 5 pc these circumstellar LBV nebulae can be studied in detail in the Galaxy and close members of the Local Group. An overview of morphologies and kinematics of LBV nebulae will be presented, as well as a outlook about the connection of LBV nebulae and the closely related WR nebulae.

The young massive cluster R136: in virial equilibrium and rotating

Author: Vincent Henault-Brunet

IfA, University of Edinburgh

Co-Authors: the VLT-FLAMES Tarantula Survey consortium

Session: STA1: Massive stars: From the Milky Way to beyond the Local Group

Displayed during: Poster Session A

Summary:

Detailed studies of resolved young star clusters are necessary to determine their dynamical state and evaluate the importance of gas expulsion in early cluster evolution. In an effort to gain insight into the dynamical state of the young massive cluster R136 and obtain the first measurement of its velocity dispersion, we analyse multi-epoch spectroscopic data of the inner regions of 30 Doradus in the Large Magellanic Cloud obtained as part of the VLT-FLAMES Tarantula Survey. After accounting for the contributions of undetected binaries and measurement errors, we estimate the true velocity dispersion of the cluster and find a low value consistent with what is expected if the cluster is in virial equilibrium. This suggests that violent gas expulsion has not altered the its dynamics. We find that the velocity dispersion would be at least four times larger if binaries were not identified and rejected, confirming the importance of the multi-epoch strategy and the danger of interpreting velocity dispersion measurements of unresolved extragalactic young massive clusters. We also uncover the first evidence of significant rotation of a young massive cluster.

A proper motion study of wide binary companions to Hipparcos stars with Pan-STARRS1

Author: Niall R. Deacon

MPIA

Co-Authors: M.C. Liu (IfA, Hawai`i); E.A. Magnier (IfA, Hawai`i); B. Goldman (MPIA)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

We present initial results from a survey to identify wide common proper motion companions to Hipparcos stars. Using a proper motion catalogue created for our Pan-STARRS1-2MASS search for brown dwarfs we have identified plausible candidate companions out to a projected separation of 10,000 AU. This has already yielded the discovery of a mid-T companion to the Hipparcos star HIP38939. As well as constraining the fraction of wide, low-mass companions to intermediate mass stars, such systems can be used to test evolutionary models of brown dwarfs and exoplanets using the determined properties of the companion and an age inferred from the primary. Additionally wide M dwarf companions can be used to build up a catalogue of red dwarfs with metallicities determined from their primaries. Such a catalogue can be used to create improved M dwarf metallicity measurements, greatly improving the selection criteria for targets for exoplanet searches. We present results from our initial survey containing over 800 candidate companions and discuss methods to better characterise objects and filter out chance associations.

A substellar cuckoo

Author: Sarah Casewell

University of Leicester

Co-Authors: M.R. Burleigh (University of Leicester), G. Wynn (University of Leicester), R.D. Alexander (University of Leicester), R. Napiwotzki (University of Hertfordshire), K.A. Lawrie (University of Leicester), P.D. Dobbie (Australian Astronomical Observatory), S.T. Hodgkin (University of Cambridge)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Stars with masses >1Msun with close (< 3AU), substellar companions are extremely rare, despite the fact that numerous stellar and planetary companions

are discovered at such separations. White dwarf-substellar binaries are the rare descendants of these unusual systems, and in extreme cases these galactic fossils offer unique insights into both the birth and death of these stars and their companions. We have discovered a close substellar companion to a massive white dwarf member of the Praesepe open star cluster. Using the known age of the cluster and the cooling time of the white dwarf we have determined the mass of the progenitor star (3.5-3.7MSun; B9). The high mass of the white dwarf means that the substellar companion must have been engulfed by the B star's envelope while it was on the late asymptotic giant branch, locating the original orbit of the substellar companion at ~ 2AU. We are also able to establish the conditions under which the system formed, and conclude that the substellar object was probably captured by the white dwarf progenitor early in the life of the cluster.

Dual Chemistry of GB PNe from HST, VLT and Spitzer

Author: Lizette Guzman-Ramirez

JBCA, University of Manchester

Co-Authors: Albert Zijlstra

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Galactic Bulge Planetary Nebulae show evidence of mixed chemistry with emission from both silicate dust and PAHs. We analysed a sample of 40 nebulae using Sptizer, a sub-sample of these were observed with HST and VLT (UVEX and VISIR). A strong correlation is found between strength of the PAH bands and morphology, in particular, the presence of a dense torus. A chemical model is presented which shows that hydrocarbon chains can form within oxygen-rich gas through gas-phase chemical reactions. We conclude that the mixed chemistry phenomenon occurring in the Galactic Bulge Planetary Nebulae is best explained through hydrocarbon chemistry in an UV-irradiated, dense torus.

Evolution towards the field binary population in dense star clusters

Author: Thomas Kaczmarek

Max-Planck Institut für Radioastronomie

Co-Authors: C. Hövel (Forschungszentrum Jülich), S. Pfalzner (Max-Planck Institut für Radioastronomie)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Surveys of the binary populations in the solar neighbourhood have show, that the periods of G- and M-type stars are \textit distributed in the range from 0.1 days to $10^$ days. However, observations of young binary populations in various star forming regions suggest a \textit period distribution rather than a log-normal distribution. In the here presented study, we investigate, if the early evolution of the binary populations in there natal environments can change a initially log-uniform period distribution to a log-normal one. Most stars, including binaries, form in star clusters of thousands of stars which are embedded in the gas, they are forming from. In these dense systems two important processes take place: i) the orbital decay of embedded binary systems and ii) the destruction of soft binaries in three body interactions. To investigate the effect of these two processes on the period distribution, we performed Monte-Carlo simulations of binary populations to model the former process, while the latter was simulated using Nbody simulations of a binary population embedded in a ONC-like star cluster. Neither of the two processes is capable to change a log-uniform to a log-normal period distribution. While the orbital decay significantly reduces the number of short-period binaries and does not effect wide binaries, the cluster dynamics do not alter short period binaries but reduce the number of wide binaries. However, after we combined the two processes, the log-uniform distribution was successfully converted to the a log-normal period distribution. To prove this we performed a χ^2-test of our evolved period distribution and the observed period distribution of Duquennoy \& Mayor 1991 and obtained a probability of 89% that both distributions have been sampled from the same parent distribution. To further generalize the results obtained for the ONC, we additionally reperformed the above mentioned simulations for clusters of varying initial stellar and gas densities. For them, we investigate, if the dynamical evolution of the binary population is self-similar as described by Kaczmarek (2011) for ONC-like systems and how the shape of the period distribution differs when varying the stellar and gas-densities in the cluster.

Infrared-Interferometry of the septuple system nu Scorpii

Author: Rebekka Grellmann

Universitaets-Sternwarte Muenchen

Co-Authors: Thorsten Ratzka (USM) Thomas Preibisch (USM) Rainer Koehler (LSW) Paola Mucciarell (USM)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Using infrared interferometry for the search of companions around stars efficently fills the gap between spectroscopic and visual (adaptive optics etc.) studies in terms of angular resolution. Only in this way, a complete picture of the mulitplicity of stars can be obtained. In this talk I will focus on interferometric observations of the septuple hierarchical B star nu Scorpii perfomed with the AMBER instrument at the Very Large Telescope Interferometer. Using published speckle interferometry observations we can constrain the orbit of one of the close companions (~80 mas). We furthermore combine this observation with ROSAT X-ray data of the system and can thus make even more conclusions about the mass distribution between the companions.

Kepler

Author: Rene Breton

University of Southampton

Co-Authors: M. H. van Kerkwijk (University of Toronto), S. A. Rappaport (MIT), J. A. Carter (CfA)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Thanks to Kepler's staggering photometric capabilities, we can now obtain stellar light curves with accuracies of a few parts in 10,000. Such high level of precision allowed for the first measurement of Doppler boosting in a binary system in 2010, a feat that opened the door to the photometric measurement of orbital radial velocities! When Doppler boosting is observed in conjunction with transits/eclipses, one gains great leverage at inferring physical parameters of a binary system. In this talk, I will discuss developments in this area in the light of the recent discovery in Kepler data of several thermally bloated, hot white dwarfs in close orbit with more or less normal stars of spectral class A/F. These systems, which are likely the long-sought direct descendants of Algol-type binaries, pose certain challenges in terms of binary evolution.

Multiplicity of B type stars by direct imaging

Author: Christian Adam

Astrophysical Institute and Observatory, FSU Jena

Co-Authors: R. Neuhäuser (AIU Jena)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

It is still not clear, whether intermediate mass stars form preferentially by accretion of material through a circumstellar disk or by coagulation of many lower mass stars in a multiple system. Maybe, both ways of formation are possible, then it is still unknown, how often each of the two channels is chosen by nature. Intermediate mass stars very often are multiple (Zinnecker & Yorke, 2007, ARA&A) with a binary fraction of 70 to 90 % (Pfalzner & Olczak, 2007, A&A; Ostrov, 2002, MNRAS). For many high and intermediate mass stars, no deep and sensitive multiplicity survey has been done. In particular, only few of these stars have been observed so far by AO imagers, which can find very faint companions also at a separation range (roughly 0.1 to few arc sec, i.e. long orbital periods), which is not reachable for spectroscopic surveys (short periods). In this presentation we present some preliminary results of our search for multiplicity among B-type stars and introduce a new method for calibration of archival data, if no extra calibration images are taken (for pixel scale and/or detector orientation). In particular we will show a new, possible sub-stellar companion to the young B-type star HR 3672.

Observation of the Planetary Nebula surrounding V458 Vulpeculae via its Light-Echo

Author: Rebkah Hounsell

Liverpool John Moores University

Co-Authors: D.J. Harman (Liverpool John Moores University), M. J. Darnley (Liverpool John Moores University), and M. F. Bode (Liverpool John Moores University)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Nova V458 Vulpeculae was discovered in outburst on 2007 August 8th at a magnitude of 9.5, reaching its peak visual magnitude a few days later at V = 8.1. The nova was seen to occur within a planetary nebula (PN) making it one of only two novae observed to have occurred in such an environment and as such very rare event. Due to fash ionization by the nova outburst, light is being re-emitted by the PN gas creating a light-echo effect. Since 2007, V458 Vul has been imaged multiple times by the Liverpool telescope in addition to several other telescopes worldwide producing 20 epochs of H-alpha data between 2008 and 2011. Each epoch of data provides a one-off map of the PN material for a given light-echo paraboloid. Using these data the illumination of the PN with time has been examined and a 3D reconstruction of its morphology obtained using C. Comparison to PN models created in the morphokinetic modelling tool XS5 has enabled measurements of the PN size, inclination, position angle, and distance. Here we present the results of a detailed reconstruction of the PN geometry based on a study of the light-echo propagation over a four year period.

OH Maser Flaring Event in o Ceti

Author: Sandra Etoka

JBCA - The University of Manchester

Co-Authors: Eric Gerard (Observatoire de Paris - Meudon - Fr); Anita Richards (JBCA - The University of Manchester - UK); Dieter Engels (Hamburger Sternwarte - Germany); Jan Brand (INAF, Istituto di Radioastronomia - Italy); Thibaut Le Bertre (Observatoire de Paris - Meudon - Fr)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

o Ceti (a.k.a Mira A) is known as the prototype of Miras and Mira-type long-period variable stars. o Ceti has a typical optical period of 332 days; nevertheless, it is quite a remarkable Mira. It belongs to a detached binary system (Mira AB) in which mass transfer by wind interaction is taking place.

The hot companion of o Ceti, Mira B (either a main-sequence star or a white dwarf), is orbiting ~75 AU. OH masers - originating in the outer part of the circumstellar shell (CSE) - are commonly found towards isolated Miras, they are fairly unusual around binary systems close enough to be in interaction as is the case for the Mira AB system. Flares in OH are a fairly rare event. They have been detected only towards Miras (i.e., not observed so far in any OH/IR objects). All the 6 previous other documented flares emanated from isolated stars. And, the spectral characteristics seem to indicate that OH flaring features occur in the inner CSE. But this has never been confirmed by actual mapping yet. O Ceti experienced a flaring event in the 1990's. After 10 years of non-emissivity, in November 2009, it showed a new outburst in the 1665 MHz OH maser line. It has been active since and is continuously monitored at the Nancay Radiotelescope (NRT) and we also mapped it with the EVN+MERLIN. We present here the preliminary results of this exceptional event.

Period decrease in three SuperWASP eclipsing binary candidates near the short-period limit

Author: Marcus Lohr

Open University

Co-Authors: A.J.Norton (Open University)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

W UMa-type variables are contact binaries with low-mass main sequence components. Their light curves exhibit continuous variation associated with the ellipsoidal Roche-lobe-filling components, and eclipses of similar depth due to a shared atmospheric envelope, concealing low mass ratios. Their orbital periods, typically of several hours, exhibit a lower limit around 0.22d. The reason for this is uncertain, but may be associated with a lower limit of primary mass and/or mass ratio, below which the stars rapidly inspiral and merge. Our research follows up the identification of 53 W UMa candidates near the short-period limit, by Norton et al. (2011), in SuperWASP archival data. Here, a three-part period search program confirmed the periods of all but nine objects as <20000s. Additionally, O-C diagrams were automatically constructed, indicating period decrease significant at more than 5σ in three objects. One system with a period of only 0.21d appears to be losing orbital period at a rate of about 0.3s/yr, suggesting a possible merger on a rapid timescale. Such objects can help understand W UMa evolution and the reason for the short-period limit. We are currently trying to model these systems to determine their parameters, and to identify further SuperWASP short-period eclipsing binaries.

PG1544+488: First of its kind -- A binary containing twin hot helium-rich subdwarfs

Author: H. Tugca Sener-Satir

Armagh Observatory

Co-Authors: Prof.Dr.C.Simon Jeffery - Armagh Observatory

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Our research aims to study binary systems containing at least one unusual hot subdwarf. Such systems demonstrate the extreme range of possible outcomes of common-envelope ejection in a close binary. The first object to be studied is PG1544+488, a binary containing two extremely helium-rich subdwarfs in a 12 hour orbit. Spectroscopic observations obtained with the William Herschel Telescope provide improved orbital parameters and much tighter constraints on possible progenitors.

Photometric and spectroscopic study of the recurrent nova T Pyx in its 2011 outburst

Author: Farung Surina

Astrophysics Research Institute, LJMU

Co-Authors: F.Surina (Astrophysics Research Institute, Liverpool John Moores University) R.A.Hounsell (Astrophysics Research Institute, Liverpool John Moores University) M.F.Bode (Astrophysics Research Institute, Liverpool John Moores University) M.J.Darnley (Astrophysics Research Institute, Liverpool John Moores University) D.J.Harman (Astrophysics Research Institute, Liverpool John Moores University) F.M.Walter (Department of Physics and Astronomy, Stony Brook University, USA)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

T Pyx is a short orbital period recurrent nova with previous outbursts in 1890, 1902, 1920, 1944, 1966, and now 2011. The outburst in 2011 was discovered and reported to have a visual magnitude of 13.0 on 2011 April 14.29. White light observations of T Pyx, using The Solar Mass Ejection Imager (SMEI) were made from 2011 April 15.70 UT (t = 1.4 days) to 2011 May 20.90 UT (t = 36.6 days). These photometric observations provide unprecedented detail regarding the behavior of the light curves and are compared to the spectra of T Pyx obtained by FRODOSpec on the Liverpool Telescope plus those obtained by the SMARTS telescopes. The investigations of how spectra change together with brightness are presented in order to

determine the origin of light curve variability in the early stage of the nova outburst.

Planets around the cataclysmic variable UZ Fornacis?

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Co-Authors: T.R. Marsh (University of Warwick)

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

UZ Fornacis is an eclipsing binary of the cataclysmic variable type. Accurate observations show that the time from one mid-eclipse to the next is not constant. A possible cause for deviations from strict orbital periodicity is the presence of small bodies in wide orbits around the close binary. These have a gravitational influence on the binary which is strictly periodic. Recovering this from the mid-eclipse time data provides limits on the planets' orbits and minimum masses. Here we investigate data of UZ Fornacis which spans roughly 27 years. Using Markov Chain Monte Carlo fitting suggests their may be two or three planets in orbit around UZ Fornacis. Subsequent analysis of the dynamical stability of such a planetary system shows if it is stable on timescales exceeding 10^6 years. If unstable, it is unlikely for us to find and observe such a system. Other possible causes for the mid-eclipse timing variations that can be considered are variations in existing magnetic fields and apsidal motion.

Probing the Substellar Graveyard

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Co-Authors:

Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

We present the results of a near-infrared survey using UKIDSS to identify brown dwarf companions to white dwarfs. The sensitivity of UKIDSS in such a survey is addressed leading to an estimate of the white dwarf + brown dwarf binary fraction.

Searching for companions in CRIRES spectra and slit-viewer images of telluric standards

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Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

This project aims at producing an atlas of the 500+ mainly early-type telluric standards observed to date with CRIRES, which is the near to- mid-infrared high-resolution spectrometer on the VLT. The project comprises two parts: (1) To produce spectra of all of the telluric standards taken to date that can be used for a variety of scientific and technical purposes (looking for the presence of companions in the stellar spectra, searching for warm CO in the disks of early-type stars, spectral analysis of B type stars to act as templates for stars with high extinction in the optical, avoiding tellurics in the future that show emission-line features etc) and (2) To use the slit viewer images of CRIRES in order to search for previously unresolved stellar companions. These slit-viewer images (typically in J, H or K bands) have a plate scale of around 0.05 arcseconds and, due to the adaptive optics system in CRIRES, have a spatial resolution of typically <0.2 arcseconds. Although they are shallow (integration times generally a few seconds), the high-resolution infrared nature of the observations makes them useful for detecting new companions. Due to the properties of speckle, the putative faint companions will have to be followed up at a future date to determine (1) If they are really stellar objects and (2) If the proper motions are the same in order to confirm if they are companions or just background objects. Initial results are presented including a sub-sample of the reduced spectra and a number of cases that show putative companions.

Suppression of X-rays during an optical outburst of the helium dwarf nova KL Dra

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Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

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Summary:

KL Dra is a helium accreting AM CVn binary system with an orbital period of 25 mins. Approximately evey 60 days there is an optical outburst which has a duration of 10 days where its brightens by 4 mag. We present the most sensitive X-ray observations made of an AM CVn over the course of an outburst cycle. A series of eight observations were made using XMM-Newton which started shortly after an optical outburst. We find that the X-rays are suppressed during the optical outburst: there appears to be a delay in the re-appearance of the X-rays compared to the decay of the UV emission. There is

some evidence for a spectral variation of the X-ray spectrumduring the course of the outburst (especially at the softest energies) and that its temperature is cooler during optical outburst compared to quiescence.We compare these results with outburst from the hydrogen accreting dwarf novae.

The Dependence of Dust Formation Timescale on the Speed Class of Novae

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Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

Dust formation in novae appears to depend strongly on how fast the nova optical light curve declines (their speed class). Using simple relationships of e.g. speed class with luminosity and ejection velocity, it can be shown that the dependencies effectively cancel, leaving dust formation essentially independent of speed class. After a nova outburst the spectrum of the central hot source evolves, with an increasing proportion of the radiation being more energetic than the Lyman limit. The rate at which the spectra evolve depend on the speed class. We have refined the models by assuming radiation at higher energies than the Lyman limit is absorbed by neutral hydrogen gas internal to the dust formation sites. Here we present the effect our theoretical refinement has on the relationship between dust formation timescale and speed class, where we now find a much more sensitive relation between these two quantities.

The formation and fragmentation of discs around primordial (Pop III) protostars

Author: Paul Clark

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Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

The very first stars to form in the universe heralded an end to the cosmic dark ages and introduced new physical processes that shaped early cosmic evolution. Until now, it was thought that these stars lived short, solitary lives, with only one extremely massive star, or possibly a very wide binary system, forming in each dark matter minihalo. Here we describe numerical simulations that show that these stars were, to the contrary, often members of tight multiple systems. Our results show that the discs that formed around the first young stars were unstable to gravitational fragmentation, producing small binary and higher-order systems that had separations as small as the distance between the Earth and the Sun. The first stars could thus have given rise to high redshift gamma-ray bursts and X-ray binaries, which may be detectable with ongoing and planned facilities on the ground and in space.

The sky has still got the blues for us to explore! The blue objects catalogue from The RATS project

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Session: STA2: Binary Stars: Duplicity is Everywhere

Displayed during: Poster Session B

Summary:

We present the first catalogue of "blue" objects selected from The RATS (the RApid Temporal Survey) project, which explores the faint, variable sky. The RATS project covered approximately 40 square degrees of the sky close to the Galactic plane via observations taken between 2003-2010. The observational strategy was to take exposures approximately every minute with wide-field CCD cameras for two hours in each field. To select “blue” objects, we have developed an automated colour-selection method on a field-by-field basis. Our targets, include white dwarfs, white dwarf binaries (such as AM CVn binaries and other CV's, non-interacting WD-WD binaries etc.), sdB's, stellar pulsators for example. We anticipate that this work will allow us to place constraints on the space density of these objects.