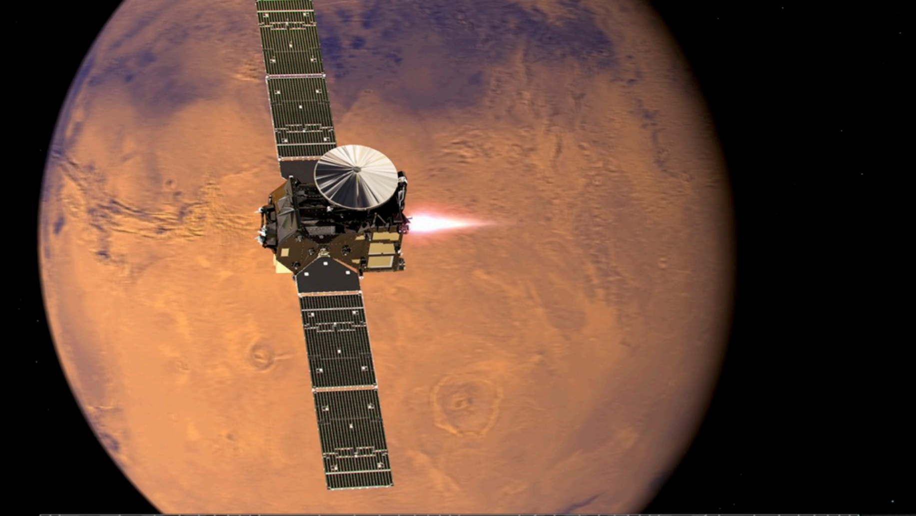

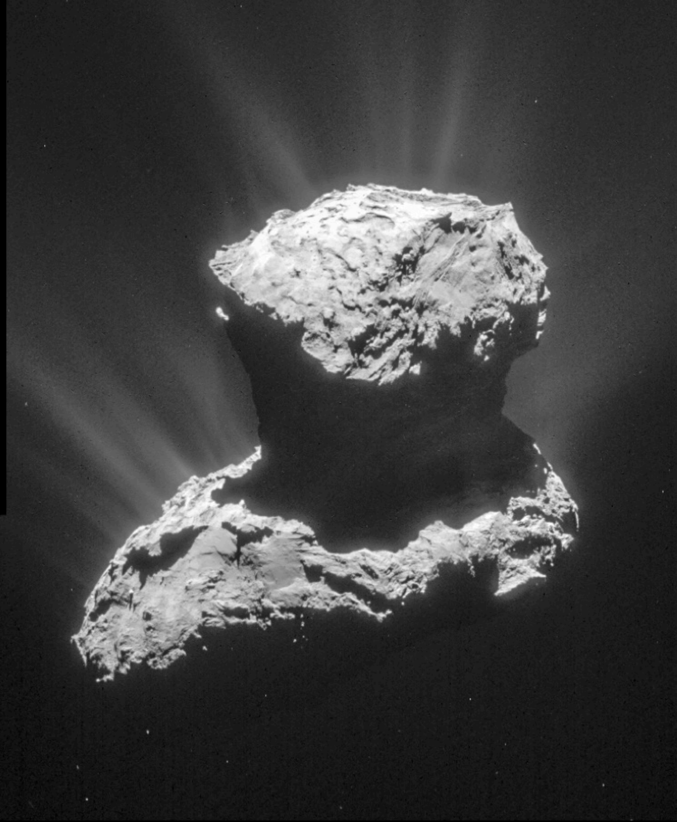

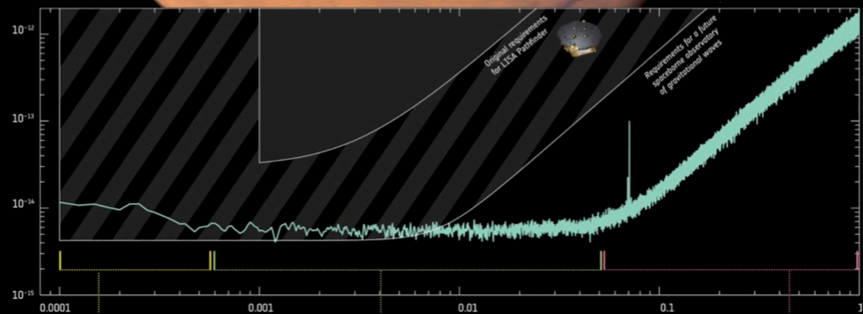

SCI Science Workshop 9

Akersloot
7-9 November 2016

esa

ESA SCI Science Workshop #9
7–9 November 2016
Aklersloot, The Netherlands

Abstracts

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Arvind Parmar
Mylène Riemens
Elliot Sefton-Nash
Jan Tauber

Presenter list

Oral Presentations

Listed alphabetically by author last name

Nicolas Altobelli (ESAC); C. Vallat; T. Cornet; K. Fiege; S. Navarro; C. Munoz; E. Groother; O. Witasse

Understanding the Weathering of the Jovian Icy Moons: experiments; models and data

We review the on-going efforts undertaken recently by a group of ESA planetary scientists and external collaborators to combine data analysis, modelling and experimental data with the goal to characterize the space weathering processes at play at the surface of the Jovian icy moons. This works includes:

1. numerical modeling aiming at quantifying the interplanetary impactors flux responsible for the sputtering of the icy moons surfaces, the dynamics of the resulting ejecta and their subsequent transport across the Jovian system
2. data analysis, in particular of the galileo infrared spectrometer. A working pipeline was developed which allows to analyse the archived reflectance spectra and the mapping of the identified chemical species and physical ice properties on the moon's surface, as a diagnostic for space weathering
3. experimental studies to improve the qualitative and quantitative understanding of the effect of bombardment of ion/protons/electrons/dust on 'typical' Jovian moon ices. This will be done by controlling in the lab the ice target composition and structure, the flux of weathering agents, and detecting and measuring subsequently the alteration of the target.

Scientific context

The Juice (ESA) and Europa Clipper (NASA) missions will be launched in the next decade in order to study the habitability of the icy moons of Jupiter. The focus of both missions is to characterize the conditions that may have led to the emergence of habitable environment in the interior of Ganymede, Europa and Callisto.

The existence of icy moons around gas giants, located well beyond the 'snow line' of their host star, and able to maintain liquid water below an icy crust through the energy gained by tidal heating, is a tantalizing prospect for astrobiology. The important numbers of exoplanets of Jupiter size discovered so far and the ubiquity if water in the galaxy makes this type of habitat maybe the most common one for the emergence of life as we know it (carbon based and using water as solvent).

While sub-surface liquid water oceans have been inferred from Galileo data at Europa and Ganymede, the recent discoveries by the Cassini spacecraft at Saturn provided a clear confirmation that icy moons are potential habitats. Cassini discovered that both Enceladus and Titan harbor an internal, global scale, liquid water ocean. Hydrothermal activity was found to occur at the water-rocky core interface, with an active circulation of ocean constituents from to the interior to the surface and their ejection into space through cryo-volcanic activity. Enceladus hydrothermal activity is reminiscent of the one occurring at the Earth oceans floor, where it provides the energy and nutrient to an adapted ecosystem.

The Juice and Europa clipper mission will look on a complementary way for such habitats in the Jovian system. Without the existence of plumes driven by cryo-volcanic activity, that could be directly sampled from space, clues on the ocean composition have to be found on the moon's surface using remote sensing techniques. Fortunately, it is established that there are mechanisms that transport material between the ocean and the surface, such that, in principle, deciphering the surface composition should provide constraints on the ocean's composition.

However, things are not so easy in the Jovian system because the surfaces of the icy moons are altered, weathered by varieties of agents. The exogenic bombardment of the surface by energetic electrons, protons, ions and micro-meteoroids populating the Jovian magnetosphere modifies on a short time scale (compared to the moon's evolution time scale) the surface ice composition and physical structure. Without a quantitative understanding of the effects of each weathering agent on the icy moons surface, deciphering the intrinsic composition of the moon's surface, and hence, ocean composition, is very difficult.

From the Galileo data, we know that the surface of each moon reacts differently to its environment. The dust instrument around Ganymede, Europa and Callisto detected a dusty exosphere with different properties. The leading and trailing side differences in term of albedo and surface composition inferred from the Galileo infrared spectrometer data between the different moons also suggest different alteration processes depending not only on the moon's distance to Jupiter, but also on the intrinsic properties of the surfaces.

Jacopo Chevallard (ESTEC)

Modeling and interpreting the spectral energy distribution of galaxies in the era of JWST/NIRSpec

Understanding the physical processes driving the formation and evolution of galaxies requires modeling their spectral energy distributions (SED). In this talk, I will present BEAGLE, a new general-framework tool for spectral analyses of galaxies. BEAGLE allows one to describe, in a flexible and physically consistent way, both the production of starlight in galaxies and its transfer through the interstellar and intergalactic media (ISM and IGM). It is therefore an ideal tool to produce realistic mock catalogues of galaxies as well as to interpret (spectro-photometric) observations. Currently, BEAGLE incorporates: a state-of-the-art population synthesis code, a photo-ionization model describing the emission from ionized gas, a model accounting for the effect of alpha-element variation on stellar emission, different prescriptions for dust attenuation, and several sets of star formation and chemical enrichment histories drawn from semi-analytic models and hydro-dynamic simulations. The code can deal with both photometric and spectroscopic data, and can accomplish three different, but closely related, tasks: create synthetic (i.e. "mock") catalogues of galaxy observables and compare the statistical properties of such catalogues with observations, create and fit synthetic observations to test our ability to retrieve input physical parameters, fit, with a Bayesian approach, galaxy observations to obtain statistical constraints on selected galaxy physical parameters. After a general overview of the code capabilities, I will present two applications of BEAGLE, for the determination of photometric redshifts from low S/N observations of distant galaxies, and for the simulation of JWST/NIRSpec observations.

Guido De Marchi (ESTEC); N. Panagia; E. Sabbi; the HTTP team

44,000 and counting

We are studying the recent formation of low-mass star in the Tarantula Nebula using observations from the Hubble Tarantula Treasury Project. Looking for stars with prominent Halpha excess emission, we have identified more than 44,000 pre-main sequence (PMS) stars over an area of 200x200 pc2. We are able to detect and study not only the youngest PMS objects, but also those approaching the main sequence, with ages older than 10 Myr. This is so far the largest sample of individually resolved young low-mass stars. We find that the distribution of PMS stars is considerably more diffuse than that of massive stars: while many young PMS stars are often close to massive objects, a similarly high number of both young and older PMS objects are clumped in regions with very few or no high-mass stars around. This suggests that the conditions for the formation of low-mass stars are more lenient than those required by high-mass stars, and could have important implications for the concept of initial mass function. In the central regions, around the R136 cluster, we have already completed the analysis of the physical properties of both younger and older PMS stars. Comparing these results with our previous studies of other massive star-forming regions, we find that the metallicity of the environment plays a crucial role in regulating mass accretion. It is likely that in the early Universe PMS stars would accrete more and longer.

Ben de Vries (ESTEC); H. Skogby; R. Waters; M. Min

Observing core formation and metamorphism in extrasolar asteroids using JWST

Processes central to planet formation leave imprints on the composition and structure of the dust grains involved. Examples of such processes are the annealing and growth of dust grains, the formation of chondrules and the equilibration of and core formation in planetesimals and proto-planets. Minerals in dust grains can be studied over astronomical distances by observing their mid-infrared resonances. Space telescopes like ISO and Spitzer already showed how abundant minerals are in the universe, but now the sensitivity of JWST will revolutionise the use of minerals in understanding planet formation. Not only will JWST be able to detect previously undetectable and less abundant minerals (like feldspars and calcite), it will also give us access to fainter systems as well as faint dust structures in young planetary systems, like for example zodiac dust belts. To understand how minerals and their mid-infrared resonances change when their parent planetesimals grow to metre and kilometre sizes, we are analysing chondrite and achondrite meteorites in the laboratory. In preparation of JWST we are measuring laboratory mid-infrared spectra of these meteorites in order to define observables of equilibration (experienced by chondrites) and core formation (experienced by acondrites). Equilibration is the change in mineral composition in a planetesimal due to the mild heating (up to 800 K) of a planetesimal by the decay of radioactive isotopes. Core formation is the (partial) melting of a planetesimal, creating an iron core and a silicate crust. The formation of a core influences the olivine over pyroxene ratio and the iron content of the silicates in the crust, as well as that it introduces minerals like feldspar (a Na, Ca, Al and K bearing silicate) to the mix. The temperatures experienced during equilibration and core formation are a strong function and thus probe of the size and formation timescale of the planetesimal. Metre and kilometre sized extrasolar planetesimals are difficult to study, since they cannot be directly observed and they are too small to detect with methods used for detecting planets. Therefor we have limited knowledge about for example the size or the formation timescales of these planetesimals, which are essential measurements for advancing planet formation theories. We focus on minerals as a method to determine geological properties of planetesimals. Minerals in extrasolar planetesimals can be studied when observing the micron sized grains formed by mutual collisions and subsequent grinding of these planetesimals. During the scientific conference we would like to present our laboratory spectra and explain where they can be downloaded and how they can be used to probe parent-body processes like core formation with JWST. With these spectra we want to help fellow scientists to prepare for and model JWST observations of proto-planetary disks and debris disks.

Meiert Grootes (ESTEC)

Gas-fueling and the Galaxy Gas-Cycle - A Galaxy Survey Perspective

Gas-fuelling, i.e. the accretion of ambient gas from the inter-galactic medium (IGM) into a galaxies interstellar medium (ISM), constitutes one of the fundamental processes determining galaxy evolution. In particular, this process is thought to underly the well-known, tight relation between the stellar mass and the star formation rate of (star-forming) galaxies via self-regulated feedback. Furthermore, theory predicts that this pathway of galaxy evolution will be subject to a wide range of environmental influences, ranging from the impact of the galaxies larger scale environment (dark matter halo mass, thermodynamic state of the ambient medium) to galaxy-galaxy interactions. To date, dis-entangling the different relevant physical processes has proven to be exceedingly challenging, making direct empirical constraints for comparison with theoretical predictions scarce and often blunt. Here I present the results of recent work making use of the combined spectroscopic and multi-wavelength Galaxy And Mass Assembly survey (GAMA) to address the question of gas-fuelling, demonstrating how the wealth of information available in new generation surveys such as GAMA enables a very incisive consideration of questions of galaxy evolution with a robust statistically representative basis. In particular I will focus on the finding that gas-fuelling of satellite spiral galaxies is on-going and largely independent of environment (contrary to the standard paradigm), as well as on the model of self-regulated galaxy evolution.

Matteo Guainazzi (ESTEC)

A Milky Way twin sewpt by an Ultra-Fast X-ray Wind

A super-massive black hole sits at the center of most bulge galaxies. The tight relation between black hole mass and stellar velocity dispersion in the bulge suggests that black holes can affect the interstellar gas and the star formation across the whole host galaxy. This happens through a still poorly understood process called "AGN (Active Galactic Nuclei) feedback". Accretion disk outflows, best observed in X-rays through strong resonant absorption lines, are one of the most likely feedback messenger. Kinetic outflow rates are consistent with the feedback requirements set by cosmological simulations of galaxy evolution in powerful quasars. However, in this talk I report on the unexpected discovery of an outflow with a potentially strong feedback in a low-luminosity AGN, hosted in an undisturbed spiral galaxy. What's wrong with our understanding of the cosmological co-evolution of accreting black holes and the host galaxy?

Eleni Kalfountzou (ESAC)

A benchmark study of Active Galactic Nuclei

In recent years the study of active galactic nuclei (AGN) has undergone a renaissance. This is due to the fact that AGN activity is now widely believed to be an important phase in the evolution of every massive galaxy in the Universe. However, the picture is still not clear, with investigations at different wavelengths producing many differences of opinion as to the amount of radiation that is absorbed and reprocessed by dust, how this is related to the host galaxy and whether the triggering mechanism behind the AGN activity is also responsible for massive star-formation activity. Moreover, it is also unclear how these processes depend on luminosity, radio-loudness and orientation. A drawback of all previous surveys is that they are fundamentally limited by the degeneracy between redshift and luminosity in flux-density limited samples. We have constructed well-defined samples of radio-quiet and radio-loud quasars, along with radio galaxies. These samples are defined to span a factor of >100 in both optical and radio luminosity, with each subsample composed of objects with matched luminosity distributions, at a single cosmic epoch ($0.9 < z < 1.1$). Combining multi-wavelength observations and surveys (e.g. XMM-Newton, UKIRT, Spitzer, Herschel, SDSS, VLA), we aim to create a detailed picture of how the full SEDs of AGN change as a function of luminosity, orientation, radio-loudness and redshift which is crucial for improving our understanding of virtually all aspects of the AGN phenomenon. At the same time, it will also provide a benchmark sample from which other AGN surveys will benefit, in particular when computing bolometric luminosities and accretion rates. Our results, extracted from the full SEDs, optical spectra and wide-field photometric observations, will be discussed in terms of the fundamental questions such as: Do AGN feedback quench the star formation in their hosts, or do black holes and stellar bulges form in parallel? Is star formation different in the host galaxies of radio-loud and radio-quiet AGN and whether all radio-loud AGN are the same in this respect? Which are the dust properties of AGN over the epoch of activity and the Unification picture? What is the evolutionary status of the clusters forming around the z 1 AGN and whether this depends on the central mass of the AGN host galaxy/black hole, the radio-loudness, or on the fraction of massive galaxies in the cluster?

Sarah Kendrew (Baltimore)

The Milky Way Project: Star formation studies in the Milky Way Galaxy via citizen science

Infrared bubbles in the interstellar medium are valuable tracers of recent massive star formation and HII regions. With the Milky Way Project, we produced a highly complete catalogue of thousands of these objects in the Galactic Plane via classifications of images from the Spitzer GLIMPSE and MIPSGAL surveys by over 35000 volunteers. By combining the locations of these bubbles with complementary survey data at different wavelengths, we applied statistical methods to study the physical properties of the ISM in the vicinity of bubbles, the effects of stellar feedback on the surrounding medium, and the importance of triggered star formation on galactic scales. Our work demonstrates the power of intelligent combination of heterogeneous datasets and the use of statistical methods for extracting new knowledge from survey data.

Peter Kretschmar (ESAC); on behalf of a larger collaboration

Studying Stellar Winds in Massive X-ray Binaries

Strong winds from massive stars are a topic of interest to a wide range of astrophysical fields. In High-Mass X-ray Binaries the presence of an accreting compact object on the one side allows to infer wind parameters from studies of the varying properties of the emitted X-rays, but on the other side the accretors gravity and ionizing radiation can strongly influence the wind flow. Based on a collaborative effort of astronomers both from the stellar wind and the X-ray community, this presentation attempts to review our current state of knowledge and indicate avenues for future progress.

René Laureijs (ESTEC); B. Altieri; B. Carry; P. Gomez; M. Kidger; R. Vavrek

Detecting solar system objects with Euclid

Even though Euclid is ESAs next cosmology mission dedicated to measure dark matter and dark energy, it will detect solar system objects (SSOs) while surveying the extragalactic sky. The capabilities of the Euclid instruments - deep high resolution imaging in the visual and near-infrared, and near-infrared spectroscopy - in combination with Euclid's survey strategy, are very suitable to detect of order 10^5 SSOs. After a brief general description of the mission we will assess the scientific prospects of detecting SSO with Euclid. Assuming a realistic survey strategy we show which physical parameters for SSOs can be derived from the Euclid data. We present Euclid's discovery space for different populations of SSOs. We find that the Euclid survey has the potential to discover $\sim 10^4$ new objects. By extending in the near-infrared the spectral coverage provided by Gaia and future LSST detections, Euclid will refine the spectral classification of many SSOs. We will give an overview of the present activities and the ideas we have for processing the Euclid SSO detections.

Danny Lennon (ESAC); C. Proffitt

Constraining the evolution of massive stars using Hubble spectroscopy

We use HST spectroscopy in the ultra-violet to measure the abundance of Boron in the atmospheres massive stars in a nearby galactic cluster. As Boron is easily destroyed in stellar interiors, its surface abundance provides one of the strongest known constraints on the efficiency of rotational mixing that is a critical free parameter in modelling the evolution of stars with masses in excess of about 8 solar masses. Analysis of our sample of stars confirms that these mixing processes are less efficient than previously thought, in agreement with our conclusions derived for lower metallicity stars based on an analysis of nitrogen abundances in stars of the Large Magellanic Cloud.

Carlo Felice Manara (ESTEC); J. Voirin; T. Prusti; J. de Bruijne; E. Zari

A deeper understanding of the evolution of young stars and their disks

Studies of the evolution of young stars and the surrounding protoplanetary disks are key to understand how planet formation works. Different observational techniques must be combined to have a complete picture of the evolution of the disk-star system. I will present recent results obtained combining spectroscopic studies of young stars in the Ophiucus, Lupus, and Chamaeleon I star forming regions with sub-mm intereferometric ALMA data, which are giving us an unprecedented view of disk evolution. Moreover, I will present some preliminary results of studies of young star forming regions with Gaia, which is giving us new insight on the evolution of stars in young clusters.

Paul McNamara (ESTEC); LTP Collaboration

LISA Pathfinder: First Steps to Observing Gravitational Waves from Space

With the first direct detection of gravitational waves a little over a year ago, the gravitational window to the Universe has been opened. The gravitational wave spectrum spans many orders of magnitude in frequency, with several of the most interesting astronomical sources emitting gravitational waves at frequencies only observable from space. ESA has been active in the field of space-borne gravitational wave detection for many years, and in 2013 selected the Gravitational Universe as the science theme for the third large class mission in the Cosmic Vision science programme. In addition, ESA took the step of developing the LISA Pathfinder mission to demonstrate the critical technologies required for a future mission. The goal of the LISA Pathfinder mission is to place a test body in free fall such that any external forces (acceleration) are reduced to levels lower than those expected from the passage of a gravitational wave. LISA Pathfinder was launched on the 3rd December 2015 from the European Spaceport in Kourou, French Guiana. After a series of 6 apogee raising manoeuvres, the satellite left earth orbit, and travelled to its final science orbit around the first Sun-Earth Lagrange point (L1). Following a relatively short commissioning phase, science operations began on 1st March 2016. In the following 3 months over 100 experiments and over 1500hours of noise measurements have been performed, demonstrating that the observation of gravitational waves from space can be realised. In this presentation, I will first outline the LISA Pathfinder mission and goals, followed by a review of the on-orbit performance.

Jan-Uwe Ness (ESAC)

Short-period X-ray oscillations in super-soft novae and persistent super-soft sources

Transient short-period ($<$100 s) oscillations have been found in the X-ray light curves of several Super Soft Sources (SSS), both in permanent SSS and during the transient SSS phase of some novae. I will present the five cases that have so far been found and discuss relations to the X-ray spectrum and to system parameters. While the oscillations may relate to the rotation period of the underlying white dwarf, more likely are pulsations within the nuclear burning regions.

Karen O'Flaherty (ESTEC); Communication; Outreach and Education Group; SCI-A

What's new in ESA science communication? (And why you should care.)

The past few years have seen a number of new communication and outreach initiatives introduced by the ESA science communication team. Amongst these are new products, ranging from static infographics to interactive data visualisations, from cartoons to virtual reality experiences, as well as engagement activities such as competitions and a legacy campaign, and the fostering of new collaborations with artists and musicians. With these, we are reaching new audiences as well as serving our loyal followers. By expanding our core products we aim to find suitable ways of promoting all of our active missions, no matter what phase they are at. I will present some of these initiatives, explain the motivation behind them, and demonstrate their impact.

Denise Perrone (ESAC); F. Valentini; S. Servidio; L. Sorriso-Valvo; S. Stabile; O. Pezzi; R. De Marco; F. Marcucci; D. Brienza; R. Bruno; B. Lavraud; A. Retin; A. Vaivads; M. Salatti; Y. Zouganelis; P. Veltri

Study of differential kinetic behavior of ions in solar wind

The solar wind, although predominantly constituted of protons, is also made up of a finite amount of doubled ionized helium (alpha particles), together with a few percent of heavier ions. Several observations have shown that heavy ions (alpha particles in particular) seem to be preferentially heated and accelerated with respect to protons. However, due to very scarce measurements of heavy ions at time resolutions comparable with their kinetic scales, energy partition between species in turbulent plasma dissipation is basically unexplored. For the moment, most of the information comes from numerical simulations and a crucial support is given by self-consistent, fully nonlinear Vlasov models. Here, hybrid Vlasov-Maxwell simulations are used to investigate the role of kinetic effects in a two-dimensional turbulent multi-ion plasma, composed of kinetic protons and alpha particles, and fluid electrons. The results show that the response of different ion species to the fluctuating electromagnetic fields is different. In particular, a significant differential heating of alpha particles with respect to protons is observed, localized nearby the peaks of ion vorticity and where strong deviations from thermodynamic equilibrium are recovered. Moreover, by using a simulator of a top-hat ion spectrometer, planned on board the Turbulence Heating ObserveR (THOR mission), a candidate for the next M4 space mission of ESA, with the output of the kinetic simulations, the detailed of the three-dimensional ion velocity distributions can be solved, highlighting important non-Maxwellian features, that are clearly crucial ingredients for the understanding of the complex process of particle heating.

Timo Prusti (ESTEC)

Gaia

The first Gaia data release (Gaia DR1) took place 14 September 2016. A review of the contents is provided with examples of the first studies made with the data. A future look into Gaia DR2 is made with examples of the observations being analysed for the release.

Alana Rivera Ingraham (ESAC); Anthony Marston; et al.

The Switch for High-Mass Star Formation

The Herschel Space Observatory has provided extensive datasets of unprecedented quality and coverage. The Archive covers regions in a wide range of physical and star-forming conditions across the Galaxy. Here we introduce the latests results from an ongoing large-scale project focused on investigating and characterising star formation in the most extreme conditions. In particular, we will present new evidence that suggests that high-mass star formation is initiated under very specific threshold conditions, effectively distinguishing it from the mechanisms driving the formation of low-mass stars. This evidence will be summarised and discussed in context with theoretical models and simulations.

Pablo Riviere (ESAC)

Herschel-PACS observations of far-IR lines in young stellar objects. I. [OI] and H2O at 63 μ m

I will present a catalogue of Herschel-PACS spectroscopic observations of young stellar objects (YSOs) at 63 μm. The catalogue consists of more than 400 observations of 362 YSOs covering all evolutionary stages, from Class 0 to Class III. We detect [OI] emission in 194 sources, and line absorption in another five sources. H_2O was detected in 42 sources. There is evidence for extended [OI] emission for 77 sources, and find 3σ residuals in 71 of them. Only one source showed evidence of extended H_2O emission. The fraction of sources showing [OI] extended emission decays from Class 0 to Class II, indicating an evolutionary trend. We further analyse the presence of multiple components in the [OI] emission and find evidence for multiple components in 30 sources. We conclude that multiple dynamical components contribute to the emission, such as the disc, the envelope, winds and jets.

Regina Rudawska (ESTEC); J. Zender; D. Koschny; I. Latorre

The CILBO spectral observation program

In our talk we demonstrate the present stage of the CILBO (Canary Island Long-Baseline Observatory) meteor spectra setup in Canary Islands that is developed by the Meteor Research Group (MRG) of the European Space Agency in aim to measure the main element abundances of meteors. ICC8, the operating image-intensified camera with objective grating, is located on Tenerife station of the double-station camera setup CILBO (ICC7 and ICC9) [1]. Following procedures described in [2], the pipeline software processes data with the standard calibration procedure (dark current, flat field, lens distortion corrections). While using the position of a meteor recorded by ICC7 camera (zero order), the position of the 1st order spectrum as a function of wavelength is computed. At the same time, the meteoroid trajectory and pre-atmospheric orbit are independently measured from data collected by the double meteor observations carried by ICC7 (Tenerife) and ICC9 (La Palma). This, together with spectral information allow us to find the link between the meteoroid and its parent body, from both dynamical and physical consideration. [1] Koschny D., Bettonvil F., Licandro J., v. d. Luijt C., Mc Auliffe J., Smit H., Svedhem H., de Wit F., Witasse O. and Zender J., Geosci. Instrum. Method. Data Syst., 2, 339, 2013 [2] Zender J., Koschny D. and Ravensberg K., In Proceedings of the International Meteor Conference, Poznan, Poland, 22-25 August 2015. IMO, 126, 2014

Christian Schneider (ESTEC); H. M Guenther; J. Robrade

Stellar X-ray accretion signatures

Accretion is observed in a wide range objects with partially overlapping properties. In this contribution, I focus on accretion in young stars. Material impacting the stellar surface is shock heated to temperatures of a few MK, ideally suited for observations in the X-ray regime. Indeed, young, accreting stars show a surplus of cool plasma thought to be somehow related to accretion, the so-called soft excess. High-resolution grating spectroscopy with instruments like the RGS on-board of XMM-Newton allows us to infer the properties of this cool plasma. I will present results from our 250 ks XMM-Newton/Chandra program targeting the prototypical T Tau system and compare them with other accreting systems focusing on potentially different accretion modes. We find a strong cool excess in T Tau but line ratios indicative of low densities. Thus, the cool excess in T Tau, and likely in other accreting stars, is not caused directly by postshock emission from accretion spots, which are expected in magnetic stars like T Tau. Rather, the coolest plasma might be linked to other processes in accreting stars like an interaction of the corona with postshock plasma.

Elliot Sefton-Nash (ESTEC); Z. Faes; O. Witasse

The Origin of the Elongated Crater Population on Mars

Phobos and Deimos may have formed by accretion in a disk of debris surrounding Mars following a large impact (Craddock, 2011, Rosenblatt et al., 2016). Debris in an unstable configuration would have decaying orbits, therefore impacting the surface of Mars at a shallow angle. Craters resulting from impacts at angles less than 12° show an elongation in the direction of impact (Bottke et al., 2000). Using remote sensing data and an ellipse-fitting algorithm, we have updated a pre-existing database of elongated craters on Mars (Buchenberger, 2011) to include characterizing elements such as precise shape and location, estimated age and direction of impact. Preliminary analysis of our results indicates a majority (∼60%) of elongated craters result from impact in the prograde direction, and that a significant additional prograde bias exists in elongated craters that formed in the interval, ∼4.0 – ∼3.7 Ga, i.e. during the late heavy bombardment. Ongoing statistical analyses of crater properties will help narrow the set of elongated craters that might have originated from decaying moonlets.

References:

Bottke, W. F., Jr., Love, S. G., Tytell, D. and Glotch, T. (2000). Interpreting the Elliptical Crater Populations on Mars, Venus and the Moon, Icarus 145, p. 108–121.

Buchenberger, B., Elongated craters on Mars revisited. Masters Thesis (2011), Katholieke Universiteit Leuven.

Craddock, R. A. (2011). Are Phobos and Deimos the result of a giant impact? Icarus, 211(2), p. 1150–1161. Rosenblatt, P., Charnoz, S., Dunseath, K. M., Trinh, A., Hyodo, R., Genda, H. and Toupin, S. (2016). Accretion of Phobos and Deimos in an Extended Debris Disk Stirred by Transient Moons, Nature Geoscience 9, p. 581-583.

Håkan Svedhem (ESTEC); J. L. Vago

The ExoMars 2016 mission

The ExoMars 2016 mission was launched on a Proton rocket from Baikonur, Kazakhstan, on 14 March 2016 and is scheduled to arrive at Mars on 19 October 2016. ExoMars is a joint programme of the European Space Agency (ESA) and Roscosmos, Russia. It consists of the ExoMars 2016 mission with the Trace Gas Orbiter, TGO, and the Entry Descent and Landing Demonstrator, EDM, named Schiaparelli, and the ExoMars 2020 mission, which carries a lander and a rover.

The TGO scientific payload consists of four instruments. These are: ACS and NOMAD, both infrared spectrometers for atmospheric measurements in solar occultation mode and in nadir mode, CASSIS, a multichannel camera with stereo imaging capability, and FREND, an epithermal neutron detector to search for subsurface hydrogen (as proxy for water ice and hydrated minerals). The mass of the TGO is 3700 kg, including fuel. The EDM, with a mass of 600 kg, is mounted on top of the TGO as seen in its launch configuration. The EDM is carried to Mars by the TGO and is separated three days before arrival at Mars. In addition to demonstrating the landing capability two scientific investigations are included with the EDM. The AMELIA investigation aims at characterising the Martian atmosphere during the entry and descent using technical and engineering sensors of the EDM, and the DREAMS suite of sensors that will characterise the environment of the landing site for a few days after the landing.

ESA provides the TGO spacecraft and the Schiaparelli Lander demonstrator, ESA member states provide two of the TGO instruments and Roscosmos provides the launcher and the other two TGO instruments. After the arrival of the ExoMars 2020 mission at the surface of Mars, the TGO will handle all communications between the Earth and the Rover. The communication between TGO and the rover/lander is done through a UHF communications system, a contribution from NASA.

The composite TGO/EDM separated as planned three days before arrival at Mars, on 16 September 2016. 12 hours after separation TGO made a trajectory correction manoeuvre to avoid impacting Mars and to put the spacecraft in the correct position for orbit insertion. The orbit insertion was performed by one long, 139 minutes, burn of the main engine. A few hours after the orbit insertion Flight Dynamics confirmed that the spacecraft had entered into the correct orbit, at a slightly more than 4 sol period with a pericentre altitude of 250 km and an apocentre altitude just less than 100,000 km.

After separation the EDM coasted for almost three days in hibernation and woke up 1 hour before entry. The passive entry phase was very smooth and the parachute was deployed at hypersonic speed at the correct time. However, the parachute and the backshell were released about 40 seconds earlier than expected. After this the braking thrusters fired for only 3 seconds and then shut down and the spacecraft fell uncontrolled from approximately 4 km. An investigation team will present a report on their findings at around 20^{th} November. There is a large data set of housekeeping parameters available generated during the descent and it is likely that the problem will be fully identified and understood.

This presentation will cover a description of the 2016 mission, including the spacecraft, its payload and science and the related plans for scientific operations and measurements, a summary of the activities since arrival.

Matt Taylor (ESTEC); N. Altobelli; P. Martin; B. Buratti; Choukroun and Rosetta team

The Rosetta mission

The Rosetta Mission is the third cornerstone mission the ESA programme Horizon 2000. The aim of the mission is to map the comet 67-P/Churyumov-Gerasimenko by remote sensing, to examine its environment in-situ and its evolution in the inner solar system. The lander Philae is the first device to land on a comet and perform in-situ science on the surface. Following its launch in March 2004, Rosetta underwent 3 Earth and 1 Mars flybys to achieve the correct trajectory to capture the comet, including flybys of asteroid on 2867 Steins and 21 Lutetia. For June 2011–January 2014 the spacecraft passed through a period of hibernation, due to lack of available power for full payload operation and following successful instrument commissioning, successfully rendezvoused with the comet in August 2014. Following an intense period of mapping and characterisation, a landing site for Philae was selected and on 12 November 2014, Philae was successfully deployed. Rosetta then embarked on the main phase of the mission, observing the comet on its way into and away from perihelion in August 2015. The mission terminated with the Rosetta orbiter impacting the comet surface on 30 September 2016. This presentation will provide a brief overview of the mission and its science up to now.

Sergio Toledo Redondo (ESAC); M. Andre; Yu. V. Khotyaintsev; W. Li; D. B. Graham; A. P. Walsh; A. Masson; B. Lavraud; A. Vaivads; A. Divin; J. Dargent; N. Aunai; S. Fuselier; D. J. Gershman; J. Dorelli; B. Giles; L. Avanov; C. J. Pollock; Y. Saito; T. E. Moore; V. Coffey; M. O. Chandler; P.-A. Lindqvist; R. B. Torbert and C. T. Russell

Cold plasma in magnetic reconnection: in-situ observations at the magnetopause.

Magnetic reconnection is a fundamental plasma process that changes the magnetic field topology and transfers energy from the fields into the particles. It allows the exchange of energy and mass between colliding plasmas like for instance the Solar Wind and the Earth's magnetosphere. Different studies reported the presence of cold ions (originated at the ionosphere) populating the magnetosphere, which eventually reach the magnetopause boundary layer and entrain reconnection. A mixture of reconnecting plasmas with different temperature should be common in many astrophysical processes. Cluster enabled reconnection studies at ion scales more than 15 years ago and now the recently launched MMS is providing measurements at electron scales. We show that cold ions have a much smaller gyroradius and therefore introduce a new length-scale into magnetic reconnection between electron and hot ion scales. This situation leads to structures of the size of the cold ion gyroradius and changes the microphysics of the reconnection process. In addition, the cold plasma is rapidly energized while reconnection is ongoing.

Frank Tramper (ESAC); Hugues Sana; Alex de Koter

A new prescription for Wolf-Rayet mass loss and its implications for massive star evolution

We present a new empirical prescription for the mass-loss rates of hydrogen-free Wolf- Rayet stars as a function of their luminosity, surface chemical composition, and initial metallicity. The prescription provides an improvement in describing the mass-loss rates of WC and WO stars compared to the often used Nugis & Lamers (2000, NL00) prescription, in particular during the later stages of Wolf-Rayet evolution. Compared to NL00, the prescription has a shallower dependence on both luminosity and surface chemical composition, implying higher mass-loss rates at low luminosities and low surface helium abundances. We obtain a weak metallicity dependence for the wind strength of WC and WO stars, implying that if these stars are formed in low-metallicity environments, their winds are relatively strong. We discuss the implications of the new mass-loss rates for the immediate pre-supernova evolution of massive stars.

Andrew Walsh (ESAC); G. Graham; I. J. Rae

Use of Solar Wind Electron Measurements in Predicting Interplanetary Magnetic Field Direction

Plasma Electrons in the solar wind can be described with a velocity distribution function that has three components: A thermal core, a suprathermal halo and a suprathermal strahl. The former two components are broadly isotropic, while the strahl is typically closely aligned to the interplanetary magnetic field. Thus, if one can identify the strahl electrons in particle data, this information can be used to constrain the direction of the interplanetary magnetic field. Here we describe the first step in this process: Investigating the variability of the strahl with heliocentric distance.

David Williams (ESAC); D. Baker; L. van Driel-Gesztelyi; D. Long

Observing the internal dynamics of a solar filament eruption

Solar filament eruptions are phenomena of interest to our understanding of the Sun and its influence on the heliosphere. For the Sun, they represent an important mechanism for removing highly non-potential magnetic flux from active regions. In the wider heliosphere, they represent the eruption of a flux rope, creating a strong transient disturbance to the magnetic field and plasma dynamic pressure, and driving energetic particles at the shock that precedes it. Recreations of the path taken by the shock front have demonstrated that these are not necessarily radial, but instead experience feedback from heliospheric environment as they pass through it. One of the most challenging things to do in astronomy, however, is to simultaneously measure 3 spatial dimensions or velocity components while using 2-dimensional detectors typically found in cameras. Almost always, one dimension is sacrificed or two are mixed, compromising our ability to get the full 3D velocity, for example, of a target of interest. Since 2010, though, the Solar Dynamics Observatory has recorded high-sensitivity images of two ion species also observed through the slit of Hinode's EUV Imaging Spectrometer (EIS). We have analysed a rare dataset of a filament eruption that was captured by both observatories, with a view to constraining the eruptionÕs full velocity vector. In the process, we have uncovered some interesting dynamics, not only in the apex of the eruption, but also along its flanks, and discuss how these might fit our current picture of coronal mass ejections. Solar filament eruptions are phenomena of interest to our understanding of the Sun and its influence on the heliosphere. For the Sun, they represent an important mechanism for removing highly non-potential magnetic flux from active regions. In the wider heliosphere, they represent the eruption of a flux rope, creating a strong transient disturbance to the magnetic field and plasma dynamic pressure, and driving energetic particles at the shock that precedes it. Recreations of the path taken by the shock front have demonstrated that these are not necessarily radial, but instead experience feedback from heliospheric environment as they pass through it. One of the most challenging things to do in astronomy, however, is to simultaneously measure 3 spatial dimensions or velocity components while using 2-dimensional detectors typically found in cameras. Almost always, one dimension is sacrificed or two are mixed, compromising our ability to get the full 3D velocity, for example, of a target of interest. Since 2010, though, the Solar Dynamics Observatory has recorded high-sensitivity images of two ion species also observed through the slit of HinodeÕs EUV Imaging Spectrometer (EIS). We have analysed a rare dataset of a filament eruption that was captured by both observatories, with a view to constraining the eruptionÕs full velocity vector. In the process, we have uncovered some interesting dynamics, not only in the apex of the eruption, but also along its flanks, and discuss how these might fit our current picture of coronal mass ejections.

Poster Presentations

Listed alphabetically by author last name

[Poster # 25] Bruno Altieri (ESAC); ; Max Mahlke (ESAC trainee); Hervé Bouy (CAB/CSIC)

Mining the Kilo-Degree Survey to search for Solar System Objects

We present the methods used to acquire position, photometry, and proper motion measurements of solar system objects (SSOs) in the Kilo-Degree Survey (KiDS). Optical images of over 400 square-degrees of the sky were searched in up to four filters using the AstrOmatic software suite to reduce the pixel to catalog data. The solar system objects within the acquired sources are filtered out using a set of filters analyzing their motion and size. SSOs detections were visually inspected to estimate the degree of contamination in the dataset. We find that of the 30000 SSOs in the KiDS images, 46.0 % match the position of an SSO in the SkyBot database at that epoch within 10 arcsec. We plan to use this successful method on the Euclid survey.

[Poster # 21] Nicolas Altobelli (ESAC); B. Geiger; L. Colangeli; M. Fulle; S. Merouane; M. Rubin; M. Summer; R. Soja; R. Srama

Rosetta Data Fusion

We present the status of the Rosetta Data Fusion proposal, kicked-off recently, and aiming at combining data from Giada, Cosima, Rosina, Osiris and the navigation camera, as well as numerical modelling in order to achieve a consistent interpretation of the dust and gas data collected in the comet vicinity.

[Poster # 27] Chrysa Avdellidou (ESTEC); Detlef Koschny; Marco Delbo; Mark Price; Mike Cole

Impacts can alter or reveal the composition of the impactor.

Recent observations of asteroidal surfaces indicate the presence of materials that do not match the bulk composition of the body. The discovery of multi-lithology meteorites, such as the Almahata Sitta from the asteroid 2008 TC3 and Benesov, and the identified exogenic material on asteroids, e.g. on Vesta, Itokawa and Lutetia raises two fundamental questions: What is the possibility of forming these objects by collisions between bodies of differing composition? Are asteroids with mixed mineralogies more abundant than it was previously thought? A possible explanation for the presence of these exogenous materials is that they are products of inter-asteroid impacts in the Main Belt, and thus interest has increased in understanding the fate of the projectile during hypervelocity impacts. In order to gain insight into the fate of impactor, we have carried out a laboratory programme, covering the velocity range of 0.38–3.50 km/s, devoted to measuring the survivability, fragmentation and final state of the impactor. Future work involves monitoring of light flashes produced by hypervelocity impacts on lunar regolith, using real meteorites as projectiles. The aim is to understand the influence of impactors material (carbonaceous vs. ordinary chondrites) and impact speed on the produced flash. In turn, this will serve as a laboratory calibration for the real lunar flashes observations that are starting this winter as part the ESA funded program 'NELIOTA'.

[Poster # 1] Luca Calzoletti (ESAC); Stefano Pezzuto

Deriving the absolute calibration of the PACS 160 from the AKARI all-sky survey

The PACS camera on-board the Herschel Space Observatory was built to observe the far-infrared sky at 70, 100 and 160 μm. The mapmakers in HIPE, Unimap and JScanam, were developed to recover the extended emission without loosing sensitivity to point-like or compact sources. The data preprocessing done before the map generation, however, gives a final product, which is calibrated except for an unknown zero-level, an offset. We present a procedure to derive this offset by means of a comparison between the PACS maps at 160 μm with those, absolutely calibrated, derived by the AKARI satellite team at 140 μm. We compare our results with those obtained with a model prediction of the emission at 160 μm based on Planck-IRAS data. We show that our procedure is reliable and easily reproducible by any astronomer and, as such, it can be adopted for calibrating all the (suitable) PACS maps.

[Poster # 26] Jack Carlyle (ESTEC); D. Williams; L. van Driel-Gesztelyi; D. Innes; A. Hillier

Mass Diagnostics of Eruptive Filament Material

Filament eruptions are not only breathtakingly beautiful, but also key to our understanding of the variable environment which is the solar atmosphere. From the distribution of the material and internal density structure, it is possible to learn about the associated magnetic field which drives the transient activity in the corona, and knowledge of the total mass can answer questions regarding the kinetic energy of coronal mass ejections (CMEs). My research centers around the development of a technique which uses multi-wavelength EUV images from SDO/AIA to determine the mass of any plasma which appears in absorption, as filaments and associated eruptions frequently do. This method is being continuously developed to not only increase the accuracy of results, but also to widen its applicability to a broader spectrum of data (figuratively and literally). I show how I have successfully examined several events using this technique, particularly focusing on partially failed eruptions. I also demonstrate how is possible to use these results to further analyse the material, for example, by constraining numerical experiments which aim to recreate observed plasma instability. My current work aims to work with Solar Orbiter-like data ahead of launch in order to fully prepare for what will surely be a fantastic mission.

[Poster # 11] Ginevra Favole (ESAC)

Star-forming galaxies as tools for cosmology in new-generation spectroscopic surveys

Among star-forming galaxies, there is a particular population whose rest-frame optical spectra exhibit strong nebular emission lines. These galaxies will be the preferred targets of new-generation spectroscopic surveys as Euclid, the Dark Energy Spectroscopic Instrument (DESI), the 4-metre Multi-Object Spectroscopic Telescope (4MOST), and the Subaru Prime Focus Spectrograph (PFS). All these surveys will observe emission-line galaxies up to redshift z=2 to trace star formation and to measure the baryon acoustic oscillations as standard ruler for distances, in the attempt to unveil the nature of dark energy and probe the large scale structure of the Universe. Therefore, understanding how to measure and model the clustering properties of the emission line galaxies and how they populate their host dark matter halos are fundamental issues that I address using state-of-the-art data to prepare the clustering prospects and theoretical basis for future experiments.

[Poster # 8] Bernard Foing (ESTEC); N. Cox; J. Cami; EDIBLES VLT project team; HST C60+ proposal team

Diffuse Interstellar Bands and Large Organics in Space

We describe an ongoing large VLT project (EDIBLES) to survey Diffuse Interstellar Bands (DIBs) in a comprehensive set of lines of sight. This is following up our discovery of interstellar C60+ (Foing, Ehrenfreund), the search for large organics, the correlations between DIBs and other interstellar parameters and the search for carriers of DIBs. HST observations are also planned end 2016 for the measurement of C60+ bands.

[Poster # 36] Bernard Foing (ESTEC); C; Jonglez; O. Kamps; M. Offringa; H. Vos; A. Kolodjeczyk

ExoGeoLab MoonMars Field Analogue Campaign at Eifel Volcanic Area

Recent updates on the ExoGeoLab lander prepared the system for geological field campaigns which were conducted in November 2015 and February 2016. As closest volcanic area from ESTEC, we performed the campaigns in the Eifel, Germany. These campaigns tested the abilities of remote control of the lander, doing measurements with the lander instruments, and to study the interaction with astronauts or rovers. ExoGeoLab is a collaborative project between ILEWG and ESA which has started in 2008 to support research in Moon-Mars analogue field campaigns (such as EuroMoonMars campaigns. seach and is build with the requirements of the Google Lunar X-Prize [1]. In the last years the lander has been updated with respect to the remote control and the implementation of instruments to make it suitable for geological field campaigns. Such a lander could be useful for sample analysis in a sample return mission or to assist an astronaut during manned mission. Remote control of the instruments makes it possible that experts can do analysis from Earth. Multiple instruments are included for doing geological and possibly biological analysis in the field. Two reflection spectrometers in the

UV-visible and near-infrared range are used to study the samples. A webcam is used for an optical real-time view on the sample on the sample stage.

[Poster # 20] Bernard Foing (ESTEC); Moon Village Research support group

Research in support to Moon Village studies

The DG of ESA, Jan Wörner, has promoted the concept of a Moon Village, where Europe could have a lead role. The concept of Moon Village is basically to develop a permanent and sustainable human presence and activities on the Moon with different countries and partners that can participate and contribute with different elements, experiments, technologies, and overall support. The concept has been supported worldwide, and an ESA wide working group has been established with representatives from all directorates. We report on Moon Village workshops , hands-on research and study activities. In particular we describe research performed with instruments that could equip a Moon Village research base (remotely operated sensors, cameras, telescopes, spectrometers, sample analysis), using a precursor robotic ExoGeoLab lander, and an ExoHab crew module. We also conducted EuroMoonMars field campaigns in Moon-Mars analogues (Utah, Eifel volcanic area, Poland MoonMars simulation base). We describe some experimental research conducted at ESTEC in collaboration with EAC, DLR, VU Amsterdam and other partner institutions.

[Poster # 35] Giovanna Giardino (ESTEC); G. Giardino; N. Luützgendorf; P. Ferruit; B. Dorner; et al.

The spectral calibration of JWST/NIRSpec: results from ISIM/CV3

The NIRSpec instrument of JWST can be operated in multi-object (MOS), long-slit, and integral field mode with spectral resolutions from 100 to 2700. Its MOS mode uses about a quarter of a million individually addressable mini-slit for object selection, covering a field of view of 9 square-arcminute. We have developed a procedure to optimize a parametric model of the instrument that provides the basis for the extraction of wavelength calibrated spectra from NIRSpec data, from any of the apertures, for all the modes. Here, we summarize the steps undertake to optimize the instrument model parameters using the data acquired during the latest cryo-vacuum campaign of the JWST Integrated Science Instrument Module, recently carried out at NASA Goddard, and discuss the results in terms of the expected spatial and spectral calibration accuracy of NIRSpec.

[Poster # 13] Ana Heras Pastor (ESTEC); Stefanie Raetz; Exoplanets WG

Updates of the Extra-Solar Planet Programme at ESA's Optical Ground Station

The ESA Optical Ground Station (OGS) is a 1-m telescope located at Teide Observatory, Tenerife, that was originally built for laser link tests and space debris observations. In 2004, an additional instrument was commissioned at the OGS, which was especially developed for direct imaging and long-slit spectrometry of comets. The instrument was refurbished and reinstalled for long-term use at the OGS in support of comet and extra-solar planet research. Since the first commissioning run in February 2015, four science runs with a typical duration of one to two weeks have been performed between September 2015 and July 2016. We observed 20 planetary transits within the exoplanet program mainly to refine the orbital elements, constrain their physical parameters, search for additional bodies in the system, and characterize the host stars. In addition to the exoplanet program, we contributed to a number of projects by observing young stars, monitoring young open clusters, searching for transits around direct imaging planet host stars, and obtaining spectra of runaway stars. Furthermore, we carried out ground-based photometric and spectroscopic follow-up observation of 67P/Churyumov-Gerasimenko in support of ESA's Rosetta mission and investigated the association of comet 252P/LINEAR with meteor showers observed on Earth. We will give an overview of the observations and show first results.

[Poster # 3] Aitor Ibarra Ibaibarriaga (ESAC); P. Rodriguez; R. Saxton

XMM-Newton counterparts of Gaia photometric transients

We present a preliminary study of the potential XMM-Newton counterparts of Gaia photometric alerts. We have analysed more than 1200 Gaia photometric alerts, correlating their coordinates against XMM-Newton public pointing and slew observations to check for X-ray counterparts. In this poster we present the technique used to determine the cross-matches and their X-ray characteristics. The first analysis shows that 77 Gaia photometric alerts have been observed by XMM-Newton at least once, and 6 sources have been detected as X-ray counterparts. In the less sensitive, but wider area, XMM-Newton slews, 2 counterparts were found. This work can be the seed for potential XMM-Newton follow-up observations of Gaia transient already detected in XMM-Newton observations.

[Poster # 18] Oliver Jennrich (ESTEC); LPF science collaboration

Getting kicked repeatedly - a recipe for low noise measurements

The "drift mode" in LISA Pathfinder has been designed to investigate the residual force noise in the absence of control forces on the test masses. One of the test mass is periodically given a small push against the static gravitational field and performs a number of parabolic flight which can be analyzed to determine the remaining forces. A technique to minimize the influence of the periodic forces by a 'weighted FFT' is presented.

[Poster # 9] Eleni Kalfountzou (ESAC)

Hunting Binary AGNs

Supermassive black holes (SMBHs) were first proposed to account for the energy source of active galactic nuclei (AGNs). Now it is well known that nearly every galaxy hosts a SMBH in its center. At the same time, in a ΛCDM universe, galaxies grow by hierarchical merging. During the merger, the SMBHs from each progenitor will sink to the center of the merger remnant, and therefore it seems inevitable that the two SMBHs will form a gravitationally bound system, known as an SMBH binary. Merging SMBHs are expected to be the strongest source of gravitational wave radiation to be detected by space-based laser interferometers. However, the exact temporal evolution of these binaries, which directly determines their detection rates, remains uncertain from both a theoretical and observational perspective. Quasar pairs can be classified in physical pairs, gravitational lenses and projected associations. Quasars in physical pairs are gravitationally interacting or belong to the same structure (e.g. a cluster of galaxies). They represent a formidable tool to improve our understanding of the evolution of galaxy and dark matter clustering with Cosmic Time, since they can be traced up to very high redshift. They can also provide information about the role of galaxy interactions in triggering nuclear activity. Using optical, sub-millimiter and X-ray observations we try to address open questions such as: what is the evolution path from binary quasars to single quasars, what is the role of merger-triggered SMBH accretion and its relationship to galaxy evolution, are the host galaxies of binary quasars interacting, are they bound to each other and in the process of merging? We will present our systematic search for binary quasars, evidences for inflows and outflows at these systems and the discovery of a new triple AGN candidate.

[Poster # 22] Detlef Koschny (ESTEC); Detlef Koschny; Thomas Albin; Esther Drolshagen; Sandra Drolshagen; Gerhard Drolshagen; Jana Kretschmer; Sam Leakey; Cornelis van der Luijt; Theresa Ott; Regina Rudawska; Hans Smit; Andrea Toni; Joe Zender

Scientific results from two cameras of our double-station meteor cameras in the Canaries

Since 2012, we have been operating a double-station camera system to observe meteors. We've named this system CILBO (Canary Island Long-Baseline Observatory). In total we operate 5 cameras in two locations. In this talk we will present the work we have done this year using the data from two of these systems, called ICC7 and ICC9 (ICC = Intensified CCD camera). We have performed a detailed analysis of possible biases that come from the camera system itself and the detection software. After having understood these biases, in close collaboration with students from the University of Oldenburg, we have assessed the geometrical and physical biases. We have corrected the data in such a way that we can produce a de-biased flux density distribution as a function of meteoroid mass. This work has been submitted to Planetary and Space Science. Ongoing work is related to the determination of meteoroid orbits and the de-biasing of the orbital distribution over the sky.

[Poster # 23] Detlef Koschny (ESTEC); D. Koschny; A. Toni; L. Colangeli; E. Sefton-Nash; O. Witasse; J. Vago; F. Ferri; F. Esposito; J.-L. Josset

Images from the Descent Camera on Schiaparelli

With support of SSO Faculty funding, we have requalified the flight spare unit of a camera flown on Herschel/Planck and it is now the Descent Camera (DECA) on the ExoMars Schiaparelli lander. We expect 15 images from the instrument which hopefully show Mars around the area of the landing site. This poster will show the images obtained with DECA during the descent.

[Poster # 24] Detlef Koschny (ESTEC); D. Koschny; F. Cipriani; L. Colangeli

Hayabusa grain analysis - current status

We are in the process of analyzing there asteroid sample grains returned from asteroid 1999 JU3 by the Hayabusa spacecraft. This poster will give an update of where we stand in the project.

[Poster # 15] Peter Kretschmar (ESAC); M. Knel (ECAP/FAU); J. Wilms (ECAP/FAU)

BeXRB Database

Be X-ray Binaries are largely transient systems whose brighter outbursts are often followed by multi-satellite campaigns, resulting in archival data being widely spread and non-trivial to find and use. The project undertakes to create a full database of BeXRB systems within ESAC's Multi-Mission Interface with information on these sources, their outbursts, long-term lightcurves, metadate, etc., linking to the relevant data archives and to Virtual Observatory services. The poster will give a summary of the project and its status.

[Poster # 39] Peter Kretschmar (ESAC); N. Hell (LLNL & ECAP/FAU); J. Wilms (ECAP/FAU); R. Smith (CfA); G. Brown; P. Beiersdorffer (LLNL); C. Kilbourne; R. Kelley; S. Porter (GSFC)

Atomic Data for X-ray Astronomy

X-ray line spectroscopy is an important diagnostic tool in astrophysics, whose role will become more important in the future with the advent of more high-resolution instruments like the Athena X-IFU or the late ASTRO-H mission. But for many lines in commonly used atomic physics databases, the line energy is known to less precision than that achieved by these instruments, often the actual uncertainty is not even known. A project is underway to improve the situation for the most relevant lines combining laboratory measurements at Lawrence Livermore National Laboratory and state-of-the-art theoretical calculations. In addition, a software interface to simplify the use of atomic physics databases in common X-ray spectroscopy tools is being developed.

[Poster # 6] Marcos Lopez-Caniego (ESAC); J. Tauber; P. Carvalho; B. Altieri; L. Calzoletti; L. Conversi; X. Dupac; M. Sanchez-Portal; I. Valtchanov; R. Vavrek

Improving the Planck source catalogues with the help of IRIS and Herschel

Two SRE research projects have been funded by the Faculty to carry out a multi-frequency analysis of Planck and Herschel data. In the first project we aim to produce a new catalogue of thermal sources using as input the sources in the Second Planck Catalogue of Compact Sources (PCCS2) at 857 GHz, combining Planck and IRIS maps to estimate the SED of the objects and the parameters of a grey-body fit to their SED. The catalogue will also flag possible non-thermal sources. In the second project we combine Planck and Herschel maps to re-assess the reliability of sources in the PCCS2, and eventually, to produce a new version of the catalogue that will increase significantly the number of sources with reliability information. For this project we have collected an initial set of Planck and Herschel maps and catalogues and a detailed comparison between the two data sets is taking place. Within 2016, we have worked on both projects in parallel. It was soon realized that we needed a tool that allowed us to evaluate quantitatively the reliability of the source and background detections. For this purpose we have developed a Bayesian likelihood machinery that can be used in both projects and is capable of estimating the SED of the source and background. This code is able to produce SED parameters of both source and local background for any catalogue of Planck + IRIS sources, as well as the parameter posterior distributions which allow to estimate parameter uncertainties. We are now analyzing the results on individual sources to assess their reliability and to tune thresholds and other parameters of the algorithm. As soon as the robustness of this tool has been demonstrated, we will use it to achieve the goals of both projects. In this poster we will describe the method and give some examples of current results.

[Poster # 7] Marcos Lopez-Caniego (ESAC); D. Herraz; F. Argueso; L. Bonavera; D. Clements; G. De Zotti; J. Gonzalez-Nuevo; A. Lahteenmaki; B. Patridge; L. Toffolatti; M. Tornikoski

A Planck multifrequency catalogue of radio-selected sources

We have produced a multi-frequency catalogue of radio-selected sources using the Planck 2015 intensity maps. As opposed to previous band-merged Planck catalogues, this band-filled catalogue is constructed by means of a multi-frequency filtering technique which gives better results in term of both the global number of detections and the statistical homogeneity of the catalogue. The source targets are selected at radio frequencies but the catalogue follows the targets up to 857 GHz. We have already completed the first version of the catalogue and are working on the statistical study and physical interpretation of the catalogue, the identification of potentially interesting/extreme objects, external validation and/or follow-ups of the sources.

[Poster # 17] Uwe Lammers (ESAC); Robin Geyer; Sergei Klioner

Search for Gravitational Waves in the Data of Scanning Astrometric Missions

The project presented here is a proof-of-concept study with the goal to determine whether it is, in principle, possible to detect gravitational waves (GW) with a scanning astrometry satellite. The study should first deal with the theoretical aspects of the effects of gravitational waves of different frequencies on the results of standard astrometric solutions. Another aspect is to find a feasible computational algorithm to search for the gravitational waves in the residuals of the standard astrometric solution. Implications on a Gaia-like mission and Gaia-like data processing is also evaluated.

[Poster # 32] Daniel Mueller (ESTEC); Catherine E. Fischer; Ineke De Moortel

JPEG2000 image compression of solar EUV images

For future solar missions as well as ground-based telescopes, efficient ways to return and process data become increasingly important. Solar Orbiter, e.g., is a deep-space mission, which implies a limited telemetry rate that makes efficient on-board data compression a necessity to achieve the missions science goals. Missions like NASA's Solar Dynamics Observatory (SDO) and future ground-based telescopes such as the Daniel K. Inouye Solar Telescope, on the other hand, face the challenge of making petabyte-sized solar data archives accessible to the solar community. New image compression standards address these challenges by implementing efficient and flexible compression algorithms that can be tailored to user requirements. We analyse solar images from the Atmospheric Imaging Assembly (AIA) instrument onboard SDO to study the effect of lossy JPEG2000 image compression at different bit rates. To assess the quality of compressed images, we use the mean structural similarity (MSSIM) index as well as the widely used peak signal-to-noise ratio (PSNR) as metrics and compare the two in the context of solar EUV images. In addition, we perform tests to validate the scientific use of the lossily compressed images by analysing examples of an on-disk and off-limb coronal loop oscillation time series observed by AIA/SDO. The goal of this research is to make optimal use of the limited telemetry of Solar Orbiter by tuning the parameters of on-board image compression depending on the intended scientific use.

[Poster # 12] Louise Nielsen (ESTEC); Pierre Ferruit; Giovanna Giardino; Stephan Birkmann; Jeff Valenti and Antonio Garcia Muñoz

Characterising exoplanet atmospheres with JWST/NIRSpec

With its unprecedented sensitivity, stable observing conditions and access to the near to mid-infrared wavelength range, the James Webb Space Telescope (JWST) will after launch in 2018 provide a unique tool for the study of transiting exoplanets. JWST observations will allow us to characterise the atmospheres of alien worlds in greater detail than ever before. The near-infrared spectrograph NIRSpec is one of four instruments on JWST and has an observation mode dedicated to spectroscopy of exoplanets orbiting bright host stars. My YGT project has been dedicated to the development of the NIRSpec Exoplanet Exposure Time Calculator (NEETC) which is optimised to deal with exoplanet observations and their very specialised observing strategy. The NEETC will allow future users to fully investigate NIRSpec's observation modes and capabilities while testing the feasibility of specific observations. I will give examples of NEETC simulations for well know transiting exoplanets, discussing the observation strategy and possible science goals. The capabilities and limitations of NIRSpec for exoplanet observations will be highlighted.

[Poster # 38] William O'Mullane (ESTEC)D. Lennon; et al

SCI-O funded research

Short description of science projects currently funded by SCI-O.

[Poster # 33] Denise Perrone (ESAC); O. Alexandrova; O. W. Roberts; S. Lion; M. Maksimovic; Y. Zouganelis

Statistical analysis of compressive coherent structures in the solar wind

Understanding the physical mechanisms of dissipation, and the related heating, in turbulent collisionless plasmas (such as the solar wind) represents nowadays one of the key issues of plasma physics. Although the complex behavior of the solar wind has been matter of investigation of many years, some of the primary problems still remain a puzzle for the scientific community. Here, the nature of the turbulent fluctuations close to the ion scales, in both slow and fast solar wind streams, is investigated by using high-time resolution magnetic field data of multi-point measurements of Cluster spacecraft. The presence of coherent structures characterizes the analyzed time intervals, with a strong wave-vector anisotropy in the perpendicular direction with respect to the local magnetic field and typical scales around ion characteristic scales. Furthermore, it has been shown for the first time that different families of coherent structures participate to the intermittency at ion scales. In slow solar wind, compressive structures, such as magnetic holes, solitons and shock, and alfvénic structures in form of current sheets and vortices are observed. These last ones can have an important compressive part and they are the most frequently observed during the considered interval of slow solar wind. On the other hand, in fast solar wind the ion scales are dominated by Alfvén vortices with small and/or finite compressive part and by several current sheets aligned with the magnetic field.

[Poster # 10] Janine Pforr (ESTEC); The VUDS team; mentor: Pierre Ferruit

Star formation and dust properties of high redshift galaxies as seen through the Hydrogen Lyman-alpha emission line

The search for and study of the first galaxies; which formed when the Universe was less than 1 Gyr old (z>6); drives current astronomical research and future space missions; such as JWST. Understanding how these galaxies formed and evolved is crucial to understanding our current Universe. The very first galaxies are expected to be strong emitters of the Lyman-alpha 1216A line due to their primitive chemical composition and strong star formation. The role of Lyman-alpha emitting galaxies in the evolutionary path; their properties and distinction from non-emitting galaxies is still under debate due to biases in galaxy sample selections; the scarcity of spectroscopic data for galaxies at z>2 (within first 3 Gyr); and degeneracies between galaxy properties determined purely from photometric data. I will present my plans for addressing these issues during my ESA fellowship by studying the properties of Lyman-alpha emitting galaxies and their evolution with cosmic time using the VIMOS Ultra-Deep Survey; the largest spectroscopic survey of galaxies between z=2-6.5.

[Poster # 14] Timo Prusti (ESTEC); U. Lammers; J. de Bruijne; C. Manara; J.-U. Ness; H. Siddiqui; K. Lehtinen; T. Markkanen; K. Muinonen; M. Poutanen

Carte du Ciel and Gaia

Gaia provides a realisation of ICRF in the optical wavelengths. This allows re-calibration of old images (CCD or photographic plates) into absolute astrometry. Carte du Ciel photographic plates have sensitivity matching that of the Tycho-Gaia Astrometric Solution stars. The study involves digitisation of the plates in the Helsinki zone and calibration into the ICRF with TGAS stars. The study is to explore changes in proper motions between decade and century time scale in order to identify and study blended binary stars with degeneracy between orbital and proper motions.

[Poster # 28] Miriam Rengel (ESAC); William Reach; Paul Hartogh and Hideo Sagawa

Tracing the Composition of Hydrogen Cyanide in the Stratosphere of Titan from Space; Airborne; and Ground-Based Observations

We investigate the composition of Hydrogen Cyanide (HCN) in the Stratosphere of Titan from the Herschel Space Observatory, SOFIA, IRAM-30m, and APEX. By obtaining the spectral emission, using a line-by-line radiative transfer code, and scaling a well-probed reference distribution with a vertically constant factor, we infer the HCN vertical distribution. We perform inter-comparisions between our results. These advances allow a further characterization of the complex atmosphere of Titan and help to advance the study of the abundance distribution and the investigation of a variety of processes in Titan atmosphere.

[Poster # 29] Owen Roberts (ESTEC); X. Li; D. Perrone; C.P Escoubet

Rapid changes in the solar wind proton velocity distribution function observed with CIS

The collisionless nature of the solar wind plasma, as well as the ability to support a number of waves and coherent structures, give rise to a number of non-Maxwellian features in the velocity distribution function. Using observations of the full three dimensional distributions from the Cluster Ion Spectrometer the VDF is seen to change significantly on timescales of minutes. In some instances double cores of the velocity distribution function can be seen. Using wavelet analysis the properties of the magnetic field fluctuations (coherency, phase, power) can be obtained at the instant the VDF is sampled. Additionally multi-spacecraft timing can also help characterise fluctuations and determine whether coherent structures contribute to the shape of the VDF.

[Poster # 30] Owen Roberts (ESTEC); A. Walsh; C.P. Escoubet; P. Kajdic

Variability of the electron power spectrum in the solar wind

At sub ion scales the slope and morphology of the turbulence power spectrum is a topic of open debate. A short interval of solar wind magnetic field data sampled at 450Hz by Cluster's STAFF-SCM instrument when in burst mode show the presence of sporadic short duration energetic events, which last for a few seconds within a minute interval. Wavelet coherence and phase between components in the plane perpendicular to the magnetic field suggest that these fluctuations are whistler waves. Although they only cover make up to 10% of the time they are clearly visible in the global power spectral density. Electron distributions sampled show the presence of two beams during the most intense emission. The source of these fluctuations is unclear since the electron moments suggest the plasma is stable with respect to the whistler anisotropy instability and the electron heat flux instability.

[Poster # 16] Celia Sanchez (ESAC)

Time resolved hard X-ray spectroscopy of V404 Cyg over the June 2015 outburst

The hard X-ray spectrum of Galactic black hole binaries is produced by Comptonization of soft seed photons by hot electrons in the vicinity of the black hole. The resulting energy spectrum is governed by two main parameters: the electron temperature (Te) and optical depth of the emitting plasma (τ). The extremely bright outburst of the black hole transient V404 Cyg in June 2015, provides a unique data set to perform time resolved spectroscopy in hard X-rays. Thus allowing a detailed study of the evolution of the parameters describing the Comptonizing plasma. We present here the results of the analysis of data from the IBIS/ISGRI instrument onboard INTEGRAL, in the energy range 20–200 keV obtained over the period 18–28 June 2015.

[Poster # 4] Richard Saxton (ESAC); A. Read; S. Komossa

A summary of X-ray emission characteristics from Tidal Disruption Events

Flares caused by the disruption and subsequent accretion of a star by a super-massive black hole are rare events. Only around 20 have been found in X-ray observations and a similar number in optical and UV surveys. By comparing data taken while XMM-Newton slews between targets and X-ray observations from 20 years ago we have been able to find 5 of these flares. Their spectral and timing properties are diverse, indicating that while black holes may have no hair, the way that they eat stars is certainly a hirsute process. We look at the phenomenology of disruption events and compare them with current models.

[Poster # 19] Elliot Sefton-Nash (ESTEC); E. Sefton-Nash; J. C. Bridges; L. Kissick; F. Butcher; P. Donnelly; J. D. Piercy; J. L. Vago; D. Loizeau; L. Lorenzoni; P. M. Grindrod; M. Balme

Characterizing Rock Abundance at ExoMars Landing Site Candidates

We present preliminary work to characterize surface rock abundance at ExoMars Rover landing site candidates. A challenge in quantifying the abundance of surface rocks is using the population of large ($\sim$1 m) rocks that are resolved in orbital images to infer the size of the smaller, unresolved rock population. The ExoMars Rover Landing Module's clearance of 35 cm [1] makes it necessary to know the probability of encountering rocks where $0.35 < D < 1$ m. 'Float rocks' are individual fragments of rock not associated with a continuous outcrop or body of rock, e.g. transported rocks or impact debris. These can be identified in Mars Reconnaissance Orbiter HiRISE [2] images, where the mid-afternoon observation times cause float rocks to appear as bright sunlit features adjacent to strong shadows. However, the smallest features resolvable in HiRISE images occupy around 3-4 pixels, corresponding to $\sim$1 m-sized rocks. This inherently limits the ability to directly identify from orbit the small, but potentially hazardous rock population. 'Outcrop' is defined as continuous expanses of bedrock or surficial deposits exposed at the surface [3]. Both float rocks and outcrop can contribute to slopes that may constitute a hazard for landed missions. We sample the size frequency distribution of detectable float rocks at ExoMars Rover landing site candidates and fit them to the canonical rock abundance model [4] to infer unresolved small rock populations. We report on the consistency of manual counting and on software developments to automate rock counting. We highlight the importance of synergistic approach that uses both visible and infrared data. Visible data is resolution-limited, but gives individual counts and rock locations, while infrared 'rock abundance' (retrieved by measuring anisothermality across bandpasses) can indicate the total fraction of high thermal inertia material on the surface, and thus is sensitive to all sizes of float rocks and rocky outcrop, as well as flat, non-hazardous terrain.

References: [1] ExoMars 2018 Landing Site Selection User's Manual (2013), ESA (EXM-SCI-LSS-ESA/IKI-003). [2] McEwen, A. S. et al. (2007), J. Geophys. Res. 112 (E05S02). [3] Lorenzoni, L. V. et al. (2013), EXM-MS-RS-ESA-00013 (Iss.5, Rev.1), ESA. [4] Golombek, M. and Rapp, D. (1997), J. Geophys. Res. 102 (E2) p. 4117–4129.

[Poster # 40] Marco Sirianni (Baltimore); ESA JWST Science Operations Team

Engaging the Astronomical Community in preparation for JWST

We present initiatives and strategies to engage the astronomical community in preparation for JWST first call for proposal in late 2017

[Poster # 31] Sergio Toledo (ESAC); ; P. Escoubet; F. Cipriani; R. Nakamura; K. Torkar; Y. Khotaintsev; P. Lindqvist; M. Andriapoulou; A. Masson; H. Laakso; O. Roberts; L. Turc

Particle in Cell simulations of a spacecraft potential controller (ASPOC) on the Magnetospheric MultiScale (MMS) mission

The NASA Magnetospheric Multiscale (MMS) mission is a Solar-Terrestrial Probe mission comprised of four identically instrumented spacecraft that will use Earth's magnetosphere as a laboratory to study the microphysics of magnetic reconnection. The MMS payload contains a new generation of very fast particle detectors, capable to measure distribution functions with a resolution of 30 ms for electrons (cf. 4 s on Cluster). MMS was launched in March 2015. The Active Spacecraft Potential Control (ASPOC) system, based on the emission of an ion beam, is used to reduce the platform electrostatic potential to a few volts positive while the spacecraft is operating in tenuous plasma environments. Due to the spacecraft spin, the spacecraft generated photoelectron cloud and the positive space charge in the ASPOC plumes, the environmental field variability is difficult to disentangle from the pure geometrical effects. A 3D numerical model of MMS has been built in order to characterize the electrostatic environment of the spacecraft during ASPOC operations and the resulting perturbations on DC electric field measurements provided by the Spin-Plane Double Probes. We report here the characteristics of this model, simulations of the spacecraft dynamic in the Sun while the ASPOCs are operating, and provide the first results on the observed behavior of the DC Electric-field components as resulting from the spacecraft itself. Our outputs are compared to data acquired on January 1st 2016 when the spacecraft was crossing the dayside magnetosheath.

[Poster # 34] Sergio Toledo Redondo (ESAC); A. Salinas; J. Porti; O. Witasse; S. Cardnell; J. Fornieles; G. J. Molina-Cuberos; G. Deprez and F. Montmessin

Schumann resonances at Mars: effects of the day-night asymmetry and dust

Schumann resonances are waves in the Extremely Low Frequency range (few tens of Hz) that are accommodated in the electromagnetic cavity formed between the conducting lower ionosphere and the surface of the planet. Their parameters (amplitude, frequency, quality factor) depend on the electromagnetic characteristics of the cavity, namely the surface, atmosphere and lower ionosphere. In addition they provide insights on the electrical activity in the atmosphere. Therefore, they are a powerful tool to investigate the planets and moons of the Solar system. Severe dust storms have been reported to occur on Mars, which modify the electromagnetic properties of the atmosphere and may be a source of electric activity. The ExoMars mission carries the microARES instrument onboard the Schiapparelli lander, and will attempt to measure them in-situ for the first time. We performed numerical simulations of the Mars electromagnetic cavity, and accounted for the day - night asymmetry and different dust scenarios that ExoMars may encounter. The resonances are more energetic on the nightside and the first resonance is expected at 9 - 14 Hz, depending on the amount of dust.

[Poster # 2] Laura Tomas (ESAC); Maria Santos-Lleo; Nora Loiseau; Matthias Ehle

The Starburst-AGN relation in a nearby low luminosity AGN: NGC 1566

NGC 1566 is a southern nearby face-on spiral galaxy harbouring a low luminosity unobscured AGN nucleus, as well as a circumnuclear star-forming ring. We present here our XMM-Newton X-ray observations of NGC 1566, that have been performed as part of our ongoing study addressing the link between low luminosity AGN activity and central star formation. X-ray images and spectra offer a unique opportunity to separate and analyse both emission components: Hard X-ray emission is considered a signature of AGN activity, while the soft X-ray emission is attributed to hot plasma heated by the mechanical energy released into the medium by stellar winds and supernovae explosions. Our X-ray results, in combination with the data available at other wavelengths (ALMA, HST, Herschel, etc), will help in understanding the Starburst-AGN connection in nearby galaxies (where both contributions can be resolved in X-rays) and also in disentangling both types of activity in objects at farther distances.

[Poster # 5] Juan Carlos Vallejo (ESAC); Miguel A.F. Sanjuan

Role of dark matter haloes on the predictability of computed orbits

One prediction of the cold dark matter models is that galaxy-scale dark matter haloes are described by a triaxial density ellipsoid. Triaxial models must be handled with particular care. Depending on the degree of triaxility, the phase space of a logarithmic potential can be occupied to a large extent by chaotic orbits. The main goal of this work is to analyse the role of the shapes and orientations of triaxial dark matter haloes on the predictability of the computed orbits. To do this, we selected a mean smooth fixed gravitational time-independent potential that models the Milky Way, focusing on the parameters controlling the shape and orientation of a triaxial dark halo. We analyse the correlation between chaos and low predictability values, and how they depend on the dark halo parameter values. We derived a predictability index from the distributions of the finite-time Lyapunov exponents. We computed those distributions and analysed the evolution of their shapes when the finite-time interval sizes are varied. The predictability index can be computed using the interval lengths corresponding to the timescales when the flow dynamics leaves the local regime and enters the global regime. These analyses reveal that not all chaotic orbits have the same predicta bility and that the predictability of some orbits is more affected than others by the orientation and shape of the dark halo. We show that the lowest predictability may be linked to strong unstable dimension variability. These results have been accepted for publication in Astronomy and Astrophysics (DOI: http://dx.doi.org/10.1051/0004-6361/201629206)

[Poster # 37] Ivan Valtchanov (ESAC); SPIRE FTS and Photomer teams

Challenges for the extended source calibration of the Herschel-SPIRE Fourier-Transform Spectrometer

I will discuss some challenges for the SPIRE-FTS extended source calibration scheme and introduce a correction method using cross-calibration with the SPIRE photometer. I will illustrate the critical impact on the science results produced with the previous calibration.