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Book of Abstracts

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Session ASA

Disques protoplanétaires dans le (sub)millimétrique : paver la route vers ALMA
J.F. Gonzalez
(Centre de Recherche Astrophysique de Lyon)

Cluster Lensing Survey in the Millimeter
P. Jablonka
(Observatoire de Paris - EPFL)
I will present a 1.3mm continuum survey (IRAM Large Programme) of distant dusty galaxies out to redshift z>5-8. Our strategy is to map out the critical line regions of five galaxy clusters selected for their highly accurate mass models and extensive multi-wavelength dataset (HST, Spitzer IRAC, eMerlin, and Herschel). The 1.3 mm source population at the faintest fluxes (sub-mJy levels) is yet to be discovered, but is expected to dominate the star formation rate density at high redshifts and produce the bulk of the cosmic infrared background (CIB) at this wavelength. Identifying and studying the sub-mJy mm population is one of the core science driver for the future ALMA observatory. However, with the recent development of WIDEX, the Plateau de Bure Interferometer (PdBI) is already able to start investigating the properties of typical star-forming galaxies out to z$\sim$ 8.

Phases précoces de la formation des étoiles
Sébastien Maret et al.
(Laboratoire d'Astrophysique de Grenoble)

Session ASGaia-PNCG

The chemical enrichment in the halo from first galactic stars

Piercarlo Bonifacio
(GEPI - Observatoire de Paris - CNRS -Univ. Paris Diderot)

The cosmic microwave background and the cosmic expansion can be interpreted as evidence of the fact that the Universe was extremely hot and dense about 14 Gyr ago. Under these physical conditions nuclear reactions could take place and form deuterium, the two stable isotopes of He and traces of 7Li. Formation of heavier nuclei was prevented by the absence of any stable nucleus with A=5 and by the rapid expansion and cooling of the Universe. In the subsequent evolution of the Universe the small density fluctuations lead to the gravitational collapse of the material and at some stage this must have lead to the formation of stars. These stars contributed to the reionisation of the Universe which was over 50% reionised at redshift z=10. Current observations do not allow to study galaxies at these high redshifts, however local stars with ages above 13 Gyr were formed at redshift 10, or larger. Such stars offer us the unique opportunity of having a snapshot of the chemical composition of the ISM at these early epochs. The old, extremely metal-poor (EMP) stars, whose atmospheres provide this crucial information, are very rare and their discovery requires dedicated surveys. I will review the recent advances in this field.

Dynamical modelling of the Galaxy and stellar migration in the disc

Famaey, B. & Minchev, I.
(Observatoire Astronomique de Strasbourg)

We show the effects on the non-axisymmetry of the Galactic potential. In particular, we report that spiral structure interacting with a central bar is an effective mechanism for radial mixing in the disc. This mechanism could account for both the observed age-velocity relation and the absence of age-metallicity relation in the solar neighborhood. We show that observable signatures of this mechanism could be found by GAIA, combined with chemical tagging conducted with a high-resolution ground-based spectrograph.

The dynamical and chemical evolution of dwarf spheroidal galaxies

P. Jablonka
(Observatoire de Paris - EPFL)

Stellar chemical abundances can now be derived in Local Group dwarf galaxies with the same precision as in our Galaxy. These new datasets, combined with chemo-dynamical numerical simulations, dramatically improve our understanding of stellar nucleosynthesis as well as of the formation and evolution of galaxies. I will present some of the latest results, suggest some developments to be undertaken and discuss the benefit of GAIA in this domain.

The Besançon Galaxy model : comparisons to photometric surveys and modelling of the Galactic bulge and discs

Céline Reylé, Annie Robin, Mathias Schultheis, Doug Marshall
(Observatoire de Besançon, Institut UTINAM)

Exploring the in-plane region of our Galaxy is an interesting but challenging quest, because of the complex structure and the highly variable extinction. We here analyse photometric near-infrared data using the Besançon Galaxy Model in order to investigate the shape of the disc and bulge. We present new constraints on the stellar disc, which is shown to be asymetric, and on the bulge, which is found to contain two populations.

Galaxies near and far, one year after the Herschel Launch

Marc Sauvage
(UMR AIM Paris-Saclay)

On may 14th 2009, the Herschel Space Observatory was launched from the Kourou space port. After a few month of calibration and setup (including the full recovery of the HIFI instrument), Herschel has moved into the routine execution of its Key Projects. This review will attempt at covering some of the most exciting results that Herschel is bringing to the field of extragalactic astronomy.

Bayesian model comparison in cosmology with Population Monte Carlo

Kilbinger, M.
(Excellence Cluster Universe + Observatory Munich)

I present a new adaptive importance sampling technique and show applications for cosmological parameter estimation and model selection. Compared to Markov Chain Monte Carlo, Population Monte Carlo (PMC) provides a lower variance and has a simple in-built diagnostics to assess its performance. Since it is completely parallellisable, results can be achieved with significantly reduced wall-clock time. Further, PMC allows the calculation of the Bayesian evidence at no additional computational cost.
I will show results for model selection using CMB, SNIa and BAO data for dark energy and curvature scenarios, and for primordial perturbation models.

Properties of the thick disc far from the Solar neighbourhood

Georges Kordopatis, Patrick de Laverny, Alejandra Recio-Blanco, Albert Bijaoui and Christophe Ordenovic
(Observatoire de la Côte d'Azur)

Vertical gradients in kinematics, metallicities and spatial structure are crucial ingredients of Galaxy formation models. For that purpose,a spectroscopic survey of nearly 700 stars towards l$\sim$270, b$\sim$47 has been made, to detect and characterize possible stellar sub-populations in the Galactic Thick disc. MATISSE algorithm has been used to obtain the atmospherical parameters of the stars (Teff, logg, [M/H]) and Y^2 isochrones to get the distances. We present here results obtained, as well as a comparison with Besançon's model of the Milky Way of the metallicities, distances and kinematics obtained for that sample.

3D tomography of local interstellar gas and dust

Séverine Raimond, Rosine Lallement and Jean-Luc Vergely
(LATMOS)

Interstellar absorption data and Strömgren photometric data for target stars possessing a Hipparcos parallax have been combined to build a 3D tomography of local gas and dust. We show the latest inverted 3D distributions within 250 pc, compare gas and dust maps and discuss the present limitations and improvements in progress. Gaia extinction data and follow-up ground-based stellar spectra (e.g. with GYES at the CFHT) will provide a far larger database that should allow a 3D tomography of much higher quality and extended to much larger distances.

Our Galaxy from the synthetic galaxy library for Gaia

Brigitte Rocca-volmerange
(CNRS/Institut d'Astrophysique de Paris et Université Paris sud)

The synthetic galaxy library, templates of the Hubble sequence, is computed for Gaia simulations (Tsalmantza et al, 2009) with the help of the code Pégase(www.iap.fr/pegase). For all types, more precisely Sc spiral, scenarios of galaxy evolution predict detailed stellar populations from which integrated properties (density numbers of stars, stellar, metal/dust gas masses) are deduced.The case of our Galaxy will be analyzed. We complete predictions in the infrared with the code Pégase.3.

Galactic Plane image sharpness as a check on cosmic microwave background mapmaking

Boudewijn F. Roukema
(Torun Centre for Astronomy, Nicolaus Copernicus University)

The largest uncollapsed inhomogeneity in the observable Universe is statistically represented in the quadrupole signal of the cosmic microwave background sky maps as observed by the Wilkinson Microwave Anisotropy Probe (WMAP). The time-ordered-data (TOD) of the WMAP observations define a constant temporal offset of 25.6 ms between the spacecraft positions and the observations. This is not documented in the WMAP Explanatory Supplement. It has recently been suggested that this offset constitutes an error that was ignored in compiling the TOD into all-sky maps, and that this implies that most of the previously estimated quadrupole is artificial. Here, the two possibilities that the timing offset caused an error in (i) calibration of the uncalibrated TOD, or (ii) compilation of the calibrated TOD into sky maps, are investigated. The optimal focussing of bright objects in the Galactic Plane plays a key role in part (ii).

The interplay between gas, dust, and star formation in the M33 galaxy

S. Verley
(Universidad de Granada - LERMA ObsPM)

The spiral galaxy M33 belongs to the local group and allows us to study star formation processes with great accuracy. The Spitzer telescope reaches spatial resolutions of the order of some parsecs and reveals the interactions between young stars and the interstellar medium. We estimated the star formation rate in M33, using Halpha, UV and IR tracers. We tested the radial and local Kennicutt-Schmidt laws in M33 reaching an unprecedented resolution of 180 pc. The Herschel view of the most compact emission in M33 is also presented.

Poster contributions

The catalogue of Radial Velocity standard stars for the RVS : status and progress

L. Chemin, C. Soubiran, F. Crifo, G. Jasniewicz, L. Veltz, D. Hestroffer, D. Katz, A. Siebert, S. Udry
(Laboratoire d'Astrophysique de Bordeaux)

A new full-sky catalogue of Radial Velocity standard stars is being built for the determination of the Radial Velocity Zero Point (RVZP) of the RVS. After a careful selection of 1420 candidates matching well defined criteria, we are now observing all of them to verify that they are stable enough over several years to be qualified as reference stars. We present the status of this long-term observing programme on three spectrographs : SOPHIE, NARVAL and CORALIE, complemented by the ELODIE archive. Because each instrument has its own zero-point, we observe intensively IAU RV standards and asteroids to homogenize the radial velocity measurements. We can already estimate that ∼10% of the candidates have to be rejected because of variations larger than the requested level of 300 m/s.

SED fitting of nearby galaxies in the Herschel Reference Survey

Laure Ciesla, Alessandro Boselli, Véronique Buat, Luca Cortese
(Laboratoire d'Astrophysique de Marseille)

The Herschel Reference Survey is a guaranteed time Herschel (infrared ESA space observatory) key project and will be a benchmark study of dust in the nearby universe (Boselli et al. 2010a). We use Herschel images of a statistically complete sample of 323 galaxies at 250, 360, 520 ∼m. The sample spans the whole range of morphological types (ellipticals to late-type spirals) and environments (from the field to the centre of the Virgo Cluster). We plan to use the Survey to investigate (i) the dust content of galaxies as a function of Hubble type, stellar mass and environment, (ii) the connexion between the dust content and composition and the other phases of the interstellar medium, and (iii) the origin and evolution of dust in galaxies. We also use the available multi-frequency data to carry out an analysis of the statistical properties of the sample. The first step of this work is to perform optical, near-infrared and far-infrared photometry of the selected galaxies (data are given by SDSS, Spitzer and Herschel telescopes). For other wavelengths (ultra-violet, radio), we use data from the NASA database NED. Yet, we have computed UV to radio continuum spectral energy distributions of 51 nearby galaxies recently observed with SPIRE (Spectral and Photometric Imaging REceiver) onboard Herschel (Boselli et al. 2010b). We fit the data using Draine & Li (2007) models of dust emission implemented in the code CIGALE (Code Investigating GALaxy Emission, Noll et al. 2009). CIGALE enables us to determine the best fit model and, thanks to a Bayesian analysis, estimate several physical parameters such as dust mass, dust temperatures, the fraction of PAH composing the dust, for all the galaxies of the sample. The results of Draine & Li (2007) are compared to those obtained using other models or SED templates such as Siebenmorgen & Krügel (2007), Dale & Helou (2002), Chary & Elbaz (2001), and combinations of modified black bodies, in order to compare them. The goal of this study is to provide galaxy parameters and SEDs templates for all morphological types in any environment.

LIRGs at intermediate redshift

Giovannoli,Buat,Noll,Burgarella,Magnelli
(LAM)

Studying Luminous InfraRed Galaxies (LIRGs) is particularly important in the growing-up of the stellar mass from z=1 to z=0, and to determine physical properties of these objects at the redshift 0.7. LIRGs are now identified to play a major role in galaxy evolution from z=1 to 0. The global star formation rate (SFR) at z $\sim$ 0.7 is mainly produced by LIRGs. We perform a multiwavelengths study of a LIRGs sample in the Extended Chandra Deep Field South at z=0.7, selected at 24 μm by MIPS onboard Spitzer Space Telesco pe and detected in 17 filters. Data go from the near ultraviolet to the mid-infrared. This multiwavelengths dataset allows us to bring strong constraints on the spectral energy distributions (SEDs) of galaxies, and thus to efficiently derive physical parameters as the SFR, the total infrared luminosity, attenuation parameters and star formation history. We distinguish a sub-sample of galaxies detected at 70 μm which we compare to the rest of the sample to investigate the relative importance of this wavelength on the determination of the physical parameters. An important part of this work is the elaboration of a mock catalogue which allows us to have a reliability criteria for the derived parameters. We study LIRGs by means of a SED-fitting code CIGALE. At first, this code creates synthetic spectra from the Maraston (2005) stellar population models.The stellar population spectra are being attenuated by using a synthetic Calzetti-based attenuation law before the addition of the dust emission as given by the infrared SED library of Dale&Helou (2002). The originality of CIGALE is that it allows us to perform consistent fits of the dust-affected ultaviolet-to-infrared wavelength range. This technique appears to be a very powerful tool in the case where we can have access to a dataset well-sampled over a large range of wavelengths. We are able to derive a star formation history and to estimate the fraction of infrared luminosity reprocessed by an active galactic nucleus. We study the dust temperatures of our galaxies detected at 70 μm and find them colder than predicted by models. We also study the relation between the SFR and the stellar mass and do not find a tight correlation between both, but a flat distribution and a large scatter which is interpreted in terms of variations of star formation history.

Cosmological simulations and galaxy formation : prospects for HST/WFC3

S. Peirani, R. M. Crockett, S. Geen, S. S. Khochfar, S. Kaviraj & J. Silk
(IAP)

The star formation history of nearby early-type galaxies is investigated via numerical modelling. Idealized hydrodynamical N-body simulations with a star formation prescription are used to study the minor merger process between a giant galaxy (host) and a less massive spiral galaxy (satellite). We find that the evolution of the star formation rate is extended over several dynamical times and shows peaks which correspond to pericentre passages of the satellite. The newly formed stars are mainly located in the central part of the satellite remnant while the older stars of the initial disc are deposited at larger radii in shell-like structures. Synthetic 2D images in J, H, NUV, Hβ and V bands, using the characteristic filters of the Wide Field Camera 3 (WFC3) on the Hubble Space Telescope, reveal that residual star formation induced by gas-rich minor mergers can be clearly observed during and after the final plunge, especially in the near-ultraviolet band, for interacting systems at (z $<=$ 0.023) over moderate numbers of orbits.

The Herschel view of HII regions in M33 (HERM33ES)

S. Verley, M. Relaño, C. Kramer, E. M. Xilouris, M. Boquien, D. Calzetti, F. Combes, C. Buchbender, J. Braine, G. Quintana-Lacaci, F. S. Tabatabaei, S. Lord, F. Israel, G. Stacey, P. van der Werf
(Universidad de Granada - LERMA ObsPM)

Using the high resolution and sensitivity of the Herschel PACS and SPIRE photometric data, we study the compact emission in the Local Group spiral galaxy M33 to investigate the nature of the compact SPIRE emission sources. We extracted a catalogue of sources at 250um in order to investigate the nature of this compact emission. For the 159 compact sources selected at 250um, we find a very strong Pearson correlation coefficient with the MIPS 24um emission and a rather strong correlation with the Halpha emission, although with more scatter. The very strong link between the 250um compact emission and the 24um and Halpha emissions, by recovering the star formation rate from standard recipes for HII regions, allows us to provide star formation rate calibrations based on the 250um compact emission alone. Taking advantage of the unprecedented Herschel resolution at these wavelengths, we also focus on a more precise study of some striking Halpha shells in the northern part of the galaxy. The morphological study of the Halpha shells shows a displacement between far-ultraviolet, Halpha, and the SPIRE bands. The different locations of the Halpha and far-ultraviolet emissions with respect to the SPIRE cool dust emission leads to a dynamical age of a few Myr for the Halpha shells and the associated cool dust.

GYES a wide field spectrograph for the CFHT
Bonifacio & the GYES Team
(GEPI)
We are conducting a feasibility study for a high resolution (R 20000), multi-fibre, spectrograph to be installed at the prime focus of the Canada-France-Hawaii telescope (CFHT). The main purpose of such an instrument is to conduct a spectroscopic survey complementary to the GAIA mission. The final GAIA catalogue (expected around 2020) will provide accurate distances, proper motions and spectrophotometry for all the stars down to a magnitude of 20. The spectroscopic instrument on board the GAIA satellite will provide radial velocity only for stars brighter thn about the 17th magnitude, and the chemical information will be limited to the stars bighter than the 13th. A wide field spectrograph on a 4m class telescope will allow to collect the necessary complementary spectra. Our base-line is to re-utilise the field corrector previously at CFHT for photographic imaging, which will give access to a field of diameter 0.9 degrees, unvignetted and 1 degree, with only 5vignetting on the outer rim. We envisage a pick-and-place fibre positioner similar to that of 2dF, at the Anglo Australian Telescope. Simulations indicate that it will be possible to accomodate 500 fibres in the available field. The spectrograph design is aimed at the highest possible efficiency and uses Volume Phase Holographic gratings as dispersing elements. Our current desing is a double-arm spectrograph (red and blue) which allows a total spectral coverage of 150 nm.

The XMM large scale structure survey
Nicolas CLERC, Marguerite PIERRE, Jon WILLIS and the XMM-LSS collaboration
(CEA/Service d'astrophysique)
The XMM-LSS is the largest deep galaxy cluster survey to date. Extensive coverage exists from X-ray to radio wavelengths over the 11 deg2 area. The survey enables the detection of clusters (M$\sim 10^{14}$ Mo) well above z>1, taking into account the well-modelled selection function. We provide the current census of the XMM-LSS clusters and focus on the characterization and identification of high redshift (z>1.2) X-ray clusters.

Session ASHRA-SF2A-SAIt

Multi-conjugate adaptive optics on the E-ELT
E. Diolaiti, J.-M. Conan, I. Foppiani et al.
(INAF - Osservatorio Astronomico di Bologna)
MAORY is the multi-conjugate adaptive optics module for the European Extremely Large Telescope. It is designed to compensate the atmospheric turbulence over a 2 arcmin field of view in the wavelength range 0.8-2.4 micron. Performance and sky coverage are achieved by means of three deformable mirrors, driven by a wavefront sensing system based on laser and natural guide stars. High accuracy photometry and astrometry and infrared spectroscopy are the key science applications of the MAORY module with its client instruments. The module design and its expected performance will be presented.

YAW : premières conclusions sur un nouvel analyseur de surface d'onde
Brangier M, Gendron E, Buey JT, Chenegros G, Sevin A, Pouplard F, Hubert Z, Vidal F, Rousset G
(LESIA)
We present the lasts results for YAW, a new concept for an optical differentiation wavefront sensor, recently tested on SESAME bench. Particularly, we discuss the performances of this sensor for laser tomography on ELT's

Challenges for adaptive optics in SPHERE high contrast imaging
D. Mouillet et al
(LAOG)
SPHERE is a second generation instrument for the VLT, dedicated to high contrast imaging. I will emphasize the corresponding challenges for adaptive optics in such an instrument, the specific technological and system developments made, and some critical fields of research for the future.

Poster contributions

The CAOS problem-solving environment : last news

M. Carbillet et al.
(UMR 6525 H. Fizeau (UNS/CNRS/OCA))

We present recent developments of the CAOS problem-solving environment (PSE), an IDL-based software tool whose original aim was to define and simulate as realistically as possible the behavior of a generic adaptive optics (AO) system, from the atmospheric propagation of light, to the sensing of the wave-front aberrations and the correction through a deformable mirror. The different developments made through the last years result in a very versatile numerical tool complete of a global graphical interface (the CAOS Application Builder), a general utilities library (the CAOS Library) and different specialized scientific packages : the original one designed for end-to-end AO system simulations (the Software Package CAOS), an image reconstruction package with interferometric capabilities (the Software Package AIRY), an extension of the latter specialized for the LBT instrument LINC NIRVANA (the Software Package AIRY-LN), an ad hoc package dedicated to the VLT instrument SPHERE (the Software Package SPHERE), and an embedment of the analytical AO simulation code PAOLA (the Software Package PAOLAC). We present the status of the whole CAOS PSE, together with the most recent developments, and plans for the future of the overall tool.

E2E simulator for AO for the Extremely Large Telescope ELT

Manal Chebbo Brice Le Roux
(LOOM/OAMP)

The control of AO systems dedicated to ELT is a difficult problem related to the large number of degrees of freedom. The standard and most used adaptive optics AO control starting from the integrator to the LQG are not useful in such a case. In fact, for future Extremely Large Telescope (ELT's) the number of degrees of freedom is very large related to the large diameter of the ELT's and the emergence of new architectures for the AO systems. So that the necessary computational power for real time control RTC on such systems is currently unattainable when using these control methods. Thus, more efficient algorithms are required. We present simulation results of a tomographic AO system in the configuration of EAGLE instrument (multi-object adaptive optics).

Space active optics : in-situ compensation of lightweight primary mirrors' deformations

M. Laslandes, M. Ferrari, E. Hugot
(Laboratoire d'Astrophysique de Marseille)

The need for both high quality images and light structures is a constant concern in the conception of space telescopes. The goal here is to determine how an active optics system could be embarked on a satellite in order to correct the wave front deformations of the optical train. The optical aberrations appearing in a space environment are due to mirrors' deformations, with three main origins : the thermal variations, the weightlessness conditions and the use of large weightlighted primary mirrors. We are developing a model of deformable mirror as minimalist as possible, especially in term of number of actuators, which is able to correct the first Zernike polynomials in a specified range of amplitude and precision. Flight constraints as weight, volume and power consumption are considered. Firstly, such a system is designed according to the equations from the elasticity theory : we determine the geometrical and mechanical characteristics of the mirror, the location of the forces to be applied and the way to apply them. Then the concept is validated with a Finite Element Analysis, allowing to optimize the system by taking into account parameters absent from the theory. At the end, the mirror will be realized and characterized in a representative optical configuration.

Visible Spectroscopy of Terrestrial Exoplanets with SEE-COAST

A.-L. Maire, R. Galicher, A. Boccaletti et al.
(Observatoire de Paris/LESIA)

While more than 450 exoplanets have been discovered, mid-infrared photometry and near-infrared (NIR) low-resolution spectroscopy ($\sim$40) were obtained for a few transiting gazeous planets. Nevertheless, transit photometry and spectroscopy are limited to close-in planets ($\sim$0.05 AU). In order to perform photometry and spectroscopy of wide-separated planets (more than 1 AU), direct imaging is requested. To date, 12 planet candidates were detected by this method. In a near future (2011-2014), dedicated ground-based instruments (SPHERE, GPI) and the JWST will provide the first NIR photometry and spectroscopy measurements of gazeous planets around young stars and M-dwarf stars in the solar neighborhood. However, the detection and the characterization of terrestrial planets require extremely good and stable conditions that are met in space. Our team propose the SEE-COAST mission, a 1.5-m space telescope, that aims at visible spectroscopy and polarimetry of mature giant and massive terrestrial planets. My PhD work deals with the simulation of the SEE-COAST instrumental concept and image analysis techniques to assess its ability to retrieve the spectrum of these planets in conditions as realistic as possible.

Experimental advances in phase mask coronagraphy

Mamadou N'Diaye Kjetil Dohlen Salvador Cuevas
(Laboratoire d'Astrophysique de Marseille)

Stellar coronagraphy is a key technology for current and future planet search and characterization instruments, both on the ground and in space. We pursue the research on coronagraphs based on cylindrical phase-masks and report in this paper on recent advances in terms of the trade between spectral bandwidth and achievable contrast. We also consider some interesting options concerning focal-plane wavefront sensing in such coronagraph systems.

Exoplanet Characterization with Angular and Spectral Differential Imaging

A. Vigan, C. Moutou, M. Langlois, F. Allard, A. Boccaletti, M. Carbillet, D. Mouillet and I. Smith
(Laboratoire d'Astrophysique de Marseille)

In the near future, new high-contrast imaging instruments dedicated to the direct detection of exoplanets at large orbital separations will be installed at the focus of large ground-based telescopes. Data obtained with these instruments optimized for very high contrast are strongly limited by the speckle noise. Specific observing strategies and data analysis methods, such as angular and spectral differential imaging, are required to attenuate the noise level and possibly detect the faint planet flux. Even though these methods are very efficient at suppressing the speckles, the photometry of the faint planets is dominated by the speckle residuals and it has a direct impact on the determination of the physical parameters of the detected planets. We present here the simulations that have been performed in the context of IRDIS, the dual-band imager of VLT-SPHERE, to estimate the influence of the photometric error on exoplanet characterization. In particular we show that the expected photometric performances will allow the detection and characterization of exoplanets down to the Jupiter mass at angular separations of 1.0arcsec and 0.2arcsec respectively around high mass and low mass stars with 2 observations in different filter pairs. We also show that the determination of the planets physical parameters from photometric measurements in different filter pairs is essentialy limited by the error on the determination of the surface gravity.

Approximate analytical expression for AO-corrected coronagraphic imaging in preparation for the characterisation of exoplanets by IFS.

Marie Ygouf - Laurent Mugnier - Jean-François Sauvage - Thierry Fusco - David Mouillet - Jean-Luc Beuzit
(ONERA/LAOG)

The next step in the field of extrasolar planets is on the verge of being reached with instruments such as SPHERE (Spectro Polarimetric High contrast Exoplanet REsearch), which will be capable of performing at the same time direct detection and spectral characterization. Integral Field Spectrographs(IFS's) produce multispectral images made up of two spatial and one spectral dimensions.
In these multispectral images, the star is not completely cancelled by the AO-corrected coronagraphic system because of residual aberrations of the latter. In particular, the star image comprises quasi-static speckles that must be disentangled from the planet signal in order to get the sought information : is there a planet, where is it and what is its spectrum ?
To this aim, we are developing a specific image post-processing method using a Bayesian inverse problem approach. The essential required building block of such a method is a data model (often called "direct model") with a minimal number of unknown parameters. In the framework of the SPHERE project for the VLT, we propose an approximate analytical model of a long-exposure star image for an AO-corrected coronagraphic imaging system and we present some preliminary numerical simulations to validate this model.

Session Enseignement

Accompagner les enseignants sur des projets de diffusion de la culture scientifique
Thierry Botti
(Observatoire Astronomique Marseille Provence)
De la participation à la formation continue des enseignants à une conférence dans un établissement, les possibilités d'accompagnement des enseignants par les centres de recherche sont très variées. Nous vous présenterons les grands types d'actions dans lesquelles les équipes de l'Observatoire Astronomique de Marseille Provence s'impliquent. Nous ferons ainsi ressortir le contexte général dans lequel ces actions peuvent être mises en oeuvre et nous présenterons les principaux acteurs avec lesquels nous travaillons.

L'Opéra de l'Univers
X.Delfosse, J.Lilensten, C.Ferrari, C.Bouvard, N.Cauchies, H.C.Nataf,C.Perrier, A.Senet
(LAOG/Observatoire de Grenoble)
For many years OSUG (Observatoire des Sciences de l'Univers de Grenoble) has pursued an outreach mission in the Grenoble's region (and beyond) on a wide scope of Universes Sciences : climate, glaciology,geology, hydrology, geophysics, planetology, astrophysics... As the expectation of the local public became more important, OSUG wished to be associate with a science museum to fulfill this task as best as possible. Moreover, France has a good network of planetaria. Unfortunately, one of its main scientific region (i.e. Grenoble and the surrounding Alps) has no such facility. In this paper, after a short summary of the OSUG's outreach action, we present a new initiative called "L'Opera de l'Univers" which will include a planetarium and a museum.
This project will be developed as a close cooperation between the city of Pont de Claix (Grenoble's southern suburbs) which is leading the project and academic structures (OSUG representing J.Fourier University and CNRS/INSU). This link is essential for us to present a modern science to the citizens, to show the results which are emerging from the laboratories. "L'opera de l'Univers" will be part of a bigger project dedicated to Arts and Sciences. It will allow encounters between artists and scientists, and offer a place to them to meet with the public. A coherent project is emerging where sciences and arts are not as separate slices of an onions, but are truly working altogether.

Presentation du m2r d'Astrophysique et Milieux Dilues de Grenoble
J. Ferreira
(Laboratoire d'Astrophysique de Grenoble)

Learning Mathematics with Astronomy
Vienne etal
(IMCCE / Université de Lille)
Within the framework of the e-training offered by Paris observatory, we propose a new training for french-speaking students. The idea is to use Astronomy as a source of examples to learn Mathematics. Thus lecturers/professors can find attractive mathematics exercises. This resource is still under construction. However a preliminary version is available on the web. This project was carried out with the assistance of UNISCIEL (UNIversité des SCiences En Ligne) and CNL (Contenus Numériques en Ligne) from Lille University.

Poster contributions

L'origine du monde présentée aux enfants : projet grand public dans le cadre de l'AMA09
claire moutou
(lam)

Serie de conférences sur les pulsars et etoiles hyper-denses
L. Di Gallo, E. Gourgoulhon,E. Khan,J. Margueron, F. Mottez, J. Novak, M. Oertel, M. Urban.
(LUTH, CNRS-Observatoire de Paris)
A series of conferences about neutrons stars in french high schools during the international year of astronomy 2009 will be presented.

conclusions du groupe de prospective enseignement
D. Rouan
(LESIA-Observatoire de Paris)
Présentation des conclusions du groupe de prospective enseignement PAA09

Présentation du Master d'Astrophysique de l'Université Paul Sabatier
G. Soucail, C. Peymirat, P. Jean
(Observatoire Midi-Pyrénées)
I will present the organisation of the formation in Astrophysics and Space Science at the Université Paul Sabatier, proposed over 2 years. This formation delivers two specialities in the Master diploma, one research track (M2R ASEP) and one professional tracl (M2P TSI).

Near Earth Asteroids astrometry with Gaia and beyond

D.Bancelin, D.Hestroffer, W.Thuillot
(IMCCE-Observatoire de Paris)

Gaia is a mission that will be launched in 2012, and will observe a large number of Solar System Objects down to magnitude V lower than 20. The solar system science mission is to map thousands of MBA, NEO, comets (and also planetary satellites) with the principal purpose of orbital determination (better than 5 mas astrometric precision), determination of asteroid mass, spin properties, and taxonomy. Besides Gaia will be able to discover new objects, in particular Near Earth Objects (NEOs) in the region below solar elongation of 90°, which are harder to detect with current ground-based surveys. During the 5-year mission, Gaia will continuously scan the sky with a specific strategy : objects will be observed from two lines of sight separated with a constant basic angle. Five constants -already fixed- determinate the nominal scanning law of Gaia : The inertial spin rate (1°/min) that describe the rotation of the spacecraft around an axis perpendicular to those of the two fields of view, the solar-aspect angle (45°) that is the angle between the Sun and the spacecraft rotation axis, the precession-period (63.12 days) which is the precession of the spin axis around the Sun-Earth direction. Two other constants are still free parameters : the initial spin phase, and the initial precession angle that will be fixed at the start of the nominal science operations. These latter are constraint by scientific outcome (possibility of performing test of fundamental physics) together with operational requirements (downlink to Earth windows). Several sets of observations of specific NEOs will hence be provided according to the initial precession angle. The purpose is to study the statistical impact of the initial precession angle on the error propagation and on the collision probability, especially for PHAs. We will also analyse the advantage of combining space-based to ground-based observation over long term, as well as in short term from observations in alert.

Accelerometers of the GOCE Mission : return of experience from one year of in-orbit

Bruno Christophe, Jean-Pierre Marque, Bernard Foulon
(ONERA)

The tri-axes Gradiometer of the ESA GOCE Mission is conceived around six electrostatic accelerometers developed by ONERA. The contribution of the accelerometers to the mission is double by providing the Satellite with the combination of linear accelerations as input to the continuous drag compensation and attitude control system and with the scientific data measurements to be on-ground processed for the Earth gravity gradients restitution. The satellite was launched on March 17th, 2009 and the gradiometer was switched on in Science mode on April 7th. Since, the accelerometers are continuously feeding the science channel with data, first during the commissioning and calibration phases, then during the first measurement phase started in September 2009. The presentation will illustrate the in-flight behaviour of the six accelerometers as deduced from the analysis of their output signals.

Evaluation de l'ITRF2008p par telemetrie laser

ILRS GRGS AC
(OCA-IMCCE-GRGS)

Effects of asteroids on spacecrafts orbiting the Lagrangian point L2. Application to Herschel, Planck and Gaia.

P.Kuchynka, J. Laskar, A. Fienga, M. Gastineau et P. Robutel
(IMCCE-Observatoire de Paris)

The Lagrangian point L2 presents many advantages for space observatories. Today it harbors the Herschel and Planck satellites and it has also been selected for the incoming Gaia mission. In this presentation we will give a short overview of the dynamics in the proximity of the L2 point. We will then present results of our investigation of asteroid perturbations on objects placed on quasiperiodic orbits around L2. Given the fact that spacecraft orbits are corrected on a regular basis, the asteroid effects are in general negligible. A few individuals could be an exception to this rule because of their extremely close approaches with L2.

The MICROSCOPE space mission and the in flight calibration plan for its instrument

Agnès Levy, Pierre Touboul, Manuel Rodrigues, Gilles Métris, Alain Robert, Vincent Josselin
(ONERA)

MICROSCOPE is a fundamental physics space mission which aims at testing the Equivalence Principle (EP) with an accuracy of 10^{-15}. The gravitational signal is measured precisely by a differential electrostatic accelerometer which includes two cylindrical test masses made of different materials. The accelerometer is onboard a drag-free microsatellite which is controlled Earth pointing or rotating about the normal to the orbital plane with a very stable angular velocity. The accuracy of the measurement used for the EP test is limited by the defects of the instrument's physical parameters and by the environment of the instrument on board the satellite. These defects are partially measured or estimated with ground tests or during the integration of the instrument on the satellite. However, to satisfy the EP test accuracy objective, these evaluations are not sufficient and an in-orbit calibration is therefore needed to characterize finely the defects and to correct the measurements. After an overall presentation of the MICROSCOPE mission and its scientific goal, the presentation will focus on the accelerometer onboard the satellite and will describe the specific procedures which are planned to determine in orbit the exact values of the instrument's defects.

INPOP08 ephemeris : adjustment to Lunar Laser Ranging observations

H. Manche, A. Fienga, J. Laskar, M. Gastineau, S. Bouquillon, G. Francou ; P. Kuchynka
(Observatoire de Paris/IMCCE)

INPOP08 is a planetary solution developped at the Paris Observatory. Equations of motion of the planets and more than 300 asteroïds are numerically integrated. Parameters and initial conditions are fitted to planetary observations (Fienga et al.,2009) and to Lunar Laser Ranging measurements. We will briefly present the dynamical model, the physical effects taken into account in the reduction of LLR observations and the residuals obtained.

Dernière nouvelles de L'Action Spécifique GRAM

Gilles METRIS et Peter WOLF
(OCA - Geoazur)

La station de télémétrie Laser Mobile de l'Observatoire de la Côte d'Azur à Grasse (France), l'instrument, ses missions et les projets scientifiques associé.

F.Pierron & All.Observatoire de la Côtte d'Azur-Grasse-France
(Observatoire de la Côte d'Azur)

The Mobile Satellite Laser Ranging System from "Observatoire de la Côte d'Azur" à Grasse (France), technical issues, measurements campaigns and scientific projects linked to this instrument.

Poster contributions

Densification of reference frames : towards new VLBI observationaml strategies

Laurent Chemin & Patrick Charlot
(Laboratoire d'Astrophysique de Bordeaux)

The goal of this project is to define new Very Large Baseline Interferometry strategies for astrometric surveys in order to densify the reference grid defined by observations of extragalactic sources. This could be achieved by combining the observations of faint radio sources by the phase referencing technique with those of bright sources observed by group delay.

The evection resonance : solar and oblateness perturbations

Vienne A., Frouard J., Fouchard M.
(IMCCE / Université de Lille)

Among resonances commonly influential to the dynamics of satellites, the evection resonance introduces an important correction to the precession frequency of the satellite, as it is well known for the Moon's problem. However, the dynamic of the resonance itself, which is important for satellites stability and capture topics, including its libration and circulation regions, and its elliptic and hyperbolic points, has not been extensively studied. Here we investigate its dynamic with an improved analytic model, making comparisons with previous works, and resort to numerical methods and integrations to study and localize the different features of the resonance. This resonance is found in the outer orbital region near the orbital stability limit. However we also study and localize an other libration region that can be found much more closer to the parent planet when its oblateness is taken into account in the model.

Session PCHE

HLX-1 in ESO 243-49 : the strongest evidence for the existence of Intermediate Mass Black Holes

O. Godet, D. Barret, N. Webb & B. Plazolles (CESR), S. Farrell, K. Wiersema (University of Leicester, UK), T. Maccarone (University of Southampton, UK), M. Servillat (Harvard-Smithsonian CfA, USA), S. Oates (MSSL, UK), I. Heywood (University of Oxford, UK)
(CESR)

Fundamental physics in observational cosmology

P. Peter
(CNRS)

Observational cosmology has now become accurate enough that fundamental physics effects are becoming measurable. For instance, high energy particle theories may produce topological defects, or modify the light dispersion relation around the Planck scale, or more generically break the Lorentz invariance over ver large scales. The evolution of the Universe can also be rather different from what the usual paradigm states it is, as, in particular, it can have experienced a contracting phase bouncing to the currently expanding one; this not only takes place in loop quantum cosmology, as is often stated, but also in string based models (e.g. the pre big bang) or in plain quantum cosmology using the Wheeler de Witt formulation.

Latest results on Galactic SNRs in the gamma-ray domain

M. Renaud
(Laboratoire de Physique Théorique et Astroparticules)

Latest results on Galactic SNRs as seen in the gamma-ray domain, mainly with Fermi and the current generation of Cherenkov telescopes, are reviewed. From the youngest isolated SNRs to the more evolved ones interacting with the surrounding medium, these observations provide new insights into the long-standing question of sources at the origin of Galactic cosmic-rays.

Towards new analysis of Gamma-Ray sources with the HAGAR telescope array in the Indian Himalayas

Richard J. Britto (on behalf of HAGAR collaboration)
(Tata Institute of Fundamental Research)

The High Altitude GAmma-Ray (HAGAR) array is a wavefront sampling array of 7 telescopes, set-up at Hanle, at 4270 m amsl, in the Ladakh region of the Himalayas (North India). It constitutes the first phase of the HImalayan Gamma-Ray Observatory (HIGRO) project. HAGAR is the first array of atmospheric Cherenkov telescopes established at a so high altitude, and was designed to reach a relatively low threshold (currently around 200 GeV) with quite a low mirror area (31 m^2). Data are acquired using the On-source/Off-source tracking mode, and by comparing these sky regions the strength of the gamma-ray signal is estimated. Regular source observations are running since Sept. 2008 and preliminary results on Crab nebula were reported by 2009. Improvements of our analysis method are still going on, like estimation of arrival direction and estimation of night sky background. New softwares are under development for analysis of flash ADC modules, which provide more information from the incoming Cherenkov light wavefront. We report and discuss our new estimation of the systematics through dark region studies, and present new preliminary results from gamma-ray sources, etc., in this paper.

High-energy radiation from the relativistic jet of Cygnus X-3

Benoît Cerutti, Guillaume Dubus, Gilles Henri
(Laboratoire d'astrophysique de Grenoble)

Cygnus X-3 is an accreting high-mass X-ray binary composed of a Wolf-Rayet star and an unknown compact object, possibly a black hole. The gamma-ray space telescopes AGILE and Fermi found the definitive evidence that high-energy emission is produced in this system. We propose a scenario to explain the GeV gamma-ray emission in Cygnus X-3. In this model, energetic electron-positron pairs are accelerated at a specific location in the relativistic jet, possibly related to a recollimation shock, and upscatter the stellar photons to high energies. The comparison with Fermi observations shows that the jet should be inclined close to the line of sight and that pairs should not be located within the system. Energetically speaking, a massive compact object is favored. We report also on our investigations of the gamma-ray absorption of GeV photons with the radiation emitted by a standard accretion disk in Cygnus X-3. This study shows that the gamma-ray source should not lie to close to the compact object.

Large scale magnetic field variability in accretion discs.
Rémi de Guiran, Jonathan Ferreira.
(LAOG)
Accretion discs are composed of ionized gas in motion around a central object. Sometimes, the disc is the source of powerful bipolar jets along its rotation axis. Theoretical models invoke the existence of a bipolar magnetic field crossing the disc and require two conditions to produce powerful jets : field lines need to be bended enough at the surface of the disc and the magnetic field needs to be close to equipartition. The work of Petrucci et al (2008) on the variability of X-ray binaries supposes that transitions between pure accretion phases and accretion-ejection phases are due to some variations of the magnetization. This rises the problem of the magnetic field dragging in accretion discs. We revisit the method developed by Lubow et al (1994), coupling it with momentum and mass conservation in a 1D MHD code. Considering a variability of the accretion rate at the external radius of the disc, we show the consequences of such a transport on the behaviour of magnetization, and its possible implications on the dynamic of the disc.

Contribution of phonons to the thermal properties of the neutron star crust
Di Gallo Luc & Oertel Micaela
(Luth (Observatoire de Paris))
Neutron stars are compact objects, created in supernova explosions at the end of the life of massive stars. They contain matter under extreme conditions, in particular concerning the density : starting from a lattice of (neutron rich) nuclei in the crust one reaches nuclear matter at several times the density of atomic nuclei in the center. One way to understand this object is to do theoretical modelisation in confrontation to observations. Among observations of pulsars there is the thermal emission of its surface. This observable, which depend on the heat transport properties, is very sensitive to the superfluid and superconducting character of the different sutructures inside the star. I focus my presentation on the inner crust, where we can find an interesting nuclear structure called the "Pasta Phase". Within a superfluid hydrodynamics approach I will discuss its excitation spectrum and the influence on the heat capacity.

Search for neutrinos from transient sources with the ANTARES telescope and optical follow-up observations
D. Dornic
(IFIC- Valencia)
The ANTARES telescope has the opportunity to detect transient neutrino sources, such as gamma-ray bursts, core-collapse supernovae, flares of active galactic nuclei... In order to enhance the sensitivity to these sources, we have developed a new detection method based on the follow-up by optical telescopes of “golden” neutrino events such as neutrino doublets coincident in time and space or single neutrinos of very high energy.
The ANTARES collaboration has therefore implemented a very fast on-line reconstruction with a good angular resolution. These characteristics allow us to trigger an optical telescope network. Since February 2009, ANTARES is sending alert triggers one or twice per month to the six robotic telescope of TAROT and ROTSE . This optical follow-up of such special events would not only give access to the nature of the sources but also would improve the sensitivity to transient neutrino sources.

Fermi Gamma-ray Space Telescope observations of recent gamma-ray outbursts of 3C 454.3
Lise Escande
(Université Bordeaux 1, CNRS/IN2P3, CENBG)
The flat spectrum radio quasar 3C 454.3 underwent an extraordinary outburst in December 2009 when it became the brightest gamma-ray source in the sky for over one week. Its daily flux measured with the Fermi Large Area Telescope at photon energies E>100MeV reached 22x10-6 ph/cm2/s, representing the highest daily flux of any blazar ever recorded in high-energy gamma-rays. It again became the brightest source in the sky in April 2010, triggering a pointed-mode observation by Fermi. The gamma-ray temporal and spectral properties during these exceptional events will be presented and discussed.

recent results of the FIGARO collaboration
B. Gendre, A. Corsi, G. Stratta, A. Klotz, J.L. Atteia, M. Boer, S. Cutini, F. Daigne, R. Mochkovitch, L. Piro
(ASDC)
The FIGARO collaboration aims are to study the early phase of the gamma ray burst afterglows and the prompt-to-afterglow transition phase, using multi-wavelength observations (mostly from Swift and TAROT). Here, we review the recent results of the collaboration, including the discovery of a rising part of the optical light curve and its theoretical interpretation (text in french).

AMS un detecteur de physique des particules dans l'espace.
Corinne Goy
(Lapp)
Thanks to its ability to identify and to measure simultaneously fluxes of protons, antiprotons, electrons, positrons, gamma rays and nuclei in a large acceptance detector and on an extended energy range, AMS will improve the knowledge of standard mecanisms governing the propagation of cosmic rays and will probe the existence of new physics, such as the nature of Dark Matter. The status of AMS, a few months away from its launch and installation on the Space Station in the second half of 2010, will be presented

Core collapse supernovae : Effect of the magnetic field on fluid motions
Jérôme Guilet, Thierry Foglizzo, Sébastien Fromang
(CEA - Saclay)
Multidimensional fluid motions play an essential role in the dynamics of core collapse supernovae. We investigate how this fluid dynamics is affected by a large scale magnetic field. In particular, we consider the shock oscillations caused by the standing accretion shock instability. These oscillations create Alfvén waves that are amplified at the so called Alfvén surface (where the Alfvén speed equals the advection velocity) and we study the consequences of this amplification.

Lorentz Symmetry and Quantum Gravity with astrophysical sources
A. Jacholkowska
(LPNHE)
Lorentz Invariance Violation (LIV) is a good observational window on Quantum Gravity models. Within last few years, all major Gamma-ray experiments have published results from the search for LIV with variable astrophysical sources : Gamma-ray Bursts with detectors on-board satellites and Active Galactic Nuclei with ground-based experiments. In addition, most of future experiments (SVOM, CTA and others) put the search for LIV in their main physics goals. As the latest results tend to disfavour first order effects with energy, excluding a whole set of models based on space-time "foam", it is possible that the whole theoretical landscape will change in the next years. In light of these exciting new results, a status report about both the theoretical and observational aspects will be presented.

Simulation of black hole formation in stellar collapse
J. Novak, M. Oertel, B. Peres
(LUTH, CNRS - Observatoire de Paris)
The collapse of massive stars leads in principle to the formation of a black hole with possible observables, from gamma-rays to neutrinos and gravitational waves. The complex physics involved in this phenomenon require the use of numerical models. We here present a starting project, based on the code CoCoNuT, to perform realistic studies in full general relativity and with detailed microphysics, of the collapse of a rotating stellar core to a black hole.

An extended equation of state for simulations of stellar collapse
M. Oertel, A. Fantina
(LUTH, CNRS-Observatoire de Paris)
In core-collapse events matter is heated and compressed to densities above nuclear matter saturation density. For progenitors with masses above $\sim$25 solar masses, which eventually form a black hole, the temperatures and densities reached during the collapse are so high that a traditional description in terms of electrons, nuclei, and nucleons is no longer adequate. We will present here an improved equation of state which contains in addition pions and hyperons. They become abundant in the high temperature and density regime, and we will discuss the effect on the thermodynamic properties.

High energy emission from compact objects : observation, modelisation and theory
Petrucci
(LAOG)
After a short introduction of the main characteristics of the high energy emission of compact objects (AGN, microquasars), and the different research topics in which our group is involved, I will focus on two of them : 1) the development of a accretion-ejection model and its application to microquasars and 2) the first results of the long (10 days) multi wave-length (from optical to soft gamma-rays) monitoring of the Seyfert galaxy Mkn 509.

Gamma-Ray Burst Observations with Fermi
F. Piron, on behalf of the GBM and LAT collaborations
(CNRS/IN2P3/LPTA)

Coincident searches for neutrinos and gravitational waves with the ANTARES and LIGO/VIRGO detectors
V. Van Elewyck for the GWHEN group [ANTARES & VIGO/LIGO Coll.]
(APC)
Both gravitational waves (GW) and high-energy neutrinos (HEN) are cosmic messengers that may escape very dense media and travel unaffected over cosmological distances, carrying information from the innermost regions of the astrophysical engines. For the same reasons, such messengers could also reveal new, hidden sources that were not observed by conventional photon astronomy. In this talk I will describe the strategies for coincident searches of GW and HEN from astrophysical sources that are currently developed by the ANTARES and VIRGO/LIGO collaborations within the GWHEN working group.

Poster contributions

Observations with the High Altitute GAmma-Ray (HAGAR) telescope array in the Indian Himalayas
Richard J. Britto (on behalf of HAGAR collaboration)
(Tata Institute of Fundamental Research)
For several decades, it was thought that astrophysical sources emit high energy photons within the energy range of the gamma-ray region of the electromagnetic spectrum. These photons originate from interactions of high energy particles from sources involving violent phenomena in the Universe (supernovae, pulsars, Active Galactic Nuclei, etc.) with gas and radiation fields. Since the first reliable detections of cosmic gamma rays in the 1970's, improvements in instrumentation have led gamma-ray astronomy to an established branch of modern Astrophysics, with a constant increase in the number of detected sources. But the 30-300 GeV energy range remained sparsely explored until the launch of the Fermi space telescope in June 2008. The gamma-ray telescope array HAGAR is the first array of atmospheric Cherenkov telescopes established at a so high altitude (4270 m a.m.s.l.), and was designed to reach a relatively low energy threshold with quite a low mirror area (31 m^2). It is located at Hanle in India, in the Ladakh region of the Himalayas. Regular source observations have begun with the complete setup of 7 telescopes on Sept. 2008. We report and discuss our estimation of the systematics through dark region studies, and present preliminary results from gamma-ray sources, etc., in this paper.

Radio follow-up of High Energy sources with the NRT. Results and on-going programs.
Martin, Theureau, Colom, Gérard et al.
(Observatoire de Paris)

Une exploration des objets Trans-Neptuniens avec Herschel

A. Delsanti
(Laboratoire d'Astrophysique de Marseille)

Over a thousand of minor bodies are known to orbit the Sun in a region located beyond Neptune (the Trans-Neptunian Objects, or TNOs). These objects are the most primitive remnants of the planetesimal disk from which the outer planets formed. Their study can provide important constraints on the formation and evolution of the Solar System. The physical properties of these objects are only beginning to be unveiled. Crucial parameters such as size, albedo, density and thermal properties are difficult to assess, and can mainly be derived from far-IR wavelength measurements.
The Herschel Open Time key program "TNOs are cool : a survey of the Trans-Neptunian region" (Mueller et al. 2009, Earth Moon and Planets 105, 209-219) is providing us a unique opportunity to explore the thermal and physical properties of about 140 minor bodies of the outer Solar System (TNOs and Centaurs). We will review the results obtained during the early phase of observation of the Herschel Space Observatory, and present the forthcoming studies.

The first steps of interstellar chemistry revealed by Herschel/HIFI

E. Falgarone on behalf of the PRISMAS team
(Observatoire de Paris & Ecole Normale Supérieure)

The Herschel/HIFI key-project PRISMAS was designed to shed light on the first steps of interstellar chemistry, among which those taking place in the diffuse medium, weakly shielded from the UV radiation field. The results obtained so far go beyond our expectations. The absorption lines of HF, OH+, H2O+ and CH+ obtained in the direction of remote star forming regions provide new sensitive probes of the diffuse medium, including those containing only a small fraction of molecular hydrogen. They also reveal the processes driving this specific chemistry (turbulent dissipation, cosmic ray ionization).

Preliminary work to ALMA, HERSCHEL, SOFIA : submillimeter wave spectroscopy of isotopic species of methyl formate.

Goubet, M., Margulès, L., Motiyenko, R., Bailleux, S., Huet, T. & Wlodarczak, G.
(Laboratoire Phlam)

Complex organic molecules are relatively heavy, their maximum absorption is in the millimetric domain at about 300 GHz. But the most abondant, like methyl formate, could be detected in the ISM up to 900 GHz (Comito et al. 2005). We will present here the last results obtained about the two 18O and the doubly-deuterated species of methyl formate. This concludes the systematic investigation up to 660 GHz for the mono-substituted isotopic species with either 13C, 18O, or D, which began in 2006. The lines from these isotopic species will certainly be present in the spectra which will be recorded in the next years with the very sensitive telescope ALMA, HERSHEL and SOFIA. The detection of isotopic species is very important for the astrophysical community to improve the interstellar chemical modeling and to understand the formation mechanism of these complex organic molecules. Our interest was also on the theoretical aspects. Like other complex organic molecules, methyl formate displays a large amplitude motion. Here it is the rotation of the methyl group with respect to the rest of the molecule. Theoretical models were developed to reproduce accurately the observed frequencies for large quantum numbers values as J-values as high as 70 could be reached. Similarly the investigation of the doubly-deuterated HCOOCHD2 was undertaken to test the model developed for mono-deuterated HCOOCH2D (Margulès et al. 2009). This work is supported by ANR-08-BLAN-0054 and ANR-08-BLAN-0225.
- Comito, C., Schilke, P., Phillips, T.G., et al. 2005, Astrophys. J. Supp., 156, 127 - Margulès, L., Coudert, L.H., Mollendal, H., et al. 2009, J. Mol. Spec., 254, 55

SPIRE spectroscopy of the interstellar medium

E. Habart, A. Abergel, E. Dartois, D. Naylor, E. Polehampton, J.-P. Baluteau, A. Zavagno, C. Joblin and the SAG 4 consortium
(Institut d'Astrophysique Spatiale (IAS))

The SPIRE Fourier Transform Spectrometer (FTS) on-board Herschel allows us, for the first time, to simultaneously measure the complete far-infrared spectrum from 194 to 671 microns. A wealth of rotational lines of CO (and its isotopologues), fine structure lines of C and N+, and emission lines from radicals and molecules has already been observed towards several galactic regions and nearby galaxies. The strengths of the atomic and molecular lines place fundamental constraints on the physical conditions but also the chemistry of the interstellar medium (ISM). FTS mapping capabilities are also extremely powerful in characterizing the spatial morphology of the extended region and understand how the gas properties vary within the studied region. A first analysis of FTS observations of selected galactic sources with precise excitation conditions and geometry including HII regions, photodissociation regions (PDRs) and molecular cloud cores will be presented. This study as part of the SPIRE ISM consortium key program (Abergel et al. 2010) illustrates the promise of the FTS for the study of the ISM and emphasizes the need for complementary spectroscopic data to be obtained from HIFI, PACS and ground-based instruments.

Herschel/HIFI révéle les premières phases de la formation stellaire

F. Herpin, L. Chavarria, S. Bontemps, T. Jacq, J. Braine, A. Baudry, F. van der Tak, F. Wyrowski, E. van Dishoeck
(LAB/OASU)

The understanding of the star formation is still on progress. Especially, the formation of high-mass stars is much less understood than the low-mass case : even the time order of observational phenomena is uncertain. Water, one of the most important molecules in the Universe, might elucidate key episodes in the process of stellar birth, and especially could be a major role in the formation of high-mass stars. For both types of stars, the source chemical composition is not well known and even less known is the chemical evolution of the interstellar matter throughout the various phases of star formation.

This talk presents the first results of the various Herschel Space Observatory star formation key-programs. One of the instruments on-board HSO, HIFI, is the most powerful spectrometer never built, covering a huge frequency range, most of them unaccessible from ground. In particular, one of the KP, WISH, aims at following the process of star formation during the various stages and at using the water as a physical diagnostic throughout the evolution. The HIFI instrument is used to make maps and spectra of $\sim$20 lines in $\sim$20 sources spanning a large range in physical parameters, from pre-stellar cores to UCHII regions.

I will review the status of the programs and focus specifically on the spectroscopic results. I will show how powerful are the HIFI high-resolution spectral observations to resolve different physical source components such as the dense core, the outflows or the extended cold cloud aroung the object.

Premiers résultats Herschel sur les disques proto-planétaires

C.Pinte, F. Menard
(LAOG, Grenoble)

TBW

La base de données cinétiques pour l'Astrochimie : KIDA

V. Wakelam
(Laboratoire d'Astrophysique de Bordeaux)

KIDA (for KInetic Database for Astrochemistry) is a project initiated by different communities in order to 1) improve the interaction between astrochemists and physico-chemists and 2) simplify the work of modeling the chemistry of astrophysical environments. Here astrophysical environments stand for the interstellar medium and planetary atmospheres. Both types of environments use similar chemical networks and the physico-chemists who work on the determination of reaction rate coefficients for both types of environment are the same.

Rates of excitation for molecules of astrochemical relevance

L. Wiesenfeld, A. Faure
(Laboratoire d'Astrophysique de Grenoble)

We have set up a framework for calculating in a precise and controlled way the collisional properties of several molecules of astrophysical meaning. The collisional properties of molecules help in understanding the excitation scheme of the various rotational levels, observed by the ground telescopes in the cm- sub mm spectral regions as well as by the newly launched Herschel space telescope, with a special emphasis to the heterodyne spectrometer HIFI.

We have been very successful in calculating and assessing the properties of some of the main molecules observed in astrophysical media. The quantities that are relevant for astrophysics are rotational and vibrational quenching/excitation rates by means of collisions of H2 : we have dealt with H2O and with some organic molecules (CO, HC3N, H2CO, NH3) as well as the isotopomers of some of those species. We calculate those rates by means of successively determining an intermolecular potential energy surface and calculating inelastic cross sections and rates classically and/or quantum mechanically.

We use these rates for simulating and interpreting some astrophysical spectra with a special emphasis on star forming regions. We compare the inelastic cross-sections with experiments performed in laboratory conditions relevant for the analysis of the ISM.

Dust silicate emission in FIR/submm

Anne Coupeaud, Karine Demyk, Claude Meny and Céline Nayral
(CESR)

The observations of PRONAOS and Archeops in the submillimeter wavelength range revealed a dependence with temperature of the spectral index of the dust emissivity β. This parameter is of a great importance since it is used for the estimation of the dust mass. Our goal is to characterize and to explain the unusual optical properties of the big silicate grains with temperature in this domain of long wavelengths. With the experimental set-up ESPOIRS (Etude Spectroscopique des Propriétés Optiques dans l'InfraRouge et le Submillimétrique des analogues de poussière) we performed some experiments on absorption properties (5-1000 μm) of analogues interstellar grains in function of the temperature (300K to 4K). This study is very helpful for the interpretation of the data of Herschel and Planck.

Initial highlights of the Herschel imaging Survey of OB Young Stellar Objects (HOBYS)

T. Hill, F. Motte, A. Zavagno, S. Bontemps, N. Schneider, M. Hennemann, J. di Francesco and the HOBYS consortium
(CEA/Saclay)

I will present highlights from the Herschel key program HOBYS obtained during the science demonstration and early routine phases (Motte, Zavagno, Bontemps, et al.).

- The multi-wavelength Herschel images of Rosette reveal a clear dust temperature gradient in the molecular cloud, demonstrating the strong influence of the NGC6334 UV field and winds on the cloud. These results make Rosette one of the best regions to investigate the relative importance of triggered versus spontaneous star formation (Schneider et al. 2010). - The spatial resolution and sensitivity of these Herschel images allows us to pinpoint individual high- and low-mass protostars within the cloud. The PACS images in particular reveal young clusters of protostars. Spectral energy distributions, using Herchel (SPIRE and PACS) as well as Spitzer, provides robust measurements of a protostar's mass and luminosity. The evolutionary diagram (M_env vs L_bol) of Rosette protostars complements such diagrams drawn for low-mass star-forming regions (Hennemann et al. 2010). - Several hundred $\sim$0.5 pc clumps have been identified in Rosette covering a large range in the mass spectrum compared with e.g. the Gould-belt survey. We will investigate variations of the cloud structure (mass spectrum, gas concentration, gravitational boundedness,...) as a function of the distance to the O stars (Di Francesco et al. 2010). A comparison with the results obtained for the high-mass star-forming region NGC7538 will be made (Reid et al.). - The properties of the YSO population on the borders of the Galactic HII regions RCW 120 and Sh104 are reported. A series of red sources, not previously detected, which may represent the early stages of star formation are seen in the PACS and SPIRE bands. SEDs constrain, their physical properties (mass, age, evolution stage) allowing us to discuss how the HII region has triggered the formation of a new generation of stars (Zavagno et al. 2010). -These Herschel images of Rosette and NGC7538 provide the first unbiased and complete census of their OB-type young stellar objects including high-mass infrared-quiet protostars, which were overlooked by Spitzer.

The fundamental properties (luminosity and mass) of YSOs in the HOBYS fields will be used to constrain their evolutionary stage and lifetime of intermediate- and high-mass YSOs, ultimately improving our understanding of high-mass star formation.

Dust properties within molecular clouds as seen by Herschel using a new spectral inversion technique

D.J. Marshall, L. Anderson, J-Ph. Bernard, C. Brunt, M. Huang, P. Martin, L. Montier, J. Mottram, D. Paradis, I. Ristorcelli1, & J. Rodon
(CESR)

The dust properties inferred from the observed dust spectral energy distribution provides us with crucial information on the physical state of the interstellar medium. The conditions within molecular clouds are particularly interesting as these are the future sites for star formation. However, the derivation of dust properties within molecular clouds is not trivial as many line of sight components contribute to the dust emission. I will present a new spectral inversion method with which it is possible to obtain the dust properties within individual molecular cores. For several of the molecular cores, the derived temperatures of the dust is seen to be higher than in the surrounding HI. This shows that the heating source is embedded in the core, making these objects new "hot molecular core" candidates.

Herschel-PACS observation of the T Tauri disk TW Hya : constraining the disk dust and gas mass

Wing-Fai Thi & Herschel-GASPS team
(Laboratoire d'Astrophysics de Grenoble)

We present Herschel-PACS observations of the disk around the TTauri star TW Hya. We complement this with continuum data and ground-based 12CO 3-2 and 13CO 3-2 observations. We model the continuum and the line fluxes with the 3D Monte-Carlo code MCFOST and the thermo-chemical code ProDiMo. We detect the [OI] line at 63 but the [OI] line at 145 micron and the [CII] line at 157 micron. Preliminary modeling suggests a dust mass for grains with radius $<$ 1 mm of $\sim$1.9E-4 Msun (total solid mass of 3E-3 Msun) and a gas mass of (0.5-5)E-3 Msun.

Star formation triggered by Galactic HII regions : first results from the Herschel Space Observatory

Zavagno, A., Anderson, L.D., Russeil, D., Rodon, J.A., Deharveng, L., Baluteau, J.-P., Motte, F., Bontemps, S., Abergel, A., Molinari, S.
(LAM)

We present the first results obtained with the Herschel Space Observatory on a sample of Galactic HII regions that show triggered star formation on their borders. The Herschel satellite reveals a population of young, highly embedded sources never seen before. The large wavelength coverage of the Herschel satellite allows us to characterize, for the first time, the physical properties of these young sources. We will show how Herschel opens a new window in this research field and present the rich perspectives offered.

Comparison of desorption energies and behavior of two isomers, DME and EtOH ices, on different analogues of interstellar dust grains

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(Observatoire de Paris et Université de Cergy-Pontoise)

The surface chemistry of CO, involving successive reactions network with O, H and traces of C and N, leads through different chemical pathways to the formation of many hydrogenated and complex compounds. These species are detected around many luminous proto-stars, the so-called hot cores that are usually surrounded by regions of warm (>100K) and dense (>106 cm-3) material. It is now well accepted that the light species (H2O, CO2, NH3, HCOOH...) are formed during the cold cloud phase (<50K) and are evaporating or sublimating during the early phase of star formation when ice covered grains are heated in the 50-150K range. But when heavier molecules are formed is still subject to discussion. Among these heavy molecules are two important isomeric compounds, CH3OCH3 (Di Methyl Ether or DME) and CH3CH2OH (Ethanol or EtOH) which are presenting very different abundances. Is this due to their respective formation mechanisms or to their desorption energies and behavior? We have studied the desorption of these two molecular ices using the FORMOLISM experimental setup at Cergy and performing TPD (thermally programmed desorption) experiments. We have measured their desorption energies and have compared their behavior on different analogues of interstellar dust grains (silicates and different morphologies of water ice). Our measurements confirm theoretical calculations. They also could explain some observational results in hot cores.

This work is funded in part by the ANR (Agence Nationale de la Recherche) under contract 07-BLAN-0129, the CR IdF (Conseil Régional d'Ile de France) under the SESAME contract I-07-597R and the CGVO95 (Conseil Général du Val d'Oise).

Morphology changes of interstellar water ice analogues after hydrogen atom exposure

Mario Accolla a,b, Emanuele Congiu a, François Dulieu a, Henda Chaabouni a, Elie Matar a, Hakima Mokrane a, Giulio Manicò b, Valerio Pirronello b & Jean-Louis Lemaire. a Université de Cergy-Pontoise and Observatoire de Paris, LERMA, UMR 8112 du CNRS, 95000 Cergy-Pontoise, France b Università di Catania, DMFCI, 95125 Catania, Sicily, Italy
(Observatoire de Paris et Université de Cergy-Pontoise)

Experiments on interstellar water ice analogues show changes in the ice morphology as a consequence of atomic hydrogen exposure. Our work gives evidence that a thin highly porous ice is gradually changed into a more compact structure, with increasing H-atom fluence.

Spectroscopic observations of cold and dense clouds show the presence of "dirty ice" mantles on dust grains, mainly composed by water molecules. These ices are enriched by the presence of other simple species that are either formed by surface reactions or accreted from the gas phase. While there is quite a general consensus that interstellar water ice is mainly amorphous, its morphology still remains poorly known. Morphology is important due to its influence both on the catalytic efficiency of grain surfaces and on the release to the grain of the fraction of the formation energy of species, as shown by laboratory simulations of molecular hydrogen formation1. Ice porosity may be identified through the weak infrared absorption features ($\sim$ 2.7 $\sim$m) showing the presence of dangling bonds on the pore surface. To our knowledge, there has been to date no detection of such absorptions in the infrared spectra of interstellar ices, perhaps suggesting that they may have a compact nature2. It has been already investigated that interstellar porous ice may be compacted by the transient heating of stellar radiation3 and cosmic ray bombardment4.

We report in a poster our experimental work, performed using FORMOLISM (the experimental apparatus at the Cergy-Pontoise University), that shows relevant changes in the ice morphology following atomic hydrogen irradiation. In particular, it is shown that a thin highly porous ice film is gradually changed into a more compact structure. This is probably due to the transient heating caused by the energy released to the ice during H2 formation. Such a process may also produce in the interstellar space compact amorphous ice mantles concurrently with the other envisaged processes.

Reference : 1 L. Hornekar, A. Baurichter, V. V. Petrunin, D. Field & A. C. Luntz, 2003, Science, 302, 1943 ; 2 J. V. Keane, A. C. A. Boogert, A. G. G. M. Tielens, P. Ehrenfreund, & W. A. Schutte, 2001a, A&A, 75, L43 ; 3 D. Chakarov & B. Kasemo, 1998, Phys. Rev. Lett, 81, 5181, 4 M. E. Palumbo, 2005, J. Phys. Conf. Ser., 6, 211.

This work is funded in part by the ANR (Agence Nationale de la Recherche) under contract 07-BLAN-0129, the CR IdF (Conseil Régional d'Ile de France) under the SESAME contract I-07-597R and the CGVO95 (Conseil Général du Val d'Oise).

Observations of atomic metals in the circumstellar envelope of the carbon-rich dusty star IRC+10216

Mauron N., and Huggins, P. (Graal, NYU)
(Graal, CNRS et UM2 Montpellier)

We have detected gas-phase atomic metals in the envelope of IRC+10216, the archetype dusty carbon-rich AGB star. We found absorption lines of neutral species, Na, K, Ca, Fe and Cr, as well as CaII. These lines are seen in absorption on the VLT optical spectrum of a background star at $\sim$ 1400 pc away from us and located at 35 arcsec from the center of the IRC+10216 nebula. This line of sight is close enough to the center to display some molecular species like C2, and to permit metals not to be too much ionized as in the diffuse ISM. Despite the fact that the background star has a G-type spectrum, it is possible to extract the circumstellar absorption lines with the use of a template solar spectrum. Analysis of these lines and a model of photoionization in the expanding envelope provide the column densities of the metals in the gas phase. It is found that the known metal bearing molecules (like NaCN, NaCl) are not abundant enough to be at the origin of these atomic metals that we detect in the gas. It is the first time that gaseous Fe is detected in a cool AGB dusty envelope. Its strong depletion (-2.24 in log) means that nearly all iron returns to the ISM under the form of dust.

Oscillator strengths and predissociation rates for Rydberg transitions in CO between 93 and 93.5 nm

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(aObservatoire de Paris-Meudon, bUniversité de Cergy-Pontoise, cUniversité UMPC, Paris VI, dDepartment of Physics and Astronomy, University of Toledo, USA)

CO is used as a probe of astronomical environments ranging from planetary atmospheres and comets to interstellar clouds and the envelopes surrounding stars near the end of their lives. One of the processes controlling the CO abundance and the ratio of its isotopologues is photodissociation. Accurate oscillator strengths and predissociation rates for Rydberg transitions are used for modeling this process. We present initial results of a survey to obtain the necessary data for transitions in 12C160, 13C16 0, and 13C160. Data on a series of overlapping bauds between 93.0 and 93.5 nm were acquired at the DESIRS, beam line on the SOLEIL synchrotron. A VUV Fourier Transform Spectrometer provided a resolving power of about 300000 ; this resolution greatly aided our ability to disentangle absorption from the overlapping bands. Absorption bands were analyzed by synthesizing the profiles with codes developed independently in Meudon and Toledo. The synthetic spectra were based on tabulated spectroscopic data. Each synthetic spectrum was adjusted to match the experimental one in a non-linear least-squares fitting procedure with the band oscillator strength, the line width (instrumental, thermal, and predissociation), and the wavelength offset as free parameters. We will compare our results to previous ones and will describe future directions for this effort. The authors acknowledge the support of the SOLEIL synchrotron facility through lime allocation and the DESIRS beam line team. This work was funded in part by NASA and the CNRS-PCMI program.

Session PNP

Dynamical parameters determination in multiple systems

Beauvalet L., Lainey V., Arlot J.-E.
(IMCCE-Observatoire de Paris)

Many Kuiper Belt Object and asteroids have now been discovered to be part of more complex dynamical systems consisting of a primary and its satellites. In this case, the primary's motion is not strictly keplerian around the Sun since the influence of its companions disturbs its trajectory. We present a model which will allow for a global solution when fitting the orbital parameters to astrometric observations. The goal of this work is to be able to constrain the masses and other dynamical parameters in this kind of system. The multiple system which has been studied for the longest time and would then make a perfect candidate is Pluto's one, with its binary Pluto/Charon and its smaller satellites. Our model has been tested on simulated observations of Pluto's system in order to determine the parameters which can be properly determined.

Search and characterization for extrasolar planets in the Northern hemisphere with the SOPHIE consortium

I. Boisse, F. Bouchy, G. Hébrard, S. Udry, X. Delfosse, C. Moutou, A-M. Lagrange, D. Queloz et al.
(Institut d'Astrophysique de Paris)

The SOPHIE Consortium started, in Nov. 2006, several programs of exoplanet search and characterization in the North hemiphere with the spectrograph SOPHIE based on the 1.93m OHP telescope. We present here the latest SOPHIE results which include new exoplanets, studies of transiting planets through Rossiter effect, follow-up observations of photometric surveys and characterizations of stellar activity of planet-host stars.

A collisionless scenario for Uranus tilting

BOUE Gwenaël & LASKAR Jacques
(IMCCE - Obs. de Paris)

The origin of the high inclination of Uranus' spin-axis (Uranus' obliquity) is one of the great unanswered questions about the Solar system. Giant planets are believed to form with nearly zero obliquity, and it has been shown that the present behaviour of Uranus' spin is essentially stable. Several attempts were made in order to solve this problem. Here we report numerical simulations showing that Uranus' axis can be tilted during the planetary migration, without the need of a giant impact, provided that the planet had an additional satellite and a temporary large inclination. This might have happened during the giant planet instability phase described in the Nice model. In our scenario, the satellite is ejected after the tilt by a close encounter at the end of the migration. This model can both explain Uranus' large obliquity and bring new constraints on the planet orbital evolution.

Coupling dynamical and collisional evolution of dust in circum-stellar disks

S. Charnoz, L. Fouchet, E. Di-Folco, E. Pantin
(Laboratoire AIM, Université Paris Diderot /CEA/CNRS)

Numerous observed circumstellar disks are believed to be both dynamically and collisionally active. Unfortunately planets and large bodies that could be embedded in are still difficult to observe and their putative properties are indirectly inferred from the observable dusty content. It is why constraining the size distribution coupled with dust-dynamics is so critical. Unfortunately, coupling effects such as a realistic time-dependant dynamics, fragmentation and coagulation, has been recognized as numerically challenging and almost no attempt really succeeded with a generic approach. In these disks, the dust dynamics is driven by a variety of processes (gravity, gas drag, radiation pressure, Poynting-Robertson effect etc..) inducing a size-dependant dynamics, and, at the same time collisional evolution induces a progressive change of the local size distribution. These two effects are intimately coupled because the local dynamics and size-distribution determines the local collision rates, that, in-turn, determines the size-distribution and modifies the particle's dynamics. Here we report on a new algorithm that overcomes these difficulties by using a hybrid approach extending the work of Charnoz & Morbidelli (Icarus, 2004, 2007). We will briefly present the method and focus on : (1) gaseous protoplanetary disks either laminar or turbulent (the time dependant transport and dust evolution will be shown) and (2) post-planetary disks with or without planets in which we will map the regional size distributions of micrometer dust.

ASTEP : Towards the detection and characterization of exoplanets from Dome C

Crouzet N., Guillot T., Agabi A., Rivet J.-P., Bondoux E., Challita Z., Fanteï-Caujolle Y., Fressin F., Mékarnia D., Schmider F.-X., Valbousquet F., Blazit A., Bonhomme S., Abe L., Daban J.-B., Gouvret C., Fruth T., Rauer H., Erikson A., Barbieri M., Aigrain S. and Pont F.
(Observatoire de la Côte d'Azur)

The Concordia base in Dome C, Antarctica, is an extremely promising site for photometric astronomy due to the 3-month long night during the Antarctic winter, favorable weather conditions, and low scintillation. The ASTEP project (Antarctic Search for Transiting ExoPlanets) is a pilot project to discover transiting planets, and understand the limits of visible photometry from this site. ASTEP South is the first phase of the project. The instrument is a fixed 10 cm refractor with a 4k x 4k CCD camera in a thermalized box, pointing continuously a 3.88° x 3.88° field of view centered on the celestial south pole. The instrument observed nearly continuously during the 2008 and 2009 Antarctic winters, and the data are of good quality. The weather conditions are estimated from the number of stars detected in the field. For the 2008 winter, the statistics are between 56.3% and 68.4% of excellent weather, 17.9% to 30% of veiled weather and 13.7% of bad weather. Using these results, we show that the detection efficiency of transiting exoplanets in one given field is improved at Dome C compared to a temperate site such as La Silla. This shows the high potential of Dome C for photometry and future planet discoveries (Crouzet et al. A&A 2010). The second phase of the project is ASTEP400, an equatorial 40 cm telescope entirely designed and built for photometry under the extreme conditions of the Antarctic winter. The instrument is now installed at Concordia and the first campaign started in March 2010.

SMART-1 new results and future lunar exploration

Bernard H. Foing (ESA/ESTEC)
(ESA)

SMART-1 Small Mission for Advanced Research and Technology [1-7].achieved its first objective to demonstrate Solar Electric Primary Propulsion (SEP) for future Cornerstones (such as Bepi-Colombo) and to test new technologies for spacecraft and instruments. SMART-1 science payload, with a total mass of some 19 kg, featured advanced technologies, and innovative instruments with a miniaturised high-resolution camera (AMIE) for lunar surface imaging, a near-infrared point-spectrometer (SIR) for lunar mineralogy investigation, and a very compact X-ray spectrometer (D-CIXS) for fluorescence spectroscopy and imagery of the Moon's surface elemental composition. We present a synthesis of lessons learned, technologies and exploration results from SMART-1, as a contribution to the preparation of subsequent missions. We shall review the highlights with focus on recent published results. SMART-1 has been useful in the preparation of Selene Kaguya, the Indian lunar mission Chandrayaan-1, Chinese Chang'E 1, the US Lunar Reconnaissance Orbiter, LCROSS, and subsequent lunar landers. SMART-1 has been contributing to planetary science [3-6], and helped to prepare the next steps for exploration : survey of resources, monitoring polar illumination, and mapping of sites for potential landings, robotic villages and for future international lunar bases. Links : http ://sci.esa.int/smart-1/, http ://sci.esa.int/ilewg/ References : [1] Racca, G.D. et al. (2002) P&SS, 50, 1323. [2] Foing, B.H. et al (2003) Adv. Space Res., 31, 2323. [3] Foing B.H. et al (2006) Adv Space Res, 37, 6. [4] Grande, M. et al. (2003) P&SS, 51, 427. [5] Grande, M. et al (2007) P&SS 55, 494. [6] Pinet, P. et al (2005) P&SS, 53, 1309. [7] Josset J.L. et al (2006) Adv Space Res, 37, 14.

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Is meridional circulation responsible for CAIs radial transport in proplanetary disks ?

S. Fromang, W. Lyra
(CEA Saclay)

Calcium-Aluminum-rich Inclusions (CAIs) are the most primitive solids formed in our solar system. Because they condensed at high temperature, they are thought to have formed close to the sun. Yet, the discovery of CAIs in comets orbiting at large distances from the sun as reported by the Stardust mission suggests that CAIs were efficiently transported out to large radial distances in the solar nebula. Recently, a large scale meridional flow has been suggested as being responsible for that transport. Such a large scale flow naturally emerges out of viscous disk theories that are commonly used to model turbulence in protoplanetary disk. Here, I will use high resolution MHD simulations of global turbulent disk to investigate from first principles whether such flows indeed develops in turbulent accretion disks. Consequences of these simulations for the radial transport of CAIs will be discussed.

Combined stellar and planetary modeling

M. Havel T. Guillot
(Observatoire de la Côte d'Azur)

Transiting exoplanets are key to understanding planetary formation and evolution. However, the determination of their mass and size, and hence of their composition depends crucially on our ability to correctly infer the properties of their parent stars. Our goal is to investigate how uncertainties on stellar parameters and possible systematic effects in the modeling of stellar evolution impinge on planet characterization. We create an extensive grid of stellar models based on mass, chemical composition and input-physics, compare it with other widely used stellar models and perform a sensitivity test on planetary properties. In some cases such as CoRoT-2, we identify a new ensemble of solutions corresponding to the pre-main sequence evolution of the parent star that allow for a self-consistent solution accounting for the large planet size. On the other hand, CoRoT-9 is of special interest since it allows a validity check for planetary evolution models. We also revisit the question of the star-planet metallicity correlation in light of stellar evolution models for various metallicities.

A new model of cometary non-gravitational forces

L. Maquet, F. Colas, J. Crovisier, L.Jorda
(IMCCE-Observatoire de Paris)

The gravitational orbit of a comet is affected by the sublimation of water molecules by the nucleus when the comet approaches perihelion. This outgassing triggers a non-gravitational force (NGF) which significantly modifies the orbit of the comet. The amplitude of the perturbation depends on several parameters which can be constrained by visible, infrared and radio observations of the coma and nucleus of the comet. It depends also on the nucleus density, which can in turn be determined by modeling the effect of the NGF on the orbit of a comet. This method is the only method available so far to estimate the density of cometary nuclei. Up to now, the modeling of this effect is mostly based on an empirical model defined in the early 70's [1] which uses a simplified isotropic outgassing model. Attempts have been made to use advanced anisotropic thermal models to calculate the NGF taking into account several observational constraint and to retrieve the nucleus density [2], but : (i) this approach is restricted to a handful of cometary nuclei which are sufficiently well-known to allow this type of modeling, and (ii) the authors usually don't fit directly the astrometric measurements but rather « nongravitational parameters » calculated with the above-mentioned empirical model. We present a new model for non-gravitational forces with the aim of revisiting the problem of NGF calculation and nucleus density determination. The method is based on the separation of the surface of the nucleus in several surface elements located at different latitudes. The contribution of each surface element to the overall NGF is fitted from the astrometric measurements together with the density of the nucleus. This new method will be used to interpret future astrometric measurements of these pristine objects with GAIA.

Poster contributions

Irradiated disks and planet population synthesis

Cabral N., Fouchet L., Alibert Y., Mordasini C., Benz W.
(Institut de Physique de Bern)

Recent planet population synthesis models (Alibert et al 2010, submitted) have emphasized the key role played by the proto-planetary disk properties in determining the overall planet population characteristics. We present a disk model that takes into account viscous heating and irradiation by a central star and compute the resulting disk structure. As a first step, we consider the case of an equilibrium flaring angle. We then compute the flaring self-consistenly and show that this results in self-shadowed area which affect the disk structure. We illustrate the consequences of the resulting changes in the disk structure on the planet population by comparing synthetic populations corresponding to each of the different structures.

News from CoRoT space mission

A. Santerne, C. Moutou, F. Bouchy, G. Hébrard, R. Diaz, D. Queloz, M. Deleuil
(Laboratoire d'Astrophysique de Marseille / Observatoire de Haute-Provence)

Transiting exoplanets are crucial to understanding planetary formation and structure because they are the only ones we could determine mean density by measuring the radius and the mass using precise photometry and spectroscopy. CoRoT is the first space mission dedicated to find transiting exoplanets. From the first transiting brown dwarf to the first transiting rocky planet, CoRoT have already discovered many very interesting exoplanets. In 2010, the number of CoRoT transiting exoplanets will increase significatively with for example a temperature Jupiter in a 95-days period or a highly-eccentric hot-Jupiter. I will present theses new exoplanets discoveries.

(LAM/OAMP)

How can mixed modes constrain the mixing processes at the edge of the convective core ? The case of the solar-like pulsator CoRoT-target HD 49385.

S. Deheuvels E. Michel
(LESIA)

In solar-like pulsators massive enough to have a convective core, the mixing processes at the boundary between the core and the radiative region are still ill-described (overshooting, graviational settling, rotation, ...). This generates large uncertainties on the age and evolutionary stage of the observed stars. To improve the theoretical models, we need new observational constraints of these phenomena.
To this respect, the seismic study of evolved stars (end of the main sequence or beginning of the post main sequence) is very promising. The spectrum of these stars contain mixed modes which have a p-mode behavior at the surface and a g-mode behavior in the center, because of the coupling between the two cavities. It was already suggested that the frequency of these mixed modes is sensitive to the mixing processes at the edge of the core (Dziembowski and Pamyatnikh 1991). For modes of low degree l, the coupling between the cavities is strong, and we showed in a previous work (Deheuvels and Michel 2009) that it had an effect on more than two modes and induced a characteristic distortion of the ridge of degree l in the échelle diagram. This distortion brings complementary information on the profile of the gradient of chemical composition in the center, and thus on the transport of chemical elements.
Such a distortion was observed in the oscillation spectrum of the solar-like pulsator HD 49385, obtained from 137 days of CoRoT data collected for this star (Deheuvels et al. 2010). We show in this presentation how the frequency of the mixed mode and the distortion of the ridge allow to constrain the mixing at the edge of the convective core.

Geometry and kinematic of two Be stars with the VEGA/CHARA instrument

Delaa O. et al
(OCA)

The origin, the geometry and the kinematics of the circumstellar disk around Be stars, responsible for the observed near IR-excess and emission lines, is still debated even if recent interferometric observations with the VLTI /AMBER and VLTI/MIDI instruments seem to indicate that the presence of an equatorial disks and polar stellar wind around Be stars are not correlated. We propose to measure the size, orientation, shape and kinematics of 2 Be stars, namely 48 Per and psi Per.

Stellar rotation in the Hyades and Praesepe : gyrochronology and braking timescale

P. Delorme A. Cameron
(University of St-Andrews)

We present the results of photometric surveys for stellar rotation in the Hyades and in Praesepe, using data obtained as part of the SuperWASP exoplanetary transit-search programme. We determined accurate rotation periods for more than 150 sources whose cluster membership was confirmed by common proper motion and colour-magnitude fit to the clusters' isochrones. This allowed us to determine the effect of magnetic braking on a wide range of spectral types for ages around 600Myr for the Hyades and Praesepe. Both clusters show a tight and nearly linear relation between colour and rotation period on the F,G and K spectral range. This confirms that loss of angular momentum was significant enough that stars with strongly different initial rotation rate did converge to the same rotation period for a given age and mass, by the age of Hyades and Praesepe. In the case of the Hyades our colour-period sequence extends well into the M dwarf regime and shows a clear-cut breakdown of the colour-period relation, with identification of numerous rapid rotators from $\sim$0.5SM down to the lowest masses probed by our survey ($\sim$0.25SM). This provides crucial constraints on the rotational braking timescales and further clears the way to use gyrochronology as an accurate age measurment tool for main sequence stars.

Thermohaline instability and rotation-induced mixing in low- and intermediate-mass stars.

Lagarde Nadège & Charbonnel Corinne
(Observatoire de Genève)

Thermohaline mixing was recently identified as the dominating process that governs the photospheric composition of low-mass bright giant stars (Charbonnel & Zahn 2007a). Here we present the predictions of stellar models computed with the code STAREVOL that takes into account this mechanism together with rotational mixing. We compare the predictions with recent observations and discuss how the corresponding yields for 3He are compatible with the observed behaviour of this light element in our Galaxy.

Hydrodynamical simulations of Pinwheel nebula WR 104

Astrid Lamberts, Guillaume Dubus, Sebastien Fromang
(LAOG)

Pinwheel nebulae are formed in colliding wind binaries composed of a Wolf-Rayet star and an early-type star. The interaction of the winds creates a shocked structure that turns into a spiral due to orbital motion. Those systems present infrared emission from dust, whose origin is still poorly understood. Up to now, all models have assumed ballistic motion along an Archimedean spiral. We performed hydrodynamical simulations of a particular system, WR 104. Adaptive mesh refinement enables us to resolve the initial wind interaction region within the binary and to follow the flow up to several steps of the spiral. This allows us to determine the density and velocity in the shock region at all scales, providing new constraints for dust formation in pinwheel nebulae.

The 3D structure of Rossby vortices in protoplanetary discs

H. Meheut, F. Casse, P. Varniere, M. Tagger
(APC - Université Paris Diderot)

Vortices are at the center of numerous studies in the context of planetesimal growth in protoplanetary discs. They have been invoked to accelerate the growth of grains (Barge & Sommeria, 1995) by concentrating them in their centre. However most of the studies concerned two dimensional vortex. Here we address the question of the vertical structure of a vortex formed by the Rossby wave instability and how the 3D structure change the evolution of the grains in the vortex.

How to use and publish with the free available code CESAM2K

Bernard PICHON
(CNRS-OCA)

In this very short presentation (5-10 mn), the free available code CESAM2k for stellar structure and evolution is presented with a special emphasis on the conditions of publishing results in journals (with referees). The chart of using CESAM2k is available on http ://www.oca.eu/cesam/charte_CESAM.txt. Note that the code CESAM (prior to 2000) is obsolete and only CESAM2k (since 2001) is updated.

Shock-Induced Polarized Hydrogen Emission Lines in omicron Ceti

N. Fabas, A. Lèbre, D. Gillet
(GRAAL - Universite Montpellier 2 - Montpellier)

We have performed a spectropolarimetric survey of the variable Mira star omicron Ceti along three pulsation cycles. We present those new data collected with NARVAL instrument mounted on the Telescope Bernard Lyot (TBL) in Pic du Midi (France). We have detected time variable polarimetric signatures (on UQV Stokes spectra) associated to Balmer Hydrogen emission lines supposed to be formed behind the front of a shock wave propagating throughout the stellar atmosphere. We confirm the shockwave assumption which was one of the explanations proposed by McLean & Coyne (1978) to understand the linear polarization of the Balmer lines of Mira. In the future, we plan to extend this work initiated with omicron Ceti (M type Mira) to other Mira variables (C and S- spectral types Miras).

Similarity properties and scaling laws of radiating shocks and accreted column in magnetic cataclysmic variables : The POLAR Project

E. Falize, B. Loupias, A. Ravasio, C. D. Gregory, A. Dizière, M. Koenig, C. Michaut, C. Cavet, J.-P. Leidinger, X. Ribeyre
(CEA-DAM-DIF)

Search for cool brown dwarfs with the new optical and near-infrared whole sky surveys

B. Goldman, Th. Henning
(MPIA)

The first brown dwarfs have been discovered 15 years ago, and the coolest ones have temperatures of about 500K, almost bridging very low mass stars to the Solar giant planets. Indeed some insolated exoplanets have temperatures typical of brown dwarfs. With a new generation of on-going and soon-to-start surveys such as PanSTARRS1, UKIDSS/VISTA and WISE, the prospects to find brown dwarfs in larger number, various flavours and cooler temperatures have never been so good. In this paper I describe our recent discoveries from the UKIDSS near-infrared survey, including one of the two coolest "benchmark" brown dwarfs. I also present the prospects of the optical PanSTARRS1 survey which started regular operation in May.

Long-term magnetic field monitoring of the Sun-like star ksi Bootis A

Morgenthaler A., Petit P., Aurière M., Dintrans B., Fares R., Gastine T., Lanoux J., Lignières F., Morin J., Ramirez J., Saar S., Théado S., Van Grootel V.
(LATT)

Phase-resolved observations of the solar-type star ksi Bootis A were obtained using the Narval spectropolarimeter at Telescope Bernard Lyot (Pic du Midi, France) during years 2007, 2008, 2009 and 2010. The data sets enable us to study both the rotational and the long-term evolution of various activity tracers. Here, we focus on the large-scale photospheric magnetic field (reconstructed by Zeeman-Doppler Imaging), the Zeeman broadening of the FeI 846.84 nm magnetic line, and the chromospheric CaII H and Hα emission. We observe a global decrease of all magnetic proxies over the years, accompanied in the magnetic maps by a decreased fraction of magnetic energy stored in the toroidal field component.

Effective temperature scale of M dwarfs

Arvind Singh Rajpurohit, Céline Reylé, Mathias Schultheis, France Allard
(Observatoire de Besançon, Institut UTINAM)

We present a comparison of low-resolution spectra of 60 stars covering the whole M-dwarf sequence. Using the most recent PHOENIX stellar atmosphere models (Allard, Homeier & Freytag 2010, in preparation) we do a quantitative comparison to our observed spectra in the wavelength range 450-850 nm. We perform a first confrontation between models and observations by comparing the TiO band intensities and we assign effective temperatures. Teff-colour and Teff-spectral type relations will then be compared with the published ones.

Session PNST

Activité solaire et forçage climatique

Thierry Dudok de Wit
(Université d'Orléans)

Over 99.99% of the energy input to the terrestrial environment comes from solar radiation, and yet the impact of solar variability on long-term changes remains a highly controversial issue. Direct radiative forcing is the most studied mechanism but other much weaker ones can have a significant leverage. Interestingly, these mechanisms have direct astrophysical relevance and much still remains to be learned by viewing the Sun as a star. In this presentation I shall briefly review the main mechanisms by which solar variability affects the Earth, and put them in a more astrophysical context.

Tomography of the solar photosphere from Hinode observations

M. Faurobert, Cl. Aime, G. Ricort.
(Université de Nice)

We have used Hinode/SOT spectroscopic observations in the magnetic sensitive lines of FeI at 602 nm to explore the depth variations of solar photospheric structures. A cross-correlation method between images obtained out of disk center at different line widths allows us to measure with a high accuracy the depth differences between the images. As an example we show that the altitude of the region where the contrast inversion of the granulation takes place is derived and compared to model predictions.

Poster contributions

Automated detection of filaments and their eruptions from SDO data

E. Buchlin C. Mercier S. Parenti S. Engin J.-C. Vial
(Institut d'astrophysique spatiale)

It is clearly important for space weather applications to understand the evolution of filaments, and especially their eruptions, associated with CMEs. In the view of the cadence and continuity of SDO observations, AIA and HMI offer a unique tool for such a program. Because of the data volume and requirement of short latency, only an automated detection can be used. We report here on results obtained with the Bernasconi et al. (2005) code from images in Halpha, and on preliminary results from a new code that we are developing for images in He II 30.4 nm (SOHO/EIT, STEREO/SECCHI and SDO/AIA). We compare the efficiency of these codes and we discuss the selectivity obtained with the addition of magnetic information, e.g. on the polarity inversion lines from SDO/HMI.

A universal law for solar wind turbulence at electron scales

Galtier & Meyrand
(IAS, Université Paris-Sud)

Solar wind turbulence is characterized by a Kolmogorovian magnetic fluctuations spectrum at large scales followed by a second inertial range with steeper spectra associated to nonlinear dispersive processes. Recent observations reveal the presence of a third region - called dissipation range - at scales smaller than the electron inertial length and characterized by even more steeper spectra. We investigate this regime in the electron magnetohydrodynamics approximation and derive an exact and universal law for third-order structure functions. This law corresponds to a magnetic fluctuations isotropic spectrum in $k^{\{}-11/3\}$ compatible with the observations. We conclude on the possible existence of a third turbulence regime in the solar wind instead of a dissipation range as recently postulated.

Exact nonlinear diffusion equations for anisotropic MHD turbulence with cross-helicity

Galtier & Buchlin
(IAS, Université Paris-Sud)

Exact nonlinear diffusion equations of spectral transfer are derived for anisotropic magnetohydrodynamics in the regime of wave turbulence. The background of the analysis is the asymptotic Alfvén wave turbulence equations from which a differential limit is taken. The result is a universal diffusion-type equation in {**k**}-space which describes in a simple way and without free parameter the energy transport perpendicular to the external magnetic field {**B_0**} for transverse and parallel fluctuations. These exact equations are compatible with both the thermodynamic equilibrium and the finite flux spectra derived by Galtier et al. (2000) ; it improves therefore the approximate model proposed by Litwick & Goldreich (2003) for which only the second solution is recovered. This new system offers a powerful description of a wide class of astrophysical plasmas with non-zero cross-helicity.

CDPP activities in the international Virtual Observatories context

Jacquey, C. ; Gangloff, M. ; André, N. ; Génot, V. ; Cecconi, B. ; Lavraud, B. ; Pallier, E. ; Budnik, E. ; Bouchemit, M. ; Bourrel, N. ; Harvey, C. ; Penou, E. ; Hitier, R. ; Francoise, D. ; Heulet, D. ; Besson, B.
(CESR)

The CDPP (Centre de Données de la Physique des Plasmas) has been archiving space plasma data for more than ten years. Beside its archiving activities, the CDPP was early involved in space physics data model standardization through its collaboration to the SPASE group and CAA. More recently it took an active part in the development of Virtual Observatories in the fields of heliophysics (within HELIO (FP7) in collaboration with MEDOC and BASS2000 data centres), planetology (within EUROPLANET RI (FP7)) and space weather within (VISPANET (ESA)). A review of the CDPP involvement in these projects will be presented.

Science outputs of the CDPP on-line analysis tool AMDA

Génot, V.; Jacquey, C.; Budnik, E.; Bouchemit, M.; Gangloff, M.; Fedorov, A.; Lavraud, B.; André, N.; Fruit, G.; Louarn, P.; Harvey, C. C.; Pallier, E.; Penou, E.; Hitier, R.; Cecconi, B.; Francoise, D.; Heulet, D.; Pinçon, J.L.; Besson, B.

(CESR)

According to the Virtual Observatory paradigm the CDPP developed an on-line data mining / event searching tool, AMDA (Automated Multi-Dataset Analysis) : it is a web-based facilities for analyzing on-line space physics data coming from its own local database as well as remote ones (CDAWeb, CAA, MAPSKP, THEMIS database). This tool allows the user to perform on-line classical manipulations such as data visualization, parameter computation or data extraction. AMDA also offers innovative functionalities such as event searching using the data from multiple sources in either a visual or an automated way, the generation, exploitation and management of time-tables, or event lists. This presentation will focus on scientific analyses performed by AMDA users in recent years. This will illustrate how the use of analysis tool accessing large distributed data sets may reveal new scientific results, and generate new ideas for analysis tools.

The transport of cosmic rays in the Galaxy : constraints on the diffusion coefficient from gamma ray observations of the W28 region
S. Gabici
(APC)

Invited Talk, TBD
Mazelle Christian
(CESR)
TBD

Particules énergétiques piégées autour des planètes magnétisées
A. Sicard-Piet, S. Bourdarie
(ONERA)
The magnetic field in the vicinity of the Earth becomes such that all relativistic charged particles are trapped and their movement is then quasi-periodic. These special conditions are thus favorable to the accumulation of high-energy charged particles in certain regions of space which creates the radiation belts. Such radiation belts exist around any magnetized planet. Several way exist to measure particles of the radiation belt, like in-situ data or synchrotron emission in the case of giant planet like Jupiter.

The Sun as a Particle Accelerator : Hard X-ray, gamma-ray, radio and in-situ diagnostics of energetic particles
Nicole Vilmer LESIA-Paris Observatory
(LESIA-Observatoire de Paris)
Violent phenomena in the solar atmosphere lead to the production of energetic particles and of bubbles of ionized matter which propagate in the interplanetary medium with speeds of several thousands of kilometres per second. The source of the fast particles and of the mass ejections is well known to be linked to the existence of a complex magnetic field at the surface of the Sun. Solar flares are characterized by a fast brightening in the active regions surrounding sunspots and also by intense (several order of magnitudes) enhancements of radio and UV/X-ray emissions from the Sun. During flares, the Sun behaves as an efficient particle accelerator. While some high energy particles (electrons and ions) produce high energy radiation in the solar atmosphere (X-rays and gamma-rays), others will escape in the interplanetary medium, propagate along interplanetary magnetic field lines and eventually reach the Earth's orbit. I shall review here some results (both observational and theoretical) on solar particle acceleration provided by X-ray/ γ-ray observations obtained by the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) mission (as well as by INTEGRAL/SPI). I shall also present some results obtained on electron acceleration and transport in flares provided by the combination of decimetric to kilometric radio observations (from ground-based and space instrumentation) with X-ray spectrally and spatially resolved observations. I shall finally discuss some of the scientific objectives of Solar Orbiter related to the issue of particle acceleration and transport at the Sun and in the inner heliosphere.

Fermi acceleration in astrophysical shock waves
A.Marcowith
(L.P.T.A.)
Recent developments in the physics of Fermi acceleration in astrophysical shocks will be reviewed. Special attention will be addressed to supernova shock waves were the cosmic ray streaming instability is expected to produce a highly turbulent magnetic field. Consequences on the origin of the high energy cosmic ray spectrum will be discussed in conclusion.

WWW.NMDB.EU : THE REAL-TIME NEUTRON MONITOR DATABASE

K.-L. Klein, N. Fuller, the NMDB Team
(Observatoire de Paris)

The Real time database for high-resolution neutron monitor measurements(NMDB), which was supported by the 7th Framework Programme of the European Commission, hosts data on cosmic rays in the GeV range from European and some non-European neutron monitor stations. Besides real-time data and historical data over several decades in a unified format, it offers data products such as galactic cosmic ray spectra and applications including solar energetic particle alerts and the calculation of ionisation rates in the atmosphere and effective radiation dose rates at aircraft altitudes. Furthermore the web site comprises public outreach pages in several languages and offers training material on cosmic rays for university students and researchers and engineers who want to become familiar with cosmic rays and neutron monitor measurements. This contribution presents an overview of the provided services and indications on how to access the database. Operators of other neutron monitor stations are welcome to submit their data to NMDB.

Globular cluster spectroscopy

Piercarlo Bonifacio
(GEPI - Observatoire de Paris - CNRS -Univ. Paris Diderot)

The Globular Clusters are an important component of the Galactic Halo, although in terms of mass they represent less than 1/10 of the mass of the Halo, their integrated luminosity is large and thus allows to trace the Halo at large distances. Their colour-magnitude diagrams are fairly simple, which has, for a long time, led to the notion that Globular Clusters are composed by a coeval single stellar population and ideal test-bench for stellar evolution theories. In the twenty years between roughly 1980 and 2000 great advances were made in the studies of Globular Clusters thanks to the availability of two-dimensional solid state detectors which allowed to build accurate colour-magnitude diagrams with statistically significant numbers of stars. Starting from the end of the 1990's the advent of the 8m class telescopes opened up the possibility of high resolution spectroscopic studies, which, for the nearest clusters, extend down to the Main Sequence. A major step forward with respect to the study of the brightest giants afforded by the 4m telescopes. The surpises then began to come and the detailed chemical abundance patterns which became available, clearly pointed towards a complex chemical evolution and the presence of multiple stellar populations. This was later confirmed by the detection of multiple Main Sequences and Sub Giant branches in some Globular Clusters. Detailed chemical abundances is not the only result coming from high resolution spectra, the availability of radial velocities with accuracy of 1 m/s makes some Globular Clusters and ideal test-bench for alternative theories of gravity, such as MOND. In this review I will give my personal perception of the most exciting advances in the field of Globular Cluster spectroscopy in the last years.

Open Clusters as tracers of the Galactic disk

Angela Bragaglia
(INAF-Osservatorio Astronomico di Bologna)

Open clusters are one of the best tracers of the properties of the thin disk of our Galaxy. I will concentrate on the metallicity distribution defined by open clusters and on its evolution with time, since this offers important information for the models of formation and chemical enrichment of the disk. I will also discuss how results of the Gaia satellite will influence our understanding of the open clusters and the Galactic disk.

Dwarf Galaxies in the Local Group : Cornerstones for Stellar Astrophysics and Cosmology

G. Bono, P.B. Stetson, A.R. Walker, M. Fabrizio, M. Monelli, M. Nonino, plus Carina Collaboration
(Universita' di Roma Tor Vergata)

Dwarf galaxies have been the crossroad of significant theoretical and observational efforts, but we still lack firm constraints corncerning their formation and evolution.They are also fundamental laboratories to investigate the impact of the environment on star formation and on chemical evolution in stellar systems that are 3-4 order of magnitudes smaller than giant galaxies and to constrain the evolutionary properties of metal-poor, intermadiate-mass stars. We present some recent results concerning the dwarf spheroidal Carina and the dwarf irregular IC10. In particular, we focus our attention on the evolutionary properties of their stellar populations using accurate and deep color-magnitude diagrams together with homogeneous sets of isochrones and helium burning evolutonary models. We also briefly discuss the impact that the transition from old, low-mass (horizontal branch) to intermediate-age (red clump) helium burning stars has in constraining the star formation history of complex stellar systems.

Chemical Abundances and the Enrichment History of Local Group Dwarf Galaxies

V. Hill
(Laboratoire Cassiopée, Observatoire de la Côte d'Azur)

At the lower end of galaxy masses, the classical dwarf spheroidal galaxies (dSph) allow to probe chemical enrichement on the smallest scales, and perhaps in its simplest expression. Particularly interesting are the issues concerning the efficency with which metals are retained or lost in these shallow potential wells. Another fundamental issue concerns the earliest epochs of star formation : are first stars formed in similar ways and proportions in all halos ?

In this talk I will review the chemical abundances of individual stars in the nearby classical dwarf spheroidal galaxies that have become available in increasing numbers (sample size and galaxies probed) in the last decade, in particular those obtained with FLAMES on VLT by the DART collaboration, highlighting the power of detailed chemical abundance patterns of large samples of stars to unravel the various evolutionnary paths followed by dSph galaxies. The intrisic evolution of those classical dSph systems will also be compared to ultra-faint dSph. Special emphasis will be given to the oldest and most metal-poor populations in dwarf galaxies, discussing the search for this eluding population, its detection and characterization, and the inferred relation between the Milky-Way halo and the early evolution of dSph galaxies.

Stellar populations in M31

Rodrigo Ibata
(Observatoire de Strasbourg)

In recent years the Andromeda galaxy has become the target of large, campaigns to survey its stellar populations from the centre to the outermost reaches of the halo. This flurry of activity, which has included large imaging programmes with the CFHT and spectroscopic follow-up with Keck will soon be complemented with a high-resolution panoramic survey of the disk with HST. These new photometric and kinematic data are giving us a uniquely detailed view of the structure and dynamics of the closest giant disk galaxy to the Milky Way. We are now able to study the large scale trends of galactic components and detect a plethora of small sub-structures. I will discuss the consequences of these findings for our understanding of galactic formation and the distribution of dark matter.

Spectro-photocentric variability and photometric variability of evolved stars : consequences on Gaia measurements

A. Chiavassa, E. Pasquato, A. Jorissen, S. Sacuto, B. Freytag, H. G. Ludwig, P. Cruzalebes, Y. Rabbia, A. Spang, O. Chesneau, and C. Babusiaux
(Mac Planck for Astrophysics)

Red supergiant stars are characterized by large granules on their surface which cause surface inhomogeneities and shock waves. We explore the impact of the granulation on the photocentric and photometric variability using 3D simulations of convection with CO5BOLD and the post-processing radiative transfer code OPTIM3D to compute intensity maps and spectra in Gaia G band. Finally, we find how many RSGs will have their Gaia astrometry altered by such surface granulation.

Multiple populations in GCs, a theoretical point of view

T. Decressin, H. Baumgardt, P. Kroupa, C. Charbonnel, G. Meynet
(Argelander-Institut für Astronomie)

Globular clusters exhibit peculiar chemical patterns where Fe and heavy elements are constant inside a given cluster while light elements (Li to Al) show strong star-to-star variations. Multiple branches have been discovered in several globular cluster which are related to these abundance variations. This pattern can be explained by self-pollution of the intracluster gas by recycling the wind ejected by first generation stars. I will present the current status of these polluters and some related issues about globular cluster dynamical evolution.

Massive spectroscopic analysis : the stellar population in three CoRoT/Exoplanet fields
Jean-Christophe Gazzano, Magali Deleuil, Patrick De Laverny, Alejandra Recio-Blanco, François Bouchy, Claire Moutou
(Laboratoire d'Astrophysique de Marseille)
Future is bright for massive surveys targeting thousands of stars. Most of these studies however require an accurate determination of stellar parameters such as effective temperature, abundances, or Vsini. This could be achieved only by combining multi-fibre spectroscopic observations with automated analysis software. We carried out a first study that demonstrates the feasibility of such an approach in three CoRoT/Exoplanet fields. We adapted and trained MATISSE, an algorithm initially developed to carry out the spectral analysis of Gaia/RVS spectra, to characterise the stellar population in these CoRoT/Exoplanet fields. This study was performed on the Mg I b spectral range observed with the FLAMES/GIRAFFE multi-fibre instrument at ESO. We measured the radial velocity, an estimate of the projected rotational velocity, the effective temperature, the surface gravity, the overall metallicity and the alpha-enhancement for more than 1 000 stars. Hence, we built the foundations for any study regarding transiting planet detection probabilities or Galactic structures within the CoRoT fields. This survey will be soon completed by new FLAMES observations and could be easily adapted to any other instrument.

Tracing the stellar mass assembly in the COSMOS field
Ilbert, Salvato, Le Floc'h, Aussel, Capak and the COSMOS team
(LAM)
Stellar mass assembly is the result of a complex interplay between numerous physical processes like cold gas accretion, AGN and supernovae feedback, merger. A clear and comprehensive picture describing the physical processes which regulate the stellar mass assembly is still missing in galaxy formation scenario. I will present the stellar mass assembly and star formation history measured in the 2 sq-deg COSMOS field.

A sparse population of very young stars in Cepheus
A. Klutsch, D. Montes, P. Guillout, A. Frasca, F.-X. Pineau, N. Grosso, E. Marilli, J. Lòpez-Santiago
(Universidad Complutense de Madrid)
Once mixed in the ambient galactic plane stellar population, young stars are virtually indiscernible because neither their global photometric properties nor the presence of nearby gas can help to disentangle them from older ones. Nevertheless, in the RasTyc sample, we discovered 4 lithium-rich field stars displaying the same space motion, which are located within a few degrees from each other on the celestial sphere close to Cepheus flare region and at the similar distance of the Sun. Both physical and kinematical indicators show that all stars are very young, with ages in the range 10 - 20 Myr. Using multivariate analysis methods, we selected optical counterparts of XMM/RASS X-ray sources cross-identified with late-type stars, which are located around these 4 young stars. Recent intermediate- and high-resolution spectroscopic observations of this sample allowed us to discover additional lithium-rich sources. Our preliminary results show that some of them share the same space motion as our 4 original stars. They have properties rather similar to the members of the TW Hydrae association, although they are slightly older and located in the northern hemisphere.

Properties of the thick disc far from the Solar neighbourhood
Georges Kordopatis, Patrick de Laverny, Alejandra Recio-Blanco, Albert Bijaoui and Christophe Ordenovic
(Observatoire de la Côte d'Azur)
Vertical gradients in kinematics, metallicities and spatial structure are crucial ingredients of Galaxy formation models. For that purpose,a spectroscopic survey of nearly 700 stars towards l$\sim$270, b$\sim$47 has been made, to detect and characterize possible stellar sub-populations in the Galactic Thick disc. MATISSE algorithm has been used to obtain the atmospherical parameters of the stars (Teff, logg, [M/H]) and Y^2 isochrones to get the distances. We present here results obtained, as well as a comparison with Besançon's model of the Milky Way of the metallicities, distances and kinematics obtained for that sample.

Improvement of atomic models for NLTE radiative transfer in late type stars
Thibault Merle, Frédéric Thévenin, Bernard Pichon, Lionel Bigot
(Observatoire de la Côte d'Azur)
We present our first results of improved N-LTE IR line profiles of Ca II and Mg I in good agreement with observations on the Sun. This work prepares us to analyze future RVS data of the Gaia mission. To do this we updated atomic models of magnesium and calcium. This work on NLTE effects will be also applied to correct determination of LTE chemical abundances of late type metal poor stars.

A SINFONI Integral Field Spectroscopy Survey for Damped Lyman-alpha Systems

Peroux, Bouche, Kulkarni, York and Vladilo
(Laboratoire d'Astrophysique de Marseille)

Details of processes through which galaxies convert their gas into stars need to be studied in order to obtain a complete picture of galaxy formation. One way to tackle these phenomena is to relate the HI gas and the stars in galaxies. Integral field spectroscopy provides an efficient way of detecting faint galaxies near bright quasars, further providing immediate redshift confirmation. We report the detection of H-alpha emission from a DLA and a sub-DLA galaxy. We derive SFR=1.8 M_sun/yr at impact parameter b=25 kpc towards quasar Q0302-223 for the DLA at z_abs=1.009 and SFR=2. M_sun/yr at b=39 kpc towards Q1009-0026 for the sub-DLA at z_abs=0.887. We use the NII/H-alpha ratio to derive the HII emission metallicities and compare them with the neutral gas HI absorption metallicities derived from high-resolution spectra. We also study the dynamical properties of these objects. While the DLA towards Q0302-223 is found to be dispersion-dominated, the sub-DLA towards Q1009-0026 shows clear signatures of rotation. We use a proxy to circular velocity to estimate the mass of the halo in which the sub-DLA resides and find $M\_halo = 10^{12.6} M\_sun$. We also derive dynamical masses of these objects, and find $M\_dyn = 10^{10.3} M\_sun$ and $10^{10.7} M\_sun$. For one of the two systems (towards Q0302-223), we are able to derive a stellar mass of $M\_* = 10^{9.5} M\_sun$ from Spectral Energy Distribution fit. Our work illustrates that detailed studies of quasar absorbers can offer entirely new insights into our knowledge of the interaction between stars and the interstellar gas in galaxies.

Impact of stellar rotation on the age determination of five open clusters

SANTORO, Luca ; THEVENIN, Fredéric ; PICHON, Bernard
(CNRS)

In the context of the FLAME (*) working group of the Gaia data processing consortium, we study the effects of rotation on the age determination of open clusters.
On one hand, we present rotational velocity distributions of stars for different open clusters : Pleiades, Alpha Persei, Hyades, Praesepe and Blanco-1 using the statistical inversion of Chandrasekar-Munch.
On the other hand, to validate our work, we compare our results for the Hyades with models (including rotation) obtained with Cesam2k .
(*) : Final Luminosity, Ages and Mass Estimation

Discovery of a stellar stream in the outer Galactic halo

D. Valls-Gabaud, A. Sollima, D. Martinez Delgado
(GEPI - Observatoire de Paris)

Tests of MATISSE on large spectral datasets from the ESO archive

C.C.Worley, P. de Laverny, A. Recio-Blanco, V. Hill and A.Bijaoui, Y. Vernisse
(Observatoire de la Cote d'Azur)

The automated stellar classification algorithm, MATISSE, has been developed at the Observatoire de la Côte d'Azur (OCA) as a means of determining stellar temperatures, gravities and chemical abundances for large samples of stellar spectra. It has been selected by the Gaia DPAC as one of the key programmes to be used in the analysis of the spectra that will be obtained by the Radial Velocity Spectrometer (RVS) on the European Space Agency's (ESA) Gaia satellite. A key stage in the development of MATISSE is to test its performance on large spectral datasets in order to identify and address issues with analyzing real spectra prior to the launch of Gaia in 2012. Under the GSP-Spectroscopy Work Package this testing is being carried out on large datasets of spectra from the ESO archive. Preliminary results regarding the analysis of the archived FEROS spectra will be presented.

The VIMOS VLT Deep Survey : the group catalogue

Cucciati, O.; Marinoni, C.; Iovino, A.; Bardelli, S.; Adami, C.; Mazure, A. and VVDS collaboration
(Laboratoire d'Astrophysique de Marseille)

We present a homogeneous and complete catalogue of optical galaxy groups identified in the VIMOS-VLT Deep Survey (VVDS). We use mock catalogues extracted from the Millennium simulation to study the potential systematics that might affect the overall distribution of the identified systems, and also to asses how well galaxy redshifts trace the line-of-sight velocity dispersion of the underlying mass overdensity. We train on these mock catalogues the adopted group-finding technique (the Voronoi-Delaunay Method, VDM), to recover in a robust and unbiased way the redshift and velocity dispersion distributions of groups and maximize the level of completeness (C) and purity (P) of the group catalogue. We identify 318(/144) VVDS groups with at least 2(/3) members within 0.2<=z<=1.0, globally with C=60% and P=50%. We use the group sample to study the redshift evolution of the fraction f_b of blue galaxies (U-B<=1) within 0.2<=z<=1 in both groups and in the whole ensemble of galaxies irrespectively of their environment.

Chemical heterogeneity of A stars in open clusters and Gaia

M. Gebran & R. Monier
(Université de Barcelone (DAM))

Abundance anomalies have been determined at the surface of many field and open cluster A and F dwarfs. These abundance anomalies are most likely caused by microscopic diffusion at work within the stable envelopes of A stars. However diffusion can be countercted by several other mixing processes such as convection, rotational mixing and mass loss. The typical patterns encountered are underabundances of Ca and/or Sc as well as overabundances of iron peak elements and rare earths. Non magnetic A/F stars with such patterns are classified as Am/Fm. We present a short review the surface abundances patterns of A/F stars in the Pleiades (100 Myr), Coma Berenices (450 Myr) and Hyades (650 Myr) open clusters. Real star-to-star variations of the abundances for several chemical elements in the A dwarfs in these clusters. The derived abundances are then compared to evolutionary models from the Montreal group. The results show that there are hydrodynamical processes acting within the radiative zone of these stars and hindering the effects of microscopic diffusion (mixing processes/mass loss).

In the context of the Gaia mission, we did some simulation in order to predict the number of A stars that Gaia will observe and their respective photometric/spectroscopic attainable accuracies.

Gaia RVS spectra will observe the CaII triplet and therefore yield valuable information concerning the statistics of Am/Fm stars in our Galaxy. Using Gaia astrometry data, more accurate ages (particularly for clusters) will be determined which will allow us, by comparing the predictions of the models and the observed abundance pattern, to constrain the physics and the transport processes included in the evolutionary models. An importing issue of this analysis will be the determination of the rotational velocities of the sample of A stars (up to V12-13 mag). This will yield valuable information about the formation and the evolution of these stars. Slowly rotating early A-type stars could originate from phenomena of angular momentum loss and redistribution undergone during pre-main-sequence phases.

EROS-2 Archive : Implementation and Applications

Jean-Baptiste Marquette, Eric Lesquoy
(Institut d'Astrophysique de Paris)

The EROS-2 experiment (Expérience de Recherche d'Objets Sombres) conducted between July 1996 and March 2003 a large-scale photometric survey towards the Magellanic Clouds and the Galactic center, in order to probe the eventual presence of compact objects (the so-called MACHOs) in the galactic Halo. This survey produced a unique and extremely large set of photometric light curves for more than 87 millions of stellar objects over more than 200 square degrees in two large non-standard passbands. We plan to make these data publicly available in 3 stages : (i) publication of the light curves through the database of the Time Series Center (Harvard University, PI : Pavlos Protopapas) ; (ii) publication of the catalogs through the CDS (Strasbourg) ; (iii) publication of the images through a VO architecture to be defined. The systematic astrometric calibration of these images is currently under process. Various projects are already using this EROS-2 database, other projects are encouraged to apply.

Spectral Analysis of the Stars Members of the Open Cluster M6 : Preliminary Results

T. Kilicoglu, R. Monier, and L. Fossati
(Ankara University)

Open clusters are important laboratories for stellar astrophysics. One generally assumes that stars members of an open cluster have same initial chemical composition, same age, and same distance. Thus, the differences in abundance among the stars in a cluster usually reflect the competition between radiative diffusion and hydrodynamical process (mixing by rotation). The spectral analyses of open clusters allow us to perform detailed abundance analysis for most A and F member stars. The derived abundance patterns can than be compared to the prediction of self-consistent evolutionary processes including transport processes. We have used the Giraffe spectrograph, attached to 8 meter class VLT telescope (Chile), to derive elemental abundance of the open cluster M6 (age of $\sim$100 million years). We present preliminary results : determination of effective temperatures and surface gravities of 62 stars in M6 using the available Geneva 7 color photometric observations. Preliminary abundance determination from one low resolution and two high resolution regions including 4500 - 5100 A, 5140-5350 A, and 5590-5835 A, respectively, are presented for the star CD-32 13109.

GALEX NUV Lyman Break Galaxies

G. Williger, L. Haberzettl, M. Lehnert, N. Nesvadba, D. Valls-Gabaud
(Univ. de Nice)

We present results of a search for Lyman break galaxies at $1.5<2.5$ in the GOODS-S using a NUV-dropout technique in combination with color-selection criteria. We were able to select a sample of 201 LBG-candidates. We compare our selection efficiencies to BM/BX- and BzK-selection methods, techniques solely based on ground-based data-sets, we see a higher success rate in detecting star forming galaxies in the purely studied redshift interval. For our LBG-candidate sample we estimate ages, masses, star formation rates, and extinction from SED models. We find about 15% of our LBG-candidates are comparable to infrared luminous LBGs or sub-millimeter galaxies.

Dernières nouvelles des exoplanètes
X.Delfosse
(LAOG/Observatoire de Grenoble)

Have we seen the dark matter annihilation in the cosmic electron and positron spectra ?
Julien Lavalle
(Dpt. Theor. Phys. Torino Univ.)
We will review the theoretical interpretations of the recent measurements of the positron fraction by PAMELA, and of the sum of electrons plus positrons by ATIC, Fermi and HESS. We will discuss the relevance of each of them.

Voyage vers l'origine des aurores polaires avec la mission THEMIS/Journey to the origin of the polar aurorae with the THEMIS mission
Le Contel, Olivier
(Laboratoire de Physique des Plasmas, CNRS/Ecole Polytechnique/UPMC/Paris-Sud 11)
The five satellites of the THEMIS mission were launched on February 17, 2007 by NASA. This mission was proposed by the Space Science Laboratory (SSL) of the University of California at Berkeley (UCB), where 3 of the 5 onboard instruments have been built. LPP provided the tri-axis search coil magnetometer, tailored to measure magnetic field fluctuations. CESR/CDPP (Toulouse) is in charge of a data centre that mirrors the UCB data centre. This French participation has benefited from the support of CNES. THEMIS mission aims at determining what triggers geomagnetic substorms leading to intense australis and borealis aurorae. It has been known for quite a long time that aurorae are due to charged energetic particles, electrons and ions, hitting and exciting atmospheric atoms and molecules, in the upper atmosphere of high latitude regions. Charged particles precipitation, in the auroral region, occurs every 3 hours, in average, during explosive phenomena called substorms. During substorms these particles, usually trapped by the Earth's magnetic field, are accelerated from a few eV to a few keV towards the Earth, while the magnetic configuration, at large distances from the Earth, is strongly modified. These energetic particles are coming from a giant reservoir of plasma, called the plasma sheet, and located far away from the Earth, in the night sector, typically at 7-30 Earth radii, and beyond. In this region the terrestrial magnetic field is strongly deformed and forms a magnetic tail. Yet the origin of this acceleration and of breaking of the magnetic confinement, during substorms, is still unclear. Every 4 days, THEMIS's constellation is lined up along the Sun-Earth line and collects coordinated measurements. These in-situ measurements are replaced in a more global context thanks to a network of ground-based all sky cameras and magnetometers, located in Canada and the north of United States. Indeed, the orbits are such that when the THEMIS satellites are nearly aligned their magnetic footprints are above the ground-based network. Thus the network provides a very interesting global mapping of the regions crossed by the satellites. Recent results from the THEMIS mission will be reviewed.

Presentation de la Societe Francaise d'Exobiologie
Francois RAULIN
(LISA - CNRS/IPSL, UPEC & Univ. Paris Diderot)

French activities in Adaptive Optics for the E-ELT
Michel Tallon
(CRAL - Centre de Recherche Astrophysique de Lyon)
The European Extremely Large Telescope relies on various new Adaptive Optics systems to reach its expected performances. These systems are complex and drive an intense activity in Europe, both for the telescope itself and for its instrumentation. I will review the current activities of the French High Angular Resolution community in this field.

CFHT Decade 4
Christian Veillet
(CFHT)
CFHT turned thirty in October of last year. In spite of its age and relatively modest size, CFHT is among the most productive facilities in today's astronomy, thanks on one hand to the caliber of its users, and on the other hand to a current suite of excellent instruments, an efficient queued service observing mode, and much interaction between the observatory and the PIs. With exciting new instruments under study or development, CFHT is in the process of defining a development plan, "CFHT Decade 4", covering the 2010-2020 period and beyond. This talk will be an opportunity to present the current status of this plan, seen from an observatory perspective, to the French community.

Poster contributions

Stratospheric Observatory For Infrared Astronomy
Murad Hamidouche, Erick Young, Pamela Marcum, Alfred Krabbe
(USRA- NASA Ames Research Center)
We present one of the new generations of observatories, the Stratospheric Observatory For Infrared Astronomy (SOFIA). This is an airborne observatory consisting of a 2.7-m telescope mounted on a modified Boeing B747-SP airplane. Flying at an up to 45,000 ft (14 km) altitude, SOFIA will observe above more than 99 percent of the Earth atmospheric water vapor. We outline the observatory capabilities and goals. The first-generation science instruments flying on board SOFIA and their main astronomical goals will be presented. The current open call for proposals will be summarized with the necessary information.

A CHANDRA Census of c2d YSOs : Evolution of X-ray Emission
Murad Hamidouche, Michael Jacobson, Leslie Looney
(USRA- NASA Ames Research Center)
We present an analytical study of a large sample of 109 young stellar objects in the X-ray. Unexpectedly, the X-ray energy decreases with time and with column density, while it should increase. We conclude that the youngest YSO protostars, Class0/I, emit X-rays in the 1-8 keV band. The deeply embedded sources with the strongest accretion activity are detected in the hard-band ($>$ 2keV) only. Due to extinction, their soft X-rays are not detected. To explain the decline in energy, we believe that within a timescale of few Myrs the corona cools down via the accretion material, as seen in the accreting pre-main-sequence Herbig AeBe stars.

Mergers vs Accretion
B. L'Huillier, F. Combes, B. Semelin
(LERMA/OP)
According to the hierarchical model, small galaxies form first and merge together to form bigger objects. In parallel, galaxies assemble their mass through accretion from cosmic filaments. Recently, the increased spatial resolution of the cosmological simulations have emphasized that a large fraction of cold gas can be accreted by galaxies. In order to compare the role of the two phenomena and the corresponding star formation history, one has to detect the structures in the numerical simulations and to follow them in time, by building a merger tree.