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Abstracts

Organising Committee:

Alba Alcol
Clare Bingham
Oliver Jennrich
Mark Kidger
Danny Lennon
Arvind Parmar

Authors

Moon Atlas with SMART-1 data

Miguel Almeida

During the one and half year of lunar operations SMART-1 collected about 30 000 full frame images. The data is enough to produce a map of the Moon covering 99 % of the surface with better than 200 m resolution and better than 50 m close to the lunar South Pole. However given the existence of filters of different wavelengths in front of the CCD, the image was not homogeneous, this together with the large amount of data and the process to merge the contents of the different images meant that a specific tool was needed to produce the full homogeneous maps. We will show how we handled the issue, the current status of the maps and what is intended to do with them in order to produce a Lunar Atlas.

In-situ detection of interstellar dust in the solar system

Nicolas Altobelli

We present a review of the in-situ detection of Interstellar Dust in the Solar System as performed over the last decades from different generations of in-situ dust detectors onboard different spacecraft, mainly Helios, Galileo, Ulysses and Cassini. Sub-micron sized dust of the interstellar medium has been shown to be injected into the Solar System due to the motion of the Sun relative to the Local Interstellar Cloud (LIC). An analysis of the dynamics of the grains within the Solar System, driven by the combined action of the solar radiation pressure, gravity and Lorentz forces due to the interaction with the Interplanetary Magnetic Field (IMF), provided constraints on the interstellar dust grain properties not accessible to astronomical observations. We will review the knowledge gained by the analysis of the ISD grains detected by Helios, Ulysses and Galileo. We will also present the new ISD data from the Cassini-CDA instrument, in orbit around Saturn, which shows that ISD is also flowing into the Saturnian System. The Time of Flight Mass Spectrometer (TOF) of CDA provides for the first time a direct measurement of the bulk composition of interstellar dust grains.

Herschel survey of young brown dwarf disks

Catarina Alves de Oliveira

Young brown dwarfs are known to possess circumstellar disks, a characteristic that is fundamental to the understanding of their formation process, and raises the possibility of these objects harbouring planets. Observations of the Rho Ophiuchi cluster (1 Myr) with the Herschel Space Observatory, allow us to probe the spectral energy distribution (SED) of the clusters' brown dwarf population at the far-IR, where the disk emission peaks. We will present the results of the comparison between the new observations and a grid of synthetic disks produced with a radiative transfer code. The structural parameters constrained by the extended SED coverage show a narrow distribution for all the young brown dwarfs in this cluster, suggesting that these objects share the same disk evolution and, perhaps, formation.

On Detecting Transient Phenomena

Guillaume Belanger

Transient phenomena are interesting and potentially highly revealing of details about the processes under observation and study that could otherwise go unnoticed. It is therefore important to maximize the sensitivity of the method used to identify such events. In this article, we present a general procedure based on the use of the likelihood function for identifying transients which is particularly suited for real-time applications because it requires no grouping or pre-processing of the data. The method makes use of all the information that is available in the data throughout the statistical decision-making process, and is suitable for a wide range of applications. Here we consider those most common in astrophysics, which involve searching for transient sources, events or features in images, time series, energy spectra, and power spectra, and demonstrate the use of the method in the case of a weak X-ray flare in a time series and a short-lived quasi-periodic oscillation in a power spectrum. We derive a fit statistic that is ideal for fitting arbitrarily shaped models to a power density distribution, which is of general interest in all applications involving periodogram analysis.

Atlas of High Resolution X-ray spectra: a Diagnostic Tool of the Hot Universe

Katarzyna Bensch

The European Space Agency's (ESA) X-ray Multi-Mirror Mission (XMM-Newton) is a space-based X-ray astronomical observatory, launched in December 1999. It carries three high throughput X-ray telescopes with an unprecedented effective area, and an optical monitor, the first flown on an X-ray observatory. The large collecting area and ability to make long uninterrupted exposures provide highly sensitive observations of celestial X-ray sources. The XMM-Newton mission is helping scientists to solve a number of cosmic mysteries, ranging from the enigmatic black holes to the origins of the Universe itself. The aim of the proposed work is to exploit the data from one of the instruments on-board XMM-Newton, the Reflection Grating Spectrometer (RGS), which are stored in the XMM-Newton Science Archive, XSA. RGS is the instrument with the highest sensitivity for high resolution X-ray spectroscopy in the 5 Å to 38 Å (or 0.33 keV to 2.5 keV) range ever flown in a space telescope. Its spectral range was selected in the RGS design for optimising the detection of several X-ray emission and absorption lines, including the K-shell transitions and He-like triplets of light elements such as of carbon, nitrogen, oxygen, neon, magnesium, and silicon, as well as the L shell transitions of iron. It thus offers a large number of diagnostic tools to study the gas in which the emission originates. XMM-Newton always observes simultaneously with all its instruments. Therefore, every time a bright source is observed, one RGS spectrum is obtained. There are more than 9000 XMM-Newton RGS spectra, which can be extracted from the XSA archive, and easily visualised using the BiRD tool at `http://xmm.esac.esa.int/BiRD/` The trainee will carry out a systematic analysis of the potential the RGS data in the XSA contains. The analysis will first consist on the identification of all the brightest sources observed by XMM-Newton. Then their RGS flux-calibrated spectra will be extracted. The strongest spectral features will be identified and analysed and suitable spectroscopic diagnostics will

be used to investigate the physical conditions and the chemical composition of the emitting material in the different types of objects.

Lunar volcanic glass

Sebastien Besse

Lunar volcanic glass is the petrologic expressions of rapid cooling of magma melt droplets during explosive volcanism. During the Apollo era, black, green and orange glass have been picked up by astronaut and analysed in earth-based laboratory. This discovery leads to several hypotheses and constrains about the lunar volcanic history and the origin of explosive volcanism. However, remote-sensing observations with several follow-up missions were never able to detect these volcanic glasses. We present, for the first time, indisputable identification of volcanic glass at the location of several pyroclastic deposits. This detection was only possible through the use of advanced multi-wavelengths visible and near-infrared spectrometers sent to the Moon few years ago. This discovery is linking the observations made on the lunar surface by the astronauts and the theory that explained the presence of these volcanic glasses. Apart from helping to define a new scheme for the classification of pyroclastic deposits, spectroscopic analysis of these deposits may change the view we have about their formation. The presence of high concentration of volcanic glass, instead of olivine as previously proposed, is indicating that the deposits may have more juvenile materials then initially thought. These results will help to constraint the formation and evolution of lunar explosive volcanism and constraint the volatile content of the early Solar System.

JWST/NIRSPEC capabilities for exoplanet transit observations

Stephan Birkmann

The Near Infrared Spectrograph (NIRSpec) is one of four science instruments aboard the James Webb Space Telescope (JWST) scheduled for launch in 2018. NIRSpec is sensitive in the wavelength range from $\sim 0.6\,\mu m$ to $5.0\,\mu m$, and while capable of obtaining spectra from more than 100 objects simultaneously by means of a programmable micro shutter array, it will also provide an integral field unit for 3D spectroscopy and fixed slits for high contrast spectroscopy of individual sources. One of these fixed slits is a $1.6\,\text{arcsec} \times 1.6\,\text{arcsec}$ aperture, specifically designed to enable exoplanet transit observations. Here, we will summarize the capabilities and expected performance of JWST/NIRSpec regarding the observations of transiting exoplanets.

New Herschel data of transitional disks in the Lupus dark clouds

Ignacio Bustamante

Transitional disks are young stars whose Spectral Energy Distributions (SEDs) show little or no excess emission at wavelengths smaller than $10\,\mu m$ and a significant excesses at longer wavelengths. This suggests inner holes or gaps, possibly due to forming planets. The goals

of this work are to detect new transitional disk candidates in the Lupus star-forming cloud and to study their properties, modelling their SEDs with the newest data available from Herschel's instruments, PACS and SPIRE, taken as part of the Herschel Goulds Bet Survey. These new data provide information about the outer regions of protoplanetary disks and hence complement the previous Spitzer and ground-based picture. We use the Herschel Interactive Processing Environment (HIPE) to measure the fluxes at the new wavelengths of all previously known sources identified by Spitzer, and then complete their SEDs. Applying our transitional disks identification method based on 2MASS, WISE and Herschel fluxes, we report two transitional disks in Lupus III (Sz 91 and Sz 111), one of which is new to the literature. Then, using a new three-dimensional dust continuum radiative transfer code called Hyperion, we model their SEDs to constrain the physical properties of these unusual disks.

Lightning on Venus

Alejandro Cardesin

Although the occurrence of lightning in the Venus atmosphere has been published several times in the past years, always on the basis of detected electromagnetic pulses, the subject is still controversial and it is generally agreed that an optical observation of the phenomenon would settle the issue. The Venus Express mission has been observing the Venusian Atmosphere continuously since 2006, producing great amounts of hyper-spectral data from the Visible to the Near InfraRed with the VIRTIS instrument. In this contribution we show a new analysis of the whole data collection of hyperspectral images produced by VIRTIS in the visible range. The preliminary results show the feasibility of the concept and we are now able to identify transient events in the data that could eventually be caused by lightning in the atmosphere, although there is still a lot of work to do to optimize the search parameters and analyze all of the results and exclude the effects of cosmic rays in the data.

Terra incognita: first insight into the gas properties of the host galaxy of GRB 980425

José María Castro Cerón

Long duration ($> 2\,$s) X-ray bursts (GRBs) have been found to be associated with violent and luminous supernovae. Such massive stars have very short lifetimes and therefore GRBs pinpoint the location of galaxies that have recently undergone an episode of star formation. Hence, GRBs may provide a promising means of identifying and studying star formation in the Universe. We will present a critical assessment of this issue by using the determination of the gas excitation state for the closest GRB host galaxy. This is crucial because GRBs and their host galaxies are potentially excellent tracers of the global star formation history, which is of fundamental importance to our understanding of galaxy formation and evolution. Hence, research concentrated on GRB host galaxies is not only important from the point of view of GRB science, but also in the much broader perspective of cosmology. The star formation history in the Universe may potentially be explored using the GRB rate as a function of redshift. This was predicted theoretically and we have growing evidence that indeed GRBs trace star formation. However, this kind of study requires prior detailed investigation of

GRB host galaxies, which has not been fully addressed yet. GRB 980425, associated with SN 1998bw, is the closest known GRB ($z = 0.0085$) and represents an excellent laboratory for detailed GRB studies. Its host galaxy is a dwarf barred spiral dominated by a large number of star–forming regions. The interplay between dust thermal emission, radio emission and star formation is not yet well understood, even for the closest known GRB host. Moreover, the properties of molecular gas are very poorly understood for GRB hosts, since none of them had been spectroscopically detected in the far IR until now, which would be necessary to study the properties of their interstellar medium. Herschel has provided an important step forward with both of these issues. We will discuss a detailed study of the closest known GRB host by means of PACS spectroscopy. A highly significant Herschel detection of the C II and O I lines of the host of GRB 980425 allows us to determine its ionisation state with great accuracy. This is leading us to an understanding of whether the GRB 980425 host can be regarded as a normal star forming galaxy, or its star formation rate is enhanced. Our Herschel observations are further contextualised by additional data we have already obtained from ATCA and ALMA. The host of GRB 980425 will be used widely as a low redshift benchmark for the interpretation of high redshift GRB hosts ALMA detections (in a way similar to how Arp 220 is used to interpret high redshift ULIRGs), and it will have consequences for the utilisation of GRBs as tracers of star formation in the Universe.

The solar system science operations laboratory

Marc Costa

The Solar System Science Operations Laboratory (SOLab) is a research and development project funded by the European Space Agency and carried out at the European Space Astronomy Centre in Madrid, inside the Science Operations Department of the Science and Robotic Exploration (SRE) Directorate of the European Space Agency (ESA). The aim of this project is to investigate new software techniques for computation, visualization and analysis of scientific observation opportunities for interplanetary missions, focusing on the geometrical requirements to cover the scientific mission objectives. The existing framework has been designed with a multi-mission approach, with the capability to geometrically simulate different types of remote sensing and in-situ instruments with any type of central body, and targets. A first prototype was developed for the Venus Express mission, in the frame of its training program. It uses SPICE, a planetary ancillary data library, to simulate the spacecraft surroundings as well as all the relevant scientific parameters, and allows the user to modify pointing parameters in order to optimize the observing conditions while keeping within the spacecraft constraints. This prototype entered production in a limited frame as a pointing analysis and implementation tool for the Venus Monitoring Camera on board Venus Express. With the success of the first prototype, a second prototype was developed addressing the scientific requirements with a multi-mission and multi-target Frame. With the same core, the focus now was to further extend its functionality to extended periods, and to provide a large range of science analysis tools so that a science focused analysis tool can be used in different parts of the planning cycle, from the early study phases to the last week before an observation takes place. This second implementation is currently providing operational support to Venus Express and Mars Express and is supporting the development

phases of future missions like Solar Orbiter, BepiColombo, MarcoPolo-R, Rosetta and JUpiter ICy moons Explorer (JUICE). JUICE is a mission chosen in the framework of the Cosmic Vision 2015-2024 programme of the SRE. JUICE will survey the Jovian system with a special focus on the three Galilean Moons. Currently the mission is under study activities during its Definition Phase. For this period the future Science Operations are being studied by the Science Working Team (SWT). SOLab is providing active support to the SOWG in synergy with other operational tools used in the Department. This contribution will outline SOLab's capabilities, synergies as well as use cases. It will be focused on the support that is being provided to JUICE for the early study of its Science Operations Concept feasibility demonstrating the added value that such a tool provides to planetary science missions.

SWAP observations of the long-term large-scale evolution of the EUV corona

Anik de Groof

SWAP observations of the long-term, large-scale evolution of the EUV corona The Sun Watcher with Active Pixels and Image Processing (SWAP) EUV solar telescope on board the Project for On-Board Autonomy 2 (PROBA2) spacecraft has been regularly observing the solar corona in a bandpass near 17.4 nm since February 2010. With a field-of-view of 54 arcmin × 54 arcmin, SWAP provides the widest-field images of the EUV corona available from the perspective of the Earth. By carefully processing and combining multiple SWAP images it is possible to produce low-noise composites that reveal the structure of the EUV corona to relatively large heights. A particularly important step in this processing was to remove instrumental stray light from the images by determining and deconvolving SWAP's point spread function (PSF) from the observations. In this paper we use the resulting images to conduct the first-ever study of the evolution of the large-scale structure of the corona observed in the EUV over a three-year period that includes the complete rise phase of solar cycle 24. Of particular note is the persistence over many solar rotations of bright, diffuse features composed of open magnetic field that overlie polar crown filaments and extend to large heights above the solar surface. These features appear to be related to coronal fans, which have previously been observed in white-light coronagraph images and, at low heights, in the EUV. We also discuss the evolution of the corona at different heights above the solar surface and the evolution of the corona over the course of the solar cycle by hemisphere.

Pre-main sequence stars older than 8 Myr in the Eagle Nebula

Guido De Marchi

Nino Panagia, STScI; Mario Guarcello, CfA; Rosaria Bonito, INAF-PA

Attention is given to a population of 110 stars in the NGC 6611 cluster of the Eagle Nebula that have prominent near-infrared (NIR) excess and optical colours typical of pre-main sequence (PMS) stars older than 8 Myr. At least half of those for which spectroscopy exists have a Hα emission line profile revealing active accretion. In principle, the V-I colours of all these stars would be consistent with those of young PMS objects (< 1 Myr) whose radiation is heavily obscured by a circumstellar disc seen at high inclination and in small part scattered

towards the observer by the back side of the disc. However, using theoretical models it is shown here that objects of this type can only account for a few percent of this population. In fact, the spatial distribution of these objects, their X-ray luminosities, their optical brightness, their positions in the colour-magnitude diagram and the weak Li absorption lines of the stars studied spectroscopically suggest that most of them are at least 8 times older than the 1 Myr old PMS stars already known in this cluster and could be as old as ~ 30 Myr. This is the largest homogeneous sample to date of Galactic PMS stars considerably older than 8 Myr that are still actively accreting from a circumstellar disc and it allows us to set a lower limit of 7 % to the disc frequency at ~ 16 Myr in NGC 6611. These values imply a characteristic exponential lifetime of ~ 6 Myr for disc dissipation.

Metallicity

Lauranne Fauvet

We present preliminary results regarding the metallicity of the dwarf galaxies M33 and NGC6822. We used the HFI Planck data, extracted from the first Planck public release. We calculated the flux associated to each of those Galaxies using all of the HFI channels. The flux calculations were validated by comparison with the SPIRE data. We then extracted their associated Spectral Energy Distribution. By fitting these spectra to a grey body law we were able to constrain the spectral behaviours of those two Galaxies. The constraints on the associated spectral indices allowed us to evaluate their metallicity and were compared to the Herschel's results.

Trans-Neptunian objects with the James Webb Space Telescope

Pierre Ferruit

Scheduled for launch in 2018, the James Webb Space Telescope (JWST) will be one of the major space observatories of the next decade. This powerful 6.5-meter space telescope will include a suite of 4 instruments providing unprecedented imaging and spectroscopic capabilities from 0.6 µm to 28 µm. We have been studying how JWST could be used to probe the surface composition of trans-Neptunian objects (TNOs) using near-infrared imaging and spectroscopic diagnostics. In this context we have worked on the definition of two potential TNO observation programs that could be carried out with JWST. After giving a brief overview of JWST capabilities and status, we will present these two programs, highlighting the improvement brought by JWST to this type of studies.

Comparative planetology and astrobiology: geochemical habitats and biodiversity

B.H. Foing

C. Stoker, NASA Ames Research Centre, US; P. Ehrenfreund, Leiden Institute of Chemistry, NL; Space

Policy Institute, George Washington University, Washington D.C., USA; Z. Martins, Imperial College London, South Kensington Campus, London UK; S.O.L. Direito, I. Rammos, L. Rodrigues, A. Svendsen, L. Rodrigues, W.F. Röling, G.R. Davies, Vrije Universiteit, Amsterdam, Faculty of Earth & Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, NL; C.S. Thiel, Institute of Medical Physics and Biophysics, University of Münster, Germany; ILEWG, ; D. Loizeau, ESA/ESTEC; D. Blake, NASA Ames Research Centre, US; J.M. Kotler, Leiden Institute of Chemistry; G.E. Orzechowska, R.D. Kidd, Jet Propulsion Laboratory, CalTech, Pasadena; J.D.A. Clarke, Geoscience Australia; V. Pletser, ESA/ESTEC; A. Borst, Vrije Universiteit, Amsterdam, Faculty of Earth & Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, NL; ILEWG; S.T. Peters, Vrije Universiteit, Amsterdam, Faculty of Earth & Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, NL; L. Wendt, C. Gross, FU Berlin; M.B. Wilhelm, NASA Ames Research Centre, US; Cornell University; EuroGeoMars2009 and ILEWG EuroMoonMars 2010-2013 teams

We have performed field campaigns in the Utah desert to study the habitability and biodiversity in relation to geochemical and extreme environmental parameters. The EuroGeoMars2009 and ILEWG EuroMoonMars/DOMMEX 2010-2013 campaigns [1, 2, 9] were conducted at Mars Desert Research station (with the support of NASA Ames, ILEWG, VU Amsterdam, ESA/ESTEC, and partners). The desert near Hanksville in Utah provides a diversity of sites analogous to Mars including ancient fluvial sandstone; gullies; lacustrine and fluvial clays; carbonaceous pyritic units; paleochannels; small scale mineral and subsurface niches; concretions & endolith environments. We deployed a suite of instruments and techniques [1, 2, 9] relevant to habitability and astrobiology research (including sample collection, context imaging from remote to local and microscale, drilling, spectrometers and Polymerase Chain Reaction PCR). A number of soil and rock samples were selected from diverse geological habitats, documented and analysed in situ. Subsequently, they were sent for detailed analysis in remote laboratories using XRD/XRF, Infrared spectrometry, amino acid analysis, Solid Phase Microextraction and Organic solvent Extraction with GC-MS analysis, composition and organics analysis, and biota diversity studies using culture-independent molecular analyses directed at ribosomal RNA genes [1-9]. We shall present the in situ and laboratory analysis relevant to habitability and biodiversity under extreme environments. An extraordinary variety of putative extremophiles, mainly Bacteria but also Archaea and Eukarya was observed [3, 4, 9]. A dominant factor in measurable bacterial abundance seems to be soil porosity and lower clay-sized particle content [6-8]. A protocol was developed for sterile sampling, contamination issues, and the diagnostics of biodiversity via PCR and DGGE analysis in soils and rocks samples [10, 11]. We compare the 2009 campaign results [0-9] to new measurements from 2010-2013 campaigns relevant to: merging between remote sensing and in-situ measurements; the study of minerals; the comparison between fluvial environments and concretions; the detection of organics and signs of life.

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Disk-integrated reflection lightcurves of planets

Antonio Garcia-Munoz

The light scattered by a planet atmosphere contains valuable information on the planet's composition and aerosol content. Typically, the interpretation of that information requires elaborate radiative transport models accounting for the absorption and scattering processes undergone by the star photons on their passage through the atmosphere. I have been working on a particular family of algorithms based on Backward Monte Carlo (BMC) integration for solving the multiple-scattering problem in atmospheric media. BMC algorithms simulate statistically the photon trajectories in the reverse order that they actually occur, i.e. they trace the photons from the detector through the atmospheric medium and onwards to the illumination source following probability laws dictated by the medium's optical properties. BMC algorithms are versatile, as they can handle diverse viewing and illumination geometries, and can readily accommodate various physical phenomena. As will be shown, BMC algorithms are very well suited for the prediction of magnitudes integrated over a planet's disk (whether uniform or not), a configuration for which they clearly outpace other approaches based on solving the radiative transport equations over each spatially-resolvable element of the disk and summing the weighed contributions. Disk-integrated magnitudes are relevant in the current context of exploration of extrasolar planets because spatial resolution of these objects will not be technologically feasible in the near future. I have been working on various predictions for the disk-integrated properties of planets that demonstrate the capacities of the BMC algorithm. These cases include the variability of the Earth's integrated signal caused by diurnal and seasonal changes in the surface reflectance and cloudiness, or by sporadic injection of large amounts of volcanic particles into the atmosphere. Since the implemented BMC algorithm includes a polarization mode, these examples also serve to illustrate the potential of polarimetry in the characterization of both Solar System and extrasolar planets.

The work is complemented with the analysis of disk-integrated photometric observations of Earth and Venus drawn from various sources.

Lyra on Proba 2

Antonio Garcia Munoz

Lyra, the Large Yield Radiometer, is a payload instrument on board ESA's technology demonstration satellite Proba-2. Lyra measures solar-disk integrated fluxes over four separate UV filters at (1) 115-125 nm (Lyman-alpha), (2) 200-220 nm (Herzberg continuum), (3) 17-31 nm (aluminium), and (4) 1-20 nm (zirconium). Lyra commenced its scientific mission in March 2010 and has since been monitoring the Sun's radiometric output. The data are publicly available after an initial quality check and subsequent process of standard calibration. Lyra's scientific goals include aeronomy, i.e. the investigation of the interaction between the Sun and the Earth's upper atmosphere. Inserted in a Sun-synchronous orbit, Proba-2 follows approximately the Earth's dawn/dusk divide from altitudes of about 715 km above sea level. The orbit includes regular periods when the Earth blocks either partially or totally the Sun's view from the satellite. Each occultation season spans about 3 months centered in December every year, and provides unique opportunities to explore the Earth's upper atmosphere through the technique of transmission spectro-photometry. One occultation takes no longer than a few minutes and because they start from a high-altitude view of the unimpeded solar disk, the transmission determinations are self-calibrated. Lyra is indeed particularly well endowed for aeronomy investigations because the instrument's four filters can simultaneously probe the atmosphere at overlapping altitudes from 100 km to 600 km. At ESTEC, we have recently commenced the analysis of Lyra's light curves for transmission vs. tangent altitude. The ultimate goal of this project is to investigate the Earth's upper atmosphere up to 600 km, which is an altitude range generally recognized as poorly characterized. Particular attention will be paid to the response of the Earth's upper atmosphere to solar events energetic enough as to drive the atmosphere away from its more quiescent conditions. For this reason, the solar input and the terrestrial space environment will be fully characterized during the Proba-2 occultation periods. This is work in progress, and we will present an up-to-date account. The investigation of Lyra's data demonstrates the capacities of a solar-focused mission to produce unique Earth-atmospheric science. The conclusions from this work in progress are expected to be valuable also in the investigation of the upper atmospheres of the other Solar System planets.

The largest database of properties of nuclear star clusters

Iskren Georgiev

I will present our results from the largest and most homogeneous measurements of structural and photometric properties of Nuclear Star Clusters (NSCs) of spiral galaxies from HST/WFPC2 archival imaging. Such a large database is essential for understanding the formation and evolution of nuclear star clusters across the spectrum of galaxy mass and morphological type. NSCs in spiral galaxies in particular are significantly under-represented

in this type of analysis. We will discuss what are the general properties (sizes, masses) of the NSCs of the entire sample and discuss what are the implications of their formation, evolution and co-existence with super-massive BHs and AGNs.

XMM-Newton looks at the Seyfert 1.8 → Seyfert 1 transition of NGC 2617

Margherita Giustini

The Active Galactic Nucleus of NGC 2617 went on a dramatic outburst during 2013, from the IR up to gamma rays, and dramatically changed its optical look, going from being a Seyfert 1.8 to a Seyfert 1. I will present the results of the analysis of two XMM-Newton observations performed within one month, when the source was found to increase its X-ray flux by a factor of two.

Identification and classification of Solar System Objects with Euclid

Pedro Gomez

As part of the Euclid legacy science, we expect to detect and characterize $\sim 10^5$ Main Belt Asteroids (MBAs) and many other Solar System Objects (SSOs) outside the main belt like Trans-Neptunian Objects (TNOs) and Near Earth Objects (NEOs). The Euclid survey although not in principle focused on the Ecliptic plane will focus on a relatively poorly explored discovery space, opening the possibility to potentially exotic and interesting discoveries. The SSOs science case will be driven within ESA with external scientific support. Euclid being a cosmological mission, the identification of SSOs will also allow removing them from the data pipelines and hence increasing the scientific return of the mission.

X-ray emission regimes and rotation sequences in the M34 open cluster

Phillipe Gondoin

One magnetic field diagnostic for cool stars is coronal X-ray emission. The X-ray emission from late-type stars in open clusters exhibits two kinds of dependences on stellar rotation. Fast rotators show a relatively constant X-ray to bolometric luminosity ratio at a so-called saturation level. Slower rotators show a decline of their X-ray emission with decreasing rotation rate. The physical significance of the transition between these two regimes is a matter of debate.

In the past decade, photometric monitoring programs have produced a large number of rotation period measurements in young open clusters. These data indicate that young stars tend to group into two main populations that lie on narrow sequences in diagrams where the measured rotation periods of the members of a stellar cluster are plotted against their (B-V) colours.

I report on a correlation between the saturated and non-saturated regimes of X-ray emission and the rotation sequences that have been observed in the M34 open cluster from extensive

rotation periods surveys. An interpretation of this correlation in term of magnetic activity evolution in the early stage of evolution on the main sequence is presented.

Venus Express Aerodynamic Drag Experiments

Emmanuel Grotheer

Håkan Svedhem

Over the past 3 years, the Venus Express (VEx) mission has periodically conducted aerodynamic drag experiments (ADE). These ADE campaigns do not utilize a scientific instrument. Instead, the control signals from the attitude control system are used to derive the atmospheric density. As VEx approaches the pericenter of its orbit during an ADE, it is allowed to descend to an altitude of about 165 km to 185 km. During such passes, the spacecraft is commanded to maintain a 3-axis stabilized attitude. While VEx passes through Venus' upper atmosphere, the atmospheric constituents push on the two solar array panels. The solar arrays are purposefully rotated to positions in which the atmosphere's push will induce a torque on the spacecraft as a whole. As a result, the attitude control system commands the reaction wheels to counteract this aerodynamic drag torque. The resulting attitude control system signals can then be filtered to improve the signal-to-noise ratio and yield measurements of the atmospheric density. We will discuss some of the techniques utilized to remove both the periodic and random noises from the data. Results of the filtered density profiles will be shown and compared to the original, unfiltered data. The filtered density profiles will aid the study of atmospheric structures, including for example gravity waves and potentially Kelvin-Helmholtz instabilities. These results will also be cross-validated against data from some of VEx's remote-sensing instruments, namely the Visible and InfraRed Thermal Imaging Spectrometer (VIRTIS) and SPectroscopy for Investigation of Characteristics of the Atmosphere of Venus (SPICAV). An early, unexpected result of this research has been the discovery that Venus' density gradient across the day-night terminator in the vicinity of the North pole is steeper than had been previously anticipated. This work will be complemented by upcoming aerobraking tests, at which time the on-board accelerometers will also be able to provide data that can be converted into an atmospheric density reading.

How fundamental are disk outflows in Active Galactic Nuclei

Matteo Guainazzi

I present the results of a systematic study of ionized outflows in an unbiased complete sample of X-ray selected bright Active Galactic Nuclei in the local Universe. Modelling X-ray spectra with CLOUDY-based photoionized spectra yields ionization parameters, column densities and outflow velocities for about 40 outflow components. Besides characterizing the physical properties of the outflow and their covering fraction. we will focus our attention on the impact that warm absorber may have on the presence and detection of relativistically distorted emission line profiles.

Jupiter Trojans – where is the ice?

Aurelie Guilbert-Lepoutre

Jupiter Trojans are asteroids trapped into the L4 and L5 Lagrangian clouds of the Jupiter-Sun system. Their origin is still a matter of debate, and their study could bring crucial insights on different models of the solar system formation and evolution. Trojans could have formed where they are, in which case they might give highlights on the formation of Jupiter. They could have formed in other regions of the solar system, like the primordial transneptunian disk, before being trapped on their current orbits when the giant planets migrated. Jupiter Trojans are often regarded as dead or dormant comets. Their low albedos, colours and surface composition are consistent with those of comets. Their rotation period distribution indicates possible past outgassing. However, despite an intense observational effort, no ice has ever been reported at the surface of Trojans, nor any coma produced by comet-like activity ever detected. In this work, we assume that Trojans were indeed comets at some point of their history. We study their thermal evolution, with the aim of constraining the survival of water ice under a mantle of dust.

Novae as supersoft x-ray sources in M31

Martin Henze

Novae represent the major class of supersoft X-ray sources (SSSs) in the central region of our neighbouring galaxy M31. From 2006 until 2012 we carried out a dedicated monitoring of the M31 central region with XMM-Newton and Chandra, specifically designed to detect and characterise SSS states of novae. Only X-ray observations allow direct access to the nuclear burning white dwarf after the nova outburst. Here, I present new results based on an updated catalogue of 79 novae with SSS counterpart – by far the largest sample known in any galaxy, to date. Global trends and correlations were established between various nova parameters and their implications for the physics of the nova outburst will be discussed. Furthermore, there is certain evidence for different X-ray parameters of sub-samples associated with the M31 bulge and disk, although the question whether both populations are inherently different is far from resolved. The X-ray monitoring of large, homogeneous samples of extragalactic novae is shown to be a powerful tool to study nova population properties and the dependence of observable characteristics on the underlying stellar population.

What can the occult do for you?

Benne Holwerda

Occulting galaxy pairs i.e. the serendipitous overlap of two galaxies, can be used to detect and map interstellar dust in galaxies, assuming both galaxies are symmetric. The GalaxyZoo identified some 2000 occulting pairs. Differential photometry reveals the amount of dust while long-slit or integral field unit observations directly measure the extinction curve through the foreground galaxy. I will discuss our ongoing follow-up efforts on the occulting pairs

identified by the GalaxyZoo volunteers (GALEX, HST, WHT, WYIN etc) and future uses for the resulting measures of dust extinction (e.g. as a prior in SNIa measurements).

Dust lanes in edge-on galaxies

Benne Holwerda

Part of the edge-on perspective of a spiral galaxy is the thin dark band due to interstellar dust absorption. The cumulative effect of interstellar matter clouds in the disk dim the stellar light enough to result in the dark band mid-plane. The presence and characteristics of this morphological feature are telling of the underlying physics of the disk itself. The canonical view is that in massive disks, the vertical balance between gravitational pull and turbulence in the ISM results in a thin dust lane while in less massive galaxies the dust clouds are distributed throughout the height of the stellar disk. However, this result was based on a select sample of bulgeless galaxies and a dust lane can only be identified reliably if the stellar disk is thick enough to highlight it. With the launch of the Herschel Space Observatory, it is now possible to resolve the height of the dust disk in nearby spirals. Several massive edge-on spirals are targeted by legacy programs, specifically by the HEROES project and I present my complementary survey of low-mass edge-on spirals, NHEMESES. The first result was on NGC 4244 with 13 more galaxies now observed. Complementary to these far-infrared and sub-mm observations, a survey of dust lanes in SDSS by the GalaxyZOO2 citizen science project shed more light on dust lane frequency in local edge-on spirals. In the HST COSMOS imaging, the communality of dust lanes in massive edge-on spirals can be explored to higher redshift ($z \sim 1$).

XMM-Newton spectra analysis of MAXI J1659-152

Aitor Ibarra

MAXI J1659-152 is a bright X-ray transient black-hole candidate binary system discovered on 25 September 2010. A XMM-Newton Target of Opportunity (ToO) observations was performed on September 27/28, 5 hours after the ToO trigger. These observations, in conjunction with observations from RXTE and Swift, showed it to be the shortest period (2.4 hours) black-hole candidate binary known to date. We have re-processed the data using the latest SAS analysis software. We show preliminary results of an analysis of the X-ray spectral properties of the transient as observed by the EPIC-pn and RGS

12 Years of Monitoring of Outbursting Comet 29P/Schwassmann-Wachmann 1

Mark Kidger

Comet 29P/Schwassmann-Wachmann 1 (SW1) is a giant comet of 14.6 years period with a low-eccentricity orbit entirely between Jupiter and Saturn. It is best known for its remarkable outbursting activity in which it will, in an interval of a few hours, develop an intense, stellar nucleus and may increase in brightness by 1 magnitude per hour, with an amplitude of up to

7 magnitudes (a factor of 1000 in brightness). Activity of the comet has been relatively low since 2010. Herschel observed SW1 at four epochs: three spectroscopic observations of the 110-101 water line with HIFI in 2010 and four epochs of imaging with PACS. Observations with HIFI in April 2010 show a weak water vapour detection during a major outburst, showing that superheating of grains must be present to permit water vapour sublimation at a heliocentric distance greater than 6 AU. We show the archive of CCD monitoring of this comet obtained since 2001, which has almost 18 000 aperture photometry observations use it to place the Herschel observations in their context.

Herschel's SEUs: the plot thickens

Mark Kidger

The current solar maximum has been the lowest since the start of the 20^{th} Century, meaning that cosmic ray fluxes have been correspondingly high. The four year record of the cosmic ray flux from Herschel's SREM shows a drop of a factor ~ 2 in the cosmic ray flux between 10 MeV and 166 MeV between the end of 2009 and the end of mission. It is assumed that the energetic cosmic ray flux is the cause of Single Event Upsets (SEUs), bit-flips in the on-board memory that affects instruments and the satellite mass memory. While there is evidence that the rate of SEUs in Herschel's SPIRE and HIFI instruments were lower around the time of peak solar activity in 2011, a study of bit-flips in Herschel's mass memory finds that although there was a significantly higher rate of bit flips in the first 6 months of the Herschel mission, the rate of bit flips was constant to a high degree from then on. Furthermore, no variations in the rate of bit flips in mass memory exist above the errors between the start of 2010 and the end of mission.

Recognition of Cluster bow shock crossings

Tomasz Klos

Harri Laakso

The purpose of Cluster mission is to study the small-scale structures of Earth's plasma environment. The four Cluster spacecraft, each equipped with 11 scientific instruments, fly in formation separated by few tens to 10 000 kilometers. The Cluster spacecraft provide a 3-dimensional data of, among others, bow shock, magnetopause, polar cusp and auroral zone regions. The bow shock is a collisionless shock front formed due to the supersonic solar wind stream hitting the Earth's magnetic field. As a result, the supersonic solar wind is rapidly decelerated, being subsonic in the downstream side of the shock, called the magnetosheath. The nature of the bow shock and the regions upstream and downstream of the bow shock depends strongly on the direction of the interplanetary magnetic field with respect to the local normal of the bow shock. A spacecraft leaving solar wind region and entering magnetosheath (and vice versa) detects sudden changes in total magnetic field and electron and ion densities and velocities, among other parameters. Most parameters, although changing at the shock front, do not change in any consistent manner that they could be used for the automatic detection of the shock. There are two main difficulties in detecting the bow shock crossings.

Firstly, the sudden jumps don't occur at exactly the same time in all physical parameters. They can be separated by up to a few minutes. The second difficulty comes from the fact that solar wind is much faster than the spacecraft itself (400 km/s on average compared to around 3 km/s). As a consequence, even a small change in solar wind velocity causes the bow shock to move with high speed. This results in multiple crossings within one orbit and, quite often, within a couple of minutes. The algorithm developed in the CAA searches for the bow shock crossings by identifying sudden jumps in data from six variables coming from four instruments. If these jumps occur at approximately the same time in at least 3 variables, a bow shock crossing is detected. Some additional checks are performed to ensure consistency of the results. A GUI application has also been developed to provide an easy method for manual corrections of the detected boundaries.

DECA - the Descent Camera for the 2016 ExoMars Descent Module

Detlef Koschny

DECA is a reflight of the Visual Monitoring Camera (VMC) which has imaged the upper stage separation of Herschel/Planck. We have been qualifying the Flight Spare model of the VMC, now called DECA (Descent Camera), such that it can be part of the 2016 ExoMars Descent Module. DECA will be mounted such that it can image the surface of Mars before touchdown of the EDM. After switch-on, it takes 15 images, separated by 1.5 seconds. This presentation will address the expected results and show what was done to ensure that the instrument is flight-worthy for going to Mars.

The cold environments of FU Orionis-type eruptive stars

Ágnes Kóspàl

FU Orionis-type stars (FUors) are young stellar objects experiencing large optical outbursts due to highly enhanced accretion from the circumstellar disk onto the star. FUors are often surrounded by massive envelopes, which have a significant role in the outburst mechanism. Conversely, the subsequent eruptions might gradually clear up the obscuring envelope material and drive the protostar on its way to become a disk-only T Tauri star. In order to study the dust and gas in the envelope, we obtained Herschel and IRAM observations of several FUors at continuum wavelengths and at different molecular lines. I will present these results and discuss the evolution they outline within the FUor group and in the broader context of the formation of low-mass pre-main sequence objects.

The last mile – physics of the accretion column

Peter Kretschmar

Accreting X-ray pulsars are among the best observed objects of X-ray astronomy with a rich data set of observational phenomena in the spectral and timing domain. While the general picture for these sources is well established, the detailed physics behind the observed

phenomena are often subject of debate. In this presentation I summarize recent observational, theoretical and modelling results for the structure and dynamics of the accretion column based on the work of a large collaboration of scientists. These results clearly indicate the presence of different accretion regimes and yield possible explanations for variations of observed features with luminosity.

The water regime of dwarf planet (1) Ceres

Michael Kueppers

The traditional view of minor bodies in the (inner) Solar System being divided into icy comets and rocky asteroids has been challenged by recent results, such as the discovery of comets on asteroidal orbits and the detection of water ice frost on the surface of asteroid (24) Themis. The discovery of water ice on the surface of asteroids has profound implications for how the Solar System formed, and challenges our ideas about the stability of ice in the inner Solar System. The study of volatiles in the asteroid belt places strong constraints on the temperature and composition distribution in the proto-planetary disk,and on possible sources of terrestrial water, and strongly constrains formation models of the early Solar System. Water may have played a significant role in the evolution of Ceres. Despite the mostly featureless spectrum of Ceres in the visible and near-infrared (NIR), the weak but mysterious absorption features in the 3 µm – 5 µm region have been repeatedly interpreted as water ice frost or hydrated silicates. Thermal evolution models of Ceres suggested liquid water in the mantle in the past and perhaps even today. HST images and NIR observations of Ceres showed a remarkably homogeneous surface, possibly a consequence of relatively recent or even current global scale resurfacing driven by liquid-phase activity and/or volatile sublimation. While the results of surface spectra are ambiguous, detections of water vapour or its dissociation products around Ceres are a clear proof of a wet Ceres. Theoretical studies suggested that water ice could remain stable at shallow depths over the age of the solar system on MBAs. As the largest MBA and a dwarf planet, Ceres accounts for $\sim 1/4$ of the total mass in the main belt, and has a much larger surface area than any single small main-belt comet. In 1992, a 3 sigma detection of OH was reported based on IUE observations. So far, attempts at confirming that detection failed. We will report on observation of Ceres we performed on Nov. 2011, Oct. 2012 and March 2013 with the ESA Herschel Space Observatory. We used the Heterodyne Instrument for the Far Infrared (HIFI) to search for the water ground state line at 557 GHz.

Status of the balloon-borne far-infrared polarisation mapping experiment (PILOT)

Rene Laureijs

PILOT (Polarised Instrument for Long wavelength Observation of the Tenuous inter-stellar medium) is a balloon-borne astronomy experiment led by IRAP in Toulouse. The first PILOT flight is scheduled for late 2013 (from Kiruna). PILOT carries a 1m class telescope to map polarized emission at 240 micron arising from dust grains present in the diffuse ISM. There are advanced plans to include a and 550 micron channel. The observations constrain the large

scale geometry of the magnetic field in our Galaxy and provide the magnetic field alignment properties of dust grains. In this domain, the measurements of PILOT are complementary to those of Planck, which has also polarisation capabilities. RSSD has supported payload design studies in the past, and we are presently working on an optics straylight study to fully understand the instrument design for polarisation measurements, and to help designing the optical baffle of the telescope. We present the experiment, the RSSD involvement and the status of the project.

Measuring proper motions of massive runaway stars with Hubble

Danny Lennon

Using the Hubble Space Telescope we are measuring the proper motions of massive stars in two key areas in the local Universe; around our Galactic Centre and around the most massive nearby resolved young cluster R136 in the Large Magellanic Cloud. Our objective is to determine the origin of isolated massive stars known to exist in these fields, known variously as walkaway, runaway and hyper-velocity stars. Our findings will be used to contain models of stellar ejection from very massive star clusters and/or from vicinity of the the black hole in the Galactic Centre.

H0557-385: an apparently regular Seyfert Galaxy with a most interesting X-ray spectral history

Anna Lia Longinotti

Active Galactic Nuclei are powered by accreting supermassive black holes that shine mainly in the X-ray band. The radiation generated by this so-called AGN central engine gets reprocessed by interacting with the surrounding gas via absorption and emission processes. As a consequence, the emerging spectrum of AGN observed by us provide a wealth of information on the properties of the circumnuclear material. The Seyfert 1 Galaxy H0557-385 has shown extreme variability in multi-epochs spectra obtained by many X-ray observatories, especially by XMM-Newton. The wealth of data that were analysed show that the source undergoes a "slow", long term (~ 5 years) and more extreme spectral variability but also a more rapid variation on weeks time scale. We will show that this behaviour can be explained by changes in the properties of the gas distributed around the central region of the AGN and particularly in the context of gas clouds orbiting the AGN Broad Line Region, as proposed also for other Seyfert Galaxies.

Finding rare evolved massive stars in the Galaxy

Anthony Marston

Determining the Galactic distribution and numbers of massive stars, such as Wolf-Rayet stars (WRs), is hampered by intervening Galactic or local circumstellar dust obscuration. In order to probe such regions of the Galaxy we can use infrared observations, which provide a means

for finding such hidden populations through the dust. The availability of both 2MASS and Spitzer/GLIMPSE large-scale survey data provides infrared colours from 1.25 µm to 8 µm for a large fraction of the inner Galactic plane. In 2005 we initiated a pilot study using the combined set of infrared colours for early-release GLIMPSE fields and showed that WRs typically occupy a sparsely populated region of the colour space. Spectroscopic follow-up has allowed the identification of a growing number of these rare, evolved massive stars which has lead to the discovery of approximately 20 % to 25 % of all known galactic WR stars. In this presentation we show the development of this project and some of the key results and possible implications for the numbers and locations of WR stars found so far. Some possibilities for future research in the field are also indicated.

Prototype of an imaging centroiding system developed with reconfigurable hardware (PGA)

Raul Martin

The aim of the poster is to describe a small prototype of an image centroiding system developed with reconfigurable hardware (FPGA). Emphasis has been placed on the system architecture, to make it modular and upgradeable. The algorithm that is used is very close to the Cramer-Rao limit, which means that is nearly optimal in terms of precision. That is, it is able to extract all the information stored in the images. However, it is quite slow when executed as software on a typical desktop computer. The main objective of this work has been to accelerate the algorithm using an FPGA board. The goal is to achieve microsecond performance, which would allow the systems to be used in e.g. adaptive optics (AO) or Attitude and Orbit Control System (AOCS) applications. A full embedded system has been developed using both new devices created from synthesis from high level language and existent intellectual property from Xilinx. This utilization of pre-existing hardware devices allows us to create a whole personalized system in time spanned by a typical ESAC trainee (six months). The main results from the project and the performance achieved will be presented in this poster.

Observing Very Bright Stars with Gaia

J. Martin-Fleitas

A. Mora, J. Sahlmann, R. Kohley

We present the Gaia on-board autonomous object observation system, both as configured to observe in the nominal range ($G = [5.7 - 20.0]$) and after the Science Operations Centre (SOC) contribution to the algorithm configuration, which in addition will allow Gaia to observe very bright stars ($G = [2.0 - 5.7)$). Comprehensive on-ground simulations at the SOC, complemented by tests carried out by Astrium, led to the definition of a new parameter set that has now been adopted as Gaia's flight configuration baseline. We have identified four science cases related to extrasolar planets that benefit from this magnitude range extension. We present this case as a practical example on how including the SOC team in the early phases of the design of the Spacecraft Payload Module can significantly increase the scientific output and legacy of the mission.

VLF saucers source region and generation revealed by the four Cluster satellites

A. Masson

M. Berthomier, J. Pickett, A. Fazakerley, C.P. Escoubet, H. Laakso

VLF saucer is a natural tracer of auroral region where local particle acceleration occurs, important for future missions on giant planets like JUICE. We present here for the first observations of these emissions by multiple spacecraft in the Earth magnetosphere. This allows for the first time to triangulate their source and raise fundamental questions about what was thought to be so far their generation mechanism. VLF saucer is a natural radio-wave phenomenon observed in the auroral zone since the 1960's. It has a characteristic V-shaped signature on electric field spectrograms in the VLF range. Many properties of VLF saucers have been established in the 1970's based on Alouette and Isis spacecraft. Further investigations continued thanks to satellites flying over the auroral zone such as Viking, Polar and FAST. Since 2006, the orbits of the ESA/NASA Cluster satellites are slowly evolving from a nominal polar orbit to an oblique one. Meanwhile, the original 19 000 km perigee of their orbits went down to a few hundred kilometres and then back up. Since spring 2009, Cluster scientists can make use of this natural orbital drift to target a new key region of the magnetosphere: the Auroral Acceleration Region (AAR). The AAR continues to be targeted by the Cluster mission, with a recent data campaign achieved successfully in Spring 2013. On rare occasions, VLF saucers are observed by the Cluster spacecraft, as they need to fly close enough to their source to catch them. Unique observations of VLF saucers by the four Cluster satellites will be presented. These data not only enable for the first time to triangulate their source region. It also allows revisiting some of the hypotheses commonly used so far in the analysis of their source region, including plasma composition. Finally, the multiple point observation of VLF saucers question fundamental aspects of their generation. Indeed, no theory (e.g. based on electron holes) is able to support the continuous generation of these electrostatic waves during several minutes, as observed by Cluster.

Some aspects of the impact of the radiation environment on the operations of Planck

Luis Mendes

I use data acquired by the Standard Radiation Environment Monitor on board the Planck satellite to analyse the impact of the radiation environment at L2 on the operations and data acquisition of Planck. I will summarise the most important radiation events observed during the lifetime of the Planck mission and will illustrate their impact on the thermal stability of the instruments on board Planck.

Herschel/PACS photometry of transiting planet host stars with candidate warm debris disks

Bruno Merin

Dust in debris disks is produced by colliding or evaporating planetesimals, the remnant of the planet formation process. Warm dust disks, known by their emission at $< 24\,\mu$m, are

rare (4 % of FGK mainsequence stars), and specially interesting because they trace material in the region likely to host terrestrial planets, where the dust has very short dynamical lifetimes. Dust in this region comes from very recent asteroidal collisions, migrating Kuiper Belt planetesimals, or migrating dust and are hence particularly interesting in the case of systems with planets at those orbital distances. Statistical analysis of the source counts of excesses as found with the mid infrared Wide Field Infrared Survey Explorer (WISE) suggests that warm-excess candidates found for the Kepler transiting-planet host-star candidates can be explained by extragalactic or galactic background emission aligned by chance with the target stars. However, there is non-zero possibility that any of such systems could have a transient excess detectable at other wavelengths. Here we report Herschel/PACS 100 µm and 160 µm follow-up observations of a sample of Kepler transiting-planet host-star candidates and three planet-hosting stars with WISE candidate warm debris disks. No clear detections were found in any of the objects at either wavelength. This confirms that none of the planet hosting stars CoRoT-10, WASP-33 and HAT-P-28 have a debris disk comparable to that of eta Corvi and places a loose constrain on the presence of such rare warm disks around the Kepler planet-hosting candidates. However, the lack of detections and the nature of some of the nearby emissions found at far-IR wavelengths supports the result by Kennedy & Wyatt (2012) that suggests that most of the WISE-identified mid-IR candidate excesses around these systems do indeed originate from chance alignment from either background IRbright galaxies and/or interstellar emission.

Chamaeleon by Herschel

Bruno Merin

This contribution presents four papers prepared by our ESAC/ESTEC group analyzing the Herschel PACS and SPIRE maps of the Chamaeleon star-forming regions, obtained as part of the Gould's Belt Herschel Key Program. 1) Winston et al. (2012) presents the Herschel detections of known objects in the Chamaeleon I region, the richest star-forming cloud in the Chameleon complex, and shows that both protostars and disks have similar Herschel colors. 2) Spezzi et al. (2012) analyzes the Herschel data of the protostars and disks in the Chamaeleon II region, the second most active one, and shows how the Spitzer plus Herschel data constrain the possible parameters of the protoplanetary disks. 3) Matra et al. (2012) shows a detailed investigation of a former transitional disk in Chamaeleon I, namely T54, and shows that the higher spatial resolution of Herschel as compared with that of Spitzer allows to discard part of its far-infrared excess as unrelated emission from a nearby nebulosity, hence making this object a wrongly previously identified transitional disk. 4) Finally Ribas et al. (2013) studies the nature of the many other transitional disks in the Chamaeleon I region, discarding a few other wrongly previously identified transitional disks and constraining the nature of the confirmed transitional disks, with large inner holes, which could be forming planets at the present time. All this investigations are a showcase of our current exploitation of the rich Herschel maps of the Chamaeleon regions.

Abstract Submission Using an On-line Wiki for Venus Express Science Operations

Donald R. Merritt

The Venus Express mission was launched in November 2005, and since April 2006 has been making the first long-term systematic study of the atmosphere of Venus. Since the start of nominal science operations, the science operations team (located near Madrid, Spain) had been collecting and maintaining their operations processes in a continuously updated word processing file. The continuously updated, "living" nature of this document, coupled with having updates generated by multiple users, made this a good candidate for conversion to an on-line wiki format. This presentation will discuss:

- the Venus Express experience with their Process Document
- the critical idea of a "living" document in order to capture the required process information
- the reasons that a conversion from document to wiki format was considered
- the conversion experience
- the experience with using the data in wiki format

Additional detail: At the start of nominal science operations for the Venus Express (VEX) spacecraft, the European Space Agency (ESA) VEX Science Operations Team (VSOC) began maintaining a written document that contained information useful to the team. The goal was knowledge capture, both for the complex processes used to generate the science planning files, as well as all types of information used by the team in order to produce the final spacecraft commanding and pointing files. Based upon my past experience, the Process Document was acknowledged as a "living" document, and no restrictions were placed upon the addition or editing of content. No forms were filled out to propose document additions or updates, and no formal review boards were held to verify changes. The contents were considered to be under continuous review by the entire team. The document had only one basic level of control: each change required an update to the revision number of the current version, and the document would be placed on the operations team's document versioning system. This preserved a record of the changes, and allowed rollback to previous versions if any changes were disputed. However, no changes were ever disputed, and no rollbacks were made. The size of the document grew to 265 pages in Microsoft Word format. In describing the nature of the VSOC Process Document, it sounded a great deal like a wiki, except in paper form. It was proposed in June 2009 that the document be converted into a wiki format. It was thought that this would allow for better change tracking, streamlined entry and modification (which was thought to make the capture of additional data possible), and improved internal and external linking. Over August and September 2009, one individual was tasked with transferring the Process Document into a wiki format. No budget was allocated, and this was done only with free tools and advice found in public forums. The conversion process took approximately two months, until it was considered completed. The total time was approximately 1 man-month for a FTE. After the conversion was completed, a meeting was held with the team members, and the wiki format was considered superior for their purposes to the original document format. The wiki continues to undergo format updates as experience is gained, but the document is on-line and in use. The session presentation, limited to 20 minutes, would consist of 6 charts which would focus on: 1. Context: the VEX mission and

the VSOC team. 2. Original process document: purpose, format, use, maintenance, growth. 3. Why the conversion to a wiki was considered. 4. How the conversion from document to wiki was performed. 5. Result of the conversion, and success of the wiki format. 6. Importance of using written procedures and checklists for nominal, repetitive operations.

Understanding uncertainties in the astrometric solution of early Gaia data by incorporating a priori knowledge

D. Michalik

L. Lindegren, D. Hobbs, Lund Observatory; U. Lammers, ESAC

Gaia is ESA's next-generation astrometry space mission and will be launched before the end of 2013. It aims at determining the astrometric parameters of one billion of celestial objects with unprecedented accuracy. Normally the astrometric solution will determine five parameters per source: two angles defining the barycentric direction to the star ("position"), the two time derivatives of these angles ("proper motion"), and the parallax as a measure of the distance to the star. In same cases it will not be possible to determine all five parameters in the solution, even with the full five years of Gaia data. This will be true for even more sources during early and intermediate data releases, based on only parts of the total Gaia mission. In these cases the astrometric solution will fall back to a partial solution, e.g. determining only the two angles for the position. By doing so, the neglected effects of the remaining parameters produce errors which are not reflected in the formal uncertainties of the estimated parameters. We are presenting a possible solution for this scenario by incorporating a priori knowledge in some of the parameters. This will allow us to improve our understanding of the uncertainties of the astrometric solution, hence avoiding grossly underestimating the real errors in intermediate data releases of Gaia.

The story of Gauss: from epic exploration to modern matrix inversion

Helen Middleton

Daniel Heyner and Karl-Heinz Glameier

On 25$^{\text{th}}$ April 1827, the famous Norwegian geophysicist Professor Christopher Hansteen and twenty-one-year-old Adolph Erman left Berlin and set off on a two-year expedition around the world. Adolph documented their epic journey and took measurements of the geomagnetic field along the way, at places with names now lost. These geomagnetic observations were utilized by Carl Friedrich Gauss in his theory of spherical harmonics in terrestrial magnetism. This was published in 1839, has now been translated into English and contains the original measurements. Can modern inversion techniques, using the same data, reach the same results?

Time to weigh black holes

Sara Elisa Motta

QPOs have been detected in many BHXBs and are thought to originate in the innermost regions of the accretion flow around the black hole. Even though their origin and nature is still debated, the study of QPOs provides a way to explore the inner accretion flow around black holes and neutron stars. Few theoretical models have been proposed to explain the origin of QPOs, but only one has been proved to be promising so far, having shown good agreement with observations. I will present the results obtained testing the Relativistic Precession Model onto the black hole binary GRO J1655-40. We show that the predictions of the Relativistic precession model match to a remarkable accuracy the observed fast-time variability properties of the source and for the first time we could demonstrate that it is possible to measure with high precision the mass and the spin of black hole X-Ray binaries through the sole use of X-Ray timing.

Surprises from Dynamic High-resolution X-ray Spectra

Jan-Uwe Ness

The key data product of an X-ray observation is an events table with information of calibrated position, energy, and arrival time for each individual X-ray photon. If a dispersive grating is inserted into the light path, the position information from an events file can be used to extract a spectrum from the dispersed photons. Since positional precision of the CCD detectors is much higher than their energy resolution, a dispersive spectrum has much higher spectral resolution. In addition to exploring the high positional precision, the time information can be used to extract spectra from selected time intervals. This is of particular interest for variable sources to understand the origin of variations. A dynamic spectrum is a 3-dimensional representation of wavelength, time, and intensity. I developed a method to produce dynamic X-ray grating spectra by extracting a series of spectra from adjacent short time intervals and displaying them as wavelength versus time and a colour code for intensity. I will show examples for several observations of novae, holding some surprising behaviour such as extremely short-lived emission lines and clear indications of changes in absorption.

Stormy space weather at Mars in 2012

Andrea Opitz

Olivier Witasse, Eduardo Sanchez-Diaz and the MUAN team

The solar activity maximum made the heliospheric processes in year 2012 very animated with a huge number of solar eruptions. This spectacle was well registered by the favorable three vantage point solar observations, namely by SOHO, STEREO Ahead and Behind; the three spacecraft were evenly separated in the ecliptic with ~ 120 degree longitudinal separation. Beginning of 2012 Mars was in conjunction with Earth, this way the accuracy of the prediction of solar wind parameters from near-Earth observations to Mars is the

highest. During the conjunction, the experiments onboard Mars Express were devoted to study the interactions between the solar wind and the martian ionosphere. With this wealth of data, we could well characterize the space environment of Mars and its response to the solar disturbances such as fast-slow solar wind stream interaction regions or coronal mass ejections. Although the space weather at Mars was really stormy with several solar eruptions hitting the planet, we managed to differentiate the effects of the shock front and the magnetic cloud in the response of the martian plasma environment. The behaviour of the different plasma regimes around Mars depends on the characteristics of the solar disturbance and on its duration.

What did we find when we observed recently discovered (a) Main Belt Comet Panstarrs (P/2012 T1) and (b) Comet ISON (C/2012 S1) known as the "comet of the century"?

Laurence O'Rourke

A new Main-Belt Comet (MBC) P/2012 T1 (PANSTARRS) was discovered on 2012 October 6, approximately one month after its perihelion, by the Pan-STARRS1 survey based in Hawaii. It displayed cometary activity upon its discovery with one hypothesis being that the activity was driven by sublimation of ices; as a result, we searched for emission assumed to be driven by the sublimation of subsurface ices. Our search was of the H_2O 110-101 ground state rotational line at 557 GHz from P/2012 T1 (PANSTARRS) with the Heterodyne Instrument for the Far Infrared on board the Herschel Space Observatory on 2013 January 16, when the object was at a heliocentric distance of 2.504 AU and a geocentric distance of 2.064 AU. Perihelion was in early 2012 September at a distance of 2.411 AU. While no H_2O line emission was detected in our observations, we were able to derive sensitive 3s upper limits for the water production rate and column density of $< 7.63 \times 10^{25}$ molecules/s and of $< 1.61 \times 10^{11}\,\mathrm{cm}^{-2}$, respectively. An observation taken on 2013 January 15 using the Very Large Telescope found the MBC to be active during the Herschel observation, suggesting that any ongoing sublimation due to subsurface ice was lower than our upper limit. Comet C/2012 S1 (ISON) was discovered in September 2012, at $r_h = 6.3$ AU from the Sun, by the Russian astronomers Vitali Nevski and Artyom Novichonok using a 15.7-inch reflecting telescope of the International Scientific Optical Network (ISON), near Kislovodsk. Its orbit is nearly parabolic consistent with a dynamically new comet coming freshly from the Oort cloud. It is peculiar in that it is a sungrazer ($q = 0.012$ AU on 28 November 2013) although not of the Kreutz group. This comet is expected to be the brightest comet for decades reaching a magnitude (according to Horizons) brighter than the full moon at closest approach to the sun. On closest approach, the comet will pass approximately 0.072 AU from Mars on 1 October 2013, and it will pass approximately 0.42 AU from Earth on 26 December 2013. Because of its expected exceptional brightness, comet ISON is the object of a worldwide observing campaign. We performed observations of newly discovered comet C/2012 S1 (ISON) in March and April 2013 ($r_h = 4.2$ AU to 4.5 AU) in the far-infrared with the Herschel Space Observatory and observations from ground at millimetric wavelengths obtained with the 30 m antenna of the Institut de radioastronomie millimétrique (IRAM). While H_2O was not detected, we derived a sensitive 3 upper limit of $Q_{H_2O} < 3.5 \times 10^{26}$ molecules s^{-1}. A marginal 3.2σ detection of CO is found, corresponding to a CO production rate of $Q_{CO} = 3.5 \times 10^{27}$ molecules s^{-1}. The

Herschel PACS measurements show a clear detection of the coma and tail in both the 70 µm to 160 µm maps obtained. Under the assumption of a 2-km radius nucleus, we infer dust production rates in the range 10^{13} kg s^{-1} and 40 kg s^{-1} to 70 kg s^{-1}, depending whether a low or high gaseous activity from the nucleus surface is considered. We constrain the size distribution of the emitted dust by comparing PACS 70 µm and 160 µm data, and considering optical data. Size indexes between −4 and −3.6 are suggested. The morphology of the tail observed on 70 µm images can be explained by the presence of grains with ages larger than 60 days.

Near Earth Objects: Encounters with spacecraft and the Earth

Laurence O'Rourke

The Herschel MACH-11 (Measurements of 11 Asteroids and Comets with Herschel) Programme has as its prime goal to observe those asteroids and comets which have been or will be visited by spacecraft or those which are being studied with a similar goal in mind. The following Near Earth Asteroids (NEAs) form part of the list of targets making up this programme and will be addressed in this analysis: 1999 JU3 (Hayabusa 2 mission target), 1999 RQ36 (OSIRIS-REx mission Target), 1996 FG3 (Marco-Polo R backup mission target) and 99942 Apophis (Study target). An additional NEA (not part of the MACH-11 programme) will also be reviewed, namely 2005 YU55. Each target was observed using the PACS Photometer of the Herschel Space Observatory. The extracted fluxes from each observation campaign were fed into a thermpophysical model (TPM) which has been validated against a large database of asteroids including targets of other spacecraft missions. In all cases, radiometric properties of each target have been derived and will be presented, with their impact on already published data being analysed and discussed.

Cold Disks Around Nearby Stars Explored by Herschel

G.L. Pilbratt

on behalf of DUNES and Stellar Disk Evolution KP consortia

I have presented the background and first results from the exciting prospects of conducting observations of infrared excess associated with "normal" sun-like stars using Herschel in Inter-Departmental Science Workshops (IDSWs) in 2008, 2010, and 2011. Needless to say all observations in the Herschel Open Time Key Programme "DUNES" ("DUst around NEarby Stars") have now been obtained. The observations constitute a volume-limited sample of 133 of FGK stars with the aim of studying cold dust debris disks. In addition, as part of the Herschel Guaranteed Time Key Programme "Stellar Disk Evolution", observations have been conducted of the "fab four" (Vega, Fomalhaut, eps Eri, and beta Pic). Results from these two programmes include spectacular resolved images of prominent objects, and no less spectacular spectroscopic results, have been published or submitted for publication in various journals. I look forward to the IDSW as an opportunity for presenting some of these exciting results – that embrace both astronomy, interstellar medium physics, and solar system science – in a manner catering for the interest generated by my talks in previous IDSWs.

Conversations about space weather and high-energy astrophysics

Andy Pollock

Talking about the weather is the "top British trait" probably because there's so much of it about. As most of the Universe is made up of the same type of collisionless plasmas that exist in the heliosphere and cause space weather, we report here discussions that have been taking place between high-energy astrophysicists and space weather specialists. Common physical themes are explored between in situ measurements of plasmas in the local space environment and the remote radiation sensing of plasma-driven systems like colliding-wind binaries. Architectural issues are also discussed concerning the availability of science-ready data that underpins and enables both service provision and scientific investigation.

EXOSAT on tour

Andy Pollock

Hardware and system infrastructure evolve on time scales much shorter than the typical duration of space astronomy missions. Data processing software capabilities also have to evolve to preserve the scientific return during the entire experiment life time and beyond. Software preservation is a key issue that has to be tackled for all Agency missions in order to keep data usable over many years. Data, and in particular astronomical data, have a unique value because they represent a snapshot in time. This means that if the data are lost, this knowledge of the object observed is lost forever. If the data have a special format or if the processes to derive physical parameters needs custom software, then preservation of software becomes equally important as the preservation of the data. EXOSAT was the first European Space Agency (ESA) mission entirely devoted to the study of the Universe at X-ray wavelengths (0.05 keV – 50 keV). It was launched on 26 May 1983 and was operational until 9 April 1986 making 1780 observations in total of a wide variety of objects, including active galactic nuclei, stellar coronae, cataclysmic variables, white dwarfs, X-ray binaries, clusters of galaxies, and supernova remnants still popular with observers today. The EXOSAT Interactive Analysis (IA), is the software that was used to access EXOSAT telemetry to produce spectra, photon lists and images. We present the work done to bring to life the data processing software of the EXOSAT mission and consider scientific use cases that can be tackled today thanks to the continued availability of both data and software.

Beyond the Confusion: Exploiting Gravitational Lensing by Galaxy Clusters

Tim Rawle

After almost four years in operation, the Herschel Space Observatory continues to contribute greatly to our understanding of the far-infrared Universe. Unfortunately, source confusion sets the fundamental sensitivity of the data, especially for SPIRE where the beam size is largest. The deepest blank-field, extragalactic surveys can explore only the most intensely star-forming galaxies at high redshift. The "Herschel Lensing Survey" (HLS) investigates "normal" galaxies in the early Universe by using foreground galaxy clusters as "gravitational telescopes", which

magnify background objects out of this confusion noise. From deep Herschel observations of more than 500 massive galaxy clusters, we discover hundreds of intrinsically-faint lensed sources (at $z > 1$), with several confirmed to be from the first few billion years after the Big Bang ($z > 3$). Furthermore, gravitational lensing not only amplifies the observed flux, but also increases the apparent spatial resolution, allowing us to explore individual star-forming clumps within these galaxies in amazing detail. I present some of the most interesting objects observed in the Herschel Lensing Survey.

Sounding a CME Plasma Structure

Stefan Remus

The MEX, Rosetta, and VEX spacecrafts are located in the ecliptic plane of the sun which move around the sun with the planets velocity or in case of Rosetta in a free fall. Due to the different velocity of the receiving system on earth the SCs occasionally disappears behind the solar disk or the SCs travel close to the solar disk as seen from earth ground stations. During these events the radio signal path from SC to earth and vice versa travels through the plasma of the corona and is changed in amplitude and phase. These changes are frequency dependent and can be separated from other effects by using 2 signals in different frequency bands. The derived phase or path length change, which is the integrated residual of the Doppler frequency residual, can directly be transferred into the change of the number of electrons in the path. All 3 missions are equipped with a 3 way radio link and the most common used configuration for SCOs is a X-band uplink (GS to SC) and a X- and S-band downlink. An analysis of the differential downlink Doppler frequency shift is used to separate the contribution of the residual Doppler shift on the uplink. The path distance between uplink and downlink in radial direction of the sun is used to derive velocity changes of the plasma. This is shown at an example but no further interpretation or simulations are done so far.

Dust evolution in the solar neighbourhood I. Dust frequencies from 1 Myr to 100 Myr

Alvaro Ribas

Aims. We study the evolution of circumstellar disks in 22 young (1 Myr to 100 Myr) nearby (within 400 pc) associations over the entire mass spectrum using photometry covering the optical to the mid-infrared Methods. We compile a catalog of 2340 spectroscopically-confirmed members of these nearby associations. We analyze their spectral energy distributions and search for excess related to the presence of protoplanetary disks. The dataset is analyzed in a homogeneous and consistent way, allowing for meaningful inter-comparison of the obtained results for individual regions. Special attention is given to the sensitivity limits and spatial completeness of the observations. Results. We derive disk frequencies as probed by mid-infrared excess in the 22 regions. The unprecedented size of our sample allows us to confirm the timescale of disk decay reported in the literature and to find new trends. The fraction of mid-infrared excess sources increases if measured at longer wavelengths. Disk frequencies derived using different wavelength ranges should therefore be compared with caution. The

dust probed at 22 µm – 24 µm evolves slower than that probed at shorter wavelengths (3.4 µm – 12 µm). Assuming an exponential decay, we derive a timescale $\tau = 4 \ldots 5.6$ Myr at 22 µm – 24 µm for primordial disks, compared to 2 Myr – 3 Myr at shorter wavelength (3.4 µm – 12 µm. Primordial disks disappear around 10 Myr to 20 Myr. Their decline matches in time a brief increase of the number of "evolved" disks (defined here as including transitional and debris disks). There is more dispersion in the fraction of excess sources with age when measured at 22 µm – 24 µm in comparison to shorter wavelengths. Conclusions. The increase in timescale of excess decay at longer wavelength is compatible with inside-out disk clearing scenarios. The increased timescale of decay and increased dispersion in the disk frequency distribution at 22 µm – 24 µm suggest that the inner (terrestrial-planet forming) and outer (giant-planet forming) zones evolve differently, the latter potentially following a variety of evolutionary paths. The drop of primordial disks and the coincident rise of evolved disks at 10 Myr are compatible with planet formation theories suggesting that the disappearance of the gas is immediately followed by the dynamical stirring of the disk.

The population of Galactic X-ray bursters as seen by JEM-X onboard INTEGRAL

Ceia Sanchez

Type I X-ray bursts are the observational signatures of thermonuclear runways happening on the surface of accreting Neutron Stars (hereafter NS), in Low Mass X-ray Binary (LMXB) systems, caused by the unstable ignition of He and/or H fuel accreted from the low-mass companion They are short events (10 s to 100 s) detected as a fast rise in the system X-ray light curves (several orders of magnitude above the persistent level), followed by an exponential decay to pre-burst levels. Type-I Bursts radiate X-ray spectra with black body shapes and temperatures up to ~ 3 keV, that cool during the decay. Up to now, burst activity has been detected from 102 NS X-ray binaries. The large Field of View provided by the instrument Joint European Monitor for X-rays (JEM-X) onboard INTEGRAL (4.8 deg diameter, Fully Illuminated) allows simultaneous monitoring of several sources during a single pointing, thus increasing the probability of burst detection (these are not predictable events). JEM-X works in the soft energy domain (3.5 keV to 35 keV) where most of the burst energy is released. These capabilities, combined with the accumulated INTEGRAL exposure in the Galactic Center and plane, where most known X-ray bursters are located, provide a wealth of data avaiable for the study of X-ray burst activity not possible with pointed observations. For this reason, we have used all the publicly available JEMX data in the INTEGRAL archive, to carry out a systematic search of Type-I X-ray bursts serendipitously detected during INTEGRAL observations. About 100 000 science windows were analyzed, on which approximately 2300 type-I X-ray bursts were identified. We present here preliminary results of this work.

Dynamics of clusters of galaxies from narrow-band TF optical observations: the case of ZwCl 0024.0 + 1652

M. Sánchez-Portal

I. Pintos-Castro, R. Pérez-Martínez, and the GLACE collaboration

Summary: we have performed a narrow-band survey of the intermediate redshift cluster ZwCl 0024.0+1652 ($z \sim 0.4$) using the tunable filters (TF) at the OSIRIS instrument of the 10.4 m GTC telescope (La Palma). While the main purpose of the observations is the study of the star formation and AGN activity within dense environments, one of the byproducts is a wealth of accurate radial velocities of emission line galaxies (ELG) belonging to the cluster (some 200). In this work, we explore the possibility of studying the cluster dynamics, and in particular performing mass estimations using the caustic technique of Diaferio (1999) with ELGs. Our results are compared with mass estimations performed with quiescent galaxies and also by means of weak-lensing analysis.

Insights into AGN variability from XMM-Newton transients

Richard Saxton

Most active galactic nuclei (AGN) have a nearly constant radiation output, at least over a timescale of decades. In the 1990's the ROSAT satellite found a small number of AGN whose X-ray flux was seen to change by two orders of magnitude within a few months or years. At the time, the nature of this variability was never satisfactorily explained, partly due to the limited spectral resolution and bandpass of ROSAT and partly due to the lack of contemporaneous observations taken in other wavebands. Here we present highly-variable sources observed by XMM-Newton which appear to show a new AGN mode where X-ray emission comes mainly from the accretion disk. Transitions between this, presumably short-lived, mode and a stable AGN configuration, where X-rays are believed to be produced by compton-upscattering of thermal photons, helps to explain the observations made by ROSAT 20 years ago.

The most complete and detailed x-ray view of the SNR Puppis A

Michael Smith

Puppis A is a nearby extended galactic Supernova Remnant (SNR), approximately 4000 years old and one of the brightest SNRs in the X-ray sky. Despite the rich nature of this remnant, which includes a central compact object (CCO RX J0822-4300), relics of the pre-supernova and traces of the interaction between the SN shock and the surrounding gas, until recently the X-ray coverage of this source was surprisingly limited. We report on the first full and detailed view of Puppis A in the 0.3 keV – 8.0 keV energy band. Images of the remnant were produced from the combination of two new XMM-Newton pointings towards the missing southern extent with 59 archival XMM-Newton EPIC and Chandra ACIS observations. The X-ray, radio and IR emission is compared across the full remnant.

A Herschel/HIFI legacy survey of HF in the Galaxy

Paule Sonnentrucker

Diffuse molecular clouds are transitional objects that form the link between the diffuse atomic medium and dense molecular clouds. As a result, diffuse molecular clouds play a crucial role in the lifecyle of the interstellar medium and their study is critical to advancing our understanding of how molecular clouds form from the diffuse medium. Diffuse molecular clouds also provide a relatively simple laboratory in which we can study a variety of physical and chemical processes of broad applicability in astrophysics. Due to their intrinsically low opacities, diffuse molecular clouds can be observed over a wide wavelength range from FarUltraviolet to the radio. Small (diatomic and triatomic) hydrides are important tracers of the diffuse interstellar medium physics and chemistry. Possessing small momenta of inertia, these hydrides have highfrequency rotational transitions that are difficult or impossible to observe using ground-based observatories. HERSCHEL/HIFI Key Program PRISMAS (PI, M. Gerin) was aimed at surveying key hydrides within the Galaxy. This work focusses on two particular hydrides, HF and H_2O, and combines PRISMAS, WISH and Herschel Cycle 2 data. We present the most complete survey of HF in our Galaxy. The exquisite spectral resolution obtained with HIFI allows us to compare the HF distribution (a tracer of H2) with the distribution of gas-phase water in a large number of discrete diffuse molecular clouds. While the water to HF ratio is found to be relatively constant throughout the Galaxy, local variations by up to a factor of two are measured. Our observations corroborate theoretical predictions that the water abundance is variable in diffuse molecular clouds as it depends on the local cloud conditions. Our measurements also constitute a unique sample against which to test our understanding of the production of oxygen-bearing molecules in cold diffuse molecular clouds.

Exoplanets and pulsation: what stellar oscillations tell us about exoplanets

Anamarija Stankov

In 2013 the existence of more than 900 extra solar planets has been confirmed. The study of these planets and their planetary systems relies on precise values of parameters of the parent star like mass, age, radius, gravity, ... Asteroseismic studies (measurements of oscillation frequencies, amplitudes, ...) are an excellent tool to provide these values by constraining the modelling of stellar interiors, and improve the understanding of stellar evolution. The discovery of exoplanets with the transit method and asteroseismology both use the same technique, i.e. high-precision photometric time series observations. For space missions like Corot and Kepler this technique has already been successfully applied. Here we describe how these stellar parameters can be derived from their observed oscillations.

F.R. Moulton and his plans for a new lunar theory

Craig Stephenson

At the beginning of the 20^{th} century Forest Ray Moulton was arguably the leading mathe-

matical astronomer in the United States. During his approximately 30 years at the University of Chicago, Moulton wrote several introductory books on astronomy and celestial mechanics and is nowadays remembered amongst astronomers as being the co-author of the Chamberlin-Moulton planetesimal hypothesis. However, Moulton's main interest was the three-body problem and much of his research was aimed at gaining an understanding of it through the study of its periodic solutions. It is on these investigations, which began with his 1899 PhD thesis and which culminated over 20 years later with the publication of his book *Periodic Orbits*, that this talk is focused. After giving a brief introduction to Forest Ray Moulton, I will use his correspondence with the Carnegie Institution of Washington to tell the story of *Periodic Orbits*' long (11-year) road to publication and to show how the research this book contains was initially motivated by his desire to construct a new lunar theory. I will attempt to throw some light on his planned theory and to say something about the mathematical techniques which he employed throughout his research.

What to do with data of 3 million sources

Antonio Talavera

The XMM-Newton serendipitous visible and ultraviolet source survey catalogue (SUSS – a.k.a. OM catalogue) in its second release will contain 3.5 million of unique sources. More than 600 000 of them have repeated observations along more than 12 years of mission. We present a few examples of utilization of these data, fully corrected and absolute flux calibrated.

Time variability of thermal molecular emission in IRC + 10216

David Teyssier

We present the result of a monitoring of the molecular emission in the C-rich AGB star IRC+10216 over 3 years with the Herschel Space Observatory. Rotational transitions of various vibrational levels of CO, ^{13}CO, CS, CCH, H_2O, SiO, SiS, SiC_2, HCN and HNC (among others) have been collected with the HIFI, PACS and SPIRE instruments over respectively 6 (or 7), 7 and 8 epochs. Together with those data, synchronized observations have also been obtained in low excitation transitions of the same species at the 30-m telescope. While IRC+10216, like all Mira-type stars, shows significant amplitude modulation in the visible and the IR (e.g. 2 mag in the I band over a period of 635 days, Alksnis et al. 1989), variation in the rotational levels of many of those molecular species (excited mainly through collision) was shown to be negligible, especially in the outer shell (Cernicharo et al. 2000). With Herschel probing more inner layers of the envelope, the intensity monitoring shows strong and periodic variations of most of the observed molecules (in excess of 1000 % in e.g. CCH), often with differential behaviour depending on the transition level (larger variation at higher J), and generally enhanced oscillation in the vibrational modes of some of these molecules (e.g. HCN). As expected, the intensity modulation exhibits a time lag compared to the IR light-curve, allowing to infer the typical distance to the star of the zone contributing the most to the considered line emission. These results show that the effect of IR pumping through the different vibrational levels on the emergent line profiles of a given transition can

be really significant. This implies that the IR radiation field of circumstellar envelopes and its time variation has to be taken into account in any radiative transfer model in order to derive accurate physico-chemical structure of the envelope. In this contribution I will give an overview of the variation profiles of several molecules and discuss the role of IR pumping jn the line emission in the submm regime.

Global cloud morphology at different altitudes from multi-spectral imaging by Venus Express

Dimitri Titov

Simultaneous observations of Venus at wavelengths from the UV to the thermal IR with Venus Monitoring Camera and Visible and Infrared Thermal Imaging Spectrometer onboard Venus Express reveal relationships between the global cloud morphology at different levels in the Venus cloud deck. The UV view of Venus can be reasonably explained by the thermal structure and dynamics of the atmosphere. Mottled clouds at low latitudes indicate convective activity, which is supposed to bring the UV absorbers up from the depth making this region relatively dark. On the contrary, the thermal-IR images with the natural limb-darkening are very uniform, which means the absence of the local temperature variations at the cloud tops. The deep cloud structures seen at 1.74 µm are elongated along parallels and extend practically throughout the whole hemisphere. The near-IR brightness starts to decrease at 60° – 70° meaning the increase of the cloud optical depth. In the polar vortex, which is always warmer at the cloud top level than the surrounding cold collar, clouds are in average thinner. At about 60° the temperature inversions at the cloud tops in the cold "collar" region, which is perfectly seen on 5 µm images, prohibits the convection and the supply of the UV dark material from lower levels. Although the images taken by instruments onboard Venus Express in the UV, at 1.74 µm and 5 µm are essentially different, there is a definite correlation between them. The hot spiral arms that take their origin in the vortex can be seen on the dayside as dark UV features, which extends down to 50° latitude and even more, then continue again on the night side 1.74 µm image throughout the whole hemisphere and sometimes can be seen again on the dayside in the UV. Therefore these dark features are caused by the dynamical structures, which in the vertical dimension extend through the whole ~ 20 km cloud layer. It has been shown that the dark spiral arms do not correspond to gaps in the bright haze. Similarly, they are often dark in the near-IR meaning denser clouds.

Methane on Mars: What's the Deal?

Jorge L. Vago

Olivier Witasse

We will present a very brief overview of what is known (very little) and speculated (very much) about the possible presence of methane as a minor component (or trace gas) in Mars' atmosphere. We will then discuss what the implications would be, were the detection to be

confirmed, and conclude by describing the capabilities of the upcoming 2016 ExoMars Trace Gas Orbiter (TGO) to address this issue.

Significant overdensity of star-forming galaxies

Ivan Valtchanov

We report the serendipitous detection of a significant overdensity of Herschel-SPIRE 250 µm sources in the vicinity of MRC1138-26 – a well known protocluster of galaxies. The overdensity stands out at $> 5\sigma$ and no features of similar significance were found in four Herschel-observed extragalactic control fields: GOODS-North, Lockman, COSMOS and UDS. The chance of having a similar overdensity in a field with the same number but randomly distributed sources is less than 2 %. Our analysis, based only on the three SPIRE FIR bands, points towards an interesting possibility that a significant fraction of the sources in the clump may be at a similar redshift. Because the overdensity lies close to the Spiderweb protocluster we cannot rule out that it could be within the same large-scale structure. The very attractive but highly speculative interpretation is that we may be seeing for the first time a protocluster galaxies caught in their concurrent peak of vigorous star-formation.

A novel algorithm for source photometry of Herschel data: boloSource

R. Vavrek

G. Marton

The "boloSource" algorithm has been developed to subtract point- and compact sources from the diffuse background of large-scale Galactic maps observed by PACS and SPIRE photometers. This novel algorithm can produce suitable products for analysis of extended-emission and filamentary structures but it could also provide an alternative way of source photometry in highly confused regions. Preliminary tests confirmed the task can efficiently mitigate reconstruction artifacts of inversion mapping algorithms by filtering out bright sources or sharp features from the detector timeline.

Sources of electron pitch angle anistropy in the magnetotail plasma sheet

Andrew Walsh

We survey the properties of electron pitch angle distributions in the magnetotail plasma sheet at a distance between 15 and 19 R_E from the Earth, using data from the Cluster PEACE instrument. We limit our survey to those pitch angle distributions measured when the IMF had been steadily northward or steadily southward for the previous three hours. We find that, at sub-keV energies the plasma sheet electron pitch angle distribution has an anisotropy such that there is a higher differential energy flux of electrons in the (anti-) field-aligned directions. Fitting the measured pitch angle distributions with both a single and two component kappa distribution reveals that this anisotropy is the result of the presence of a second, cold, component of electrons that is observed more often than not, and occurs

during both the northward and southward IMF intervals. We present evidence that suggests the cold electron component has an ionospheric, rather than magnetosheath, source and is linked to the large scale field aligned current systems that couple the magnetosphere and ionosphere.

Spectroscopic airborne observations of the 2011 Draconids meteor shower outburst

Joe Zender

On October 8th, 2011, meteors from comet 21P/Giacobini-Zinner were predicted to outburst with expected rates of several 100 meteors per hour [1]. Based on the expected weather conditions in October, the interference of the Moon and the predicted location of the Draconid quadrant two Falcon aircraft took of in Kiruna, Sweden, before the predicted double peak to apply "double station" observations at an altitude of 13 km. This poster discusses the results obtained from the spectral airborne observations and confirm the expected main constituents of the Draconid meteors, with an early sodium release in the meteor event.

Observation and Data Reduction Two video cameras with spectral gratings were operated on the Falcon airplane provided from the German Space Agency: – IMCCE, equipped with a 12 mm lens, 30×40 degree field-of-view and 300 grooves/mm spectral grating – LCC1, equipped with a 50 mm lens, 22×28 degree field-of-view and 600 grooves/mm spectral grating. A multitude of chemical elements were identified, besides which the FeI, MgI and NaI lines.

Results The spectra obtained from the two cameras have similar characteristics: the sodium line starts to ablate early in the event indicting a fragile structure and early evaporation of the volatile material. The ratio values are slightly different than the ones observed during the 2005 Draconids(2), however within expectations (3).

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