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Abstracts

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Insights on the Zodiacal Cloud Dust Populations at Saturn from CASSINI-CDA

Nicolas Altobelli

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We report the detection of exogenic dust within the Saturnian's system by the Cassini-Cosmic Dust Analyser (CDA). We compare the dynamical signature of the detected grains with the signature expected for different dust populations at 10 AU, like particles originating upon collisions within the Kuiper Belt and drifting inward the Solar System under PR drag, cometary grains and interstellar dust. We aim with CDA data at providing new constraints on the relative contribution of these dust populations to the Zodiacal Cloud at 10 AU and a lower bound estimate of the exogenic dust mass flux in-falling into the Saturnian system.

Unveiling the Chamaeleon: Herschel's first-look at the filamentary structure in the Chamaeleon molecular cloud

Catarina Alves de Oliveira

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I will present the results on the study of the filamentary structure in the Chamaeleon molecular cloud complex unveiled by Herschel (Gould Belt Survey). Chamaeleon is one of the nearest star-forming sites. Its three main subclusters differ substantially in that Cha I has a stellar population of over 200 members, Cha II a smaller population of 60 young stellar objects, and Cha III hosts no young stellar object. By studying the large-scale structure across these regions we aim at combining the new results on the spatial and temporal properties of the filaments with the previously known properties of the cloud to understand why star formation occurs in only a small fraction of the available gas within large molecular clouds.

VOSpec v6.5: Multi-wavelength Spectral Analysis Tool and SED builder

Deborah Baines

J. Gonzalez; J. Salgado; I. Barbarisi; I. Leon; I. Ortiz; P. Osuna; C. Arviset

VOSpec is a multi-wavelength spectral analysis tool, developed by the Science Archives and VO Team at ESAC. It is designed to access and visualise spectra from worldwide facilities registered in the Virtual Observatory (such as XMM-Newton, HST, ISO, ESO and many others). The latest version of VOSpec (v6.5) was released this Summer and can access photometry services, in development, from the NASA/IPAC Extragalactic Database (NED) and CDS VizieR. Spectra in the Virtual Observatory (VO) can now be combined with photometric data from VizieR and NED databases to build combined Spectral Energy Distributions (SEDs) that fulfil new science cases. This presentation will describe the main functionalities of the latest release of VOSpec, and will show how the tool could be used to help achieve science cases for current and future ESA missions.

A surface thermal model to study comets and near surface layers of planetary bodies

Johannes Benkhoff

O. Witasse

Gas flux modeling has been used to investigate the chemical and physical behavior in near surface layers of planetary bodies including comets and asteroids. This study focuses on comets and Mars.

Comets are among the most pristine objects in the solar system and tell us about a lot about the formation and evolution history. One of the striking features of comet nuclei is their varied, often unexpected, behavior. Some exhibit outbursts when they are close to the Sun, others when they are far from the Sun. In this paper we focus on comets in orbits very closed to the sun (less than 0.1 AU). Why do some comets survive these extreme conditions?

Methane has been detected in the atmosphere of Mars by ground-based observations, Mars Express and MGS. Since then, its variability and origin remains a puzzle. Can methane be stable in the near subsurface of Mars over longer geological time scales, and be seasonally released?

Our near surface thermal model is capable of studying these questions by modeling comet nucleus outgassing processes as well as long time stability of less abundant volatile ice like methane in near surface layers of Mars.

The main features of the model are a high vertical resolution down to the centimeter range, the realistic treatment of the thermal properties of ice-dust/ice-rock mixtures, a detailed treatment of gas flux within the near surface layers and into the coma/atmosphere, and a variable temporal resolution which allows studying diurnal and annual variations.

The model allows studying the behavior of subsurface ices like water, CO_2, methane etc. on a timescale where the soil has not yet reached thermo-dynamical equilibrium. In the case of modeling Mars this approach allows studying "young" ice-related deposits, which might form in response to climate variations on short timescales as well as "old" persistent deposits. The presentation will describe the model and the assumptions, and will discuss the main outputs.

JWST/NIRSpec capabilities for exoplanet transit observations

Stephan Birkmann

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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 ∼0.6 to 5.0 micron, 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 arcsec × 1.6 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.

Atom Interferometry Measurement of the Newtonian Gravitational Constant: Status of the MAGIA Experiment

Luigi Cacciapuoti

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MAGIA is a gravity gradiometer based on a 87Rb cold-atom interferometer operating at the University of Firenze. The instrument is designed to perform a measurement of the Newtonian gravitational constant G to 100 ppm. MAGIA can currently reach a sensitivity of 300 ppm in half a day of integration time. We will present the recent progress of the MAGIA experiment and discuss the potential of atom interferometry for fundamental physics tests in space.

Review of Research Projects by INSA Employees at ESAC: INSA Virtual Labs

Alejandro Cardesin Moinelo

M. Sánchez Portal; I. de la Calle; A. Ibarra; R. Pérez Martínez

INSA personnel at ESAC provide high level technical and scientific support to ESA and in particular to the SRE-O Department for all Astronomy and Solar System missions. In order to improve and maintain the scientific and technical competences among the employees, an internal research group has been created with the name "INSA Virtual Labs", which supports and coordinates all the R+D activities carried out by INSA personnel at ESAC and aims to establish collaborations and improve synergies, not only with the ESA departments SRE-O and SRE-S, but also with other research groups, institutes and universities. The research community created within "INSA Virtual Labs" has actually established new bridges between existing ESA projects and other space agencies and research entities (NASA, INTA, etc). This represents a great means to improve the visibility of these activities towards the scientific community and serves as breeding ground for new innovative ideas and collaborations.

Serendipitous asteroid observations by OSIRIS/Rosetta

Benoit Carry

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In recent years, many efforts have been undertaken to extract the astrometry, photometry, and colors of Solar System Small Bodies from large surveys and wide-field camera, such as the SDSS Moving Object Catalog [1] or EuroNear [2]. Since 2006, the IMCCE provides a service, called SkyBoT [3], that list all the Solar System Objects in a given field of view for a given epoch. Such a tool is of high interest for any data mining purpose of large archives. We will present an extension of SkyBoT from ground-based to space-based geometries. As a demonstration, we will present our search for serendipitously observed asteroids in the data archive of the OSIRIS instrument on-board the ESA Rosetta mission.

[1] Ivezic et al., 2002: The SDSS MOC, SPIE 4836. [2] Vaduvescu et al., 2009: EURONEAR – Data Mining of Asteroids and NEAs, Astronomische Nachrichten 330 [3] Berthier et al., 2006: SkyBoT, a new VO service to identify Solar System objects, ASPC 351.

INSPIRE- A Future Mars Network Science Mission

Agustin Chicarro

Following ESA's successful Mars Express mission, European efforts in Mars Exploration are now taking place within ESA's Mars Exploration Programme, starting in 2016 with the Trace Gases Orbiter (TGO) focusing on atmospheric trace gases and in particular methane, and with the Entry and Descent Module (EDM). In 2018, an ESA rover will perform geological, geochemical and exobiological measurements of the surface and the subsurface of Mars. Both of these missions are being contemplated in collaboration with the Russian Space Agency (Roscosmos). A number of missions for 2020 and beyond are currently under technical and scientific study in ESA. Among those, a possible candidate is a Mars Network Science Mission (called INSPIRE) including three small landers with a robotic arm, to be launched on a Soyuz rocket and using direct communications to Earth, to investigate the interior of the planet, its rotational parameters and its atmospheric dynamics. These important science goals have not been fully addressed by Mars exploration so far and can only be achieved with simultaneous measurements from a number of landers located on the surface of the planet such as a Mars Network Science Mission. In addition, the geology, mineralogy and astrobiological significance of each landing site would be addressed, as three new locations on Mars would be reached by the surface stations. NASA's recently selected next Discovery-class mission (called INSIGHT) is to be launched in 2016 and represents a great precursor mission to a Mars Network Science Mission with only one lander. A mission such as INSPIRE has

been considered a significant priority by the planetary science community worldwide for the past two decades. A Mars Network Science Mission has a long heritage and demonstrated feasibility. A larger Mars Network including more than three stations, could be put in place through international collaboration (e.g., including Japan, Russia, China, USA).

How long does mass accretion last in young stars?

Nicola Da Rio

Mass accretion rates in young stars are useful to trace the temporal evolution of the circumstellar disks dispersal, which is critical for planet formation. Unfortunately, we are not good at measuring ages for young stars, since several physical and observational uncertainties (variability, differential extinction, flux excesses due to accretion itself) severely bias the estimated stellar parameters. Even worse, the measured mass accretion rates also depend on these stellar parameters. I present a detailed statistical analysis of these processes. I find that assuming the realistic overall extent of uncertainties, the real temporal decay of mass accretion in young stars must drop twice as fast as previously assumed. I will show these results and discuss the astrophysical implications.

Radial velocities for the Hipparcos-Gaia Hundred-Thousand-Proper-Motion project

Jos de Bruijne

C. Eilers, ESTEC

The Hundred-Thousand-Proper-Motion (HTPM) project will determine the proper motions of ∼113 500 stars using a ∼23-year baseline. The proper motions will be based on the Hipparcos data as first epoch (1991.25) and the first intermediate-release Gaia astrometry, with epoch ∼2014.5, as second epoch. The expected HTPM proper-motion standard errors are 30-190 muas/yr, depending on magnitude. Depending on the astrometric characteristics of an object, its radial velocity can have a significant impact on the determination of its proper motion. The impact of this perspective acceleration is largest for fast-moving, nearby stars. We determine, for each star in the Hipparcos catalogue, the radial-velocity standard error that is required to guarantee a negligible contribution of perspective acceleration to the HTPM proper-motion precision. We find that for nearly 100 stars, the radial velocities available in the literature are insufficiently precise. We also identify more than 100 stars for which radial velocities are currently unknown yet need to be acquired.

SWAP/PROBA2 observations of the large-scale, long-term evolution of the EUV corona

Anik De Groof

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PROBA2/SWAP is an EUV telescope that monitors the solar corona at 17.4 nm. SWAP's 54 ' × 54 ' field-of-view provides a unique view of large, EUV-emitting, coronal structures with heights up to approximately 2 solar radii. The aim of the present work is to analyse the evolution of the extended corona on long timescales. For that purpose, we generate high-quality, deep-exposure SWAP images by stacking many individual images obtained at relatively high cadence. We focus on large-scale, extended coronal EUV structures which appear mainly above or at the edges of active regions and can persist for multiple Carrington rotations. Here we present a first analysis of the extent and evolution of large-scale EUV structures since the beginning of the PROBA2 mission early 2010.

Broadband Long-Term Variability of VHE Blazars: the case of Mrk421

Ignacio de la Calle

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In recent years, more and more focus has been placed in broadband studies of blazars as a way to understand the mechanisms responsible for the acceleration of ultra-relativistic particles in these objects. The proposed work aims at addressing these questions by studying the long-term lightcurve of TeV Blazars by putting together archive multiwavelength data of a small sample of TeV Blazars. The study will focus on variability studies over different timescales and the dependence of this variability with parameters such as flux and energy.

This work is still in progress, and ultimately, the aim is to provide a systematic study of the variability of Blazars by first applying statistical tools to the case of the TeV Blazar Mrk421, and then by further extending this work to other Blazars in order to infer their physical properties from a statistical context.

Recent star formation in the Magellanic Clouds

Guido De Marchi

We have undertaken a systematic study of pre-main-sequence (PMS) stars spanning a wide range of masses (0.5–4 Msun), metallicities (0.1–1 Zsun) and ages (0.5–30 Myr). We have used the Hubble Space Telescope to identify and characterise a large sample of PMS objects in several star forming regions in the Magellanic Clouds, namely 30 Dor, the SN1987A field and NGC1850 in the LMC and NGC 346 and NGC 602 in the SMC, and have compared them to PMS stars in similar regions in the Milky Way, such as NGC 3603 and Trumpler 14.

Thanks to a novel method that we have developed to combine broad-band (V,I) photometry with narrow-band Halpha imaging, we have determined the physical parameters (temperature, luminosity, age, mass and mass accretion rate) of more than 3000 bona-fide PMS stars still undergoing active mass accretion. This is presently the largest and most homogeneous sample of PMS objects with known physical properties and it includes not only very young objects, but also PMS stars older than 10–20 Myr that are approaching the main sequence.

I will present the main results of this research, including the fact that mass accretion rate appears to scale with the first power of the stellar mass, with the square root of the age, and approximately with the inverse of metallicity and it is therefore systematically higher in the Magellanic Clouds than in the Milky Way for stars of the same mass and age. These results are bound to have important implications for, and constraints on our understanding of the star formation process.

Observation strategies for Cosmic Microwave Background experiments

Xavier Dupac

We present some possible sky scanning strategies for Cosmic Microwave Background experiments. Such experiments largely aim at covering the whole sky or a significant part of it, with the challenges corresponding to such endeavor. In particular, orbital (for space experiments) or geographical (for groundbased or balloon-borne experiments) constraints make it difficult to observe the sky in a smooth and uniform way. Additionally, depending on the instrument characteristics, noise and systematics control may demand some particular types of observation strategies. We shortly describe the Planck scanning strategy and we discuss other sky surveying strategies used for past CMB balloon-borne experiments, and possible conclusions to be drawn for future experiments.

Study of the Galactic magnetic field using the PLANCK satellite data

Lauranne Fauvet

J. Tauber, ESTEC; J. Fransisco Macías-Pérez, LPSC Grenoble, France; T. Jaffe, IRAP Toulouse, France; A. Banday, IRAP Toulouse, France

The PLANCK satellite is an ESA mission, launched the 14th of May 2009. It is providing measurement of the CMB anisotropies, both in temperature and polarization over the full-sky with an unprecedented accuracy. These measurements will allow us to constrain the cosmological parameters describing the dynamic and content of the Universe. In particular the study of the BB modes could give an access to information regarding the inflation period. This level of accuracy will be reachable in function of our ability to minimize the signal contamination due to Galactic polarized foregrounds. In this context we have developed and implemented a 3-D joint model of the two main polarized Galactic diffuse emissions : synchrotron and thermal dust emissions. We constrained the parameters of this model by comparison with the preexisting data from WMAP, ARCHEOPS and the 408 MHz all-sky continuum survey. We where then able to estimate the bias due to these foreground emission on the angular power spectra of the primordial BB modes. PLANCK covers a large range of frequencies from 25 GHz to 1 THz and therefore is able to give a measurement of the foreground emissions. In particular, because of its 7 polarized channels it will for the first time allow the simultaneous precise measurement of the main polarized Galactic emissions: synchrotron and thermal dust. We then explored the ability to constrain the Galactic magnetic field intensity and spatial distribution of matter with the incoming data from the PLANCK satellite experiment.

Solar image compression in view of the Solar Orbiter mission

Catherine Fischer

D. Müller, ESTEC, ESA

Solar Orbiter, being a deep space mission, has a very restricted telemetry rate that makes on-board data compression a necessity to achieve the mission's science goals. Missions like the Solar Dynamics Observatory (SDO) and future ground-based telescopes as the Advanced Technology Solar Telescope, on the other hand, face the challenge of making petabyte-sized solar data archives accessible to the solar community. New compression standards such as JPEG2000 make this possible by providing efficient, highly flexible and selective compression schemes adaptable to user requirements. In this study we analyze solar images from Hinode and the SDO with the aim to optimize the compression bit rates for solar images with respect to the science content of the data. We test the suitability of quality measures in assessing solar image quality. The structural similarity index (SSIM), for example, is a quality measure optimized for the human eye conception and was chosen as a large part of solar research still relies on the visual inspection of solar data and manual event selection as a first step. In addition, we perform tests to validate the scientific use of the compressed images by applying feature identification analysis methods such Coronal Loop oscillation analysis.

Comparative planetology and astrobiology

Bernard Foing

We review recent results obtained in Comparative planetology and astrobiology. This includes the study of volcanic, tectonic, petrology and impact processes in the Moon, Mars and the Earth. We have analysed data from SMART-1, LRO , Mars Express and MRO, and from terrestrial analogue campaigns. We also discuss astrobiology results on large organics in space and planets. These results were obtained in collaboration with colleagues from ESTEC, Vrije Universiteit, Leiden, NASA Ames and other universities.

What are the required next steps in Exoplanetology?

Malcolm Fridlund

With over 800 known exoplanets and new ones being added on a daily basis it is high time to take stock and see if the promised goal of "carrying out comparative planetology and put our own Solar System into context" have been carried out or at least being started upon.

It appears that the major result of 15 years of exoplanetary research is the enormous diversity found in eco-systems as what concerns size's of planets, numbers of planets and their distribution within the systems. All signs are pointing towards a fair fraction of main sequence stars between spectral classes A to M possessing planets. An obvious next step is to correlate the diversity found within systems with observations of star forming regions (e.g. with ALMA interferometer) in order to make the connection between observations and mechanisms of formation. This can be done and we are stating here some possible avenues to follow in the near future.

On the other hand, detailed studies and modeling of exoplanets themselves are hampered by a lack of high precision data. The problem is that the best data available have been acquired through transit observations from space and radial velocity observations from the ground. In both cases the observations provide high precision (ppm accuracy) observations of the planetary radii as well as masses. Unfortunately, these two absolutely necessary parameters are then expressed in terms of the host stars mass and radius which are only known to accuracies of $\sim$10 % – which is not enough to carry out the comparative planetology. As what concerns the ages of main sequence stars as calculated form present models the errors are typically of order 1 to several gigayears! An obvious remedy is to use the new technology of asteroseismology as suggested e.g. in the PLATO mission. This technique promises delivering radii and masses with precisions of order $\sim$1 % as well as ages to a precision of a few hundred Myrs

Ground based observations of Kepler planetary candidates

Davide Gandolfi

Based upon the analysis of the first sixteen months of photometric data, the Kepler team has recently announced more than two thousand transiting planet candidates. Although those objects have been accurately vetted for astrophysical false positives using Kepler photometry, they remain planetary candidates and deserve further investigations, which include ground-based observations. We will present some preliminary results from our photometric and spectroscopic follow-up of Kepler candidates we recently started in La Palma.

Herschel spectroscopy of proto-planetary and planetary nebulae

Pedro Garcia-Lario

E. Verdugo, ESAC

We present the preliminary results of a Herschel/PACS Spectroscopy study of a sample of proto-planetary and planetary nebulae displaying a wide variety of dust and gas chemical properties at optical and near- to mid-infrared wavelengths. The goal of this study is to explore the far infrared properties of evolved stars with different chemical composition and establish connections with their observational properties at other wavelengths as a function of their mass and evolutionary stage. The complementary information obtained at Herschel/PACS wavelengths is used to advance on the understanding of the physical and chemical processes which take place in these stars at the end of their evolution and to determine their contribution to the chemical evolution of the ISM in different metallicity environments.

Shape from shading under Titan's sky

Bjoern Grieger

During the Descent of the Huygens probe towards Titan's surface, the Descent Imager/Spectral Radiometer (DISR) aboard the probe took about 400 images. About half of these were taken with low enough altitude and emission angle to show surface features through the optically thick atmosphere. Soderblom et al. (2007) used two stereo pairs of images to photogrammetrically reconstruct the surface topography of two small patches.

Here, we investigate the possibilities to retrieve the surface topography of a larger portion of the landing site region by means of shape from shading. We base the reconstruction on the stitched image mosaic which has been put together by Karkoschka et al. (2007). In order to model the diffuse illumination from Titan's sky, we employ the results of radiative transfer computations by Tomasko et al. (2008).

Stewart and Langer (1996) have developed an algorithm to retrieve shape from shading under perfectly isotropic illumination. We have generalized this algorithm for the case of diffuse — but non-isotropic — illumination as present under Titan's sky.

It has been argued that the darker "river beds" within the brighter areas contain deposits of the same material that makes up the darker areas, however, Keller et al. (2008) have shown that the magnitude of darkening observed in the river beds could also be caused just by topographic shading due to moderate terrain. We present a digital terrain model which has been reconstructed by means of shape from shading under the assumption that there is no dark material in the river beds and which is consistent with the observed surface brightnesses. The results are compared with a stereo-reconstruction by Soderblom et al. (2007).

X-ray tomography of Active Galactic Nuclei

Matteo Guainazzi

A number of different techniques exist in the radio, IR and X-ray energy bands to constrain the size of active nuclei, as well as the geometry of circumnuclear gas and dust. To put things in context, we are now able to resolve spatial scales of the order of the Astronomical Units in objects distant hundreds Mpc away. The ESAC AGN Group has led some of these experiments in the X-ray band. I will present a summary of our results as well as of their implications for our understanding of the active galaxy innermost structure.

The Dust Lane in Edge-on Spiral Galaxies.

Benne Holwerda

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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 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 slated to be observed. Complementary to these far-infrared and sub-mm observations, a survey of dust lanes in SDSS by the GalaxyZOO2 citizen science project sheds more light on

dust lane frequency in local edge-on spirals. And in the HST COSMOS imaging, the communality of dust lanes in massive edge-on spirals can be explored to higher redshift ($z \sim 1$). I present the first results from both these projects.

The effect of radially dependent disc ionisation on black hole reflection spectra

Prashin Jethwa

Reflection spectra originating from black hole accretion discs offer a way to measure the black hole spin, in both the stellar-mass binary and AGN regimes. The form of the reflection spectrum depends on the ionisation parameter of the disc, which in turn depends on disc density and strength of the ionising radiation. Using multiple prescriptions of the radial dependence of both the disc density and ionising radiation – arising from physical considerations such as the presence of a magnetic field and the geometry of the irradiating source – we present reflection spectra from accretion discs with radially dependent ionisation. We then go on to perform a systematic analysis of the consequences of interpreting such spectra with the currently employed simplifying assumption of constant disc ionisation.

Detection of X-ray emissions during eclipses of the Cataclysmic Variables Z Cha, HT Cas and OY Car

Simon Joyce

P. Wheatley, Warwick University, UK

We present analysis of X-ray and optical observations made by XMM-Newton. The cataclysmic variable systems Z Cha, HT Cas and OY Car are eclipsing systems which gives us a chance to search for residual X-ray emission while the white dwarf and boundary layer are eclipsed. X-rays are detected during the eclipses of all 3 systems in the 0.2–1.4 keV range. The X-ray luminosity of the in-eclipse sources is estimated at $1.97–3.35 \times 10^{28}$ ergs/s. In all 3 systems the in-eclipse source is much softer than the out-of-eclipse source.

We discuss the possible origin of these emissions such as the corona of the secondary star and the accretion disk bright spot. Application of the (X-ray) activity-rotation relation shows that the detected in-eclipse sources are beyond the $L_{\rm bol} = 10^{-3}$ saturation limit. However, comparison with observations of rapidly rotating M-dwarfs, pre-CVs and CSPN shows that there are a number of systems which are observed to break the 10^{-3} saturation limit and the in-eclipse emission is consistent with the ob- served range of LX for these systems. The results suggest that the most likely source of the in-eclipse X-rays is coronal emission from the secondary star. We show that the bright spot is not a significant source of in-eclipse X-rays during these observations. The in-eclipse emission was not found to be consistent with scattering of boundary layer X-rays by surrounding material.

The effects of Solar Cycle 24 on Herschel

Mark Kidger

Miguel Sanchez-Portal, Herschel Science Centre; Alexi Glover, Space Situation Awareness

Herschel was launched at minimum between Sunspot Cycle 23 and 24, taking up station around the Sun-Earth L2 point, outside the protection of the Earth's magnetic field, at a time when the cosmic ray flux was unusually high. Since launch solar activity has been building towards the maximum of Sunspot Cycle 24. We examine the space environment as characterised by sunspot numbers, Solar Proton Events and Herschel's SREM radiation counters and the influence, if any, of solar activity on the observed rate of SEUs in the Herschel instruments.

Scientific computing using FPGAs: high performance centroiding

Ralf Kohley

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Field-Programmable Gate Arrays (FPGAs) have found its way to many scientific applications. These devices are very attractive to solve problems when high computing power, real time and deterministic behaviour and parallel computing are required. In addition their small weight, low power consumption, in-situ reprogrammability and availability of radiation-hard variants make them very interesting for space.

A SRE-OD research project is presented that aims to build core competences within ESAC to provide scientific operations support for FPGAs. To this purpose a single problem of scientific computing in FPGAs is studied: multiple centroid determination within milliseconds at the level of the Crámer-Rao lower bound (maximum precision), which has already been demonstrated for single objects within the Gaia mission. Successfully implementing the technique has many potential applications, from spacecraft high performance attitude control to adaptive optics.

Light curves from a permanent meteor camera station in the Canary Islands

Detlef Koschny

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Introduction: ESA's Meteor Research Group has recently installed a double-station meteor camera setup on the Canary islands called CILBO (Canary Island Long Baseline Observatory) which is using intensified video cameras. This presentation will give first results of this setup.

Observational setup: Two meteor camera stations were installed on the Canary islands, Spain, in 2011. One station is located close to the Optical Ground Station, ESAs 1-m telescope on Tenerife at Izaña Observatory (CILBO-T). The other one is located close to the Automated Transit Circle of the observatory on La Palma (CILBO-L). CILBO-T houses two camera systems with DEP-1700 image intensifiers fiber-coupled to the CCD of a Sony PAL video camera. A Fujinon 25 mm f/0.85 lens (used at f/1.2) yields a field of view of $22\,\mathrm{deg}^2 \times 28\,\mathrm{deg}^2$. The cameras record stars down to ca. 7 mag; the estimated fainted meteor magnitudes are around 5 mag, depending on the apparent velocity. One of the cameras is equipped with a Zeiss objective grating (651 lines/mm) to obtain spectra of the brightest meteors. CILBO-L houses an identical camera system. The cameras are pointed such that they allow double-station observations of a point half way between the two islands in 100 km altitude. Combining the data of the two systems will allow trajectory and orbit determination. The cameras are mounted in an automated roll-off roof. A weather sensor determines cloud conditions, rain, and wind. A scheduling software controls the setup such that operations is fully autonomous.

First results: The complete system has been operational since December 2011. A typical night without any major showers yields about 60 to 80 meteors. In the month of January 2012, the camera at CILBO-T detected more than 1200 meteors. Three meteors were found to have a double peak, i.e. after a first maximum and a subsequent brightness decrease, the brightness increased again. A significant number of meteors show a very unsymmetrical light curve with the brightest point at the onset of the meteor. This indicates very fragile meteoroids. In this paper, we will provide a first analysis of the measurements obtained so far, in particular focussing on the light curve properties of the observed meteors.

Conclusions: We have successfully set up a permanent meteor observatory studying meteors in the magnitude range down to about 5 mag in the Canary islands. The setup will allow determining orbits, light curves as a function of height, and, for the brightest objects, allow spectral analysis. In this paper we present first results focusing on the light curves of sporadic meteors.

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ALMA observations of molecular gas in the oldest gaseous debris disk system HD 21997

Ágnes Kóspál

Circumstellar disks are fundamentally important components of the star formation process, first as reservoirs for mass accretion, then as birthplaces of planetary systems. These disks thought to evolve from gas-dominated primordial disks to debris dust disks on the timescale of less than 10 million years. In debris disks, only a very small amount of gas is expected, and indeed, only a few debris disks with a detectable gas component are known. Recently, our group discovered that the 30 million years old HD 21997 system contains a surprisingly large amount of CO gas. The disk was selected for a detailed study with ALMA, the Atacama Large Millimeter/submillimeter Array, during its very first cycle of science operations (PI: Á. Kóspál). In this talk, I will present these new interferometric molecular gas observations. With ALMA, we were able to detect spatially and spectrally resolved CO emission from HD 21997, indicating that the molecular gas is located in a disk in Keplerian rotation around the central star. Not only ^{12}CO, but ^{13}CO and C^{18}O were detected as well, pointing to a much larger amount of gas than previously thought. The peculiar line ratios between the different transitions and isotopologues suggest special conditions in the disk. The observations may finally help to understand whether the observed gas is the leftover of the primordial disk or is of secondary origin being produced by colliding and outgassing planetesimals.

The Galactic bulge as a Christmas tree: results from almost 10 years of INTEGRAL monitoring

Erik Kuulkers

The central region of our Milky Way, the Galactic bulge, is a rich host of variable high-energy X-ray and gamma-ray point sources. These sources include bright and relatively faint X-ray transients, X-ray bursters, persistent neutron star and black-hole candidate binaries, high-mass Xray binaries, etc.. Since 2005 INTEGRAL monitors the Galactic bulge region regularly and frequently, whenever it is observable. As a service to the scientific community the high-energy light curves of sources in the field of view, as well as the images of the region are made available through the WWW at `http://integral.esac.esa.int/BULGE/` as soon as possible after the observations have been performed. Moreover, the data are made publicly immediately. We show the ongoing results of this exciting program, and focus on the transient population. Since the bulge never looks the same, it stays a region to be watched.

Astrometry of near-by stars – Improvements gained by combining data from the space missions Hipparcos, Nano-JASMINE and Gaia

Uwe Lammers

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Starting in 2013, Gaia will deliver highly accurate astrometry data which eventually will supersede most other stellar catalogues in accuracy and completeness. It is, however, limited to observations from magnitude 5.7 to 20 and will therefore not include the brightest stars. Nano-JASMINE, an ultra-small Japanese astrometry satellite, will observe these bright stars, but with much lower accuracy. Hence the Hipparcos catalogue from 1997 will likely remain the main source of accurate distances to bright nearby stars. We are investigating how this might be improved by optimally combining data from all three missions in a joint astrometric solution. This would take advantage of the unique features of each mission: the historic bright-star measurements from Hipparcos, the updated bright-star observations from Nano-JASMINE, and the very accurate reference frame of Gaia. The long temporal baseline between the missions provides huge benefits for the determination of proper motions and possible binary detection of the brighter stars, while the improvment in parallaxes is less substantial. We present a quantitative analysis of the expected gains based on simulated data for all three missions.

Three Principles of Multiplicity in Stellar Dynamics

Nathan Leigh

Within the last few years, observational surveys have revealed that high- order multiple-star systems (e.g. triples, quadruples, etc.), are common in our Galaxy. In this talk, we consider the dynamical significance of this transformation in our understanding of stellar multiplicity. To this end, we present and justify three principles of multiplicity for stellar dynamical interactions. These can be succinctly stated as follows: (1) The average cross-section for dynamical encounters increases with increasing multiplicity; (2) The total energy of an encounter on average decreases with increasing multiplicity; and (3) The probability of a direct physical collision occurring between two stars during a dynamical encounter increases with increasing multiplicity. The key consequence that arises from these principles is that, for surprisingly low number fractions, dynamical interactions involving high-order multiples can occur more often than encounters involving either single or binary stars, particularly in low-mass star clusters. Consequently, high-order multiples could be more important than previously realized for a number of astrophysical phenomena, including the formation and destruction of compact binaries and various types of stellar exotica, the dynamical evolution of star clusters, and the production of high-velocity escapers during resonant encounters.

The Planck Legacy Archive

Rodrigo Leonardi

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The European Space Agency (ESA) is charged with implementing the astronomical archive which makes available Planck data products to the world-wide community for their scientific exploitation (e.g. Tauber et al. 2010). ESA is fulfilling this obligation via the Planck Legacy Archive (PLA), which already is the official public repository of the Planck Early Release Compact Source Catalogue (ERCSC), and which will progressively include further data as proprietary periods end. In this poster contribution, we review the current status of the PLA, and we anticipate some of the functionalities that are expected in upcoming Planck data releases.

Galactic Evolved Massive Stars Discovered by Their Infrared Emission

Anthony Marston

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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 colors from 1.25 to 8 μm for a large fraction of the inner Galactic plane. In 2005 we had initiated a pilot study of the combined set of infrared colors for early-release GLIMPSE fields and show that WRs typically occupy a sparsely populated region of the color space. (This has also subsequently been demonstrated by our work in Hadfield et al. [2007, MNRAS, 376, 248] and Mauerhan et al. [2009, PASP, 121, 591].) We had an opportunity to follow up 42 of our WR candidates spectroscopically in the near-infrared, with limited additional observations of some of these candidates in the optical. Six new WRs, four late-type WN and two late-type WC stars, were discovered as a result. Of the remaining ∼86% of the sample, five appear to be O-type stars. 21 stars are likely of type Be, and 10 stars appear to be of late-type, or possibly young stellar objects, which have "contaminated" the infrared color space. The survey is generally unbiased towards clusters or field stars, and the new WRs found are in both the field and in and around the RCW 49 region (cluster Westerlund 2). In this work, and in our other

recent work, we show that the infrared broad-band colors so far to be the most efficient means of identifying (particularly, dust-obscured) candidate WRs.

Raditladi and Rachmaninoff basins: Age Analysis and Numerical modelling

Elena Martellato

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Mercury hosts the largest population of peak-ring basins among all the rocky planets and satellites of the Solar System. Among the database of such structures, we have taken into analysis two recently imaged peak-ring basins, Raditladi and Rachmaninoff, both located in the northern hemisphere and both about 300 km in diameter. In this work, we will present the state of art regarding the age analysis performed in these two basins. The results point to a very young age for both studied basins. This is a challenge in the understanding of the impactors source, because assuming a NEO-like population, only few objects are eligible for the formation of basins with so large dimensions. This overview shows why Raditladi and Rachmaninoff deserve a follow-up in the investigation. The main goal of this contribution is therefore to present the results of the numerical modeling of the impact events that originated these two peak-ring basins. The projectiles responsible for Rachmaninoff and Raditladi formation are found to be in the range of 13–16 km. My best-fit model reproduces both the rim and peak/ring diameters derived from DTM profiles, whereas the depth of the final crater is overestimated, suggesting that one has to take into account other acting mechanisms, like dilatancy or melt production.

Acknowledgements We gratefully acknowledge the developers of iSALE, including Gareth Collins, Kai Wünnemann, Boris Ivanov, Jay H. Melosh, and Dirk Elbeshausen (see `http://www.iSALE-code.de`).

Orbital observations of meteors in the Martian atmosphere using the SPOSH camera

Jonathan McAuliffe

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We investigate the expected performance of a wide-angle camera in Martian orbit, which, unlike previous cameras that have flown to Mars, is capable of recording meteor activity in that planet's atmosphere. We show that, based on our current understanding of meteor physics and the interplanetary meteoroid population, several meteors will be detected by this instrument during a single nightside pass on a low Martian orbit. The instrument will also record the signatures of meteor showers expected to occur every Martian year (1.88 Earth years). The results of this investigation will test models of the flux of "'large" (mm–cm) meteoroids at the orbit of Mars and their interaction with the Martian atmosphere.

Epsilon Indi B: ten years on

Mark McCaughrean

Since its discovery ten years ago as a very nearby brown dwarf and its resolution into a pair of brown dwarfs a year later, we have been observing the Eps Indi Ba,b binary system ever since. These observations include detailed optical-infrared photometry and spectroscopy primarily for atmospheric characterisation, relative and absolute astrometric monitoring in order to measure the system and individual dynamical masses, and high-resolution spectroscopic monitoring of Eps Indi A, the K5V primary star, in order to determine the system age via

asteroseismology. I will present a synthesis of our results to date and discuss how these key template objects can provide constraints on our current understanding of brown dwarfs.

Unveiling the formation of stars and planets in Chamaeleon with Herschel

Bruno Merin

E. Winston, ESTEC; L. Spezzi, ESO; L. Matra, ESAC; A. Ribas; C. Alves de Oliveira, ESAC; T. Prusti, ESTEC; A. Kóspál, ESTEC; R. Vavrek, ESAC; E. Puga, ESAC

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. (2012) 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.

A new Herschel view of the young star T54: not a transitional disk?

Bruno Merin

L. Matrà; C. Alves de Oliveira; N. Huélamo; A. Kóspál; N.L.J. Cox; A. Ribas; E. Puga; R. Vavrek; P. Royer; T. Prusti; G.L. Pilbratt; P. André

Context. Observations of transitional disks give us an understanding of the formation of planets and planetary systems such as our own. But care must be taken in the identification of such sources: the higher spatial resolution of the Herschel Space Observatory provides a new view on the origin of the far-infrared and sub-millimeter excesses observed.

Aims. We review the nature of previously known transitional disks in the Chamaeleon I star-forming region with Herschel data.

Methods. We analyze Herschel PACS and SPIRE images of the young star T54 together with ancillary images. We also analyze its spectral energy distribution and indications from optical and mid-infrared spectroscopy.

Results. We detect extended emission in the PACS 70 µm image ~ 6 " off source at a position angle of 196° from T54. The emission detected at longer wavelength (PACS 100, 160, SPIRE 250 and 350 µm is also offset from the position of the star. This suggests that the excess observed in the far-infrared part of the SED is not fully associated with T54. Conclusions. Herschel images show that the far-infrared excess seen in T54 is not due to a transitional disk but to extended emission south-west of the source. The object still shows point-like and now downscaled excess at mid-infrared wavelengths, but its origin cannot be constrained without higher spatial resolution data. However, different indications point towards an evolved disk or extended unresolved emission close to the source.

Herschel observations of transitional disks in Chamaeleon, evidence for non-standard outer disks

Bruno Merin

A. Ribas; B. Merin; L. Matrà; C. Alves de Oliveira; E. Winston; L. Spezzi; R. Vavrek; E. Puga; H. Bouy; D. Ardila; N. Huelamo; N.L.J. Cox; A. Kóspál; T. Prusti; G.L. Pilbratt; P. André; P. Royer

Aims. In this paper we analyze Herschel PACS and SPIRE photometry of all known transitional disks in the Chamaeleon star forming regions, as previously identified with Spitzer data.

Methods. We extract Herschel photometry of a sample of seven transitional disks in the Chamaeleon regions I and II and study their Spectral Energy Distributions to determine whether the outer disks follow the median SED of the T Tauri stars in Taurus or deviate from it.

Results. Together with a precursor Herschel study of the transitional disk T Cha, where a planet candidate has been detected inside the disk gap, this work suggests that the outer disks of the studied transitional disks in the Chamaeleon molecular cloud show signs of an unusual evolutionary stage for the age and mass of their central stars.

Scale-integrated spectral characterisation of mineralogical analogues to Mars at Rio Tinto

Richard Moissl

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Iron-sulfur assemblages within the Rio Tinto basin of Huelva province in Spain show mineralogical similarities to sites on the surface of Mars as determined by orbital and lander datasets. Exploration of Mars surface environments is intermittent and resolution-limited, and additional layers of information available for terrestrial analogue sites may extend incomplete planetary datasets. Characterising mineralogy in satellite, field and laboratory reflectance spectra of Rio Tinto sites can determine how accurately Mars-relevant mineralogies are represented in orbital data. Comparisons with Mars datasets, such as OMEGA and CRISM, can provide insights into planetary surface conditions. Interaction between materials in field mixtures can lead to potential interferences between endmembers and/or offsets in spectral features, which can obscure or hinder the identification of certain minerals. Such interactions can be difficult to predict on the basis of library spectra collected using pure materials. Determination of which diagnostic spectral features can be identified in field mixtures is an advantage of collecting data in real world environments, and can be used to aid interpretation of planetary datasets. This study utilizes the dynamic sulfur and iron deposits of Rio Tinto as an analogue of Mars sites such as Meridiani Planum, using the many scales of observation available for the terrestrial sites as a means of extending our view of Mars surface conditions from the orbital view to which we are frequently limited.

Measuring exoplanet inclinations with Gaia

Alcione Mora

E. Bopp, University of Heidelberg; R. Kohley, ESA-ESAC Gaia SOC

Aims. This poster describes a small-scale study to assess the potential of Gaia for measuring the inclination angle of planetary systems that have already been detected by Doppler spectroscopy. Special emphasis is placed on the benefits of planned early data releases from the Gaia mission.

Methods. Artificial data including random systematic and statistic errors according to the expected Gaia science performance is generated. Multiple sets of data are fitted to obtain estimates of the inclination precision for both real and artificial single planet systems.

Results. We derive approximate scaling laws that are independent of the exact mission parameters in terms of the signal-to-noise ratio and inclination including a correction factor for the eccentricity. The inclination precision can be estimated up to about 25 %. Degradation occurs for orbital periods close to one year or larger than the time span of the observations. Preliminary estimates are given for real systems with astrometric signatures larger than the expected end-of-mission parallax precision. A hypothetical early data release after 2.5 years would already yield valuable information on any planets with orbital periods smaller than this time span.

Visualizing the Sun and Heliosphere in 3D

Daniel Müller

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The next generation of heliophysics missions, Solar Orbiter and Solar Probe Plus, will focus on exploring the linkage between the Sun and the heliosphere. These new missions will collect unique data that will allow us to study the coupling between macroscopic physical processes to those on kinetic scales, the generation of solar energetic particles and their propagation into the heliosphere and the origin and acceleration of solar wind plasma. Within a few years, the scientific community will have access to petabytes of multi-dimensional remote-sensing and complex in-situ observations from different vantage points, complemented by petabytes of simulation data. Answering overarching science questions like "How do solar transients drive heliospheric variability?" will only be possible if the community has the necessary tools at hand. As of today, there is an obvious lack of capability to both visualize these data and assimilate them into sophisticated models to advance our knowledge. A key piece needed to bridge the gap between observables, derived quantities like vector fields and model output is a tool to routinely and intuitively visualize 3D time-dependent data. While a few tools exist to visualize 3D data sets for a small number of time steps, the scientific community is lacking the equipment to do this (i) on a routine basis, (ii) for complex multi-dimensional data sets from various instruments and vantage points and (iii) in an extensible and modular way that is open for future improvements and interdisciplinary usage. In this contribution, I will present recent progress in visualizing the Sun and its magnetic field in 3D using the open source JHelioviewer framework, which is part of the ESA/NASA Helioviewer Project. In addition, I will show new results from the application of methods from volume rendering and flow visualization to 3D solar magnetic fields, as well as the interactive browsing of time-dependent image data and 1D time series.

Spectral states in Be/X-ray pulsars

Elisa Nespoli

P. Reig, University of Crete

In the last quarter of a century, a unified characterization of the spectral evolution of low-mass X-ray binaries, both containing a neutron star and a black hole, was made. In this context, the discovery of source states in the X-ray emission of black-hole binaries and neutron-star low-mass X-ray binaries constituted a major step forward in the understanding of the physics of accretion onto compact objects. While there are numerous studies on the correlated timing and spectral variability of these systems, very little work has been done on high-mass X-ray binaries, the third major type of X-ray binaries. Accretion-powered pulsars with Be companions represent the most numerous class of high-mass X-ray binaries. When active, they are amongst the brightest extra-solar objects in the X-ray sky and are characterized by dramatic variability in brightness on timescales of days.

We investigated whether accreting X-ray pulsars display source states and characterized those states through their spectral and timing properties. Our work shows that Be/X-ray pulsars trace two different branches in the hardness-intensity diagram: the horizontal branch corresponds to a low-intensity state of the source and it is characterized by fast color and spectral changes and high X-ray variability. The diagonal branch is a high-intensity state that emerges when the X-ray luminosity exceeds a critical limit. In some sources, a significant correlation between spectral and timing parameters is seen, implying interplay between the accretion column and the inner accretion disk. The two branches may reflect two different accretion modes – in agreement with

recent phenomenological models – depending on whether the luminosity of the source is above or below a critical value. This critical luminosity is mainly determined by the magnetic field strength, hence it differs for different sources. For the sample of nine systems analyzed in this work, the critical luminosity lies in the range 0.1–0.3 of Eddington luminosity.

Herschel observations of Jupiter Family Comets and of the Rosetta target 67P/Churyumov-Gerasimenko

Laurence O'Rourke

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Introduction: This study provides an insight into one of the most important of the Jupiter Family Comets for ESA – 67P/Churyumov-Gerasimenko, the comet of Rosetta. [1].

Observations performed on 67P/Churyumov-Gerasimenko: In June 2010, the Herschel Space Observatory observed comet 67P/Churyumov- Gerasimenko with the PACS Instrument when the comet was at a heliocentric distance of 4.1 AU. This comet is the prime target for the Rosetta spacecraft due to arrive to orbit it in mid-2014. A 2 hour cross scan PACS observation was executed. The comet was detected only at 70 µm with a significant extended emission in the processed data set. A follow-up "shadow" DDT observation in December 2010 of the area where the comet was located in the June timeframe took place to address the original slow moving nature of the comet at the time of the June ob- servation. An empty background confirmed that what was observed by Herschel in June 2010 was indeed due to 67P.

Summary of data processing: Data processing was performed on all observation sets using the most recent HIPE software [2]. Special processing was performed to correct for pointing errors as well as to address the extended features visible in the observed comet images. The derived fluxes were aperture and colour cor- rected to obtain monochromatic flux densities at the PACS reference wavelengths.

Data Analysis – 67P: Our data analysis focuses on the expected dust emission around the comet nucleus at this distance which could have produced the flux obtained. We conclude that the extended emission offset from the anti-velocity vector is the neckline of the comet linked to dust emitted about 100 days before perihelion (180° away in true anomaly of November 2008). We present our modeling results which confirm the neckline. We also prove that the emission around the nucleus is a coma – the first time that 67P is proved to be active beyond 4 AU.

Conclusions: The benefits of Herschel in the study of comets will be highlighted. The results of observations of 67P are presented and reviewed with associated conclusions reached on the dust observed in its wake and dust production rates required to generate such dust.

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Herschel observations of the Marco Polo-R target asteroid 175706 (1996 FG3).

Laurence O'Rourke

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Background: The Marco Polo-R mission has been selected for the assessment study phase of the ESA M3 missions. This ESA-led sample return mission to the binary asteroid 1996 FG3 (launch window between 2020 and 2024) is proposed with a design that allows it to fit within the pre-defined cost cap of a M-class mission. The binary nature of the target will allow more precise measurements of mass, gravity, and density than for a single object, as well as additional insights into the geology and geophysics of the system. The asteroid has been classified by Binzel et al. [1] as a C-type. It is considered to be a typical example of a primitive object [2]. Dynamically, this is an Apollo asteroid with semimajor axis a of 1.054 AU, eccentricity e of 0.35, and and inclination i of 1.98 degrees. Measurements of the albedo derived from thermal infrared observations give a value of pV = 0.042 (+0.035 -0.017), and a combined diameter of D = 1.84 (+0.56 -0.47) km [3].

The Herschel observations: The MACH-11 (Measurements of 11 Asteroids and Comets) Programme observed this binary asteroid in two occasions in November of 2011. The observations performed had a duration of 0.6 hours with the asteroid pair moving rapidly at 6'/hr thus making removal of the background quite straightforward. The observations were performed in two observing blocks; the first block consisted of a 2 repetition blue/red map, the second block consisted of a 2 repetition green/red map, with the intention to observe the target at different phase angles.

Our Results: Our measurements serve to update the known radiometric properties for this binary asteroid through their inclusion into a thermophysical model (TPM) [4] which has been validated against a large database of asteroids including targets of other spacecraft mission e.g. Lutetia [5], Itokawa [6]. Using existing sets of published thermal observations (IRTF-MIRSI, VLT-VISIR, IRAC, SpitzerVISIR), combined with our Herschel observations, applied within this thermophysical model, we derive the radiometric properties (thermal inertia, geometric albedo, thermal inertia and surface roughness) of this target pair. The calculations were performed for the full range of possible shape and spin-vector solutions derived from the available sample of visual lightcurve observations, taking into account the implications of the asteroid satellites impact on the derived flux. The output of our model aids in deriving the asteroids thermal inertia, as well as provide important information on the surface properties of this binary asteroid; important due to their relevance in the preparation of the future Marco Polo-R spacecraft. References: [1] Binzel, R.P. et al, Icarus, 2004, 170, 259 [2] Walsh, K.J, et al, 2012, AJ, 784:104 [3] Mueller, M., et al. 2011, AJ, 141, 109 [4] Lagerros, J.S.V., (1998), Astron. & Astrophys, 332, 1123-1132, [5] O'Rourke, L. and Müller, T. et al, (2012), Planetary & Space Science, doi.10.1016/j.pss.2012.01.004 [6] Müller, T. et al. (2005), Astron. & Astrophys., 443, 347355

OSIRIS and Herschel view of Cluster of Galaxies CL0024+1652

Ricardo Perez-Martinez

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CL0024+1652 is a cluster of galaxies at $z \sim 0.4$ presenting several substructures that suggests it is in the last stages of group accretion. The galaxy transformations involved in this process are far from being completely understood. Our study focuses in those related to the variation in morphology and star formation activity by observing emission line galaxies at different wavelengths, from optical to far infrared, making use of OSIRIS at GTC and PACS at Herschel. In particular, the usage of OSIRIS in Tunable Filter mode makes it possible to scan $H_\alpha/[NII]$, H_α, [OII]3727, and [OIII]5007 up to 2.5 virial radii with unprecedented depth and exposure time effciency. Moreover, the joint analysis of these data together with those at 24 microns from Spitzer and 100 microns and 160 microns from PACS not only does it allow us to distinguish star forming vs AGN galaxies, but also quantify the star formation hidden by dust obscuration. This study is being developed within the GLACE program, that intends to study the evolution of emission line galaxies in clusters across the cosmic time. It searches for star formation activity and/or AGNs in clusters in three different redshift windows ($z \sim 0.40$; $z \sim 0.63$ and $z \sim 0.86$), providing a unique view of the evolution of cluster galaxies along such redshift range.

A multi-wavelength landscape of the evolution of galaxies in clusters: the case of RXJ 1257+4738 at z 0.87

Miguel Sanchez-Portal

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We present the results of a multi-wavelength study of the young cluster RXJ 1257+4738 at $z \simeq 0.87$, combining optical broad-band $g'r'i'z'$ imaging from OSIRIS/GTC with NIR J-band data from LIRIS/WHT, *Spitzer* mid-IR IRAC 3.6, 4.5, 5.8 and 8μm and MIPS 24μm and finally far-IR PACS 100, 160μm and SPIRE 250, 350 and 500μm photometry data from the *Herschel Space Observatory*. We have computed photometric redshifts by spectral energy distribution (SED) fitting using the *LePhare* code to compile a catalogue of more than 500 strong cluster member candidates. From these, about 100 have been detected in either mid-IR or far-IR. For these objects, we have derived the star formation rate (SFR), that ranges from less than $1\,M_\odot$/yr to more than $100\,M_\odot$/yr, and the specific SFR (sSFR) using the stellar masses derived from SED fitting. The complete catalogue of cluster candidates has been used to characterize the local density of the cluster medium by means of the Σ_5 parameter. We find that: *(a)* the MIPS 24μm and *Herschel* FIR emitters have similar masses but FIR emitters have higher SFRs, as expected from the shallower *Herschel* detection limits. *(b)* Regarding the spatial distribution of sources, a bimodal distribution at the cluster center is observed, and several high density structures around and beyond the virial radius, suggesting that the cluster is under assembly process. *(c)* The fraction of star forming galaxies is larger in intermediate density environments, but the average SFR is similar in low and intermediate densities. Surprisingly the average SFR is larger in the high density environment, although statistics are poorer due to the reduced area surveyed. *(d)* sSFR median values do not correlate with environment. High-mass galaxies have lower sSFR than low-mass galaxies in all environments, and *(d)* the cluster mass-normalised global SFR coarsely agrees with the $\propto (1+z)^6$ evolution proposed by other authors (e.g. Koyama et al. 2010).

Far-IR star-formation in XMMUJ2235.3-2557, a massive cluster at z=1.4

Joana Santos

Star-formation in the galaxy populations of massive clusters is known to be less pronounced with respect to field galaxies, and also tends to be suppressed in the core region, although indications of a reversal of the star-formation-density relation have been observed in a few $z > 1.4$ clusters.

Using deep imaging in the range 100–500 µm from PACS and SPIRE onboard Herschel, we study the total infrared emission of several cluster members and cluster candidates of XMMUJ2235, one of the most massive, distant, X-ray selected cluster galaxies at $z = 1.393$. The total rest-frame $L(8 - 100\,\mu m)$ is obtained by fitting the spectral energy distributions, with which we derive galaxy star-formation rates.

An X-ray view of the tidal disruption of a star by a super-massive black hole.

Richard Saxton

The stellar dynamics operating in a Milky-Way-like galaxy, on average, lead to a star being gravitationally disrupted by the central super-massive black hole (SMBH) every 10^5 years. The debris from the tidally disrupted star eventually falls back onto the black hole and emits a strong radiation flare, in the optical, UV and/or X-ray bands, before being accreted.

I describe a recent tidal disruption event detected during a slewing maneouver by XMM-Newton. The previously unknown X-ray source, originating from the nucleus of the galaxy SDSS J1201+30, was monitored for about

a year with the XMM-Newton and Swift satellites. A gradual decrease in flux was observed which can be attributed to a decline in the rate of return of stellar debris to the black hole.

At the end of June, the first international workshop on Tidal Disruption events was held at ESAC. Highlights from that workshop, representing a summary of the state-of-play in the field, will be presented.

The variable mesosphere of Venus, as determined by data from drag and torque measurements by Venus Express

Håkan Svedhem

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Until recently the only information on the structure of the polar upper atmosphere of Venus available has been based on the reference atmosphere models such as the VTS3 or VIRA models. These models extrapolate the values from low latitudes to high latitudes by using equivalent solar zenith angles. New measurements by Venus Express show that such extrapolations not always give correct results and that there is a permanent overestimate of the density at high latitudes.

These new results have been reached by using two different but related techniques, both using an atmospheric drag effect on the spacecraft. By reducing the pericentre altitude the total mass density in the altitude range 150-200km can be measured in situ by monitoring the orbital decay caused by the drag on the spacecraft by the atmosphere via direct tracking of the Doppler signal on the telecommunication link. Such measurements have been performed with Venus Express several times during the last years as part of the Venus Express Atmospheric Drag Experiment (VExADE). The results indicate a large variability within only a few days and have led to questions if these variations are real or within the uncertainty of the measurements. A completely different and independent measurement is given by monitoring the torque asserted by the atmosphere on the spacecraft. This is done by monitoring the momentum accumulated in the reaction wheels during the pericentre pass and at the same time considering all other perturbing forces. This requires the spacecraft to fly in an asymmetric attitude with respect to the centre of gravity, centre of drag and the velocity vector. This technique has proven very sensitive, in particular if the geometric asymmetry is large, and offers an additional method of measuring atmospheric densities in-situ that previously had not been explored with the Venus Express spacecraft. Similar measurements have been done in the past by Magellan at Venus and by Cassini at Titan. Between 2009 and 2012 several campaigns, with altitudes going as low as 165 km, were held. The highest density measured was $7.7 \times 10^{-12}\,\mathrm{kg/m^3}$ which is significantly less than earlier models predict. The results largely confirm the density measurements by the VExADE drag measurements and add to the confidence in the results from these measurements.

By using these drag and torque results and assuming a hydrostatic diffusive equilibrium atmosphere a new model has been constructed. The model is fitted to the Venus Express remote sensing measurements in the upper mesosphere (VeRa radio occultation data) and lower thermosphere (SpicaV/SOIR data) to give a continuous transition across the different regions.

General-relativity effects on the X-ray reflection spectra from black-hole accretion discs

Jiri Svoboda

X-ray spectroscopy and timing analysis of accreting black holes in active galactic nuclei and X-ray binaries provides a unique laboratory for studying radiation coming from the region with strong gravity and rapid orbital motion. Gravitational redshift and Doppler boosting significantly modify the intrinsic spectral features. In my talk, I will also discuss the influence of other general-relativistic effects due to strong space-time curvature on the X-ray reflection spectra, in particular angular directionality and time delays.

Molecular and atomic line astrophysics with Planck

Jan Tauber

L. Fauvet

Planck was launched in May 2009, and has been surveying the sky since August 2009. Planck's main objectives relate to the study of the Cosmic Microwave Background. But it also provides a source of data which is extremely useful for a wide range of astrophysics. One of the surprising things about Planck is that it allows to make all-sky maps of the line emission of some molecular and atomic species. I will describe what it can do, and what kind of science this may lead to.

Herschel/HIFI View on Massive Evolved Stars: the HIFISTARS sample of Supergiant and Yellow Hypergiant envelopes

David Teyssier

A. Marston, ESAC; J. Alcolea, OAN; V. Bujarrabal, OAN; The HIFISTARS consortium, an Herschel Guaranteed Time Key Program

We present the first results of one the HIFISTARS (Bujarrabal et al. 2010) sub-programmes dedicated to the study of the physico-chemical conditions and the mass-loss history in Red Supergiants and Yellow Hypergiants. Such sources are the most massive and luminous stars in the pathway of stellar evolution, and as such are fast-lived and characterised by very intense winds and mass-loss rates. These conditions and the large size of their envelope contribute to a particularly rich chemistry. At the end of their evolution, Super/Hyergiant stars are expected to die hard and form black holes or neutron stars after a supernova.

The HIFISTARS' sample of evolved massive stars considers three Red Supergiants (NML Cyg, Betelgeuse, and VY CMa) and two Yellow Hypergiants (IRC+10420 and AFGL2343), in a handful of submm and FIR CO/13CO lines, as well as several water, HCN, SiO, SO, SO2, and other bonus lines collected over the whole HIFI frequency ranges. While most of the CO, the OH line at 1835 GHz, and both ortho- and para- ground-state water lines are detected in all targets, there is a clear difference for the less-abundant N-bearing, Si-bearing and S-bearing species. The various water lines covered by the survey are also relatively un-evenly represented from one source to another, with some of the transitions showing up as masers. The observed lines feature complex and distinct profiles, indicative of the strong and asymmetric wings at play for some of the transitions.

Of the four sources observed so far (all but AFGL2343), VY CMa clearly stands out as an exceptional object, with most lines 2-10x stronger than any other Super/Hypergiants, and revealing in particular an extremely rich water chemistry observed nowhere in the other sources of the sample (Alcolea et al., in preparation).

A synthesis of the cloud investigation by Venus Express

Dmitrij Titov

Since April 2006, the imagers and spectrometers onboard Venus Express have provided a great amount of data about the Venus clouds. The cloud top morphology was investigated in great detail due to monitoring of UV markings. On a global scale Venus is characterized by clear separation of the dark and mottled clouds at low latitudes that indicate strong turbulence especially close to the sub-solar point. In contrast, high latitudes have bright and uniform appearance suggesting thick haze overlaying the main cloud. The transition region, usually located at 50-60 degrees latitude, is dominated by streaky clouds. Joint analysis of several experiments indicated remarkable latitudinal changes of the cloud top structure. The cloud top altitude varies from 72 km in the low / middle latitudes to 64 km in the polar region thus creating vast polar depressions. The cloud top scale height also changes from 4-5 km to less than 1 km from equator to pole. Imaging in the spectral transparency windows on the night side that sounds the deep cloud reveals significant and abrupt increase of the total opacity at 60-70 degrees latitude. Global cloud morphology on the day and night side that correspond to 70 km and 50 km respectively demonstrates a puzzling similarity. The cloud microphysical properties, like sulfuric acid

concentration and particle size, also show significant latitudinal trend. The paper will give a synthesis of the cloud investigations as well as present some recent VMC images.

Star formation at high redshift: overview of some recent Herschel results

Ivan Valtchanov

Herschel observatory is approaching the end of its nominal lifetime. The large mirror and high sensitivity detectors have been instrumental in the increase of our knowledge of the star formation in the early Universe. I review some of the most important results in this hot topic, obtained by a couple of Herschel's Key Projects with significant involvement of members of the Herschel Science Centre team.

Understand the solar UV and EUV irradiance variability and compare with the Active Regions

Joe Zender

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LYRA is a solar UV filter photometer and its channels measure the solar irradiance in four passbands. SWAP is an EUV telescope and acquired images from the whole sun in the 174A band. S. Kumara et al (2012, Solar Physics) showed the relation between the irradiance of the sun as a star measured by single pixels instruments – e.g. by LYRA onboard PROBA2 – against imaging instruments – e.g. SWAP onboard PROBA2. Starting from this point, we will use a software called SPoCA, developed at ROB (Royal Observatory of Belgium) by V. Barra et al. to extract the Active Regions and the Coronal Holes from SWAP image.The analysis of Kumara will be repeated by now on the indivudal extracted regions of the sun. The goal of the study is to analyze the relation of the LYRA measured solar irradiance from the sun as a star against the contribution of active regions of the sun towards the energy release of these regions.