Journées de la SF2A 2008
30 juin au 4 juillet, Paris
Liste des abstracts

Session SF2A

Oral contributions

What did (will) we learn about galaxies from the mid/far infrared perspective
David Elbaz
(CEA Saclay)
I will review the recent discoveries on galaxy formation and evolution that were made possible thanks to the advent of space infrared observatories. New challenges & expectations for future missions, particularly Herschel, will be discussed.

Evolutions de l'Observatoire Virtuel astronomique
Francoise Genova
(CDS, Observatoire astronomique de Strasbourg)
The status of the Astronomical Virtuel Observatory will be presented, in particular the new European project, EuroVO-AIDA (Euro-VO Astronomical Infrastructure for Data Access). The role of the Action Specifique Observatoires Virtuels France will be discussed.

Cisaillement gravitationnel et cosmologie avec le CFHTLS
Y. Mellier, M. Kilbinger
(IAP)

CoRoT first results - looking inside the stars.
E. Michel et al.
(LESIA - Observatoire de Paris)
CoRoT has now proven its ability to measure stellar luminosity variations down to the part-per-million level, over long and quasi uninterrupted periods (up to 150 days). These data carry a wealth of information on the interior of very different stars in various evolution stages. The three first runs are being analysed by the CoRoT community, unveiling stellar oscillations with unprecedented sensitivity and precision. With a few examples, we will illustrate how CoRoT is opening a new era in stellar seismology.

La poussière interstellaire à la veille des missions Planck et Herschel
Marc-Antoine Miville-Deschenes
(Institut d'Astrophysique Spatiale)
It appears clearly now that interstellar dust is not only a good tracer of the physical conditions along the star formation process in galaxies but that it plays a dominant role. It is an major actor of the chemistry, thermal balance and dynamics of the gas, from the most diffuse medium to proto-planetary disks. Therefore our understanding of the evolution of interstellar matter and of the star formation process requires a detailed description of grain properties (chemical composition, structure), surface chemistry, grain interaction with the magnetic field (grain charges and alignment process) and evolution processes (coagulation, fragmentation). This conclusion is reached on the eve of the Planck and Herschel missions which will bring answers to some of the most fundamental questions in this field. In this presentation I will describe a few recent results which bring new insights in our understanding of interstellar dust followed by what will be the major contributions of Planck and Herschel in this area.

Quelle feuille de route pour l'interférométrie optique ?
D. Mourard, G. Perrin, ASHRA
(OCA)
The European Science Vision for Astronomy has identified a certain number of important topics requiring higher angular resolution though and a very high imaging capability. Among them, the cores of galaxies, active galactic nuclei, exoplanets, first stars, first galaxies, small bodies in the solar system... Interferometric techniques have been very significantly improved during the past decade. Thanks to facilities like VLTI in Europe, more and more astrophysicists are using interferometry for their main science topics and the community is keeps growing. A very large fraction of science papers are now being published by non interferometrists and the ratio keeps increasing. Imaging of sources has been demonstrated with existing facilities and in less than half a decade higher sensitivity interferometry allowing to study distant objects of cosmological interest will be achieved. Brighter sources such as exoplanetary systems will require very high angular resolution to be studied with more statistics than possible with current techniques. Essentially all subsystems for a large facility combining ten to a few tens of 4 to 8 m class telescopes with kilometer-size baselines or more have been demonstrated, studied or are being studied. Such a facility will probably require international collaboration and common workshops have already taken place across the Atlantic. We will present the characteristics of a future facility and its potential for modern astrophysics questions, the already achieved milestones, the current technical research and the short-term prospects as well as the well matured ideas to meet the challenge. We will demonstrate that this facility must be part of a roadmap at the European level.

Les enjeux scientifiques d'ALMA
J.PETY au nom du conseil scientifique de l'ASA
(IRAM & Obs. de Paris)
ALMA est un interféromètre submillimétrique, composé de 50 antennes de 12m de diamètre, et localisé à 5000 m d'altitude. C'est le premier projet projet d'astronomie au sol d'envergure mondial. Il n'y aura qu'un seul instrument de cette catégorie au monde et tout le temps d'observation sera ouvert. Ces caractéristiques posent la question des actions que la communaté française doit conduire pour réussir à obtenir des résultats scientifiques à la hauteur de son investissement.
Après une évocation rapide des capacités et des limites d'ALMA, je présenterai l'état actuel du projet et les prochaines étapes clés : selon le planning actuel, la période de "commissionning and science verification" commence mi-2008, la période "early science" commencera fin 2010, début 2011 et la construction d'ALMA s'achevera en 2013. Je présenterai les structures d'interactions entre les utilisateurs et le projet : les ALMA Regional Centers mis en place par le projet ALMA. Je terminerai par une description des nouvelles actions engagées par l'Action Spécifique ALMA en 2009.

Exploration spatiale du système solaire et des exoplanètes
Poulet François
(Institut d'Astrophysique Spatiale)

Collisionless shock waves : intrinsic dynamics and particles acceleration processes involved
Philippe Savoini and B. Lembege
(CETP/UVSQ)
Presence of collisonless shocks and formation of associated energetic particles are numerous at quite various sites in space. Throughout the heliosphere, such shocks are associated to solar flares in the low corona, are driven outward by coronal mass ejection (CME), belong to the nearby environment of planetary magnetospheres, and are also detected in the interplanetary medium. In this paper, we will focuse on the internal shock structure itself. In order to have an insight into the shock acceleration mechanisms, both the global characteristics of the shock front (scales et geometry) and its intrinsic dynamic (time evolution) will be presented in conjonction to their impact on the particles. Indeed, it is well-known that collissionless shocks appear to be a very efficient structures to accelerate particles to high energy. In particular, the region in front of the shock (named foreshock) is populated with particles (ions and electrons) having interacted with the shock front and then reflected back with an high energy gain. Both "in-situ" multi-point measurements (mission CLUSTER-II) and numerical simulations allow us to obtain a clearer picture on the shock wave and the processes involved in the energy transfer from and into the surrounding plasma. After a brief presentation of the results obtained for ions, we will present in details the electrons behavior. In particular, current simulations evidence that the fast-Fermi acceleration (magnetic mirror) mechanism, which is commonly accepted, is certainly not the unique process responsible for these energetic backstreaming electrons and other mechanisms must also contribute and will be detailed in this presentation.

The Solar System seen by Gaia : new perspectives for asteroid science

P. Tanga, M. Delbo, F. Mignard
(Observatoire de la Côte d'Azur)

The Gaia astrometric mission of the European Space Agency, to be launched at the end of 2011, will perform a 5-years satellite survey of the whole sky at an unprecedented level of astrometric accuracy. Designed to explore the Galaxy, Gaia will indeed provide observations of small Solar System objects brighter than V$\sim$ 20, including some small planetary satellites, comets, trans-neptunian objects and asteroids. This last category will be, by far, the most populated, since we can expect to receive data for $\sim$ 250.000 objects. The observations of Gaia will provide will not only include astrometric measurements, but also multi-band photometry, thus resulting in the most accurate and homogeneous data set available on both Main Belt Asteroids and Near Earth Objects. In the frame of the Gaia Data Processing and Analysis Consortium, a specific effort is devoted to prepare the Solar System data reduction pipeline that will extract the relevant scientific information from raw observations. Impressive achievements are expected, concerning both the improvement of orbit accuracy and the physical properties of asteroids. While these results, obtained on Gaia data alone, will represent an unprecedented step forward in our knowledge of the Solar System, the science scope could be even larger if an appropriate ground-based observation campaign takes place. In this case, more difficult measurements of small perturbations in the asteroid orbital motion (such as the "Yarkovsky effect", due to the small perturbations in the orbital motion of these bodies thermal infrared emission) will become accessible for some objects. Conversely, future ground-based observations will also take profit from Gaia results and open new perspectives for classic techniques. This is the case, for example, of asteroid occultations of stars, whose predictions will be much more accurate and reliable, permitting systematic determinations of size and shapes for asteroids larger than 10 km. In this sense, Gaia heritage will not only be a revolution for Solar System science, but will also durably impact the other related observation activities.

Last news from CFHT

Veillet, C.
(Canada-France-Hawaii Telescope)

Poster contributions

Radial mixing of stars in simulations of galaxy evolution.

Bellil, Athanassoula, Prantzos
(iap)

Stellar streams observed in the solar neighborhood seem to have an origin outside this region of the Galaxy. Their is no consensus about their exact origin, however it is well established that their Galactic orbits differ from the overall rotational pattern of the Milky Way disk, since they include a substantial radial component (Famaey et al., 08). The possibility of radial mixing has been invoked on theoretical grounds (Sellwood and Binney 2002). Using a Tree-SPH code forming a spiral galaxy in a cosmological context, we try to reveal this radial mixing, understand its origins (spiral waves, Lindblad resonances), and explore its consequences on the chemical properties of the galaxy.

E-science Platform for the Exchange of Atomic and Molecular Data. French Working Group and European Proposal

M.L. Dubernet
(LERMA, Observatoire de Paris)

I will present the first steps towards building an e-science platform for the exchange of Atomic and Molecular Data for application to all fields of astrophysics, atmospheric physics, fusion. This is intended to be useful as well for physicists and chemists, for industry and for teaching. This project is related to the projects of development of standards presented in an other poster. More news about the project will be available from http ://voparis-molecular.obspm.fr

DARK MATTER AND ANTIMATTER IN THE GALAXY BALANCE, AND THERMODYNAMICS OF THE COSMIC RAYS.

Maurice LALOUM (CNRS/IN2P3, Paris LPNHE)
(CNRS / IN2P3 , Paris LPNHE)

Various outstanding paradoxes in the mechanical balance of the Galaxy are highlighted. Their outmost relevance demands a coherent and likely explanation. We propose a unique and synthetic interpretation, including a cosmological theory of the origin of the observed cosmic rays, especially at the highest energies known. It involves MATTER-ANTIMATTER ANNIHILATION in the median plane of the Milky Way, as a source of "DARK MATTER". Accordingly, we discuss the structure and balance of the Galaxy, seen as made of two parallel disks of matter versus antimatter dominance, and opposed by the repulsion of an annihilation gas, settled in the equator disk. The admitted suppression of antimatter in the Universe, after the "big-bang", is questioned. Ultra-relativistic thermodynamics of cosmic rays are still settled. Many stringent tests tend to confirm our theory ; pointedly, the now classical energy behaviour of the incident flux of energetic cosmic rays is easily derived as a power law, quite with expected exponents of -2.5 and -3, possibly (main dependence, including the first knee). Ultra-high energies, further, are easily attainable, with no necessary restriction of the "GZK" kind, for instance. Beyond 10^{20} eV, rather, a new break is still made feasible.

DARK ENERGY IN NEUTRINO OSCILLATIONS AND QUANTUM MECHANICS

Maurice LALOUM (CNRS/IN2P3, Paris LPNHE)
(CNRS / IN2P3 , Paris LPNHE)

We argue that the present classical formalism of neutrino oscillations is just approximate (cf. PDG 2006), thus still requiring various second-order corrections : internal kinetic dispersion from internal mass dispersion ; curing Lorentz invariance violation between different mass eigenstates, in transitions of the kind m1=m2 , through energy shifts $(m2^2 - m1^2)/(2p)$, made salient in phase factors ; so, necessary transfers of quadri-momentum with any medium, even "vacuum" ; so, evidence of ethereal "DARK ENERGY", in vacuum oscillations ; actual violation of some deeply rooted principles of "quantum mechanics" (corpuscular elementarity, orthogonality of eigenstates amplitudes, Wigner's rules of super-selection, Heisenberg's relations of uncertainty) ; strict non-hermiticity of the Hamiltonian operator, involving finite proper lifetimes ; neutrino mass matrices duly of the "CKM" type, as for quarks ; "UBIQUITY" concept and existence of "PROBABILITY WAVES", instead of matter waves, giving serious credibility to the paradoxical lemma of intense radiation from the vicinity of the so-called "black holes" and "pulsars" (thus, possibly faking genuine "white wells"). Spontaneous individual birth of zero-mass neutrinos (not by pair, from Lorentz invariance !), with finite momenta, might explain the paradoxical excess of "dark energy" over "dark mass", overwhelming at cosmological scales.

Revue ASHRA : la haute résolution angulaire dans l'E-ELT

Gérard Rousset
(Université Paris 7 Diderot - LESIA)

This review will give an overview of the R&D activities in the French laboratories for high angular observations with the future European ELT (E-ELT). These developments are made in the framework of the E-ELT project lead by ESO and concern mainly adaptive optics. The subjects are centered around the concept studies of some instruments, like EAGLE and EPICS, or of some facilities like the MCAO and LTAO systems. The issues linked to the cophasing of the primary mirror and the large telescope deformable mirror will also be summarised.

Session PNC

Oral contributions

The Spitzer Infrared Nearby Galaxies Survey : A Review
George J. Bendo
(Imperial College London)
The Spitzer Infrared Nearby Galaxies Survey (SINGS) is a multiwavelength imaging and spectroscopic survey of 75 nearby galaxies that span a broad range of galaxy properties. SINGS data has been used to make considerable progress primarily in studying star formation activity and in characterizing the properties of interstellar gas and dust in nearby galaxies, and the results have been broadly applied in the study of both nearby and high-redshift galaxies. Here, we summarize the results from SINGS and then discuss future surveys of the sample.

Empreinte des modèles de quintessence sur la fonction de masse des halos de matière noire
Jerome Courtin
(LUTH (Observatoire Paris-Meudon))
According to the standard model of cosmology, the universe is mainly composed of Dark Energy 76%. The remaing 24 % is made of matter, mostly Dark 20% and only 4% is baryonic. This matter leads to the formation of cosmic structure in an expanding universe. We study the imprints of the recent Dark Energy expansion on cosmic structrure formation. We use realistic quintessence cosmological models fitted on CMB data as our Dark Energy ingredient to provide the cosmic expansion. We compare the impact of peculiar cosmology evolution and structure growth on the present non-linear observables as the mass function, power spectrum, probability density function and halo profils. We show that they indeed depend on the cosmology under consideration. Contrary to the idea of universality of mass function we claim that dark matter haloes keep some track of the history of cosmic expansion.

Morphological evolution from $z \sim 2$ in the COSMOS field from Ks-band imaging
Huertas-Company, M., Tasca, L., Rouan, D., Kneib, J.P., Le Fèvre O.
(LESIA - Observatoire de Paris)
We present the morphological analysis of ~ 50000 galaxies in the COSMOS field using ground-based Ks (2.12um) band imaging from WIRCam at CFHT. We obtain for the first time the distribution of galaxies in two main morphological types (early and late) as measured from the near-infrared up to z$\sim$ 2. Morphologies are measured in an automated way with GalSVM (http ://www.lesia.obspm.fr/ huertas/galsvm.html). The K band has indeed the advantage to probe old stellar populations better linked to the underlying mass than classical optical studies with HST. We show the evolution of the morphological mixing as a function of photometric redshift and compare with the results obtained in the B rest-frame band with HST/ACS.

The sources of the CIB
G. Lagache
(Institut d'Astrophysique Spatiale)

Dipolar dark matter as an alternative to particule dark matter
Alexandre Le Tiec
(Institut d'Astrophysique de Paris)
While the Lambda-CDM model has proved to be extremely successful in explaining the fluctuations of the CMB and the growth of structures from initial perturbations, it barely explains the basic phenomenology of dark matter at galactic scales. The modified Newtonian dynamics (MOND) has been proposed as an alternative to the dark matter paradigm in order to account for that phenomenology. It postulates a modification of the standard laws of gravity in the absence of dark matter. If MOND serves very well for these purposes, its application to the realm of cosmology is rather limited. By extending the earlier works of L. Blanchet, we shall propose a third alternative in the form of a model of dark matter and dark energy based on the concept of gravitational polarization. This relativistic model will be shown to benefit from both the successes of Lambda-CDM at cosmological scales, and the phenomenology of MOND at galactic scales.

The Sunyaev-Zel'dovich effect : biases introduced in cosmological parameters estimation

N. TABURET, N. AGHANIM, M. DOUSPIS, M. LANGER
(IAS)

The Sunyaev–Zel'dovich (SZ) effect dominates over the primary CMB at multipoles higher than 3000. In the context of the *Planck* survey, we estimate the number of clusters that are expected to be detected through their SZ effect as well as the residual signal that will remain in the *Planck* maps. This residual signal can account for up to 10% of the total CMB signal at $\ell \sim 1000$ and even more at higher multipoles. Using a Fisher matrix approach, we derive the biases on the cosmological parameters estimation when such residuals are not properly taken into account in the analysis of the CMB data. We estimate the biases on the six main cosmological parameters. We show that for $\Omega_{\rm b}$, $n_{\rm s}$ and σ_8 not considering the SZ residuals in the *Planck* data analysis would introduce biases larger than 3 times the expected accuracy.

Molécules primordiales et effondrements gravitationnels

Patrick Vonlanthen Denis Puy
(GRAAL - Université Montpellier 2)

The cosmological gas hosted various chemical reactions and different molecules were created in the so-called dark ages, the main ones being molecular hydrogen and HD. Molecules based on heavier chemical species like C, N, O or F are formed in very negligible amounts in the standard big bang chemistry model. The first purpose of this presentation is to analyze the possibility to form molecules based on heavy elements during the dark age in non-homogeneous scenarios, where small-scale parts of the universe have a high baryon density, while in most part the universe has the normal, small value of the baryon-to-photon ratio.
Once primordial molecules are synthesized, they play a probably determining role in the formation of the first (Population III) stars. In particular, they are believed to be the only agent likely to cool down the primordial clouds undergoing gravitational collapse. We will show here, using a simple 1D collapse model and a large number of chemical reactions, the influence of the molecular cooling function on the temperature of the cloud gas. While the question of fragmentation is still debated, we will show that the temperature evolution strongly depends on the chemical reaction network.

Poster contributions

Observationnal constraints on a Matter-Antimatter Symmetric Milne Universe.

Aurélien Benoit-Lévy
(CEA-SACLAY/IRFU & CNRS/IN2P3/CSNSM)

The standard model of cosmology states a surprising composition of the Universe, in which ordinary matter accounts for just 5 %. The remaining 95% are composed of 70% Dark Energy and 25 % Dark Matter. However, those two components have never been identified and remain a challenging problem to modern cosmology.
One alternative to the concordance model could be the symmetric Milne Universe, composed of matter and antimatter (supposed to have negative mass) in equal quantities. One important consequence is that the expansion factor evolves linearly with time throughout the whole story of the Universe.
I will present the effects of such hypothesis on classical cosmological tests such as primordial nucleosynthesis, CMB, or Type Ia supernovae.

Cosmology and astrophysics with exact inhomogeneous models

Marie-Noëlle Célérier
(LUTH Observatoire de Paris-Meudon)

It is commonly stated that we have entered the era of precision cosmology, in which a number of important observations have reached a degree of precision, and a level of agreement with theory, that is comparable with many earth-based physics experiments. It is widely assumed that the Universe, when viewed on a large enough scale, is homogeneous and can be described by an FLRW model. The successes of the Concordance model are built on using a homogeneous background metric combined with first order perturbation theory. However, as we map out the universe around us — its mass distribution and flow patterns — in ever greater detail, the non-linear behaviour of cosmic structures becomes increasingly apparent, and the methods of inhomogeneous cosmology must come into their own. The homogeneity assumption — so essential in developing the basics of cosmology — must now be considered just a zeroth order approximation, and similarly linear perturbation theory a first order approximation, whose domain of validity is an early, nearly homogeneous universe. Since inhomogeneous solutions of Einstein's field equations provide models of both small and large structures that are fully non-linear, they seem to be best appropriate to properly interpret observations. We will give here a short summary of the current status of inhomogeneous astrophysics and cosmology, from structure formation to the reproduction of cosmological data using exact inhomogeneous solutions of Einstein's General Relativity.

The Nearby Supernova Factory

Y. Copin, on behalf of the Nearby Supernova Factory.
(IPNL - Université Lyon I)

The Nearby Supernova Factory (SNfactory) is an international project to discover and study a large sample of type Ia supernovae in the redshift range $0.03 < z < 0.08$. Follow-up spectro-photometric observations are performed using the dedicated Supernovae Integral-Field Spectrograph (SNIFS), mounted since 2004 on 2.2 m UH telescope. The goal is to acquire for each SN and over its full life-time (more than 10 epochs) high spectro-photometric quality spectra over the extended optical range (320-1000 nm).
I will present the current status of the SNfactory project, from current sample to preliminary Hubble diagram.

Evolution du champ magnétique dans les amas de galaxies

Dubois, Y. & Teyssier, R.
(CEA Saclay)

Dark Energy Forecasts with Optical Clusters Count

Marinoni + VVDS collaboration
(Centre de Physique Theorique)

I will present cosmological constraints obtained by studying the evolution of the velocity function of deep optical clusters from the VVDS and DEEP2 surveys. I will discuss observational strategies and theoretical forecasts for a large area spectroscopic cluster survey.

Molecules in the interstellar medium at high redshift

P. Noterdaeme, P. Petitjean, C. Ledoux and R. Srianand
(Institut d'Astrophysique de Paris)

We present the current status of ongoing searches for molecules in high redshift Damped Lyman alpha systems (DLAs) with the Ultraviolet and Visible Echelle Spectrograph mounted on the Very Large Telescope of the European Southern Observatory. To study the prevalence of H2, we built a sample of 77 DLAs/strong sub-DLAs, with N(HI)>=10^{20} cm^{-2} and z_{abs}>1.8, which have data that include redshifted Lyman- and/or Werner-band absorption lines. This sample of HI, H2, and metal line measurements, performed in an homogeneous manner, is more than twice as large as our previous survey (Ledoux et al. 2003). We detect H2 in 13 of these systems and measure upper limits of N(H2) $\sim$ 2 10^{14} cm^{-2} for the remaining ones. The molecular fractions are found to be in the range f $\sim$ 5 10^{-7} to f $\sim$ 0.1 where f=2N(H2)/(2N(H2)+N(HI)). We found a clear dependence of N(H2) with the column density of iron in dust. The overall detection rate in log N(HI)>=20 DLAs is found to be 10% (considering only log f>-4.5 detections) after correction for a slight bias toward large N(HI). We also present recent high resolution observations of a fourteenth H2-bearing system, selected from automated search and analysis of $\sim$ 10000 low resolution quasar spectra from the Sloan Digital Sky Survey. This system has the largest molecular fraction measured till date in a DLA (f=0.27) and also features carbon monoxide and deuterated hydrogen absorption lines. This is only the second detection of HD while the very first detection of CO in a high-z DLA. From the population in different rotational levels of CO, we are able to measure the temperature of the Cosmic Microwave Background Radiation when the Universe was $\sim$ 20% of its current age with unprecedent accuracy.

Numerical investigation of lens models with substructures using a perturbative approach

S. Peirani
(IAP)

Session PNG

Oral contributions

The Herschel Reference Sample

A. Boselli, S. Eales and the SPIRE extragalactic group
(Laboratoire d'Astrophysique de Marseille)

In order to study the dust properties of different galaxies in the nearby Universe, the SPIRE extragalactic group selected a volume limited (15< D <25 Mpc), complete sample of 323 galaxies spanning the whole range in morphological type (from ellipticals to late-type spirals) and luminosity ($10^9 < L_H < 10^{12}$ $L_{H\odot}$, -22 < M_B < -16) extracted from 2MASS, to be observed in guaranteed time with Herschel. The 250-360-520 μm SPIRE data, combined with those collected at other frequencies, will be used to trace the dust content as a function of Hubble type, luminosity and environment, and to study the physical properties of the interstellar medium in nearby galaxies. Because of its selection, the Herschel Reference Sample (HRS) will provide the community with a unique reference for future nearby and high redshift studies.

The hidden and visible star formation from z=0 to z=1

V. Buat, D. Burgarella, T. Takeuchi, S. Noll, D. Macillac
(Laboratoire d'Astrophysique de Marseille)

I will present an overview of our work in the field of the star formation and dust attenuation mainly based on a bi-variate analysis of both UV(1200-3000) and IR (8-1000 microns) emissions of galaxies from z=0 to z=1 as observed by GALEX and SPITZER (and IRAS for the local universe) The galaxies are found to brighten in UV and in IR from z=0 to z=1. The evolution is stronger in IR than in UV, as a consequence the mean dust attenuation in the universe is found to increase by $\sim$ 1 mag and about 80% of the star formation at z=1 is observed via the dust re-emission. Nevertheless when galaxies are selected either in UV or in IR with a given luminosity, there is some hint for a decrease of their dust attenuation as a function of z, the effect being larger for UV selected galaxies. The next step is to draw the star formation history of these star-forming galaxies selected either in UV or in IR and for which we have a measure of their total star formation rate (SFR). We will compare the properties of our samples in terms of SFR and stellar mass to models predicting the evolution of galaxies : there is no need of strong modifications of the physical properties in galaxies with redshift to explain their average evolution from z=0 to z=0.7. Our observations are also found consistent with the predictions of semi-analytical models.

New deep HI mapping of Messier 31

Laurent Chemin (Observatoire de Paris, GEPI), Claude Carignan (Université de Montréal), Tyler Foster (Brandon University)
(Observatoire de Paris, section Meudon - GEPI)

Results from a new mapping of the neutral hydrogen in Messier 31 is presented. Very deep observations have been obtained with the Dominion Radio Astrophysical Observatory 26-m antenna and Synthesis Telescope. Compared with previous HI studies done in the early 80's, the new dataset reveal a very extended HI distribution and velocity field for M31. Most of the HI spectra exhibit multiple emission lines, sometimes up to five peaks along the line-of-sight, which feature has never been observed in other extragalactic disks, to our knowledge. A filamentary morphology and a perturbed kinematics are revealed at large galactocentric radius. The most accurate HI rotation curve ever obtained and the kinematical parameters of the disk warping are derived by fitting a tilted-ring model to the velocity field. A Fourier analysis of the M31 velocity field is also presented, revealing non-circular motions associated to the HI ring-like structure at 14 kpc. Finally, results from mass distribution models of the rotation curve are presented.

Cosmological simulations of disk galaxies

S. Courty, B. K. Gibson, R. Teyssier
(Centre for Astrophysics/University of Central Lancashire)

The first results from a series of cosmological simulations of disk galaxies will be presented. These simulations are performed with RAMSES, an N-body/hydrodynamical code based on an adaptive mesh refinement (AMR) technique. The general properties of the stellar and gas distributions in those disks will be characterized at different redshifts and issues such as disk heating and infall rate addressed. As part of our exploration of the galaxy formation process, the disks will then be compared to those obtained in various simulations differing in their sub-grid model physics, in particular, the polytropic equation of state used to describe the multiphase interstellar medium.

Kinematics of distant luminous infrared galaxies

H. Flores, F. Hammer, M. Puech & Y. Yang
(GEPI, Observatorie de Paris Meudon)

Last years, it has been demonstrated that galaxy evolution since z $\sim$ 1 and IR emission are strongly linked, through intense and relatively short star-forming episodes occurring in Luminous InfraRed Galaxies. However, it is still unclear which process, between merging and external gas accretion, most naturally explains galaxy evolution, as HST/ACS imaging of such LIRGs has revealed morphologies ranging from regular disks to complex interacting systems. Thanks to 3D spectroscopy, new constraints can now be used for comparison with numerical models. In particular, during the last two years, FLAMES/GIRAFFE at the VLT has been used to shed a new light on the evolution of the fraction of dynamically non-relaxed systems, the Tully-Fisher Relation (TFR) or the angular momentum of distant galaxies. It has been shown that the scatter in the z $\sim$ 0.6 TFR is caused by galaxies with anomalous kinematics, which could represent as much as 40% of intermediate-mass galaxies at z $\sim$ 0.6. For the first time, GIRAFFE allowed us to detect an evolution by 0.66+/-0.14 mag of the K-band TFR zero point between z $\sim$ 0.6 and z=0. This evolution implies that z $\sim$ 0.6 rotating disks must have doubled their stellar masses over the last 6 Gyr to be observed on the TFR at z=0. They are rapidly transforming their gas into stars, in good agreement with former studies of the evolution of the M-Z relation. I will present the role of the LIRGs in the evolution of this quantities and for distant spiral rotating disks I will show some evidence for an inside-out growth, with a gas supply occurring along the disk plane in order to preserve the disk stability and match local disk properties. Spatially resolved kinematics brings new constraints to galaxy models, in addition to integrated properties and high resolution imaging. We will report on on-going work in the modeling of all galaxies in the GIRAFFE sample.

H2 energetics in Galaxy-wide Shocks : Insights on starburst triggering in galaxy collisions

P. Guillard, F. Boulanger, G. Pineau des Forêts, P.N. Appleton, P. Ogle
(Institut d'Astrophysique Spatiale)

How the gas cools and fuels galaxy formation and what processes regulate star formation in galaxies are some major questions of extragalactic astronomy. We focus on galaxy collisions and mergers which are observed to trigger IR-luminous bursts of star formation.

Recently, Spitzer observations show that some interacting systems stand out for having a high H2 to IR luminosity ratio. We propose that these systems represent an intermediate phase in the evolution of mergers, prior to the starburst.

Observations and modeling contribute to define a physical framework of the mechanical energy dissipation in this H2-luminous stage. The H2 excitation show that highly-turbulent (10-50 km/s) molecular gas is formed within hot gas. The cloud turbulence is powered by a slow energy and momentum transfer from the gas bulk motion.

We propose that the timescale to dissipate the collision kinetic energy represents the time necessary for the molecular gas to settle in gravitationally bound clouds and therefore to form stars.

Submillimetre galaxies

Rob Ivison
(Edinburgh)

The discovery of submm galaxies (SMGs) in July/August 1997 radically changed our view of the Universe, which at that time had regained a strange optical bias despite the lessons of IRAS. I will review what has been learnt about SMGs in the decade since their discovery, and refresh my knowledge of what is known about the very first SMG, SMM J02399-0136, SCUBA's first-born, detected in its first deep extragalactic integration behind the Abell 370 cluster.

Analysis of composite absorption lines in galaxy spectra.

Labasque, Boisse
(IAP)

High quality spectra are available for high redshift and closeby galaxies which contain a lot of interstellar absorption lines from UV transitions of heavy-elements (Fe, Ni, ...), and thus carry important information on metal abundances. Up to know, these data have been analysed as if the absorption lines were formed against a single continuum source (as is done for stars or quasars) whereas a galaxy spectrum is in fact a composite of many stellar spectra which probably differ a lot in the strength of the absorptions. We discuss the reliability of such a method and consider a few other more realistic but still simple models that take into account some scatter in the line of sight properties. We analyze how an "average" column density can be derived from measured equivalent widths and discuss observational strategies that help to minimise the uncertainties related to the "composite" nature of the interstellar absorptions detected in galaxy spectra.

The Interplay Between Star Formation and the ISM in Low Metallicity Dwarf Galaxies : What Can we Learn About ISM conditions in the Early Universe ?

Suzanne Madden
(CEA, Saclay)

Low-metallicity dwarf galaxies have often been proposed as primordial building blocks in the hierarchical scenario of structure formation. However several lines of evidence contradict this idea. Nevertheless, because of their low-metallicity, dwarf galaxies are attractive as local laboratories in which to study how star formation might proceed in the early universe. The effects of low metallicity on the ongoing processes in galaxies, while not well understood, can be far reaching in terms of supernova feedback, dust composition and evolution, molecule formation, galaxy morphology and in general, all heating and cooling processes. I review what we know to date about the properties of the ISM in low metallicity galaxies.

Outflows, Bubbles, and the Role of the Radio Jet : Direct Evidence for AGN Feedback at z $\sim$ 2

Nicole Nesvadba
(Observatoire de Paris / GEPI)

To accomodate the seemingly "anti-hierarchical" properties of galaxies near the upper end of the mass function within our hierarchical paradigm, current models of galaxy evolution postulate a phase of vigorous AGN feedback at high redshift, which effectively terminates star-formation by quenching the supply of cold gas. Using the SINFONI IFU on the VLT, we have identified kpc-sized outflows of ionized gas in z $\sim$ 2 radio galaxies, that appear powerful enough to unbind most of the ISM of a massive galaxy within an AGN lifetime. Comparison with the molecular gas content obtained with the IRAM Plateau de Bure interferometer suggest a strong impact on the on-going star-formation. This is to-date the only direct, kinematic evidence for AGN-driven outflows at high redshift. I will present the current status of this on-going study, and discuss why we believe that the observed outflows are indeed the fingerprints of a process which has the potential of quenching the strongest starbursts in the universe.

The evolution of the stellar mass-metallicity relation at z $\sim$ 0.6

Rodrigues
(GEPI - Observatoire de Paris)

We have gathered a representative sample of 96 intermediate mass galaxies (>10Msol) at z=0.6 and have provided robust estimates of their metallicity of their gaseous phases. We definitively confirm that the predominant population of z=0.6 starbursts and luminous IR galaxies (LIRGs) are on average, two times less abundant than the local galaxies at a given stellar mass. We do find that the metal abundance of the gaseous phase of galaxies is evolving linearly with time, from z=1 to z=0 and after comparing with other studies, from z=3 to z=0. Combining our results with the reported evolution of the Tully Fisher relation, we do find that such an evolution requires that about 30% of the stellar mass of local galaxies have been formed through an external supply of gas, thus excluding the close box model. Distant starbursts & LIRGs have properties (metal abundance, star formation efficiency & morphologies) similar to those of local LIRGs. Their underlying physics is likely dominated by gas infall probably through merging or interactions. Our study further supports the rapid evolution of z=0.4?1 galaxies. Gas exchanges between galaxies is likely the main cause of this evolution.

Dust-enshrouded star formation in XMM-LSS galaxy clusters

Sonia Temporin, Pierre-Alain Duc, Olivier Ilbert
(DSM/IRFU/SAp, CEA, Saclay)

Long after their collapse and the formation of the bulk of their stars, clusters of galaxies still accrete new members. Subject to collisions and the effects of the intracluster medium, the infalling galaxies loose their gas and ultimately their ability to form stars. In recent years, IR studies of a few individual galaxy clusters at intermediate redshifts have revealed the presence of several particularly active galaxies with total IR luminosities well above 10^{11} solar luminosities. If powered by dust-enshrouded star formation, as indicated by their spectra, these Luminous Infrared Galaxies would exhibit star formation rates of several tens of solar masses per year - values that were unprecedented in a cluster environment. Motivated by these findings, we have undertaken an investigation of the dust-enshrouded activity in a sample of X-ray selected clusters drawn from the XMM-LSS survey in the redshift range z $\sim$ 0.05 - 1.05. By taking advantage of the contiguous mid-IR coverage of the XMM-LSS field by the Spitzer SWIRE legacy survey, we examined the distribution and number density of mid-IR bright sources out to the cluster periphery and its dependence on redshift to probe the obscured side of the Butcher-Oemler effect. Toward intermediate redshift clusters we identified surprisingly high numbers of bright 24 mum sources, whose photometric redshifts are compatible with cluster membership. The surface density profile of 24 mum sources gives evidence for an excess of bright mid-IR sources in the redshift range $\sim$ 0.4 - 0.5 at cluster-centric radii $\sim$ 400 - 500 kpc. Some traces of excess appear to be present at larger radii as well, toward the infall region.

Poster contributions

VIMOS spectroscopy of the Coma cluster faint dwarf galaxies

Adami C., Durret F., Mazure A., Pello R., Ilbert O., et al.
(LAM)

We present preliminary results of new Vimos spectroscopy of faint Coma cluster dwarf galaxies (R>21). More than 1000 spectra where measured along the line of sight, selected on the basis on photometric redshifts in order to enhance the field/cluster ratio.

Observations of a z = 0.9 cluster of galaxies

Ulmer M.P., Adami C., Durret F., G. Lima Neto, O. Ilbert, G. Covone, E. Cypriano, W. Mahoney, R. Gavazzi, S. Allam, R. Kron
(LAM)

The cluster Cl 1257+4738 was found by comparing a ROSAT image with red ground based images, taken to determine if the red galaxies were young dusty ones or old early type galaxies. This adds another cluster to the handful of clusters with z larger than about 0.9. Each one provides new insights as to the relationship between the evolution of galaxies and the ICM. We acquired Chandra, XMM-Newton, Spitzer IRAC plus MIPS 24 data to study this relationship between galaxies and the ICM. The Chandra plus Spitzer and ground based data gave us the unique opportunity to find candidate galaxies and AGNs that could be at redshifts from 3 up to as high as 10.

On the reliability of Lyman-alpha emission as a cosmological tool.

H. ATEK, D. Kunth, M. Hayes, G. Ostlin, J.M. Mas-Hesse.
(IAP)

The cosmological importance of the Lyman-alpha emission line has long been demonstrated. It is a powerful diagnostic tool of star formation, especially at high-redshift since Lyman-alpha becomes the strongest emission line in the optical-NIR window at z>2.1. It can be used, in principle, to probe star-fomation rates, clustering properties, or to put constraints on the final stage of the reionisation epoch. However the resonant nature of Lya makes the above studies far from being trivial. Dust, ISM kinematics and morphology may regulate the Lya escape. We present here the results of our HST/ACS imaging compaign of six nearby starburst galaxies. The high resolution allows us to map the Lya emission variations at a very smalll spatial scale ($\sim$ 10 pc) and, combined with ground based data, to probe the role of the dust in Lya attenuation. It is found that dust is not always the main regulator factor and ISM morphology and clumpiness may play a more significant role. We found that the diffuse emission accross the galaxy body accounts for the bulk of Lya, and the escape fraction to be very low (always below 12%). Therefore, Cosmological quantities, such as SFRs, based on Lya alone, could be seriously at fault.

Nearby star-forming galaxies as "templates" for the calibration of high-z Lyman-alpha observations.

Hakim ATEK
(IAP)

Modelling galaxy interactions and mergers : the GalMer database

Di Matteo, P., Chilingarian, I., Combes, F., Melchior, A.-L., Semelin, B.
(Observatoire de Paris, GEPI)

The GalMer database (http ://galmer.obspm.fr) is a library of simulations of galaxy interactions and mergers. It contains thousands of realisations of galaxy encounters, taking into account different morphologies for the interacting galaxies, different mass ratios, orbital parameters, etc.. We will present the web access to the database, together with the available services for data analysis, and we will discuss some possible applications.

An optical view of the 4Mpc X-ray filament of Abell 85
F. Durret, G. Boue, C. Adami, G. Mamon, O. Ilbert, V. Cayatte
(IAP)
In the current paradigm of large scale structure formation by hierarchical clustering of matter, an important role is played by megaparsec scale structures, and clusters of galaxies are believed to form at the intersection of large scale structure filaments. An X-ray filament at least 4 Mpc long was discovered in Abell 85 and was interpreted as made of groups falling on to the main cluster. We present here new optical data confirming that the filament consists of a gravitationally bound overdensity of galaxies, with a possible excess of star forming galaxies. These data agree with the previous interpretation proposed for the filament.

The disturbed X-ray cluster Abell 3376 and its giant ring-like radio structures
Joydeep Bagchi, Florence Durret, Gastao B. Lima Neto and Surajit Paul
(IAP)
Abell 3376 is one of the very few clusters of galaxies known to be partly surrounded by giant (about 2x1.6 Mpc), ring-shaped non-thermal radio emitting structures. In the current paradigm of large scale structure formation by hierarchical clustering of matter, an important role is played by megaparsec scale cosmic shock waves, arising either in major mergers of galaxy clusters or in gravity-driven supersonic flows of intergalactic matter onto dark matter dominated collapsing structures such as pancakes, filaments and clusters of galaxies. The structures that we have detected at radio wavelengths may be tracing such shock waves. The temperature and metallicity maps obtained from XMM-Newton archive data show that the X-ray gas has a very perturbed structure, revealing that it has undergone several major mergers, which we will attempt to characterize.

Mouvements propres pour z=24 dans les champs du CFHT-LS Deep : naines blanches et naines brunes distantes
Bertrand Goldman, Stéphane Cuynet, Céline Reylé, Annie Robin, Mathias Schultheis
(MPIA/observatoire de Besançon)

Integral-field spectroscopy of high-redshift galaxies : Physics of galaxy formation
M. D. Lehnert
(GEPI - Observatoire de Paris)

(Nearly) quiescent disk rotation at z $\sim$ 3 on sub-kpc scales : A Lyman Break Galaxy under the Cosmic Microscope
Nicole Nesvadba
(Observatoire de Paris / GEPI)
Strongly lensed Lyman-break galaxies provide a unique window for studying the internal properties of what may be the most important population of z $\sim$ 3 galaxies – on size scales similar to those reached in the local universe. We used the near-infrared integral-field spectrograph SINFONI on the VLT to unravel the internal dynamics of the z=3.24 LBG "arc&core", finding spatially-resolved kinematics on scales from $\sim$ 200 pc to several kpc in the source plane. Our results suggest that much of the baryonic mass of low-z L* spiral bulges was already in place by z $\sim$ 3, in agreement with population synthesis "archaeology", although much of this mass was likely still in the gaseous component.

Bayesian analysis of galaxy SEDs from FUV to FIR
Stefan Noll, Denis Burgarella, Delphine Marcillac, Elodie Giovannoli, Veronique Buat
(OAMP/LAM)
Photometric data of galaxies covering the rest-frame wavelength range from far-UV to far-IR make it possible to derive galaxy properties with a high reliability by fitting the attenuated stellar emission and the related dust emission at the same time. For this purpose we have written a code which uses model spectra composed of the Maraston stellar population models, synthetic attenuation functions based on a modified Calzetti law, spectral line templates, and the Dale & Helou dust emission models. Depending on the
input redshifts filter fluxes are computed for the model set and compared to the galaxy photometry by carrying out a Bayesian analysis. The quality of the code is tested by analysing a subset of the SINGS sample of nearby galaxies. We illustrate the quality of the results by comparing them to literature data. Finally, we discuss the importance of IR data for the reliability of the fitting results.

Mass assembly and chemical evolution of galaxies along cosmic time with the MASSIV survey.
J. Queyrel, T. Contini, B. Epinat, B. Garilli et al.
(LATT)
Nowadays, powerful telescopes allow one to have deep insight into formation and evolution of galaxies since very early epochs. Thanks to these new instruments it is possible to acquire a very good knowledge of the dynamical, physical and chemical properties of high redshift galaxies, putting strong constraints on galalxy evolution models. Here we present first results of the MASSIV (Mass Assembly Survey with SINFONI in VVDS) project, an ESO-VLT Large Program with the 3D NIR spectrograph SINFONI, aimed at observing a representative sample of about 100 star-forming galaxies in the redshift range z $\sim$ 1 - 2, picked-up from the VVDS (VIMOS VLT Deep Survey). The measurement of nebular emission-lines (Ha, [OIII], etc) in the datacubes gives access to dynamical and chemical properties of galaxies through velocity and emission-line ratios maps. This allows to follow the evolution with cosmic time of the fraction of rotating disks, spheroids and mergers as well as of fundamental scaling relations such as the Tully-Fisher and Mass-Metalicity relations.

High resolution imaging of cooling filaments around NGC 1275
P. Salome et al.
(IRAM)
Giant elliptical galaxies that lie in cooling flow cluster cores are gas rich. We made the first maps of molecular gas emission in these objects and showed evidence for AGN/ICM interaction as well as the existence of very long and massive cold gas filaments. To observe in the millimeter is necessary to understand the cooling and heating balance aroung central cluster galaxies. AGN feedback may control the hot gas cooling and thus regulate the gas acretion rate onto galaxies. These results open new perspectives to probe galaxy formation scenarios at low redshift with the next generation of mm-submm facilities ALMA amd Herschel. I will focus here on our latest results showing the detailed imaging of cold gas filaments around NGC 1275 that are consistent with our predictions of AGN feedback models.

HYPERLEDA : les perspectives de l'Antarctique
Isabelle Vauglin, Philippe Prugniel
(CRAL-Observatoire de Lyon)

Session PNPS

Oral contributions

DIGIT, GASPS, DEBRIS and DUNES : four HERSCHEL Open Time Key Programs to survey the dust cycle in circumstellar disks

J.-C. Augereau, O. Absil, J. Bouvier, G. Duchêne, J.-F. Lestrade, S. Maret, C. Martin-Zaidi, F. Ménard, A. Morbidelli, J. Olofsson, E. Pantin, C. Pinte, P. Thébault
(LAOG, Observatoire de Grenoble)

Four accepted HERSCHEL open time key programs, DIGIT, GASPS, DEBRIS and DUNES, will study the evolution of the dust grains in circumstellar disks around young and Main Sequence stars. There is a strong implication of the french community in these four projects which represent a total of 930 hours (>38 days) of HERSCHEL observing time. The DIGIT and GASPS projects will focus on the first stages of planet formation, while the DEBRIS and DUNES projects will search for extra-solar Kuiper Belt analogs around nearby Main Sequence stars. During this talk, we will give an overview of the scientific goals of the four projects and will review the numerical tools that we will be providing to the teams to model and interpret the HERSCHEL observations from these programs.

The circumbinary dusty disk of upsilon Sgr revealed by mid-IR interferometric observations with the VLTI/MIDI

D. Bonneau, M. Netolicky, O. Chesneau, P. Harmanec, P. Koubsky, D. Mourard, and P. Stee
(OCA-Fizeau)

The first mid-IR interferometric observations of hydrogen-deficient binary star ups Sgr were carried out using the MIDI/VLTI instrument between April and August 2007. These observations revealed that the dusty circumbinary envelope is resolved around the N band. The calibrated fringe visibilities, the mid-IR spectrum and the SED were fitted using models computed with the MC3D 2D code using several mixtures of carbon and silicate dust, in order to determine the geometry and chemical composition of the envelope. The best model we obtain is a geometrically thin and dense disk with an inner radius of Rin = 3 +/- 1 AU and a scale height h0 = 4 +/- 2 AU. The inclination of the disk, i = 40 ° +/- 15 ° and its position angle, PA = 75 ° +/- 15 °. The chemical composition of the dust is found to be 60% of carbon dust and 40% of silicate dust. For the first time, we have found constraints on the geometry and the chemistry of the circumbinary dusty envelope of ups Sgr, which seem compatible with the evolutionary scenario proposed by Delgado & Thomas (1981). However, complementary spectro-interferometric observations in the near infrared and the visible are mandatory to investigate the complex structure of the inner circumstellar environment and directly resolve the binary in the ups Sgr system.

The young low mass TWA22 AB system : a new calibrator for evolutionary tracks ?

M. Bonnefoy[1] , G. Chauvin[1] , C. Dumas[2] , A.-M. Lagrange[1] , H. Beust[1], F. Allard[3] , J.-L. Beuzit[1] and I. Song[4] ; 1) Laboratoire d'Astrophysique de Grenoble, BP 53, F-38041 GRENOBLE Cédex 9, France email : mbonnefo@obs.ujf-grenoble.fr ; 2) ESO, Alonso de Cordova 3107, Vitacura, Casilla 19001, Santiago 19, Chile ; email : cdumas@eso.org ; 3) CRAL-ENS, 46, Allée d'Italie , 69364 Lyon Cedex 07 email : fallard@ens-lyon.fr ; 4) Science Center/Caltech, M/S 220-6, 1200 E. California Blvd., Pasadena, CA 91125 email : song@ipac.caltech.edu
(Laboratoire d'Astrophysique de Grenoble)

Tight binaries discovered in young, nearby associations, with known distances, are ideal targets to provide dynamical mass measurements. Combined with independent estimations of temperature, gravity and luminosity, direct mass measurement provides a precious benchmark for evolutionary models that remain hardly calibrated at young ages for masses lower than 0.5 solar masses. The recent development of instruments equipped with adaptive optic (AO) offers a way to achieve a full characterization of these systems.

In our program for detection of faint companions around young stars, the VLT/NACO AO-assisted imager resolved TWA22 in a tight binary ($\sim$ 100 mas). This system was identified as a member (Song et al. 2003) of the TW Hydrae association (age $\sim$ 8 Myr). Follow-up observations enable us to monitor 80% of the binary orbit. The recent measurement of the trigonometric distance lead us to the final determination of the orbital properties and a total dynamical mass (M=220 $\pm$ 21 M_{Jup}) of TWA22 AB. Additional observations with the VLT/SINFONI AO-assisted integral field spectrometer were used to obtain independent medium resolution spectra (R=1500-2000) of the primary and of the companion over the spectral range 1.0-2.5 μm. Spectral indexes, equivalent widths and least squares were employed in comparing our spectra to empirical spectral libraries of field and young dwarfs. We derive a M6V $\pm$ 1 spectral type for both components. Spectral templates of the GAIA COND v2.6 library were used to estimate the temperature and the gravity of TWA22 A and B.

To conclude, I will discuss the inconsistency found between our observations and the model predictions at the age of the young (age $\sim$ 8 Myr) TW Hydrae association. This leads us to either question the age and the association membership of TWA22 AB or to the conclusion that current evolutionary model predictions could underestimate masses of young, very low mass stars close to the substellar boundary.

Thermohaline mixing and fossil magnetic fields in red giant stars

C.Charbonnel & J.P. Zahn
(CNRS & Observatoire de Geneve)

Thermohaline mixing has been recently identified as the dominating process that governs the photospheric composition of low-mass bright red giant stars (Charbonnel & Zahn 2007a). Thermohaline convection indeed simultaneously accounts for the observed behaviour of the carbon isotopic ratio and of the abundances of Li, C and N in the upper part of the red giant branch. It also significantly reduces the 3He production with respect to canonical evolution models as required by measurements of 3He/H in galactic HII regions. However this process may be inhibited by a fossil magnetic field in a large fraction of the descendants of Ap stars (Charbonnel & Zahn 2007b). This reconciles the measurements of 3He/H in Galactic HII regions with high values of 3He in a couple of Planetary Nebulae.

High-resolution thermal infrared imaging of MWC300 with VLT/VISIR

Domiciano de Souza, Kervella, Bendjoya, Niccolini
(Université de Nice - OCA - CNRS - UMR 6525 Lab. H. Fizeau)

B[e] stars are expected to possess dusty circumstellar environments, which are responsible for a strong infrared (IR) excess. Using single-dish diffraction-limited imaging in the thermal infrared domain, we aim at measuring the angular extension of the dusty environment of the galactic B[e] MWC300. We obtained diffraction-limited images of MWC300 at 11.25 microns using the BURST mode of the VLT/VISIR instrument. MWC300 is partially, but statistically significantly, resolved by VISIR so that we could measure the size of its dusty envelope for the first time. By assuming a 2D circular Gaussian intensity distribution and using different image analysis methods we measured a FWHM angular size of 69 ± 10 mas. For a distance of 1.8 kpc, we obtain a linear size of $125 \pm 18 AU = (1.87 \pm 0.26) \times 10^{13}$ m for the circumstellar dust emitting in the mid-IR. This measured size is shown to agree with a model that was calculated with our radiative radiative transfer code and constrained by previously reported SED data. Additionally, the flux of MWC300 at 11.25 microns is estimated as 84.5 ± 1.4 Jy $= (20.0 \pm 0.3) \times 10^{-13}$ W/m^2/μm. The VLT/VISIR now offers the possibility of obtaining mid-IR diffraction-limited images with a high signal-to-noise ratio. The MWC300's size as directly measured in this work is compatible with the theoretical size of a nearly edge-on dusty disc estimated in previous works.

Impact of Large-Scale Magnetic Fields on Stellar Structure and Evolution

Duez V., Mathis S., Brun A.S. & Turck-Chièze S.
(CEA Saclay - AIM)

The influence of large-scale magnetic fields on stellar structure and stellar evolution is semi-analytically considered. The classical set of stellar evolution equations is modified owing to the presence of a magnetic field. The field is derived for a given axisymmetric azimuthal current using a Grad-Shafranov approach, and is non force-free, acting thus directly on the stellar structure by modifying the hydrostatic balance. We discuss the relative importance of the various terms associated with the magnetic field in the mechanical and thermal balances before implementing its effects in a 1D stellar evolution code in a way that preserves its geometrical properties. Our purpose is illustrated by two cases : (i) the case of a 7 MG strength field burried below the tachocline in a solar-like star, and (ii) the case of an inner field matching at the stars surface with an external potential and multipolar magnetic field.

The weak magnetic field of the O9.7 supergiant Zeta Orionis

C. Escolano, J.C. Bouret, J.F. Donati, F. Martins, W. Marcolino, T. Lanz and I. Howarth
(Laboratoire d'Astrophysique de Marseille)

We report the detection of a weak magnetic field of 50-100 G on the O9.7 supergiant Zeta Ori, using spectropolarimetric observations obtained with NARVAL at the 2m Telescope Bernard Lyot atop Pic du Midi (France). Zeta Ori is the third O star known to host a magnetic field (along with Theta1 Ori C and HD191612), and the first detection on a "normal" rapidly-rotating O star. The magnetic field of Zeta Ori is the weakest magnetic field ever detected on a massive star. The measured field is lower than the thermal equipartition limit (about 100 G). By fitting NLTE model atmospheres to our spectra, we determined that Zeta Ori is a 40 stellar masses star with a radius of 25 solar radii ; and an age of about 5-6 Myr, showing no surface nitrogen enhancement and losing mass at a rate of about 2 10^{-6} solar mass/yr.

The magnetic topology of Zeta Ori is apparently more complex than a dipole and involves two main magnetic polarities located on both sides of the northern hemisphere ; our data also suggest that Zeta Ori rotates in about 7.0 days and is about 40 degrees away from pole-on to an Earth-based observer. Despite its weakness, the detected magnetic field significantly affects the wind structure ; the corresponding Alfven radius is however very close to the surface, thus generating a different rotational modulation in wind lines than that reported on the two other known magnetic O stars.

The rapid rotation of zeta Ori with respect to Theta1 Ori C appears as a surprise, both stars having similar unsigned magnetic fluxes (once rescaled to the same radius) ; it may suggest that the sub-equipartition field detected on Zeta Ori is not a fossil remnant (as opposed to that of Theta1 Ori C and HD191612), but the result of an exotic dynamo action produced through MHD instabilities.

Direct Numerical Simulations of the kappa-mechanism

T. Gastine B. Dintrans
(LATT)

We present a purely-radiative hydrodynamical model of the kappa-mechanism that sustains radial oscillations in Cepheid variables.

We determine the physical conditions favourable for the kappa-mechanism to occur inside a layer, with a configurable conductivity-hollow. We complete nonlinear direct numerical simulations (DNS) that initiate from these most favourable conditions.

We compare the results of a linear-stability analysis, applied to radial modes using a spectral solver, and a DNS, which is developed from a high-order finite difference code.

We find that by changing the location and shape of the hollow, we can generate well-defined instability strips. For a given position in the layer, the amplitude and width of the hollow appear to be key parameters to vary to attain unstable modes driven by the kappa-mechanism. The DNS, starting from the favourable conditions, confirm both the growth rates and the structures of linearly-unstable modes. Nonlinear saturation is produced by intricate couplings between excited fundamental mode and higher damped overtones.

These couplings are addressed by projecting the DNS fields onto an acoustic subspace built from regular and adjoint eigenvectors.

First results on the Be stars observed with the CoRoT satellite.
J. Gutierrez-Soto and the CoRoT Be team
(Observatoire de Paris-Meudon)
In this talk I will present an overview of the analysis of all the Be stars observed with the COROT satellite. Be stars are very fast-rotating B-type stars which may pulsate as beta Cephei or SPB stars. COROT has already observed 5 bright Be stars in the seismology fields and several tens fainter ones in the exoplanet fields with an unprecedented quality and from 20 to 150 days. Multiple frequencies are detected in the majority of the stars. Pulsations, outbursts, beating phenomenon, possible transient modes, rotation, amplitude variability, etc. have been found in their light curves. In order to complement this study, ground-based spectroscopic data have been analysed for the stars located in the seismology fields.

Turbulent resistivity and dynamos in accretion discs.
G. Lesur, G. I. Ogilvie, P-Y. Longaretti
(DAMTP, University of Cambridge)
The magnetorotational instability (MRI) is a well known way to enhance angular momentum transport in accretion discs. However, MHD turbulence in discs may also lead to other physical effects, such as turbulent resistivity and dynamo processes.
I will present new numerical and analytical results aiming to quantify these effects. In particular, I will show that magnetorotational turbulence can lead to a significative turbulent resistivity. I will also present a non-linear dynamo cycle associated to the MRI, generating large scale magnetic fields during several orbits.

Molecular hydrogen in the disk of the Herbig star HD97048
Martin-Zaidi C., Lagage P-O., Pantin E.
(LAOG)
We present high-resolution spectroscopic mid-infrared observations of the circumstellar disk around the Herbig Ae star HD 97048 with the VLT Imager and Spectrometer for the mid-InfraRed (VISIR). We detect the S(1) pure rotational line of molecular hydrogen (H2) at 17.035 microns arising from the disk around the star. This detection reinforces the claim that HD 97048 is a young object surrounded by a flared disk at an early stage of evolution. The emitting warm gas is located within the inner 35 AU of the disk. The line-to-continuum flux ratio is much higher than expected from models of disks at local thermodynamic equilibrium. We investigate the possible physical conditions, such as a gas-to-dust mass ratio higher than 100 and different excitation mechanisms of molecular hydrogen (e.g., X-ray heating, shocks), that would explain the detection. We tentatively estimate the mass of warm gas to be in the range from 10 to nearly 1 MJup. We do not detect the S(2) and S(4) H2 lines, and then derive upper limits on the on the integrated line fluxes which allow us to estimate an upper limit on the gas excitation temperature.

Probing the role of protostellar feedback in clustered star formation.
Maury, A. André, P.
(CEA - SAp)
We present the last results on the NGC2264-C proto-cluster. Based on a comparison between millimetric observations and SPH simulations, Peretto et al. (2007) showed that, in addition to turbulence, another source of support should be added to the simulations to explain the global stability of the region. New spectroscopic data have been taken using the 30-m telescope of IRAM. Analysis of these data shows evidence of eleven outflows emerging from various proto-stellar sources. From a quantitative study we lead, we deduce the global momentum injected in this region. We discuss the relative support induced by these flows with regard to the stability of the proto-cluster.

Brown dwarfs and planetary mass objects in young stellar clusters

Moraux, Burgess, Bouvier
(LAOG)

The discovery of hundreds of exoplanets and isolated brown dwarfs have led to new theories of star and planet formation. Models are now able to predict the shape of the initial mass function (IMF). It is expected to be lognormal at low masses, with a peak around a fraction of solar mass and a lower limit around 3-8 Jupiter masses. Another important prediction is that the substellar part of the IMF is expected to vary in different environments, while the higher mass power-law part should be invariant to local conditions.
In this contribution, I will briefly review the results that we obtained from a CFH12K and MEGACAM large program (02B-04B). We detected brown dwarfs down to 30 MJup in a variety of star forming regions and young open clusters with an age ranging between 30 and 600 Myr. This allowed us to reliably derive the IMF from 30 MJup to the most massive stars in these regions, and thus to address the issues of the IMF's shape and peak mass.
The new observational frontier is the detection of very low mass brown dwarfs (BD) and isolated planetary mass objects (IPMO), down to a few Jupiter masses, the predicted lower limit of the IMF. Only deep near-infrared surveys can reveal these ultra-low mass objects. I will present a WIRCam large program (06A-08B) that we are now conducting at CFHT to detect BD and IPMO with masses between 1 and 30 MJup in a sample of 6 young clusters. I shall present new results that we obtained in Rho-Ophiucus and IC348. Four faint T-dwarf candidates have been detected from narrowband methane observations and might be very young isolated Jupiter mass objects.

Coagulation and crystallization of silicates in protoplanetary disks : a c2d Spitzer/IRS survey

Olofsson, J., Augereau, J.-C., & Spitzer c2d/IRS team
(LAOG)

Silicates are observed in every places where dust can survive : in the interstellar medium (ISM), in the Earth mantle, in comets and it is now common knowledge that there are also present in circumstellar disks around young stars. The ISM sub-micron sized silicates are highly amorphous (>99%), while the silicate Mg-rich crystallinity fraction can reach 40% in comets like Hale-Bopp in the Solar System. The silicates have to be exposed to high temperatures to crystallize, and their presence in long-period comets suggests that dust has been heavily processed and transported in the disk. Statistical studies of planet forming disks are keys on understanding if these processes are generic and can occur in other protoplanetary systems.
As part of the Cores to Disks (c2d) Legacy Program, we obtained more than a hundred of Spitzer/IRS spectra of T Tauri stars, in the spectral range 5-35 μm, where many crystalline features are present. We will show that most of these objects ($\sim$ 70%) show silicate emission features, either attributed to amorphous or crystalline grains. Studying the 10 μm feature, we find that grain growth has occured and the quasi-systematic presence of micron-sized grains in the disks upper layers indicate ongoing turbulent vertical mixing. We will also show that crystalline dust grains are present in the outer/deeper cold regions of the disk, with typical temperatures of about 100K, which suggests efficient radial transport mechanisms. Overall, our study shows that vertical and radial transport seem to be generic dynamical processes in disks, that challenge theoretical disk evolution and planet formation models.

Dynamo processes in Sun-like stars : exploring the mass-rotation plane

P. Petit, B. Dintrans (OMP), M. Auriere (OMP), C. Catala (LESIA), J.-F. Donati (OMP), R. Fares (OMP), T. Gastine (OMP), F. Lignières (OMP), J. Morin (OMP), F. Paletou (OMP), J. Ramirez (LESIA), S.K. Solanki (MPS), S. Theado (OMP)
(OMP)

Sun-like stars are able to continuously generate a large-scale magnetic field through the action of a dynamo. Various physical parameters of the star are able to affect the dynamo output, in particular the rotation and mass. Using new generation stellar spectropolarimeters (ESPaDOnS@CFHT, NARVAL@TBL), it is now possible to measure the large-scale magnetic field of solar analogues (i.e. stars very close to the Sun in the mass-rotation plane, including strict solar twins). From spectropolarimetric time-series, tomographic inversion enables one to reconstruct the field geometry and its progressive distortion under the effect of surface differential rotation. I will detail the first results obtained on a sample of main-sequence dwarfs, probing masses between 0.7 and 1.4 solar mass and rotation rates between 1 and 3 solar rotation rate.

Multiwavelength modeling of circumstellar disks

Christophe Pinte, Francois Menard, Gaspard Duchene, Jean-Charles Augereau
(University of Exeter)

The on-going revolution due to high angular resolution observations and increasing wavelength coverage promises to unlock tightly-kept secrets of circumstellar disks. Thanks to these advances, many issues have already been addressed : putting constraints on large scale geometry of disks, fi nding evidences of grain growth and annealing, of dust settling, exploring dust properties evolution as a function of radius. Most of these resul ts are based on models that emphasis on fitting either SEDs or scattered light images or, more recently, interferometric visibilities. In this contribution, we will present a more global approach which aims at interpreting consistently the increasing amount of observational data i n the framework of a single model, in order to get a more global picture and to better characterize both the dust population and the disk properti es. Results of such a modeling applied to a few disks (IRAS 04158, IM Lup) for which large observational data-sets are available (scattered light images, polarisation maps, IR spectroscopy, X-ray spectrum) will be presented. Combining all these observations allows to draw strong constraints on model parameters and to derive the first direct (ie using N_H rather than N_{CO}) measurement of the gas-to-dust ratio in a protoplanetary disk and new evidences of dust settling.

Oscillations of rapidly rotating stars

Daniel R. Reese, Keith B. MacGregor, Stephen Jackson, Andrew Skumanich, Travis S. Metcalfe
(University of Sheffield)

In this talk, I will show numerical calculations of pulsation modes in rapidly differentially rotating stellar models based on the self-consistent field (SCF) method (e.g. MacGregor et al., 2007). The pulsation calculations are based on the numerical method presented in Lignieres et al. (2006) and Reese et al. (2006). I will compare these results with previous calculations based on simpler polytropic models, and discuss how the structure of the frequency spectrum is affected by differential rotation and other stellar parameters. In particular, differential rotation can lead to a breakdown of regularities in the frequency spectrum in favour of a more chaotic behaviour.

Probing Herbig Ae/Be stars with AMBER : latest results

E. TATULLI & the AMBER consortium
(LAOG)

In this presentation, I adress the recent results obtained with AMBER on spectro-interferometric the observations of Herbig Ae/Be. I emphasize the unique hability of AMBER to probe the hot circumstellar gas, together with the dust emission.

Poster contributions

Convective mixing and dust clouds in brown dwarf's atmospheres

Allard, F, Freytag, B., Ludwig, H.-G., Homeier, D., Steffen, M.
(Centre de Recherche Astrophysique de Lyon)

The temperatures in the atmospheres of brown dwarfs are so low that molecules can condensate and form "dust". These dust grains should sink under the influence of gravity into deeper layers and vanish from the atmosphere clearing it from condensible material. However, observed spectra can only be reproduced by models assuming dust formation and its resulting greenhouse effect in the visible layers. The question is : what prevents the grains from falling down ? Or : how is fresh condensible material mixed up into the atmosphere to allow new grains to form ?

We present 2D radiation-hydrodynamics simulations with CO5BOLD of the upper part of the convection zone and the atmosphere containing the dust cloud layers. The calculations cover a temperature sequence of stars with different dust formation regimes (M, L and T spectral types). We investigate the mixing mechanisms acting in different heights in the atmospheres.

Theoretical amplitudes of asymptotic solar gravity modes and prospect for other stars

K. Belkacem
(LESIA Observatoire de Paris)

Solar gravity modes are mainly trapped inside the radiative region and are then able to provide information on the properties of the central part of the Sun. However, they are evanescent in the outer convective region, so near the photosphere, where seismic measurements are possible, their amplitudes are expected to be very low ; their detection is thus quite challenging and has been attempting for more than 30 years.

Since the mode surface velocity results in a balance between the efficiency of the excitation and the damping rates. We investigate the stochastic excitation of gravity modes by turbulent convection as well as their damping rates. We explore the low frequency domain ($\nu \in [20; 120] \mu$Hz), which as we will explain, is more favorable to a reliable theoretical estimation of the gravity-mode amplitudes.

We find that the maximum velocity is obtained for the $\ell = 1$ mode with a value of several millimeters that is order of magnitudes higher than previous works. From those results, the delectability threshold of those modes will be discussed.

Finally, using the same formalism, we will give some prospect on the excitation of solar-like oscillations in superficial convective layers as well as convective cores of other stars more massive than the Sun. This is an important issue in the COROT framework since the detection of solar-like oscillations will provide strong seismic constraints and give access to the dynamical properties of the convective layers.

Metal-rich T-dwarfs in the Hyades cluster

J. Bouvier, E. Moraux
(LAOG)

We present the results of a search for brown dwarfs (BDs) and very low mass (VLM) stars in the 625 Myr-old, metal-rich ([Fe/H]=0.14) Hyades cluster. We performed a deep (I=23, z=22.5) photometric survey over 16 deg2 around the cluster center. We report the discovery of the first 2 BDs in the Hyades cluster, with a spectral type T1 and T2, respectively. Their optical and near-IR photometry as well as their proper motion are consistent with them being cluster members. According to models, their mass is 50 Jupiter masses at an age of 625 Myr. We also report the discovery of 3 new very low mass stellar members of the cluster and confirm the membership of 16 others. We find the Hyades mass function to be strongly deficient in very low mass and substellar objects compared to the IMF of younger open clusters. We interpret this deficiency as the result of dynamical evolution over the past few 100 Myr.

Supersonic-jet experiments using a high-energy laser : numerical simulations and experimental results

C. Cavet[1], B. Loupias[2], E. Falize[3,1], H. C. Nguyen[1,4], C. Michaut[1], M. Koenig[2], C. D. Gregory[2], S. Bouquet[3,1], N. Ozaki[2,5], A. Benuzzi-Mounaix[2], T. Vinci[3] ; 1. LUTH, Observatoire de Paris, CNRS, Université Paris-Diderot ; place Jules Janssen, 92190 Meudon, France 2. LULI, Ecole Polytechnique, CNRS, CEA, UPMC, Route de Saclay, 91128 Palaiseau, France 3. CEA/DIF/DPTA BP 12, 91680 Bruyeres-le-Chatel, France 4. Laboratoire de Mathématiques, Université Paris-Sud, Orsay, France 5. Graduate School of Engineering, Osaka University, Suita, Osaka 565-0871, Japan

(LUTH, Observatoire de Paris, CNRS, Université Paris-Diderot)

In order to understand some physical aspects of young star jets and radiative shocks, we developed a hydrodynamic code (HYDRO-MUSCL) taking into account radiative losses. In the goal to validate theoretical assumptions and numerical simulations, we use the laboratory astrophysics approach. Here, we present new results of laboratory jet experiments performed in 2008 with the LULI2000 laser facility. High power lasers allow to produce high-speed plasma jets (150 km/s) and to study their propagation in a medium. Laboratory jets give informations about the jet morphology, its head shape (bow-shock), and its fluid parameters (radial and transverse velocity, radius evolution, temperature and electronic density). In previous experiments obtained in 2007 [1, 2], we demonstrated the importance of implementing several diagnostics to measure the required parameters in order to infer the relevant dimensionless scaling parameters. Hitherto we used only visible diagnostics to measure plasma density. And now a new diagnostic based on proton beam has been introduced in the experimental setup allowing to measure plasma with higher density. Furthermore we have been studied a new physical aspect in order to reproduce the jet bow-shock : the interaction between the plasma jet and an ambient medium. Finally we can define the similarity between astrophysical situation and laboratory one by the scaling laws defined between this two scales [3, 4]. The similarity is fulfilled when characteristic dimensionless parameters are conserved to assure that these two phenomena occur in the same physical regime.

[1] Loupias, B. and al., 2007, Astrophys. Space. Sci., 307, 103 [2] Loupias, B. and al., 2007, Phys. Rev. Lett., 99, 265001 [3] Ryutov, D.D., Drake, R.P., et al., 1999, Astrophys. J. 518, 821 [4] Falize, E. Bouquet, S. and Michaut, C., 2008, "Radiation Hydrodynamics Scaling Laws in High Energy Density Physics and Laboratory Astrophysics", ArXiv 0805.3052v1

Theoretical and numerical studies of Vishniac instability in supernova remnants

C. Cavet(1), H. C. Nguyen(1,2), C. Michaut(1), E. Falize(3,1), S. Bouquet(3,1) ; (1) LUTH, Observatoire de Paris, CNRS, Université Paris-Diderot ; place Jules Janssen, 92190 Meudon, France ; (2) Laboratoire de Mathématiques, Université Paris-Sud, Orsay, France ; (3) CEA/DIF/DPTA BP 12, 91680 Bruyeres-le-Chatel, France

(LUTH, Observatoire de Paris, CNRS, Université Paris-Diderot)

In this work, the Vishniac instability is first of all theoretically studied in supernova remnants. This instability is sometimes invoked to explain fragmentation of interstellar medium, but its role is not correctly demonstrated. Conditions and assumptions required for the instability growth are detailed and explained. In addition, an experimental feasibility of the Vishniac instability combined with a radiative shock experiment is examined with the high-power laser facility, i.e., LIL (Bordeaux, France). Another part of this study is also to simulate this instability, because we would compare its numerical growth rate with analytical theory which we derived as an extension of the initial approach by Vishniac. To lead this numerical work we have developed an hydrodynamic code (called HYDRO-MUSCL) and we will show new results.

The first moments of Novae explosions observed with the VLTI

Olivier Chesneau

(UMR 6525 H. Fizeau, Univ. Nice Sophia Antipolis, CNRS, Observatoire de la Côte d'Azur)

Over its recent history, optical long baseline interferometry has been slowly expanding the range of targets observable. The VLTI represents a breakthrough in terms of sensitivity and wavelength coverage and offers the opportunity to investigate the temporal evolution of transient events like novae. The early phases of a nova outburst can potentially be studied by the VLTI in J, H, K, with a spectral resolution of typically R=1500 (i.e. 200 km/s) with the AMBER, provided that the nova is close enough (<3-5kpc). The first application of these observations is a direct distance estimate taking into, at least in a first order account, the geometry of the event. This allows us also to spatially and spectrally resolve the numerous emission lines seen during the very first phases of a nova. If it happens that the nova belong to the group of novae forming dust (1/3 of all novae), AMBER observations can be switched to MIDI ones as proved to be very successful in the case of V1280 Sco. In this case, the dust formation event can be monitored spatially and spectroscopically, giving valuable insight on the poorly known processes leading to dust nucleation in this harsh environment.

The role of massive stars in globular clusters
T. Decressin, H. Baumgardt, P. Kroupa, C. Charbonnel, G. Meynet
(Argelander Institut fur Astronomie)
Stars in globular clusters exhibit a peculiar chemical pattern with strong abundance variations in light elements along with constant abundance in heavy elements. These abundance anomalies can be created in the H-burning core of a first generation of massive stars and due to rotational induced mixing they are convoyed to the stellar surface. If the rotation is fast enough this matter is ejected at a low velocity through the equator and then it pollutes the ISM from which a second generation of chemically anomalous stars can be formed. The dynamical consequences of the formation of two distinct populations in globular clusters are followed. In particular the observed ratio of anomalous and standard stars in clusters needed both gas expulsion by supernovae and long term evolution to be matched.

Unified self-similar analysis and Burgan-Feix transformation
E. Falize
(CEA (Bruyères le Châtel) - LUTH Observatoire de Paris-Meudon)
Self-Similar Solutions (SSS) play a key role in physics and astrophysics. They give basic information about physical systems and are an essential complement to numerical simulations. Burgan and Feix derived a transformation group - which we name the Burgan-Feix Transformation (BFT) - based upon the concept of partial invariance. The BFT leads also to new solutions through more complex analytical calculations. Including IC in the structure of solutions is very appropriate for High-Energy-Density experiments. In this work, we will propose a progressive approach, from dimensional analysis to BFT, providing SSS containing increasing degree of complexity. Moreover, we will present the theory of the BFT with different point of view.

Laboratory Astrophysics and magneto-radiating fluids : Scaling laws and similarity properties
E. Falize
(CEA (Bruyères le Châtel) - LUTH Observatoire de Paris-Meudon)
Laboratory Astrophysics is a very promising new way to explore the dynamics of magneto-radiating fluids. The validity of this new approach is based on the existence of scaling laws which provide tyhe strict equivalence between the laboratory system (experimental laser target) and its astrophysical homologous. Thus it necessary to derive these laws in a rigourous way. In this work we show how to obtain these scaling laws, with a rigourous formalism, in different magneto-radiative regimes. For each regime we focus on the number of free parameters (in the different regimes) available to determine all the physical quantities related, on the hand, to the target and to the laser, but also, on the other hand on the astrophysical objects that can potentially be reproduced in laboratory with current (LULI2000, Omega, GekkoXII, LIL) and future (LMJ,NIF) laser facilities.

Poussières et polarisation dans les atmosphères et les disques des naines brunes
Bertrand Goldman, Jan Pitann et al
(MPIA/observatoire de Besançon)

Description of the TiSAFT code (Time Series Analysis with Fisher's Test)
A.-L. Huat
(GEPI, observatoire de paris)
In the context of the preparation for CoRoT data analysis, I have developed the TiSAFT code (Time Series Analysis with Fisher's test)which extracts frequencies, amplitudes and phases from light curves using a Fourier Transform and a statistical method of detection : Fisher's test of significance. The poster provides a description of the methods used in the code as well as the results of different tests done with simulated light curves and with the CoRoT data of a Be star. I will also compare my results with the ones obtained with other codes.

Disk and Wind evolution of the Be star ACHERNAR : VINCI & MIDI data
S. Kanaan
(OCA)

Spatially resolved H2 emission from the disk around T Tau N

L. Labadie (MPIA), M. Gustaffson (MPIA), T. M. Herbst (MPIA) and M. Kasper (ESO)
(Max-Planck Institut fur Astronomie)

We present spatially resolved near IR observations of the H2 emission in the vicinity of TTau N using SINFONI, the integral field spectrograph of the VLT. The gas is detected as a ring-like structure within $\sim$ 80-100 AU from the star. The velocities of the H2 are close to the systemic velocity of TTau N, and an analysis of the excitation mechanisms plays in favor of a scenario where the H2 is linked to the atmosphere of the circumstellar disk. The possible excitation scenarii are evoked here. Eventually, when detected in the disk, H2 is also a strong tracer of the status of potential planet formation.

Polarized Hydrogen Emission Lines in Mira stars : a Mystery Behind the Shock

Lebre A., Gillet D., Fabas N.
(GRAAL - Universite Montpellier II)

We present a full spectropolarimetric study (in the four Stokes parameters I, Q, U and V) on Mira stars, and focus on the high level polarization detected in emission lines. From observations made with NARVAL instrument at TBL (Telescope Bernard Lyot) in Pic du Midi observatory (France), we confirm the early and single detection (McLean & Coyne, 1978) on Omicron Ceti - the prototype of Mira stars - when observed at its maximum luminosity : Balmer Hydrogen emission lines are strongly polarized, much more than the local contiunuum. Hence, for a sample of Mira stars, we are undergoing a complete characterization of the polarization in emission lines, with respect to the luminosity cycle. We find that this polarization in Balmer emission lines is likely to be linked with the emission line formation mechanism occurring within the de-excitation post shock wake of the strong shock wave propagating throughout the stellar atmosphere at each pulsation cycle. Moreover, according to shock wave theory, a magneto-electric field should appear just behind the shock front (where emission lines are formed), inducing polarization. To date, this field has never been conclusively detected on Mira stars (neither on any other type of radially pulsating star). Our spectropolarimetric observations constitute the first overall attempt to fully characterize and understand the associated physical mechanism.

Galactic abundance gradients from Cepheids. On the iron abundance gradient around 10-12 kpc

B. Lemasle, P. François, A. Piersimoni, S. Pedicelli, G. Bono, C. D. Laney, F. Primas, M. Romaniello
(GEPI)

Classical Cepheids provide very accurate distance estimates and are therefore adopted to trace the chemical evolution across the Galactic disk.

Homogeneous iron abundance measurements for 33 Galactic Cepheids located in the outer disk, together with accurate distances determinations from near-infrared photometry are combined to constrain the Galactic abundance gradient beyond 10 kpc. Adopting a linear regime in the [5-17] kpc range, we find a slope of -0.052 +/- 0.003 dex/kpc but the gradient is better described with a flattening in the outer disk, as we find a shallower slope (-0.012 +/- 0.014 dex/kpc) beyond 10 kpc. We also find that Cepheids present an increase in the spread in iron abundance between at least 10 and 12 kpc. Current evidence indicates that the spread in metallicity depends on Galactocentric longitude. Finally, our data do not support the hypothesis of a discontinuity in the iron gradient at Galactocentric distances of $\sim$ 10-12 kpc.

The spread in iron abundances depending on Galactocentric longitude indicates that linear radial gradients should be considered cautiously to constrain the chemical evolution across the Galactic disk.

Search for variability in L-dwarfs

Constantino Listowski, Bertrand Goldman
(MPIA)

L-type ultra-cool dwarfs have cloudy atmospheres and are rapid rotators so that patterns can appear in the cloud coverage, leading to surface heterogeneities. Photometric and spectroscopic variations have already been reported in L-type and T-type brown dwarfs.

These heterogeneities can be investigated in various wavelength regimes through spectroscopy. Bringing to light the variability caused by these heterogeneities with a chi-square test is a delicate task that needs to accurately determine the noise (photon-noise, readout-noise). Looking for correlated variability allows to work without any assumptions and insures that the detected variability, with some confidence level, is intrinsic to the science object.

We will present results for L-type brown dwarfs monitored in infrared with the NTT-SOFI spectrograph, using the blue and red arms, corresponding to wavelength ranges of 0.95-1.64 micrometers and 1.53-2.52 micrometers respectively.

Laboratory jet experiments and theoritical studies.
B. Loupias, E. Falize, S. Bouquet, C. Michaut, M. Koenig
(LULI, Ecole Polytechnique)
We will present our experimental and theoritical characterization of a jet generation in vacuum using foam filled cone target and intense laser. The obtained results on shape, time evolution, temperature and density, are in good agreements with 2D simulations. We also compared these measurements with theory and astronomical observations. Further study, with ambient gas, simulating the interstellar medium, to evaluate its effect on the above plasma jet evolution have been performed. We will demonstrate the importance to implement several diagnostics to measure the required parameters to infer the dimensionless astrophysical numbers.

The WFI Halpha spectroscopic survey
C. Martayan, D. Baade, J. Fabregat
(Royal Observatory of Blegium)
In this talk, we shall present the results from our spectroscopic survey of Halpha emitters in galactic and SMC open clusters with the ESO Wide Field Imager in its slitless spectroscopic mode. First of all, for the galactic open cluster NGC6611, in which, the number and the nature of emission line stars is still the object of debates, we show that the number of true circumstellar emission line stars is small.
Second, at low metallicity, typically in the Small Magellanic Cloud, B-type stars rotate faster than in the Milky Way and thus it is expected a larger number of Be stars. However, till now, search for Be stars were only performed in a very small number of open clusters in the Magellanic Clouds. Using the ESO/WFI in its slitless spectroscopic mode, we performed a Halpha survey of the Small Magellanic Cloud. 3 million low-resolution spectra centered on Halpha were obtained in the whole SMC. Here, we present the method to exploit the data and first results for 85 open clusters in the SMC about the ratios of Be stars to B stars.

Internal gravity waves induced transport and excitation modification by the Coriolis acceleration
S. Mathis, K. Belkacem, M.-J. Goupil, A.-S. Brun & J.-P. Zahn
(CEA/DSM/IRFU/SAp & UMR AIM)
Wave propagation, excitation and associated transport are modified by the Coriolis and the centrifugal accelerations in rotating stars. In this work, we focus on the influence of the Coriolis acceleration on the low-frequency internal gravity waves in stellar radiation zones and on their volumetric stochastic excitation in convective regions. Modification of waves structure and excitation are obtained and consequences on the wave-induced transport in rotating stars and on stellar evolution are discussed.

A search for mass-losing metal-poor carbon stars in the halo
Mauron, N.
(CNRS Graal Montpellier)
Carbon (C) stars on the AGB are cool, mass-losing objects. They play an important role in the enrichment of the interstellar medium, in particular for low-metallicity galaxies where C stars dominate over M stars on the AGB. However, AGB mass-loss at low Fe/H is poorly documented. The LMC and SMC are too distant for detecting circumstellar CO emission, so that the gas-to-dust ratios and the expansion velocities remain unknown. In the Galaxy, the very large majority of AGB C stars are found in the galactic disk, with a scale height of 200 pc and typical progenitor masses around 1.3 solar mass. However, several of them have been known to be located off the plane with $Z > 1.5$ kpc. These stars deserve attention because they might belong to the thick disk or be member of the Sgr Stream, so that they might be metal-poor and closer to us than the LMC. During a survey for finding 2MASS-selected halo C stars, we have identified 16 very cool C stars with strong mass-loss, i.e. 1 to 15 10(-6) and distances between 5 and 35 kpc. For two of them, Groenewegen et al. (1997) had already shown that there is some indication of low-metallicity, and one has a CO expansion velocity of only 3 km/s. Future CO and infrared observations of this sample of 16 C stars in the halo may help us to better characterize AGB mass-loss at low Fe/H (more details in Mauron 2008 AA 482, 151)

Triggered high-mass star formation
Vincent Minier
(CEA)

A roadmap for asteroseismic observations
B. Mosser
(LESIA, Observatoire de Paris)
Is there any future for asteroseismology after CoRoT, the space-borne mission devoted to exoplanetary search and monitoring of stellar oscillations ? We will examine what is currently achieved with CoRoT, what will be achieved soon with Kepler, and what remains to be done, in two directions : spectrometric observations and spatially resolved observations. In the near future, spectrometry can provide a much more deeper insight into the stellar structure, since the Doppler observable is about 50 times less noisy than than the photometric one at low frequency. Long-term projects will develope imagery, for mapping precisely the upper stellar envelopes.

How accurate is the use of a perturbative approach for the effect of rotation on stellar oscillations
Rhita-Maria Ouazzani
(LESIA Observatoire de paris)
Among the methods used to investigate the effect of rotation on oscillation frequencies of stellar pressure modes, we consider here perturbation techniques and direct numerical integrations of a two dimensional eigenvalue system - nonperturbative approach -. Knowing the accuracy of asteroseismic data provided by CoRoT, the issue is to determine whether it is sustainable to take the effect of rotation on stellar oscillations into account with a perturbative approach, or if we should adopt a nonperturbative method that could be much heavier numerically. The aim of this study is to determine the limits - in terms of rotational angular velocity - of a perturbative approach to model the effects of rotation on both structure and oscillation frequencies. Until now, 2D nonperturbative oscillation code has only been developed for polytropic models but not for realistic models of stars. Thus, we have used a polytropic model to compare the results of a 2D nonperturbative oscillation code provided by D. Reese, and a 1D second order and third order perturbative ones. For models whose angular velocity of rotation is that of a δScuti type star, say $50 - 145 km.s^{-1}$, we find a relative frequency difference between the results of the two codes of 0.3% to 0.9%. When we include intrinsic effects of perturbative methods such as double or triple near degenaracy coupling, we push the accuracy up to 0.02%. Considering an optimistic evaluation of uncertainties on CoRoT frequency splittings mesurements - 0.2μHz about 500μHz : relative frequency uncertainty 0.04% - we can already conclude that the perturbative method seems to be acceptable for a 2 solar radius star up to about $75 km.s{-}1$ but not further.

The POLLUX database
A. Palacios & A. Lèbre
(GRAAL -Université Montpellier II)
POLLUX is a database of high resolution synthetic spectra and associated spectral energy distributions that has been released in its first version on January, 2008. After a short demonstration, we will present the new version of the database to be released in Summer 2008, and we will expose the developpments that we consider to implement in the near future.

Formation stellaire dans NGC6334 et NGC6357
Russeil D., Cuomo C., Zavagno A., Deharveng L., et al.
(LAM)
We will present the ongoing multi wavelength survey of the two regions NGC6334 et NGC6357. This survey includes large field optical imaging Vimos observations (under reduction), CO observations (time allocated at MOPRA) and benefits of Herschel garanteed time.

Session ASHRA

Oral contributions

SEE COAST, a spectro-polarimetric imaging mission to characterize exoplanets

A. Boccaletti, J. Schneider, P. Baudoz, D. Mawet
(LESIA, Obs. Paris)

SEE COAST (Super Earth Explorer - Coronagraphic Off-Axis Space Telescope) is a space mission of which the objective is the characterization of extrasolar planets and possibly Super Earth via spectro-polarimetric imaging in reflected light. By the time of the mission, the number of planetary objects discovered by radial velocity or astrometry will constitute a significant target sample for SEE COAST. The US ExoPlanet task force has clearly recommended a direct imaging mission for the near future and so a medium size mission like SEE COAST could be the first one to actually characterize a few exoplanets. This talk will highlight the astrophysical motivation, and the trade-off that lead to a simple integrated concept of a space-based high contrast imaging instrument.

Revue JMMC

Alain Chelli
(LAOG)

Maximum-Likelihood based method for angular differential imaging

A. Cornia, L. Mugnier, J.-F. Sauvage, N. Vedrenne, T. Fusco and G. Rousset
(ONERA - Châtillon)

In the context of the SPHERE planet finder project, we propose a novel method, based on detection theory, for the efficient detection of planets using angular differential imaging.
The proposed method uses the fact that with the SPHERE instrument the field rotates during the night.
The method starts with the appropriate combination of images recorded at different times into so-called pseudo-data. It then uses jointly all these pseudo-data in a Maximum-Likelihood (ML) framework to detect the position and amplitude of potential companions of the observed star, taking into account the mixture of photon and detector noises. The method is validated on simulated data.

Progress status of ARENA reflections

N. Epchtein, on behalf of the ARENA consortium
(CNRS)

I will present the current status of reflections and achievements of the EC FP6 netwok ARENA aimed at drawing out the roadmap of future astronomical infrastructures at CONCORDIA (Dome C, Antarctica). In anticipation of the final conclusions to be delivered in 2009, I will give a preliminary insight into the international astronomical facilities that could be developed during the forthcoming decade at Dome C and their top level science cases.

Wavefront error estimation and faint companion detection by Self-Coherent Camera

Raphaël Galicher, Pierre Baudoz, Gérard Rousset
(LESIA, Observatoire de Paris)

High contrast imaging performance of coronagraphs is limited by quasi-static residual wavefront errors. To correct for these aberrations with a deformable mirror, we propose to measure them by a Self-Coherent Camera (SCC) which is based on incoherence between star and its environment. Wavefront errors are directly estimated in the science image with high sensitivity. We have demonstrated exoplanet detectability at 2.10^{-9} by numerical simulations under realistic assumptions with 10 nm rms wavefront errors and a 4m space telescope. We are also studying performances using the next generation of ground telescope instruments.

Detection of gap signatures in protoplanetary disks by interferometry from the space : a tracer of giant foming planets.

Emilie Herwats, Fabien Malbet, Christophe Pinte, François Ménard
(LAOG)

Hydrodynamical simulations have shown that sufficiently massive planets are able to open gaps in protoplanetary discs. The detection of such gaps would offer new clues for understanding organic relationship between discs and planets but also provide a mean to indirectly detect the presence of massive planet. In our contribution, we show that gaps in protoplanetary discs could be detected using future space infrared interferometers providing spectral capabilities as DARWIN or TPF. We detail the interferometric signatures of those gaps and identify gap and disk parameter ranges for which those interferometers would allow an unambiguous detection. Finally, we propose a method to interpret visibility curves computed from realistic data sets coming from a radiative transfer code, MCFOST, to yield the eventual gap presence and its characteristics.

L'ilmageur interférométrique de Fresnel

Laurent Koechlin, Paul Deba, Truswin Raksasa
(LATT, Université de Toulouse, CNRS)

The Fresnel interfermetric imager is a space based, two spacecraft system providing high angular resolution and high dynamic range adapted to various astrophysical targets such as exoplanet imaging, stellar environments, and also larger field targets such as galactic clouds. The high angular resolution is provided by a large aperture (10 to 30 meters, possibly up to 200 meters), which consists of a thin foil punched with millions of void subapertures forming an aperture synthesis array. The astrphysical goals will be presented, as well as the results of the feasibility study and future plans.

Soon arriving : interferometry at the LBT

L., Labadie (MPIA), T., Herbst (MPIA), H.W. Rix (MPIA)
(Max-Planck Institut fur Astronomie)

The Large Binocular Telescope, resulting from a US/Germany/Italy partnership, is designed to be a multi-purpose observatory with single-dish and interferometric capabilities in the optical, near and mid infrared. The LBT is partially operational for science observations, and the interferometric instruments LINC-NIRVANA and LBTI will become available in 2009. I will summarize the current status of the LBT, focusing more particularly on the Fizeau interferometric wide-field imager LINC-Nirvana. I will present also the options for collaborations outside the consortium

From long baseline interferometry to pupil masking

S. Lacour, G. Perrin, P. Tuthill
(Observatoire de Grenoble)

During this talk, I will present some imaging results obtained on Arcturus, using the IOTA optical interferometer. Parametric fitting allowed to rule out the presence of a companion with a contrast ratio of 8e-4. In a second part of this presentation, I will talk about binary detection using pupil masking. I will take example on the new SAM mode offered on NaCo for Period 82.

Direct detection interferometry in the far-infrared at Dome C

V. Minier
(CEA)

Submm/FIR astronomy is the prime technique to unveil the birth and early evolution of stars and galaxies in the local and distant Universe. Preliminary meteorological studies and atmospheric transmission models tend to demonstrate that Dome C might offer atmosphere conditions that open the 200 micron windows, and could potentially be a site for a large ground-based telescope. However, Dome C climate conditions might also severely impact and deform any telescope mirror and hardware. We present prerequisite conditions and their currently running experiments for defining a large telescope facility for submillimetre astronomy at Dome C : 1. whether the submm/THz atmospheric windows open from 200 micron during a large and stable fraction of time; 2. the knowledge of thermal gradient and icing formation and their impact on a telescope mirror and hardware. We then discuss the possibility of deploying a direct detection interferometer in the FIR/THz domain at Dome C in preparation for future space mission.

Poster contributions

The 2D apodization of rectangular telescope aperture using tow classical Michelson interferometers and monochromatic light source

Azagrouze et al
(doctorant UFR : Physique des Hautes Energies et d'Astrophysique Faculté des sciences Semlalia Marrakech Maroc)

Abstract
In this laboratory experiment, we study the possibility of producing a 2D apodization of the pupil of a telescope using tow classical Michelson interferometers. To simulate the star, we used a Laser source. Our goal is to study the performance of the assembly with polychromatic light. We present the results of experiments carried out with a rectangular aperture using a HeNe Laser source.
Key Words : instrumentation : interferometers ; methods : analytical ; laboratory ; techniques : interferometric.

Canopus angular diameter precisely measured by the AMBER instrument of the VLT Interferometer

Bendjoya, Domiciano de Souza, Vakili, Millour, Petrov
(Université de Nice - OCA - CNRS - UMR 6525 Lab. H. Fizeau)

We used the VLTI/AMBER instrument to obtain interferometric data on Canopus (visibilities and closure phases in the H and K bands with spectral resolution of 35). The adopted baselines ($\simeq$ 100 m) and the high quality of the VLTI/AMBER observations allowed us measure fringe visibilities up to the third visibility lobe of Canopus. Precise angular diameters (<1% precision) were obtained thanks to the good quality of the data. Observations beyond the first minimum suggest the presence of photospheric structures on Canopus.

GUIELOA, the Mexican Adaptive Optics

Julien Girard, Alan Watson, Luís Carlos Alvarez, Oscar Chapa, Salvador Cuevas, Ruben Flores, Fernando Garfias, Arturo Iriarte, and Luís Artemio Martínez, Beatriz Sánchez.
(Instituto de Astronomía, UNAM, Mexico)

We describe progress in the construction of an adaptive optics system for the 2.1 meter telescope of the Observatorio Astronómico Nacional on Sierra San Pedro Mártir, in Baja California, Mexico. The system will use a 19 element bimorph deformable mirror mounted on an articulated platform and a curvature wavefront sensor with natural guide stars. It will have two modes of operation. In adaptive optics mode, it is expected to give excellent correction above 1.0 μm and good correction down to 0.6-0.9 μm, depending on the seeing, although the sky coverage will be limited. In fast guiding mode, the system should give images at or better than the excellent natural seeing of the site and have much greater sky coverage. The system is currently undergoing laboratory testing.

Exoplanets characterization with long slit spectroscopy in high contrast imaging

A. Vigan, C. Moutou, M. Langlois
(Laboratoire d'Astrophysique de Marseille)

Extrasolar planets observation and characterization with high contrast imaging instruments will be a very important subject for observational astronomy in the coming decade. Dedicated new instruments are being developed in order to achieve this goal with very high performance. In particular, full spectroscopic characterization of low temperature planetary companions is an extremely important milestone. We present a new data analysis method for long slit spectroscopy (LSS) with coronagraphy which allows characterization of planetary companions with low effective temperature. In a speckle-limited regime, the method allows an accurate estimation and subtraction of the scattered starlight, in order to extract a clean spectrum of the planetary companion. This method was developed in the context of SPHERE, a second generation instrument for the VLT, that will offer several observing modes for detection and characterization of exoplanets in the near-infrared. Using this method we are able to achieve a contrast reduction of 0.5 to 2.0 magnitudes compared to the coronagraphic observations on simulated images, leading to the possible characterization of planetary companions with effective temperatures of 600 K and 900 K orbiting respectively around M0 and G0 stars at 10 pc, and for angular separations of 1.0".

Session PCHE

Oral contributions

A multiwavelength study of RXJ1713.7-3946 in radio, infrared, X- and gamma rays.
F. Acero, J. Ballet, A. Decourchelle, M. Lemoine-Goumard, M. Ortega, E. Giacanni, G. Dubner, G. Cassam-Chenaï, B. Degranges.
(Laboratoire AIM, Université Paris Diderot, CEA Saclay)
The supernova remnant (SNR) RXJ1713.7-3946 (also known as G347.3-0.5) is part of the class of remnants dominated by synchrotron emission in X-rays. It is also one of the few shell-type SNRs observed at TeV energies. The comparison of the SNR in X- and in gamma-rays can help us to understand the nature of the TeV emission. The goal of our study is to compare the remnant at the same spatial resolution in X- and gamma-rays. We also tried to obtain a good estimate of the radio flux of the remnant which is useful for multiwavelength models. Infrared observations were used to disentangle the thermal from the non-thermal emission seen in the radio observations at 1.4 GHz.

Ultra-high energy cosmic-ray spectrum measurement by the Pierre Auger Observatory
Denis Allard
(APC)
The energy spectrum of cosmic rays above 10^{18} eV estimated by the Pierre Auger Observatory is presented. The empirical method used to determine primary cosmic-rays energy will be describe and the main features of the spectrum discussed.

The JEM-EUSO project
Denis Allard
(APC)
The JEM-EUSO telescope will observe giant air showers initiated by ultra-high energy cosmic-rays from space. This new observation technique will provide a huge collection area, necessary to accumulate statistics at the highest energies where the cosmic-ray flux is expected to be very small. I will review the characteristics of the instrument as well as the main scientific goals of the project.

The High Time Resolution Spectrometer of the XEUS mission
Didier Barret
(CESR)
XEUS has been recently selected by ESA for an assessment study. XEUS is a large mission candidate for the Cosmic Vision program, aiming for a launch in 2018. XEUS is a follow-on to ESA's Cornerstone X-Ray Spectroscopy Mission XMM-Newton. It will be placed in a halo orbit at L2, by a single Ariane 5 ECA, and comprises two spacecrafts. The optics assembly of XEUS is contained in the mirror spacecraft while the focal plane instruments are contained in the detector spacecraft, which is maintained at the focus of the mirror by formation flying. The main requirements for XEUS are to provide a focused beam of X- rays with an effective aperture of 5 m^2 at 1 keV, 2 m^2 at 7 keV, a spatial resolution better than 5 arcsec, a spectral resolution ranging from 2-6 eV in the 0.1-8 keV energy band, an energy bandpass of 0.1-40 keV, ultra-fast timing and polarimetric capabilities. The are five focal plane instruments : a wide field imager, a hard X-ray imager, a cryogenic spectrometer, a fast timing instrument, and a polarimeter. I will first outline the core scientific objectives of the XEUS mission. I will then emphasize on the timing instrument : the High Time Resolution Spectrometer (HTRS). The HTRS is unique in its ability to cope with extremely high count rates (up to 2 Mcts/s, equivalent to a 5 Crab source), while providing sub-millisecond time resolution and less than 200 eV energy resolution. The potential of the HTRS observations to probe gravity in the strong field regime and matter at supra-nuclear densities will be presented, together with the current design of the instrument.

The Chinese-French SVOM mission for gamma-ray burst studies
S. Basa, on behalf of the SVOM collaboration
(LAM)
We present the space-based multi-band astronomical Variable Objects Monitor (SVOM) mission, recently decided by the Chinese National Space Agency (CNSA) and the French Space Agency (CNES). The mission which is designed to detect about 80 gamma-ray bursts (GRBs) of all known types per year, will carry a very innovative scientific payload combining a gamma-ray coded mask imagers sensitive in the range 1 keV to 300 keV, a soft X-ray telescope operating between 0.5 to 2 keV, a gamma-ray monitor sensitive in the range 50 keV to 5 MeV, and a narrow field of view telescope able to measure the GRB afterglow emission down to a magnitude limit $M_R = 23$ with a 300 s exposure.
A particular attention will be paid to the GRB follow-up in making easy the observation of the SVOM detected GRB by the largest ground based telescopes. Schedule for a launch in 2012, it will provide fast and reliable GRB positions, measure the broadband spectral energy distribution and temporal properties of the prompt emission, and quickly identify the optical afterglows of detected GRBs, including those at very high redshift.

Autonomous radio detection of HECR at the Pierre Auger Observatory
Arnaud Bellétoile
(LPSC-UJF Grenoble)
The use of the radio-detection technique in a wide area cosmic-ray detector requires autonomous antenna stations, in terms of power feeding, triggering and data transmission. A prototype has been tested at the Pierre Auger Observatory. It uses the broadband (1-200 MHz) active dipoles already in operation in the CODALEMA experiment together with a solar power supply, an independent trigger electronics and a dedicated communication system. We present here the first evidence for radio detection of cosmic ray using autonomous trigger system in coincidence with the Auger surface detector.

Simulating radiation processes in high energy plasmas
R. Belmont, J. Malzac, A. Marcowith
(CNRS/CESR)
Accreting systems such as AGN, X-ray binaries or gamma-ray bursts are known to be strong, high energy emitters. The hard emission is though to originate in plasmas of thermal and/or non-thermal high energy particles. Not only does it allow to probe the unique properties of the matter in this extreme environment, but it also has a crucial influence on the energetics and the dynamics of emitting medium. Understanding the consistent interaction between radiation and matter has become a key issue in the modelling of high energy sources. Although most of the various kinds of interactions between particles and photons are well known, they are quit complex and the way they couple non-linearly is still an open issue.
I will present a new code that solves the local, kinetic evolution equations for distributions of electrons, positrons and photons, interacting by radiation processes such as self-absorbed synchrotron, Compton radiation, pair production/annihilation, and by Coulomb collisions. This code is used to model the spectral properties of Cyg-X1. It is found that both the low-hard state and the high-soft state can be modelled with the same acceleration mechanisms but different efficiencies for the particle thermalization by synchrotron self-absorbed photons.

Anisotropie des RCHE
O. Blanch Bigas
(LPNHE)
The correlation between the arrival directions of cosmic rays observed with the Pierre Auger Observatory with energy above 60 EeV and the positions of nearby extragalactic objects is presented. We rejected the hypothesis of an isotropic distribution of these cosmic rays with at least a 99% confidence level from a prescribed a priori test.

Limite d'Auger sur le flux de photons diffus au delà de 10 EeV
C. Bonifazi
(LPNHE)
We set upper limits for the photon fraction in cosmic rays with energies greater than 10 EeV using data recorded by the Pierre Auger Observatory. These upper limits confirm and improve on previous results from other experiments and disfavor some exotic models of cosmic ray sources.

kHz Quasi-Periodic Oscillations in the low-mass X-ray binary 4U 0614+09
Martin BOUTELIER, Didier BARRET, M. Coleman MILLER
(CESR)
We report on a comprehensive analysis of the kilohertz ($\geq$ 600 Hz) quasi-periodic oscillations (kHz QPOs) detected from the low-mass X-ray binary (LMXB) 4U 0614+09 with the Rossi X-ray Timing Explorer between 1996 and 2007. Following up previous work, we investigate the frequency dependency of the amplitude and quality factor of its upper and lower kHz QPOs. We show that the behaviour of 4U 0614+09 is similar to the one reported from similar systems (e.g, 4U 1636-536, 4U 1608-52) ; in particular a drop of the quality factor of the lower kHz QPO is also observed above $\sim$ 760 Hz Hz. Furthermore, by using a data set much larger that previously analyzed, we do not confirm the previous detection of an upper QPO at 1330 Hz, and find that the frequency separation between the lower and upper QPOs is constant around 310 Hz, indeed significantly different from the recently reported spin frequency of the neutron star (414 Hz). We discuss our results in the framework of competitive QPO models.

Modélisation des blazars du TeV par un modèle inhomogène dépendant du temps de jet stratifié
BOUTELIER Timothé, HENRI Gilles, PETRUCCI Pierre-Olivier
(LAOG)
We present a new time-dependent inhomogeneous jet model of non-thermal blazar emission, which reproduces the entire spectral energy distribution together with the rapid gamma-ray variability. Ultra-relativistic leptons are injected at the base of a jet and propagate along the jet structure. We assume continuous reacceleration and cooling, producing a relativistic quasi-maxwellian (or "pile-up") particle energy distribution. The synchrotron and Synchrotron-Self Compton jet emissivity are computed at each altitude. Klein-Nishina effects as well as intrinsic gamma-gamma absorption are included in the computation. Due to the pair production optical depth, considerable particle density enhancement can occur, particularly during flaring states.Time-dependent jet emission can be computed by varying the particle injection, but due to the sensitivity of pair production process, only small variations of the injected density are required during the flares. The stratification of the jet emission, together with a pile-up distribution, allows significantly lower bulk Lorentz factors, compared to the ones obtained with the commonly used one-zone models, in better agreement with observational and statistical constraints. Applying this model to the case of PKS 2155-304 and its big TeV flare observed in 2006 with H.E.S.S., we can reproduce simultaneously the average broad band spectrum of this source as well as the TeV spectra and TeV light curve of the flare with bulk Lorentz factor lower than 15.

Etudes sur l'horizon GZK et les anisotropies dans Auger
Nicolas G. Busca
(APC)
The cutoff in the ultra high energy cosmic ray spectrum observed by HiRes and Auger has a direct interpretation in terms of the GZK effect. In this work, we review this effect in terms of horizons and discuss its implications for cosmic ray anisotropy.

Probing pulsar wind nebula with gamma-ray binaries
Benoît Cerutti, Guillaume Dubus, Gilles Henri
(Laboratoire d'astrophysique de Grenoble)
We report on our current studies of high energy radiation from gamma-ray binaries, binaries which emit most of their energy above an MeV. Gamma-gamma absorption and anisotropic inverse Compton scattering processes were previously investigated in the context of the young pulsar wind scenario. Here, we report on the gamma-ray emission that would originate from the unshocked pulsar wind itself, instead of originating at the shock between pulsar and stellar wind. The comparison of the theoretical spectral energy distributions with EGRET, HESS and MAGIC observations constrains the particle energy and the shock geometry. Pair cascading may also play a significant role in the emission from those systems. We present our approach to calculate reprocessing of secondary pairs in gamma-ray binaries and discuss preliminary results.

The gravitational wave detector Virgo : first scientific data and future plans
Eric Chassande-Mottin
(CNRS AstroParticule et Cosmologie)
Virgo has performed its first scientific data taking between May and October 2007, jointly with the detectors LIGO and GEO. In this presentation we describe the main steps towards this major milestone and the achieved sensitivity. We give a summary of the on-going analyses of the collected data. We conclude with an overview of the future detector upgrades, the next data takings and their astrophysical expectations.

Status of the Antares neutrino telescope
P. Coyle
(CPPM)
ANTARES (Astronomy with a Neutrino Telescope and Abyss environmental RESearch) is the largest neutrino detector currently operating in the Northern hemisphere. The telescope is designed to search for high-energy neutrinos originating from galactic and extra-galactic sources. The detection principle relies on the observation of Cerenkov light emitted by charged leptons resulting from charged current neutrino interactions in the medium surrounding the detector. The detector is now complete and is composed of twelve lines (a total of 900 photomultipliers), placed at a depth of about 2500 meters 40 km off the coast of Toulon, France.
The first five lines of the detector have been working continuously for almost one year. The performance and long term stability of the detector will be discussed, including an evaluation of the in-situ time and acoustic positioning resolution. First neutrino candidates will be presented.

KM3NET : A km3-scale neutrino telescope in the Mediterranean Sea.
P. Coyle
(CPPM)
KM3NET (KM3 NEutrino Telescope) is a future deep-sea research infrastructure located in the Mediterranean Sea. It comprises a km3-scale neutrino telescope and facilities for marine research. The members of the three ongoing neutrino projects in the Mediteranean (Antares, Nemo, Nestor) are participating to a design study, partially funded by the EU, to optimise the sensitivity of the design for the detection of high-energy neutrinos. The status of the project, technical options and expected sensitivity to a variety of astrophysical sources are presented.

Le projet CTA
Mathieu de Naurois pour la collaboration CTA
(LPNHE - Universités Paris VI/VII - IN2P3/CNRS)
During the last few years, very high energy (VHE) gamma-ray astronomy has emerged as a truly observational discipline, largely driven by the European-led HESS and MAGIC experiments. More than 70 VGE gamma-ray sources have been detected, representing different galactic and extragalactic source populations such as young shell type supernova remnants, pulsars wind nebulae, giant molecular clouds, Wolf-Rayet stars, binary pulsars, microquasars, the Galactic Center, Active Galactic Nuclei and a large number of yet unidentified Galactic objects. The CTA project is aiming at building a very powerful multi-functional tool for spectral, temporal and morphological studies of galactic and extragalactic sources of VHE gamma-rays, with an unprecedented sensitivity (improved by one order of magnitude compared to the previous generation experiments) and a superior angular resolution. The current plan for CTA consists of two observatories, one in each Hemisphere, with 100 GeV-100 TeV and 10 GeV-100 TeV energy coverage in the Norhern and Southern Hemisphere respectively. We will report on the scientific motivation, design status and expected performances of the CTA project, as well as on its current status.

Review of results from ground-based Gamma-ray observatories
de Ona Wilhelmi
(APC)
The field of VHE (E>100 GeV) gamma-ray astronomy has undergone a major revolution over the last four years, thanks to the results obtained by the new imaging Air Cherenkov Telescopes (IACTs). The latest generation of Cherenkov telescopes, such as HESS, VERITAS, and MAGIC, has increased the observation energy range from 100 GeV to multi-TeV, which allowed the field to enjoy a period of rapid growth, today boasting a source catalogue containing about 50 emitters of VHE gamma-rays from a variety of classes, including supernova remnants, blazars, pulsars, and microquasars. Other kinds of objects, such as pulsars, galaxy clusters or GRBs, are expected to produce also VHE gamma-rays. Furthermore, a large number of new unidentified sources without obvious counterparte at lower wavelengthe have been discovered. We will review the latest results published and discuss the most interesting cases.

Transiant sources detection with Antares and optical follow-up

D. Dornic
(CPPM/CNRS)

The ANTARES telescope has the opportunity to detect transient sources with neutrinos, such as gamma-ray bursts (GRBs), core-collapse supernovae (SNe), flares of active galactic nuclei (AGNs)... To enhance the sensitivity to these sources, we are developing a new detection method based on the coincidence of neutrinos burst and an optical detection. The ANTARES Collaboration is implementing a fast on-line reconstruction with a good angular resolution. These caracteristics allow to trigger an optical telescopes network in order to identify the nature of the neutrinos (and high energy cosmic-rays) sources. This follow-up can be done with a network of small automatic telescopes and required a small observation time. An optical follow-up of special events, such as neutrinos doublet in coincidence in time and space or single neutrino with a very high energy, would not only give access to the nature of the sources but also improve the sensitivity for neutrino detection from SNe or GRBs.

GRS 1915+105 : High-energy insights with SPI/INTEGRAL

R. Droulans E. Jourdain
(CESR)

CONTEXT. We report the results of two years of INTEGRAL/SPI monitoring of the Galactic microquasar GRS 1915+105. AIMS. From July 2004 to May 2006, the source was observed twenty times with long (+/-100 ks) exposures. We present an analysis of all the SPI data and focus on the description of the high-energy ($>$ 20 keV) output of the source. METHODS. Temporal and spectral analysis of the SPI data. Comparison to simultaneous 1.2 - 12 keV ASM data RESULTS. We find the 20 - 500 keV spectral emission of GRS 1915+105 to be bounded between two limit states. In particular, these high-energy 'states' are seen to be uncorrelated to the temporal behavior of the source, suggesting there is no immediate link between the characteristics of the coronal plasma and the the variability of the accretion flows. All spectra are well fitted by a thermal comptonization component plus an extra high-energy power law. This confirms the presence of thermal and non-thermal electrons around the black hole.

Very high energy emission from pulsar wind Nebulae.

Florent Dubois for HESS Collaboration
(LAPP - IN2P3)

Pulsar wind nebulae (PWNe) are extended structures of shocked relativistic particules powered by a pulsar at very high energy.
Interaction between these particules and the surrounding medium produces very high energy photons emission. Observation by imaging Cherenkov telescopes system in an energy scale from about 100 GeV to 100 TeV, shows various morphologies, depending of many parameters : age, ambiant medium distribution, magnetic fields. H.E.S.S. experiment enabled to find out many
sources, like Vela X or HESS J1825-137, usefull for morphology analysis. In this talk, I will present last results got with H.E.S.S. and implication with evolution model of PWNe.

Are There Magnetars in High Mass X-ray Binaries ? The Case of SuperGiant Fast X-Ray Transients

M. Falanga, E. Bozzo, L. Stella
(CEA-Saclay, SAp)

In this talk we review the theory of wind accretion in high mass X-ray binaries hosting a magnetic neutron star and a supergiant companion. We concentrate on the different types of interaction between the inflowing wind matter and the neutron star magnetosphere that are relevant when accretion of matter onto the neutron star surface is largely inhibited ; these include the inhibition through the centrifugal and magnetic barriers. Expanding on earlier work, we calculate the expected luminosity for each regime and derive the conditions under which transition from one regime to another can take place. We show that very large luminosity swings ($\sim$ 1E4 or more on time scales as short as hours) can result from transitions across different regimes. The activity displayed by supergiant fast X-ray transients, a recently discovered class of high mass X-ray binaries in our galaxy, has often been interpreted in terms of direct accretion onto a neutron star immersed in an extremely clumpy stellar wind. We show here that the transitions across the magnetic and/or centrifugal barriers can explain the variability properties of these sources as a results of relatively modest variations in the stellar wind velocity and/or density. According to this interpretation we expect that supergiant fast X-ray transients which display very large luminosity swings and host a slowly spinning neutron star are characterized by magnetar-like fields, irrespective of whether the magnetic or the centrifugal barrier applies. Supergiant fast X-ray transients might thus provide a new opportunity to detect and study magnetars in binary systems.

Simbol-X : mission overview
P. Ferrando, for the Simbol-X collaboration
(CEA/SAp & APC)

Consistent disk-jet theoretical spectral energy distribution of microquasars.
Foellmi C., Petrucci P.-O., Ferreira J., Henri G., Boutelier T.
(LAOG)
Using Grenoble's two-flow framework, we build consistent disk-jet spectral energy distributions for low-mass X-ray binaries and microquasars. Assuming a Jet Emitting Disc (JED) solution, to which the jet is anchored, in the inner regions, and a Standard accretion disc in the outer ones, we solve the thermal equilibrium of the accretion flow. The solutions of the radiative equilibrium providing a possible natural mechanism for the observed spectral hysteresis, we discuss this phenomenon with the corresponding SEDs and the long-term changes of spectral states for these objects.

Stochastic model of acceleration to Ultra High Energy
F. Fraschetti
(CEA/Saclay, SAp)
In the past year, the HiRes and Auger col laborat ions have reported the discovery of a high-energy cutoff in the ult ra- high energy cosmic- ray (UHECR) spectrum, and an apparent cluster ing of the highest energy events towards nearby act ive galact ic nuclei (AGNs). Consensus is building that such 10^{19}-10^{20} eV particles are accelerated within the radio- bright lobes of these sources, but it is not yet clear how this actually happens. We report (to our knowledge) the first treatment of particle acceleration in such environments from first principles, showing that energies of order 10^{20} eV are reached in 10^7 years for nuclei with an atomic number 8-26. This predict ion appears to be consistent with the Auger observations. However, our findings reopen the question regarding whether the high-energy cutoff is due solely to propagation effects, or whether it does in fact represent the maximum energy permitted by the acceleration process itself."

The luminosity of GRB afterglows as distance estimator
B. Gendre, A. Galli, M. Boër
(LAM)
We investigate the clustering of afterglow light curves observed at X-ray and optical wavelengths. We have constructed a sample of 61 bursts with known distance and X-ray afterglow. GRB sources can be divided in three classes, namely optical and X-ray bright afterglows, optical and X-ray dim ones, and optically bright -X-ray dim ones. We argue that this clustering is related to the fireball total energy, the external medium density, the fraction of fireball energy going in relativistic electrons and magnetic fields. These parameters can be either fixed to a standard value, or correlated. We propose a method for the estimation of the GRB source redshift based on the observed X-ray flux one day after the burst and optical properties. We tested this method on three recently detected SWIFT GRBs with known redshift, and found it in good agreement with the reported distance from optical spectroscopy.

Overview of ANGs at very high energy
Lucie Gérard for the HESS collaboration
(APC-CNRS/in2p3)
AGNs are a class of objects emitting over a very broad energy range.10% of these sources are Blazars, so named because they have jets which are orientated towards us. In this case, the observed gamma-rays, produced by the particle acceleration and emission processes in the jet, benefit from boosting by the Lorentz factor, so that their energies can reach the TeV. The first TeV Blazar, Mkn 421, was discovered in 1992 with the Whipple observatory. Today, the gamma-ray sky contains over 20 of these objects, with the detections being carried out mainly by MAGIC and VERITAS for the Northern hemisphere and by H.E.S.S for the Southern hemisphere. The detection method and the currently-operating observatories will be briefly presented. The present generation of Cerenkov telescopes has improved the quality of the spectral characterization and is now sensitive enough to detect variability on time-scales of minutes for the brightest sources. The detected TeV Blazars will be reviewed in order to underline their variety and how their study is essential for the comprehension of the processes taking place in the jets which are at the origin of the gamma emission.

Probing Quantum Gravity with the exceptional VHE flares of PKS-2155-304 in July 2006 by H.E.S.S.

A. Jacholkowska, R. Buehler, and S. Wagner, for H.E.S.S. collaboration.
(LPNHE)

The study of time lags in light curves of distant astrophysical sources as a function of energy of the photons may lead to the detection of effects due to Quantum Gravity. Here we present a search for such time lags during the H.E.S.S. observations of the exceptional VHE fares of PKS2155-304 in July 2006. The fast variability of the light curve and the wide energy coverage provide an excellent test bed for such effects. Since no significant time lag is found, we derive lower limits of the order of few 10^{17} GeV on the energy scale above which Quantum Gravity induced Lorentz Symmetry breaking could appear.

Observations of Shell-type supernova remnants with H.E.S.S.

Nukri Komin for the H.E.S.S. collaboration
(CEA, IRFU, SPP)

It is widely believed that the shells of supernova remnants (SNRs) are the sources of the Galactic Cosmic Rays up to energies of about 10^{15} eV. These high-energy protons interact with ambient material, and the subsequent neutral pion decay produces gamma rays in the GeV and TeV energy range.
H.E.S.S., a system of ground-based imaging Cherenkov telescopes dedicated to the observation of gamma rays with energies of several hundred GeV up to tens of TeV, is an ideal instrument for the observations of high-energy gamma-ray emission from SNRs. In the recent years H.E.S.S. observed a number of SNRs.Firm detections have been reported from the well-known SNRs RX J1731-3946 and RX J0852-4622 as well as the interaction of W28 with molecular clouds. Further on, the Galactic scan conducted with H.E.S.S. revealed several other SNRs.
In this talk I will give a summary of the SNRs observed so far and discuss the implications with respect to Cosmic Ray acceleration.

The optical depth of the Universe seen through ultrahigh energy cosmic ray spectacles

Kumiko Kotera, Martin Lemoine
(IAP)

The origin of ultrahigh energy cosmic rays has not yet been unveiled, in spite of decades of theoretical and experimental investigations. It is mostly challenging to hunt the sources of these charged particles, as they propagate in a magnetized medium.
We provide an analytical description of the transport of ultrahigh energy cosmic rays in a universe made up of magnetized scattering centers such as radio cocoons, magnetized galactic winds, clusters or filaments of large scale structure, with negligible magnetic fields between them. We present the notion of optical depth of the Universe to cosmic ray scattering and discuss its phenomenological consequences for various source scenarios.
It is found that part of the correlation reported recently by the Pierre Auger Observatory between active galactic nuclei and the arrival directions of ultrahigh energy cosmic rays may be affected by a scattering delusion. This experiment may be observing in part the last scattering surface of particles, rather than their source population.

Discussion on the recent results of the Pierre Auger Observatory

M. Lemoine
(Institut d'Astrophysique de Paris)

I discuss the meaning of the recent results of the Pierre Auger Observatory with respect to source models.

Propriétés supefluides des étoiles à neutrons

J. Margueron
(Institut de Physique Nucléaire d'Orsay)

We analyze the effect of neutron superfluidity on the cooling time of inner crust matter in neutron stars, in the case of a rapid cooling of the core. The specific heat of the inner crust, which determines the thermal response of the crust, is calculated in the framework of HFB approach at finite temperature. The calculations are performed with two paring forces chosen to simulate the pairing properties of uniform neutron matter corresponding to the BCS approximation and to many-body techniques including polarization effects. Using a simple model for the heat transport across the inner crust, it is shown that the two pairing scenarios mentioned above give very different values for the cooling time, i.e., of about 12 and 25 yr.

Quark matter in the interior of neutron stars

Micaela Oertel
(LUTH)

The density at the center of a neutron star reaches several times nuclear matter saturation density. At this density, the properties of strongly interacting matter are not well known. Exotic phases, such as hyperon matter, can appear. It is even possible that there is a phase transition to deconfined quark matter. Recent studies suggest that the phase structure of QCD in this domain is very rhich. I will present the main caracteristics of quark matter at high density as well as some observable consequences.

Ultraluminous X-ray sources, micoquasars and jet-inflated bubbles

Manfred W. Pakull
(CNRS - Observatoire de Strasbourg)

A large fraction of ULX are embedded in huge (>100 pc diameter) shock-ionized nebulae which allow to estimate ages and energetics in these systems. We present arguments against the hypothesis that these bubbles are genuine SNR or stellar wind powered superbubbles, and propose that they rather represent jet-inflated structures, reminiscent of the situation encountered in the microquasar/radio bubble SS433/W50. The interaction of powerful microquasar jets with the interstellar medium is currently being studied to understand the unique optically-selected SNR-candidate S26 in the Sculptor group galaxy NGC7793 (Pakull & Grise, astro-ph/0803.4345). Here, the X-ray (and radio) morphology strikingly resembles a FRII-type radio galaxy, including a $\sim$ 1E37 erg/s hard central X-ray source and two opposite soft X-ray hot spots separated by 250 pc. From multi-wavelength observations we derive an age of 2 E5 yrs and an outstanding mechanical (jet) luminosity of 8 E40 erg/s for the central microquasar in S26. We will discuss our findings in the framework of jet-inflated ULX bubble formation and point out their significance for understanding of microquasar jet interaction with the interstellar medium.

Upper limit on the diffuse flux of UHE tau neutrinos from the Pierre Auger Observatory

K. Payet, for the Pierre Auger Collaboration
(LPSC)

Through the last years, the observation of ultra-high energy (UHE) neutrinos has become one of the challenges of astroparticle physics. Many models, either astrophysical or exotic models, predict a substantial flux of neutrinos. One of the most certain contribution to this neutrino flux are the so-called GZK-neutrinos produced in the decay of pions and kaons, from the interaction of ultra-high energy protons with the CMB. Such a mechanism provides a substantial flux of muon and electron neutrinos at the point of interaction. But given the large distances traveled by the particles, an observer can expect equal fluxes of electron, muon and tau neutrinos at the observation point, due to flavour mixing and neutrino oscillations. During the last years, an increasing effort has been put forward to develop a new generation of dedicated neutrino telescopes, both in the southern (Amanda,IceCube) and the northen hemisphere (Baïkal, Antares). Such detectors are relevant for an energy range of 1E-6 to 1E-1 EeV. An Ultra-high energy cosmic-ray detector such as the Pierre Auger Observatory, although it was not developed for the detection of neutrinos, may have equal or even better potential in the UHE range of 1E-1 to 1E2 EeV, where the GZK-neutrinos are expected. In fact, it has been pointed out recently that the detection potential could be enhanced by the presence of tau neutrinos, due to oscillations, in the cosmic neutrinos flux. Upward-going UHE tau neutrinos that graze the Earth just below the horizon (also called "Earth-skimming neutrinos") have a quite high probability to interact in the crust and produce a tau lepton which, if produced close enough from the surface, may emerge and trigger an extensive air shower which may be detected by the surface detector array of the Pierre Auger Observatory, provided it does not decay too far from the ground. This detection channel has been studied precisely and based on the data collected between January 2004 and August 2007, an upper limit on the diffuse flux of neutrinos in the EeV range has been published. We will briefly explain the study of UHE tau neutrinos at the Pierre Auger Observatory and present the results of the collaboration.

Modelling the pulsed high-energy emission from pulsars
Jérôme Pétri et John Kirk
(CETP Vélizy et ENS Paris)
Although discovered almost 40 years ago, the emission mechanism responsible for the observed pulsar radiation remains unclear. However, the high-energy, pulsed emission is usually explained in the framework of either the polar cap or the outer gap model. Here we explore an alternative model called the striped wind. The purpose of this work is to study the pulsed component, light-curves as well as spectra, of the high-energy emission, above 10 MeV, emanating from the striped wind model by scattering off the soft cosmic microwave background photons on the ultrarelativistic leptons flowing in the current sheets. We compute the time-dependent inverse Compton emissivity of the wind, in the Thomson regime, by performing three-dimensional numerical integration in space over the whole striped wind. The phase-dependent spectral variability is then calculated as well as the change in pulse shape when going from the lowest to the highest energies. Several light curves and spectra of inverse Compton radiation with phase resolved dependence are presented. We apply our model to two well-known gamma-ray pulsars, namely Vela and Geminga. We are able to fit the EGRET spectra between 10 MeV and 10 GeV as well as the light curve above 100 MeV with good accuracy. Moreover, the new observations from GLAST should help to discriminate between the different emission mechanisms.

La detection des Ondes Gravitationelles par LISA - Status du projet
E.Plagnol, G.Auger, A.Petiteau, H.Halloin, O.Jeannin,O.Turazza, B.Argence, P.Prat, E.de Vismes
(APC (Paris))
The Lisa project (detection of GW in space) will be presented. An overview of the different GW sources which will be potentially detected, of the detection scheme and of the status of the project within ESA and NASA will be given.

X-ray flaring activity of SgrA*
D. Porquet
(Observatoire Astronomique de Strasbourg)
The Galactic center harbors at its dynamical center Sgr A*, the closest supermassive black hole (SMBH). Surprisingly, the luminosity of SgrA* is found to be several orders of magnitude lower than the expected Eddington luminosity. The recent discovery of X-ray flares from Sgr A*, that are believed to originate within just a few Schwarzschild radii of the black hole event horizon, has provided new exciting perspectives for the understanding of the accretion and radiation mechanism at work in this peculiarly faint SMBH. I will present the results of the April 2007 observation compaign obtained with XMM-Newton.

The positron annihilation emission of the Galaxy
N. Prantzos (IAP)
(IAP)
I will present an overview of our current understanding of the positron annihilation emission observed in the Milky Way by SPI/INTEGRAL. On the basis of recent data and theoretical estimates I will tentatively assess the merits and shortcomings of the various proposed positron sources.

Peering through the wind of IGR J19140+0951 using RXTE and INTEGRAL observations
Lionel Prat, Jérôme Rodriguez, Diana Hannikainen
(CEA Saclay/IRFU/Service d'Astrophysique)
IGR J19140+0951 was discovered by the satellite INTEGRAL in 2003. This is a High Mass X-ray binary, in which the compact object is deeply embedded in the wind coming from the supergiant companion star. Due to the high level of photoelectric absorption, this type of source couldn't be detected without hard X-rays observations. The spectra obtained in the 3-80 keV range using RXTE and INTEGRAL have allowed us to perform a precise spectral analysis of the system along its binary orbit. We were able to confirm the supergiant nature of the companion star and the neutron star nature of the compact object. Using a simple stellar wind model to describe the evolution of the photoelectric absorption, we were able to restrict the orbital inclination angle in the range 37-75 degrees. Finally, we have detected a so-called "soft excess" in at least four observations, for the first time for this source. Such soft excesses have been reported in several HMXBs in the past. We discuss the possible origin of this excess, and suggest, based on its spectral properties and occurrences close to the superior conjunction, that it may be explained as the reprocessing of the X-ray emission originating from the neutron star by the surrounding ionized gas.

Multiwavelength study of X-ray sources in the globular cluster NGC 2808 : Chandra, XMM-Newton, HST and ATCA observations

Servillat M., Dieball A., Webb N.A., Knigge C., Cornelisse R., Barret D., Long K. S., Shara M.M., Zurek D.R.
(CESR)

We aim to detect and identify the faint X-ray sources belonging to Galactic globular clusters in order to understand their role in the evolution of globular clusters.
We present a new Chandra X-ray observation of the Galactic globular cluster NGC 2808. Previous observations with XMM-Newton and ultraviolet observations with the Hubble Space Telescope are re-investigated to help identify the Chandra sources associated with the cluster.
From statistical analysis, 16 sources are very likely to be linked to NGC 2808. We find one likely neutron star low-mass X-ray binary in quiescence and 5 cataclysmic variables in the core of NGC 2808. The other 10 sources are cataclysmic variable candidates, but some of the faintest could possibly be chromospherically active binaries or millisecond pulsars. This significant population of close binaries is likely to play an important role in slowing down the core collapse of this cluster. These observations also indicate that the proportion of magnetic cataclysmic variables in NGC 2808 seems consistent with those observed in the field, opposing previous suggestions that globular cluster cataclysmic variables are predominantly magnetic. The fluctuations of cluster sources could be signatures of much sought-after cataclysmic variable outbursts in X-ray. From X-rays and radio (ATCA) observations, we found no evidence of an intermediate mass black hole in NGC 2808 and derived mass constraints.

Observatoire Auger Nord

Tiina Suomijarvi pour la collaboration Pierre Auger
(IPN-Orsay)

The recent results of the Observatory Pierre Auger indicate a suppression of the flux and an anisotropy of ultra high-energy cosmic rays. This opens a new and challenging field of investigation : the charged particle astronomy. Since the astrophysics objects as well as the magnetic fields are different seen from the southern and the northern sky, a full sky coverage is required to understand the origin of these cosmic rays. Furthermore, a significant increase of the exposure is necessary to be able to study their sources. The Pierre Auger collaboration is currently planning a second observatory in the Northern hemisphere, in Colorado, USA. This observatory will extend up to a surface of 20 000 km^2 considerably increasing the capability to observe and study cosmic ray sources. The R&D is currently in progress and a prototype array will be installed in Colorado next year.

First evidence for a log-normal random process at the origin of the variability of the blazar PKS2155-304 in VHE gamma-rays

G.Superina,B.Degrange
(LLR)

The High Energy Stereoscopic System (H.E.S.S) observed the BL Lac object PKS 2155-304 from 2004 to 2007. The light curve of PKS 2155-304 during the exceptional flaring periods from June 28th (MJD 53944) to 31th 2006 (MJD 53947) is investigated as a realization of a random stationary Gaussian process. Due to the large variations in the gamma-ray fluxes, the excess rms-flux relation is studied for the first time in this energy domain and the logarithm of the flux is found to be the relevant Gaussian variable. Structure functions and variance analysis allow to describe the process as a red noise and both studies lead to the same characteristic parameters, thus giving a consistent description of the source variability during this period.

Le radiotélescope LOFAR, un nouvel instrument pour les hautes énergies

M. Tagger et le consortium FLOW
(LPCE)

I will present the prospects offered in high-energy astrophysics by the new radiotelescope LOFAR, which can be considered as a low-frequency precursor of SKA. France, which will install one LOFAR station in Nançay in 2009, has just joined the european collaboration for the scientific exploitation of this instrument which will open a new window on the radio sky.

X-ray Bursts from the Galactic Center

Guillaume Trap, Maurizio Falanga, Andrea Goldwurm, Régis Terrier
(APC / CEA-SAp)

The center of our galaxy is a nest of compact objects. Among them, one finds a whole population of accreting neutron stars in low mass X-ray binaries (LMXBs) characterized by regular fast rises and exponential decays of their luminosities on timescales of seconds to hours. These 'X-ray bursts' are thought to results from unstable thermonuclear burning episodes of accreted material on the surface layer of the neutron stars. In spring 2007, we carried out an extensive multiwavelengths campaign on the supermassive black hole of the galactic nucleus, Sgr A*, with ground and space telescopes. Thanks to the INTEGRAL and XMM-Newton satellites, we serendipitously recorded several long and short X-ray bursts from the nearby faint ultra compact binary candidate SLX 1737-282 and soft X-ray transient GRS 1741.9-2853. I will use these two systems as an opportunity to briefly discuss our current observational and theoretical understanding of these explosive phenomena.

The physics of the spacetime close to the horizon : Numerical study of local properties for Black Holes

Nicolas Vasset, Jerome Novak
(LUTh-Observatoire de Meudon/ Université Paris VII)

We present recent computations of astrophysical spacetimes containing black holes, using numerical spectral methods and horizon excision for solving full Einstein equations. Recently new local characterizations of astrophysical black holes have emerged, introducing the isolated and dynamical horizon objects. These geometrical concepts, identical to event horizons in the well-known stationary black hole solutions, are far more well behaved in the fully dynamical case and thus well suited for the description of astrophysical dynamical (e.g. accreting) black holes. After reviewing some physical and geometrical properties of these horizons, we show that they can be used to perform simulations of black hole spacetimes, with high precision in the full general relativistic case.

Poster contributions

HESS-II reconstruction strategies and performance

Y. Becherini for the HESS Collaboration
(APC - Paris)

In mid-2009 the H.E.S.S. telescope system (called HESS-II) will be upgraded : a new telescope with a 600 m^2 mirror area and very-high-resolution camera (0.07°) will be positioned at the centre of the present configuration, lowering the threshold from 100 GeV to about 30 GeV and enhancing its sensitivity by a factor ~ 2 in the 100 GeV to several TeV energy range.
With HESS-II the investigation of the lower energy gamma ray spectra in various cosmic accelerators will be possible, giving information on the origin of the gamma rays observed. The detection of AGNs with a redshift greater than 0.2 (being less affected by absorption by Extragalactic Background Light - EBL - in this energy range) and the search for new classes of very high energy gamma ray emitters (pulsars, microquasars, GRB, and dark matter candidates) will also be key issues for the experiment.
The intertelescope trigger system of H.E.S.S. will operate in a hybrid mode, which allows to trigger on three classes of events in parallel : at very low energies on purely mono-telescope events of the very large telescope, at mid energies on combined events with an image from the very large telescope and one of the smaller ones (often with rudimentary information in the latter), and at even higher energies on current H.E.S.S. - phase I type events with additional rich information in the central telescope.
We will show the comparison of the three different regimes, based on full air-shower and instrument Monte Carlo simulations, and the implications for the different source categories.

Radio-detection of UHECR by the CODALEMA experiment

Arnaud Bellétoile
(LPSC-UJF Grenoble)

The CODALEMA experiment is based on an original approach of the detection of radio transients associated with extensive air showers induced by ultra high-energy cosmic rays. Since September 2006, CODALEMA has been under operation with a new setup at the Nançay Radio Observatory, France. We will present evidence for the radio detection of cosmic rays above 10^{17} eV, based on an event-by-event analysis and we will discuss the radio characteristics of these showers.

GRB prompt high-energy emission from internal shocks : a time-dependent model

Z.Bosnjak, F.Daigne, G.Dubus
(IAP)

We have performed detailed calculations of the prompt GRB high energy emission in the framework of the internal shock model, where GRB emission is due to the radiation of shock-accelerated electrons in shock waves propagating within the relativistic outflow. Our time dependent numerical model follows the dynamics of the internal shock phase as well as the high-energy radiative processes operating in the shocked material. The observed spectrum and time profiles are obtained by accounting for the contributions of all elementary shocks that occur during the propagation of the outflow. We show that a strong spectral evolution is expected in the observed GRB and we predict different possible behaviours at high energy in the final spectrum, depending on the values of the microphysical parameters. Our results can be used to analyse future GLAST observations and to assess physical diagnostics that have been proposed for the measurement of parameters such as the bulk Lorentz factor, the magnetic field or the typical electron Lorentz factor.

The soft x-ray excess in AGN constrained by relativistic winds in total pressure equilibrium
A.C. Gonçalves, Bozena Czerny, Agata Rózanska, Aneta Siemiginowska, S. Collin
(Observatoire Astronomique de Strasbourg)
Many Active Galactic Nuclei (AGN) show a soft X-ray excess below $\sim$ 1 keV. This feature has been attributed either to reflection of the hard X-ray source by the accretion disk or to the presence of an additional Comptonizing medium. An alternative solution is that the soft X-ray excess is caused by relativistically smeared absorption. For the absorption hypothesis to hold, the plasma should be in total pressure equilibrium to constrain the spectral distribution, which otherwise would be too strongly variable in time and from one object to the other, as compared to observations. Constant pressure absorption models offer additional advantages : although computationally complex, they are characterized by a smaller number of free parameters and they are more physically robust than simple constant density models, previously used to compute relativistic wind models. Furthermore, they can account for the clumpy and stratified nature of the absorbing gas, displaying a strong temperature, density, and ionization gradient. Encouraged by these results, we have built smeared wind models in constant total pressure, compatible with XSPEC, and we are currently applying them to model XMM data of PG1211+143. Our results will help understanding the role of absorption vs. reflection in modeling the soft X-ray excess in AGN.

The XCAT-DB : Mining XMM-Newton serendipitous source catalogue
L. Michel, A.C. Gonçalves, C. Motch
(Observatoire Astronomique de Strasbourg)
The XMM-Newtn pipeline includes a task cross-correlating X-Ray data with archival data, the ACDS developped in Strasbourg. The archival extractions resulting from this task are included into delivered datasets with X-Ray spectra, imagres or source lists. XCAT-DB is a database making the most out these correlations and out this various datasets. This system, based on Saada, has been made public at the same time as the 2nd realease of the XMM-Newton catalogue. Correlations computed by the ACDS are stored in persistent relationships allowing for very complex queries mixing constraints on X-ray data, on positions and on archival counterparts.

Clumpiness of Dark Matter with the H.E.S.S. experiment
Aldée Charbonnier
(LPNHE, Paris)
Dark matter spatial distribution is expected to be clumpy : our Galaxy is settled into a halo, which may contain sub-halos of various masses. Especially the biggest sub-halos could reach the sizes of satellite galaxies. Beyond standard physics, the supersymmetric model provides a good dark matter candidate : the neutralino. The neutralino could annihilate and produce gamma rays of high energy through this process. The High Energy Stereoscopic System (H.E.S.S.) may observe these products of annihilation. We report the results of observations of dwarfs spheroidal galaxies with the H.E.S.S. experiment, and present the possible strategy of observation of the dark matter with H.E.S.S. due to the presence of clumps.

Are AGN the best factories of high energy particles and photons ?
S. Collin
(LUTH, Observatoire de Paris-Meudon)
After reviewing the main properties of AGN and of the accretion process, I will recall the dichotomy between radio-loud and radio-quiet AGN, and I will show that the small number of radio-loud AGN make them less likely sources of high energy particles than the very many low luminosity AGN which are present in 40% of all galaxies.

Implications of the cosmic ray spectrum for the mass composition at the highest energies
Allard, D., Busca, N.G., Decerprit G., Olinto A.V., Parizot E.
(APC)
The significant attenuation of the cosmic-ray flux above » 5 10^{19} eV suggests that the observed high-energy spectrum is shaped by the so-called GZK effect. This interaction of ultra-high-energy cosmic rays (UHECRs) with the ambient radiation fields also affects their composition. We review the effect of photo-dissociation interactions on different nuclear species and analyze the phenomenology of secondary proton production as a function of energy. We show that, by itself, the UHECR spectrum does not constrain the cosmic-ray composition at their extragalactic sources. While the propagated composition (i.e., as observed at Earth) cannot contain significant amounts of intermediate mass nuclei (say between He and Si), whatever the source composition, and while it is vastly proton-dominated when protons are able to reach energies above 10^{20} eV at the source, we show that the propagated composition can be dominated by Fe and sub-Fe nuclei at the highest energies, either if the sources are very strongly enriched in Fe nuclei (a rather improbable situation), or if the accelerated protons have a maximum energy of a few 10^{19} eV at the sources. We also show that in the latter cases, the expected flux above 3 10^{20} eV is very much reduced compared to the case when protons dominate in this energy range, both at the sources and at Earth.

Rising optical afterglows seen by TAROT
B. Gendre, G. Stratta, B. Preger, L. Piro, A. Pelangeon, A. Klotz, A. Galli, S. Cutini, A. Corsi, M. Boër, JL. Atteia
(LAM)
we present the multi-wavelength observations of GRB 060904B, 070420, 071010A and 080210. These events present a rising part within their optical light curves lasting a few hundred of seconds. In one case (GRB 060904B), a flare occurs at similar time in the X-ray band, while in the other cases the X-ray light curves appear smooth during the optical rise. We investigate the possible nature of this behavior and conclude that a multi-component emission is mandatory to explain the optical afterglow.

Dark matter searches with HESS : nearby dwarf galaxies and IMBH spikes
E.Moulin,M.Vivier,P.Brun, J-F. Glicenstein
(CEA-Saclay)
WIMP pair annihilations produce high energy gamma-rays in the final state, which can be detected by IACTs such as the H.E.S.S. array of Imaging Atmospheric Cherenkov telescopes. The hadronization and decay of the cascading annihilation products lead to a continuum of high-energy photons whose flux extends up to the dark matter (DM) particle mass. We focus on searches towards dwarf galaxies and mini-spikes around intermediate-mass black holes (IMBHs) in the Galactic halo. H.E.S.S. observations on the nearby galaxies Sagittarius and Canis Major are presented. Using realistic modelling for the dark matter density profiles, constraints on the velocity-weighted annihilation cross section of DM particles are derived in the framework of Supersymmetric (pMSSM) and Kaluza-Klein (KK) models. A search for DM mini-spikes around IMBHs is described as well as constraints on the particle physics parameters in various scenarios

Projet de mesure très précise du rendement de la fluorescence de l'azote de l'air
P. Gorodetzky pour la collaboration JEM-EUSO
(APC - Paris 7)
Our group has measured the fluorescence yield of air with a 5% uncertainty (2-3 times better than other measures), but only for pure air, and at atmospheric pressure and normal temperature. We plan to extend this measurements to pressures down to 0.1 bar and temperatures down to -160°C. We have acquired a new grating spectrometer equipped with a LN2 coolled CCD having one background count per hour and per pixel. After an initial comparison to a photomultiplier of precisely known efficiency, the measurements could be made without requiring a coincidence between the incoming electron of the 90Sr source and the fluorescence photons. Measuring the yield as a function of time would be enough. The effect of impurities (H2O) would also be studied.

How polarization and scattering can reveal geometries, dynamics, and feeding of Active Galacitc Nuclei

Rene W. Goosmann, C. Martin Gaskell, Masatoshi Shoji
(Astronomical Institute, Academy of Sciences)

We present recent applications of the radiative transfer code STOKES to the modeling of Active Galactic Nuclei (AGN). The code is used to understand results from the new technique of polarization reverberation mapping and to explain the blueshifting of the high-ionization emission lines. We discuss implications of our results for the overall picture of AGN.

XMM-Newton's view of the eclipsing burster low-mass X-ray binary AX J1745.6-2901

Nicolas Grosso
(Observatoire Astronomique de Strasbourg)

From March 31 to April 4, 2007, three observations were performed by XMM-Newton as part of a multi-wavelength observation campaign of SgrA* and its neighboring X-ray transient sources. Two bright transient sources in outburst were detected during these observations. We focus here on the transient source in outburst located at about 1.5 arcmin South-West from SgrA*, which exhibited deep eclipses and type-I X-ray bursts. We identify this source with the eclipsing burster low-mass X-ray binary discovered by ASCA, AX J1745.6-2901. These XMM-Newton observations allow us to refine the period of the eclipse and the position of AX J1745.6-2901. Finally, we observed with XMM-Newton for the first time several dips. AX J1745.6-2901 is therefore the first dipper of the Galactic Center region.

The Simbol-X focal plane

P. Laurent on behalf of the Simbol-X collaboration
(CEA/DSM/IRFU/SAp & APC)

Looking at an HESS extended gamma-rays source : HESSJ1837-069

V. Marandon, G. Puhlhofer, D. Hauser, A. Djannati-Ataï, R. Terrier for the HESS Collaboration
(APC-CNRS/IN2P3)

The very high energy (VHE) gamma-ray source HESSJ1837-069 was discovered during the first scan of the galactic plane, and was tentatively associated with the unidentified ASCA source AX J1838-0655 although the offset with the HESS centroid is nearly 0.1°. Recently, thanks to RXTE observations, 70ms pulsations have been discovered from the ASCA source. This pulsar with an age of nearly 23000 yrs, and a spindown power of 5.5e36 erg/s, is a good candidate for the object powering the VHE emission, pushing in favor of a relic pulsar wind nebula interpretation for the HESS object. In the view of this very recent discovery, we will show a new analysis of the source, with nearly 25 hours of more HESS data than previously published. We will discuss the association with the pulsar, and compare it with other VHE gamma-ray emitting pulsar wind nebula.

KHz quasi-periodic oscillations in neutron star binaries

H. Méheut, M. Tagger
(APC)

Twin quasi-periodic oscillations have been observed in the emission spectrum of neutron star binaries. The models that have been proposed do not succeed to explain the frequency difference between the two kHz QPO, which is close but distinct from the rotation frequency of the neutron star. I will present a new model based on the dynamics of the gas trapped in the neutron star magnetosphere.

Suzaku observations of MKN 841 and the soft excess paradigm in Seyfert galaxies
G. Ponti, P.O. Petrucci, G. Matt, M. Mouchet, C. Boisson, A.L. Longinotti, A. C. Gonçalves, L. Maraschi, M. Cappi, P. Ferrando and K. Nandra
(Lab. Astroparticule et Cosmologie)
We show preliminary results of the study of the first of 2 long ($\sim$ 50 ks) Suzaku observations of the bright Seyfert 1 galaxy MKN 841. This source is characterized by a strong soft excess, the first ever detected in a type 1 AGN. It also shows a complex Fe K emission line that, as suggested by past XMM-Newton observations, is composed of a narrow reflection component, probably produced on the torus or the outer regions of the accretion disc, and a narrow variable one most probably produced in the accretion disc close to the central black hole (Petrucci et al. 2007).
In all fitting models we included a primary power law, a neutral iron line and reflection, the latter two components linked together assuming cosmic abundances. The soft excess has been modelled assuming different physical interpretations. In particular, we explored the possibility that it is due to either a relativistic ionized disc reflection (Ross & Fabian 2005) or to a relativistically smeared ionized absorption (Gierlinski & Done 2004). Both models give similar results from a statistical point of view, but the high energy data and the presence of a variable Fe K line seems to favour an ionized disc reflection interpretation for the soft excess in this object.

Is the ejection of the corona a general phenomenom in microquasars ?
J. Rodriguez & L. Prat
(CEA SAp & UMR AIM)
We study the the evolution of two microquasars (XTE J1550-564 and GRS 1915+105) during outbursts and focuss on the interplay between the accretion disc (1-10 keV), the so-called corona (which produces the >10 keV X-rays), and the jet (radio domain). In those two sources, the behaviour seen at those different energies leads us to propose a scenario in which the discrete ejections are triggered in coincidence with soft X-ray peaks. We also suggest that the ejected material is the corona that disappears at the same time. We study other sources to see whether the same conclusions can be drawn from the existing data.

Impact of weather conditions on extensive air showers observed with the Surface Detector of the Pierre Auger Observatory
Benjamin Rouillé d'Orfeuil
(APC)
The surface detector array of the Pierre Auger Observatory measures the density and lateral profile of secondary shower particles arriving at ground level. As the shower develops in the variable atmosphere, these measurements are affected by weather conditions. In particular, the rate of events recorded is found to vary with temperature and pressure at ground level. The effect is due to the increasing amount of matter to be traversed by the shower particles as the ground pressure increases and to the decreasing density in the lower atmosphere as the ground temperature rises, which increases the Molière radius and broadens the shower. We present a model describing the impact of the ground weather parameters on the air shower measurements. The model is validated with air shower simulations using different realistic atmospheric profiles. The rate of events with zenith angles smaller than 60 degrees shows a modulation of 10% due to seasonal variations and 2% due to diurnal variations. These modulations can be explained completely in terms of weather effects on the air shower development.

MgII and CIV absorbers along GRB lines of sight.
Vergani S. and Petitjean P.
(IAP - DIAS)
We present the results of the study of the MgII and CIV absorbers present along the line of sight of GRBs.

Simulation de gerbes atmosphériques du aux rayons cosmiques
K. Werner
(Univ. de Nantes, Subatech)
We present recent developments concerning the simulation of air showers from cosmic rays at the highest energies. Progress is mainly due to new hadronic interaction models, which take into account the wealth of information obtained at the RHIC collider, in addition to the existing data from SPS and Tevatron. Interesting is in particular the fact that considerably more muons are produced compared to older shower simulations.

Session PNP

Oral contributions

How pass through the stellar limitation in the search and characterization of exoplanets with high-precision radial-velocimetry : a succeeding test on HD 189733

I.Boisse, C. Moutou, A. Vidal-Madjar, F. Bouchy, F. Pont, G. Hebrard, X. Bonfils, X. Delfosse, M. Desort, T. Forveille, A.-M. Lagrange, B. Loeillet, C. Lovis, M. Mayor, C. Perrier, F. Pepe, D. Queloz, N. Santos, D. Segransan, S. Udry

(Institut d'Astrophysique de Paris)

Exoplanet search programs requiring high-precision velocity measurements managed to reach the better precision within instrumental domain, currently 3-4 m/s for SOPHIE spectrograph (OHP) and less than 1 m/s for HARPS (ESO). In that case, the first limitation may be astrophysical and most of the active stars are rejected from the candidates catalogs whereas new research instrument like CoRoT that need radial-velocity follow-up find planets around active stars. We need to study the available parameters in spectroscopy to disentangle radial-velocity variations due to Doppler motion to the noise induced by stellar activity related phenomena like spots in the photosphere region. We monitored the active K2V dwarf HD 189733 and his planetary 2.2-day orbital period companion with the high-resolution SOPHIE spectrograph mounted on the 1.93-m telescope at OHP. We refine the HD 189733b orbit parameters and after subtracting the orbital motion of the known planet, we compare the variability of activity spectroscopic indices measured in HeI (5876 Å), Halpha (6563 Å) and Ca II H&K lines (3934 Å, 3968 Å) to the evolution of the radial-velocity residuals and the shape of spectral lines. Then, we monitor the rotation of the spots with the stellar surface and afterwards subtract estimated radial velocity variation induced by stellar activity to reach a better precision in the parameters of the system.

INTERFEROMETRIC MAPPING OF DUST CONTINUUM, HCN AND HNC 3-mm EMISSIONS IN COMET 17P/HOLMES USING IRAM PLATEAU DE BURE.

J. Boissier (IRAM), D. Bockelée-Morvan, N. Biver, J. Crovisier, E. Lellouch, R. Moreno (LESIA-observatoire de Paris)

(IRAM)

We carried out observations of comet 17P/Holmes with the Plateau de Bure interferometer of Institut de RadioAstronomie Millimétrique (IRAM). The observations were performed on October 27 and 28 UT 2008, soon after its outburst of October 24. They include mapping and single-dish measurements of the J(1-0) lines of HCN and HNC at 88.6 and 90.6 GHz, respectively, and mapping of the dust continuum emission at these frequencies (wavelength = 3 mm). The angular resolution was about 6" ($\sim$ 7000 km at the distance of the comet) for both dates. The radial distribution of the continuum brightness from r=3500 to 25,000 km from the nucleus points to a more compact distribution than the 1/r distribution expected for a steady state coma. If one assumes that the mm-sized particles were produced during or soon after the outburst, the radial distribution implies that particles with outflow velocities from $\sim$ 10 m/s to $\sim$ 80 m/s are contributing to the 3-mm radiation. The small evolution of the radial distribution and brightness of the 3-mm continuum radiation between the two days rather suggests a sustained production of mm-sized particles in the days following the outburst, e.g., from the fragmentation of low-velocity chunks. The HCN J(1-0) integrated intensity measured on single dish spectra shows a 25 percent decrease in 9h of observations. On the contrary the flux measured in interferometric mode remains almost constant over this period. This suggests that the HCN emission contains two component : 1) the emission (decreasing with time) of molecules released with high velocities during the outburst and 2) the emission of molecules released in a steady state by the nucleus and the outburst remnants. A first analysis of the HCN data, based on simple modelling, will be presented, as well as preliminary results concerning HNC J(1-0) emission.

The SOPHIE consortium for search and characterization of northern exoplanets

Bouchy, F., Delfosse, X., Desort, M., Hebrard, G., Queloz, D., Udry, S., et al.

(Institut d'Astrophysique de Paris)

The SOPHIE consortium started in November 2006 a large and key program for search and characterization of northern exoplanets with the SOPHIE spectrograph based on the 1.93-m OHP telescope. We present here the status and results obtained within our 5 sub-programs : 1) high-precision search for low-mass planets, 2) search and characterization of hot-Jupiters around bright stars, 3) exoplanets around M dwarfs, 4) exoplanets around early type stars, 5) long period exoplanets.

Lithium depletion and the rotational evolution of exoplanet host stars
J. Bouvier
(LAOG)
Israelian et al. (2004) have reported enhanced lithium depletion in solar-mass exoplanet host stars, a result recently confirmed by Gonzalez (2008). I will present a model of the angular momentum evolution of solar-type stars over the age range from 1 Myr to 4.5 Gyr. I'll show how this model can be used to understand the relationship between the Li abundances of exoplanet host stars and their rotational evolution on the ZAMS. The model also relates early rotational evolution to PMS disk lifetimes and to the timescale for planet formation.

CO in the atmospheres of Saturn and Uranus. Observations at millimeter and submillimeter wavelengths
Cavalié, T. , Billebaud, F., Dobrijevic, M., Fouchet, T., Lellouch, E., Brillet, J., Encrenaz, T., Schieven, G.M., Wouterloot, J.
(Laboratoire d'Astrophysique de Bordeaux)
An external supply of oxygenated compounds exists on outer planets. Carbon monoxide has been detected on each giant planet. The source of CO has been proved to be mainly external on Jupiter and Neptune, but this is still not clear in the case of Saturn and Uranus. Therefore, constraining the amount of CO in the stratosphere and/or high troposphere of these planets would help solve this problem.
We performed observations of Saturn and Uranus at millimeter and submillimeter wavelengths in the CO (1-0), (2-1) and (3-2) lines. Observations were carried out with the IRAM 30-m telescope (Pico Veletta, Spain) in september 2006 (Cavalié et al 2008) and with the JCMT 15-m telescope (Hawaii, USA) in january 2008. We have recorded broad multi-band spectra of each planet using Lellouch et al (2005) observing technique. The results of these observations will be presented and discussed.
References :
Cavalié et al, 2008. A&A, in press
Lellouch et al, 2005. A&A, 430, L37-L40

The chemical diversity of comets : recent results from radio observations.
Jacques Crovisier, Nicolas Biver, Dominique Bockelée-Morvan, Jérémie Boissier and Pierre Colom
(Observatoire de Paris)
A fundamental question in cometary science is whether or not the different dynamical classes of comets are correlated with different chemical compositions. The dynamical classes point to various reservoirs of comets. If these latter are associated with different sites of formation, one would expect a diversity in the chemical compostion of comets, due to different initial conditions.
From the ground or Earth orbit, radio and infrared spectroscopic observations of a now significant sample of comets indeed revealed deep differences in the relative abundances of cometary ices. However, no obvious correlation with dynamical classes is found.
Further results came, or are expected, from space exploration. This mean of investigation, by nature limited to a small number of objects, is unfortunately focussed on short-period comets (mainly Jupiter-family). But it provides ground truth for remote sensing.
We will concentrate here on the chemical differences in comets from our database of spectroscopic radio observations which has been recently enriched by the Jupiter-family comets 73P/Schwassmann-Wachmann 3 and 17P/Holmes, and the Halley-type comet 8P/Tuttle.

Shadow hiding and multiple scattering in the Saturn's rings with Cassini/ISS
Deau E., Brahic A., Dones L., Porco C. C.
(CEA)
We derive from the phase functions of the Saturn's main rings the steepness of the linear part (from 10 to 90 degrees of phase angles) at different phase angle ranges. These steepness show distinct correlations with the optical depth of the rings. This can be understood as the proof that two regimes exist in the phase curves from 10 to 90 degrees of phase angles : firstly, that of the shadow hiding and second, that of the multiple scattering. Finally we compare our findings with numerical simulations of shadow hiding driven by Stankevich et al. (1999) for phase angles smaller than 40 degrees and by Stankevich and Shkuratov (2002) for phase angles larger than 40 degrees.

Mesure Doppler de vents dans l'atmosphère de Vénus

Patrick Gaulme
(LESIA/IAS)

Solar light gets scattered at cloud top level in Venus' atmosphere, in the visible range, which corresponds to the altitude of 67 km. We present Doppler velocity measurements performed with the high resolution spectrometer MTR of the Solar telescope THEMIS (Teide Observatory, Canary Island) on 3 Fraunhoffer lines : D2 sodium (5896 Å), Mg (5173 Å) and Fe (5576 Å). The Doppler measurements are compared to cloud tracking results obtained by Venus express.

Ethane, acetylene and propane distribution in Saturn's stratosphere from Cassini/CIRS limb observations.

S. Guerlet, T. Fouchet, B. Bézard, A.A. Simon-Miller and F.M. Flasar.
(LESIA)

In Saturn's upper atmosphere, methane photolysis by solar UV initiates a complexe hydrcarbon chemistry, which by-products are transported downwards by eddy diffusion. This photochemistry is modulated by Saturn's seasonal cycle. Moreover, the meridional hydrocarbon distribution is also affected by meridional transport, which is still poorly known. We present an analysis of limb data acquired by the Cassini/CIRS (Composite InfraRed Spectrometer) instrument, sensitive in the range 10-1400 cm-1. Spectra were acquired at twenty different latitudes between 80°S and 45°N from March, 2005 to January, 2008, which corresponds to summer in the southern hemisphere. We used a line-by-line radiative transfer model, coupled to an iterative retrieval algorithm, to determine the vertical profile of the temperature (from the methane emission band at 1305 cm-1) at each latitude. Then, this temperature was fixed in the model, so that we derived the volume mixing ratio vertical profiles of various hydrocarbons (ethane, acetylene and propane). Limb geometry allows us to improve the vertical extent and resolution of the retrieved profiles with respect to previous nadir observations. We will compare the meridional and vertical distributions of these chemical species with the photochemical models predictions and will discuss how the mismatches can be interpreted in terms of dynamical phenomena.

Exoplanets search and characterization with the SOPHIE Consortium ; Misaligned spin-orbit in the XO-3 planetary system ?

Hébrard, Bouchy, Pont, Loeillet, Rabus, Bonfils, Moutou et al.
(Institut d'astrophysique de Paris)

The SOPHIE Consortium started a large program of exoplanets search and characterization in the Northern hemisphere with the new spectrograph SOPHIE at the 1.93-m telescope of Haute-Provence Observatory, France. The objectives of this program are to characterize the zoo of exoplanets and to bring strong constraints on their processes of formation and evolution using the radial velocity technique.

We present here new SOPHIE measurements of the transiting planet host star XO-3. This allowed us to observe the Rossiter-McLaughlin effect and to refine the parameters of the planet. The unusual shape of the radial velocity anomaly during the transit provides a hint for a transverse Rossiter-McLaughlin effect, i.e. the sky-projected angle between the planetary orbital axis and the stellar rotation axis is near 90 degrees. This suggests that some close-in planets might result from gravitational interaction between planets rather than migration. This surprising result requires confirmation by additional observations.

Expérience LUCAS (Lumière cendrée en Antarctique par spectroscopie)

S. Jacquemoud, K. Agabi, E. Aristidi, L. Arnold, J. Berthier, E. Bondoux, D. Briot, Z. Challita, E. Fossat, P. Riaud, J. Schneider

(IPGP / Universite Paris Diderot)

The search for life outside our solar system is a major question for the next decades. Future space missions dedicated to the observation of exoplanets will have the capacity to measure biosignatures in the reflected light of habitable planets similar to the Earth. Vegetation is an indicator of the possible presence of life and the Earth an excellent model. Since it is extremely difficult to measure the global spectrum of our planet, several optical spectroscopy experiments have been designed since 2002 to look at the moon from ground-based telescopes and to observe the earthshine. These observations offer a unique opportunity to measure the global and absolutely calibrated albedo of the Earth, where the spectral signature of chlorophyll clearly occurs. Numerical simulations also showed daily variations of the albedo that are due to the sequence of heterogeneous surfaces (oceans and continents), which would give information about the rotation period of the planet. The only way to do such continuous measurements experimentally is to go to the pole or nearby. An original research project called LUCAS (Lumière cendrée en Antarctique par spectroscopie) that consisted in designing an instrument dedicated to the spectroscopy of the earthshine and to put it in Concordia, the new French-Italian facility of Dome C (Antarctic Plateau) was set up in 2007. This paper presents the experiment and the expected results of the project.

Etude comparée de la localisation des sources aurorales Radio (Cassini) et UV (HST) de Saturne

L. Lamy, B. Cecconi, R. Prangé, P. Zarka

(LESIA, Observatoire de Paris)

The Saturnian Kilometric Radiation (SKR) is the most intense kronian radio emission. It is an auroral emission supposedly associated with Saturn's polar aurorae, similar to the auroral kilometric radiation (AKR) at Earth. Here we investigate observations relating the SKR sources to ultraviolet (UV) aurorae. The SKR, which dominates RPWS (Radio and Plasma Wave Science) dynamic spectra, is observed quasi-continuously by the Cassini spacecraft since 2003. In parallel, ultraviolet (UV) aurorae have been observed occasionally by the Hubble Space Telescope (HST). Here, we take advantage of a long HST campaign that took place in January 2007, providing 350 images spread over 13 days. Polar projection of the HST images allow us to directly derive the intensity, latitude and local time of UV aurorae. Assuming that SKR is emitted via the Cyclotron Maser Instability, i.e. close to the local electron gyrofrequency, a goniometric (direction-finding) analysis of the data allows to measure the coordinates of the magnetic footprint of field lines carrying radio sources. Preliminary results confirm the close association between SKR and discrete UV aurorae.

Cold debris disks around low-mass M-dwarfs

J-F. Lestrade

(Observatoire de Paris)

Cold debris disks around low-mass M-dwarfs

A debris disk is evidence for a planetary system around another star because it is made of the remainings of the planet formation processes. We have conducted a search for such cold debris disks around low-mass stars at lambda=1.2mm by imaging the fields of more than 50 M-dwarfs with the bolometer array MAMBO at the IRAM 30m radiotelescope. By combining with other recent surveys conducted by MIPS70/Spitzer and SCUBA/JCMT, we establish that the present detection rate of cold debris disks around M-dwarfs is 4%, i.e. lower than for solar and A- type stars. However, the fractional dust luminosity sensitivity of these M-dwarfs surveys is not yet as deep as it is for other stars but Herschel and SCUBA2 will significantly improve this limit in the near future. We shall discuss mechanisms that could impead debris disk formation around M-dwarfs that are 70% of the stellar content of the Galaxy.

Tidal dynamics of extended bodies

S. Mathis & C. Le Poncin-Lafitte

(CEA/DSM/IRFU/SAp & UMR AIM)

Some extrasolar planetary systems exhibit an innermost planet having semi-major axis lower than 0.1 astronomical unit. Moreover, in the solar system, giant planets are very closed to their internal satellites. Therefore, it is natural in these situations to examine the step beyond the ponctual approximation for the tidal perturber. Using advanced tools for the modelling of the gravitational interaction between two extended bodies, we derive the dynamical evolution equations for such systems in their most general form and we discuss their astrophysical applications.

3D numerical simulations of the Rossby wave instability

H. Méheut, F. Casse, P. Varnière, M. Tagger
(APC)

Models of planet formation do not explain the growth of planetesimals : in certain ranges of grain size collisions are too slow compared to estimated planet formation time. The Rossby wave instability (RWI) may solve this problem by the formation of Rossby vortices in the accretion disk, speeding up the accumulation of grains in their centre (Barge & Sommeira 1995, Tagger & Varnière 2006). Up to now, only 2 dimensions numerical studies of the RWI have been done. I will present the results of 3 dimensions numerical simulations of the non-linear evolution of the RWI in a non magnetized disk and its vertical structure.

Identification of Anthracene in Comet P/Halley

Moreels Guy, Clairemidi Jacques, Mousis Olivier, Bréchignac Philippe
(Institut UTINAM, Observatoire de Besançon)

Polycyclic aromatic hydrocarbons (PAHs) have been detected in many interstellar medium (ISM) sources. They are considered as the most abundant organic compounds in these environments. We aim at identifying the carriers of the near UV fluorescence bands that appear in the spectra of P/Halley's inner coma. Near UV spectra of P/Halley were recorded on March 9, 1986 by the three-channel spectrometer onboard the Vega2 spacecraft at projected distances comprised between 421 and 932 km. We confront these data with laboratory spectra obtained under laser-induced fluorescence conditions in a jet-cooled molecular beam. The cometary spectra features are found consistent with the laboratory fluorescence spectrum of anthracene. Four main peaks coincide at 363, 367.5, 373 and 382.5 nm. We then report the identification of anthracene, a three-ring PAH in the inner coma of P/Halley at projected distances less than thousand km. The abundance of this PAH is estimated to be no more than 1 x 10-4 times relative to water. Recently, three small PAHs, namely naphtalene, phenanthrene and pyrene, were identified in dust grains collected by the Stardust probe in the environment of Comet 81P/Wild2. These findings, together with the present identification of anthracene in P/Halley's near UV spectra, confirm that similarities exist between the composition of comets and that of ISM.

Sequestration of ethane in the cryovolcanic subsurface of Titan

Mousis Olivier, Schmitt Bernard
(Institut UTINAM, Observatoire de Besançon)

Saturn's largest satellite, Titan, has a thick atmosphere dominated by nitrogen and methane. The dense orange-brown smog hiding the satellite's surface is produced by photochemical reactions of methane, nitrogen and their dissociation products with solar ultraviolet, which lead primarily to the formation of ethane and heavier hydrocarbons. In the years prior to the exploration of Titan's surface by the Cassini-Huygens spacecraft, the production and condensation of ethane was expected to have formed a satellite-wide ocean one kilometer in depth, assuming that it was generated over the Solar system's lifetime. However, Cassini-Huygens observations failed to find any evidence of such an ocean. Here we describe the main cause of the ethane deficiency on Titan : cryovolcanic lavas regularly cover its surface, leading to the percolation of the liquid hydrocarbons through this porous material and its accumulation in subsurface layers built up during successive methane outgassing events. The liquid stored in the pores may, combined with the ice layers, form a stable ethane-rich clathrate reservoir, potentially isolated from the surface. Even with a low open porosity of 10% for the subsurface layers, a cryovolcanic icy crust less than 2300 m thick is required to bury all the liquid hydrocarbons generated over the Solar system's lifetime.

Global mapping of Titan's clouds with Cassini/VIMS from July 2004 to December 2007 : clues for incoming climate changes

S. Rodriguez, S. Le Mouélic, P. Rannou, C. Sotin, G. Tobie, J.W. Barnes, M.E. Brown, C. A. Griffith, M. Hirtzig, K.M. Pitman, E.L. Schaller, R.H. Brown, K.H. Baines, B. J. Buratti, R.N. Clark, and P.D. Nicholson
(Laboratoire AIM, Université Paris7/CEA/CNRS)

We present here the first comprehensive mapping of the occurrence and location of Titan's clouds, detected thanks to their spectral signatures in the complete Cassini/VIMS (Visual and Infrared Mapping Spectrometer) data archive between July 2004 and December 2007. During this period, which includes the beginning of the transition between the south summer solstice and the spring equinox, we have detected more than one hundred cloud events. These clouds are clustered in latitudes in three specific regions : 1) The South Pole with 9-month periodic bursts, 2) long-lived large clouds at the North Pole, 3) transient temperate clouds centered around 40°S, uniformly distributed in longitudes. The VIMS observations reported here are consistent with a control of the cloud spatial distribution by the global atmospheric circulation patterns rather than by possible geographic distribution of methane sources at the surface. The cloud's southern activity tends to fade with time, as the forthcoming Titan equinox nears. If so, spectacular meteorological events like the disappearance of southern clouds and the sudden toppling over of the meteorological events towards the northern hemisphere should be observable during the Cassini extended mission.

Do clathrate hydrates have any influence on the atmosphere of Mars ?

Thomas, C., Mousis, O., Picaud, S., Ballenegger, V.
(Institut UTINAM)

Recent observations have evidenced traces of methane (CH4) heterogeneously distributed in the Martian atmosphere [1]. However, because the lifetime of CH4 in the atmosphere of Mars is estimated to be around 250-430 years on the basis of gas-phase chemistry [1], its actual sources on Mars remain controversial. Among other assumptions, it has been proposed [2] that clathrate hydrates located in the subsurface of Mars could be at the origin of the small quantities of CH4 detected. In the present work, we have thus calculated the relative abundance of CH4 in clathrate hydrates on Mars, using a statistical model based on the theory of van der Waals and Platteeuw [3]. The results show that methane enriched clathrate hydrates could be stable in the subsurface of Mars only if a primitive CH4-rich atmosphere has existed or if a subsurface source of CH4 has been (or is still) present.

[1] Krasnopolsky, V. et al. 2004, Icarus, 172, 537 [2] Chastain, B. K. & Chevrier, V. 2007, Planet. Space Sci., 55, 1246 [3] van der Waals, J.H. & Platteeuw, J.C. 1959, Adv. Chem. Phys., 2, 1

Poster contributions

Recent observations of the OH 18-cm lines in comets with the Nançay radio telescope.

Pierre Colom, Jacques Crovisier, Nicolas Biver and Dominique Bockelée-Morvan (Observatoire de Paris)
(Observatoire de Paris)

The OH 18-cm lines are systematically observed in comets with the Nançay radio telescope since 1973. These observations allow us to evaluate the cometary water production rates and their evolution with time, and to study several physical processes such as the excitation mechanisms of the OH radio lines, the expansion of cometary atmospheres, their anisotropy in relation with non-gravitational forces, the Zeeman effect in relation to the cometary magnetic field. Between 1973 and 1999, 52 comets have been successfully observed at Nançay. The radio telescope has been upgraded in 2000, and observations are now made with a sensitivity increased by about a factor of two. As of beginning of 2008, the returns of 38 comets were observed at Nançay with the refurbished instrument. The observations are organized in a data base ; the part from 1982 to 2002 is publicly available (http ://www.lesia.obspm.fr/planeto/cometes/basecom/). New analyses of the OH line shapes in terms of coma expansion velocity and of the correlation between visual magnitudes and OH production rates have been performed. Among the last comets observed at Nançay are 9P/Tempel 1 prior to its visit by Deep Impact, the two main fragments of 73P/Schwassmann-Wachmann 3 during their passage close to the Earth in 2006, 17P/Holmes just after its outburst in October 2007, and 8P/Tuttle in winter 2007-2008, also during its close approach to the Earth.

Transport atmosphérique et ondes dans les atmosphères en superrotation

A. Crespin (1), S. Lebonnois (1), F. Hourdin (1) (1) Laboratoire de Meteorologie Dynamique/IPSL, Jussieu, Paris, France
(Laboratoire de Météorologie Dynamique)

The present paper tries to caracterise planetary waves in a numerical simulation of the Venus atmospheric dynamics, performed with a General Circulation Model developed recently by our team.
We can first separate low frequency waves such as thermal tides (diurnal and semi-diurnal tides) and high frequency waves. These two families of waves are well-caracterised by their propagation : thermal tides propagate eastward (following the sun) and vertically from the middle of the clouds (in the maximum solar heating layer) while high frequency waves propagate westward
(in the same direction than the solid planetary rotation).
Thermal tides are centered on equatorial regions whereas high frequency waves are modeled in high latitudes (at around 60 degrees) above the clouds (around 65 km) and in equatorial regions below the clouds (around 20 km). These different locations of high frequency waves suggest the presence of both equatorial Kelvin-like wave and mid-latitude Rossby-like wave.
Two main groups of high frequency waves are predominant : waves with periods
smaller than 8 Earth days and waves with periods between 10 and 30 Earth days. A 4-Earth day period wave has been found in the GCM in equatorial region below the clouds, which seems to contribute significantly to horizontal angular momentum transport.
We show in particular that these high frequency waves transport angular momentum horizontally towards equator at 50 km, in good agreement with what
can been retrieved with Eliassen Palm flux diagnostics.
Passive tracers are also used to diagnose transports by waves and mean meridional circulation. This equatorward transport is a key component of the angular momentum budget, needed to explain the superrotating regime.

Legacy of the Cassini/ISS nominal tour : Evolution of the spiral of the Saturn's F ring from 2004 to 2008

Deau E., Brahic A., Charnoz C., Porco C. C.
(CEA)

From june 2004 to now, the ISS cameras of the Cassini spacecraft provided dozen of movies that follows the F ring in a resticted window in the inertial frame of Saturn, at different phase angles and spatial resolution. We used a method to combine images of one movie in the same mosaic, by using the orbital model of Bosh et al. (2002). The mosaics are well made with this orbital model, even using images of 2km/pixel of azimuthal resolution. The spiral of the F ring disvovered by Charnoz et al. (2005) is still visible in the mosaics. However the spiral' shape changed significantly from 2004 to 2008, which can be regarded as a consequence of the short time evolution of the spiral.

Doppler Spectro Imager for jovian seismology and aeronomy in Cosmic Vision context

P. Gaulme, F.X. Schmider, P. Drossart, B. Mosser, A. Coradini, O. Mousis, Y. Alibert, T. Appourchaux, P. Lognonné, J. Gay, J.P. Maillard, T. Guillot

(LESIA/IAS)

If boarded on the JGO spacecraft, the Doppler spectro-imager (DSI), essentially a Fourier transform spectrometer, will perform measurements that will allow to study global oscillation modes of Jupiter, of unique interest to confirm the existence and size of a core at Jupiter, and retrieve the density profile and degree of chemical mixing of Jupiter's interior, including the distribution of heavy elements, in complement to the gravimetry measurements planned by NASA's JUNO mission.

La spectroscopie du bruit thermique dans la magnétospère interne de Saturne-Cassini/RPWS.

Magda Evgenia Gkini, Michel Moncuquet, Nicole Meyer-Vernet

(Observatoire de Paris-Meudon/LESIA)

On July 2004, the Cassini spacecraft performed its Saturn orbit insertion (SOI). Since then and for 4 years Cassini will orbit the planet nearly 80 times, with various periapsis (so called perikrones) and inclinations. This work is interested in the closest approaches of Saturn by Cassini, i.e. the trajectory part located around the perikrones,typically between 3.5Rs and 9Rs. Around each of these perikrones, the radio-HF receiver of RPWS, observed a peak at the upper-hybrid frequency and weakly banded emissions having well-defined minima at the gyroharmonics. We have studied these spectra by using the technique of the quasi-thermal noise spectroscopy in magnetized plasmas and from that we deduced the electron density, the core and the halo temperatures in the inner magnetosphere of Saturn. We present the results for 19 perikrones, which have been accomplished during the period 02/2005-02/2008. We examine the anticorrelation between the temperature and the electron density. We show the dependence of those parameters on the distance from the planet and on the inclination related to the ring plane. From the latter we will be able to have a clear view of the large scale structure of the plasma torus in this region of Saturn's magnetosphere (embedded in the dusty ring E), which is not well known, especially because it is rather cold (typically a few eV for the core electrons) and thus hardly accessible to particle analyzers.

Nuclear spin conversion of a molecule of astrophysical interest in rare gas matrices : methane

Anica Lekic, Joël Stienlet, Cédric Pardanaud, Xavier Michaut, Jean-Hugues Fillion, Anne-Marie Vasserot and Luce Abouaf-Marguin
(LPMAA - Université Paris 6)

Methane and other hydrogenated molecules of astrophysical interest like H2, H2O, H2CO, NH3, CH3OH, or C2H4 play an important role for the chemistry in the insterstellar medium (ISM) and in the protosolar nebula. Because of the spin $\frac{1}{2}$ of the protons, these molecules exist in different nuclear spin configurations. In case of four protons as it is for methane, they are called ortho, para and meta isotopomers depending whether the total nuclear spins are I=1, I=0 or I=2, respectively. Due to the Pauli's exclusion principle and the properties of symmetry of the rovibrational molecular wave functions of the molecule, each species can be identified by its own rotation-vibration spectrum. In gas phase, each rotational state is then associated with only one of the nuclear magnetic species. In the high temperature limit (>50 K), it is known that 56.25% of the molecules are ortho, 31.25% are meta while 12.5% are para. Below 50 K, the E/A and F/A ratios become strongly temperature dependent. From these ratios of molecules measured in cometary comae [1, 2] or in dark clouds [3], it is expected to determine the formation conditions of molecules in space, and especially the formation temperature. As a first step before studying ices of astrophysical interest, we have investigated the parameters involved in the nuclear spin conversion of methane isolated in rare gas matrices at low temperatures (between 4.9K and 20 K). In these environments, the hydrogenated molecule vibrates and rotates almost freely within the cage made of rare gas atoms [4]. We present here a study, in the mid-infrared, of CH4 in rare gas matrices. The spectra were recorded in the frequency range 400-4000 cm-1 with resolution of 0.15 cm-1 using a Bruker 113V FTIR spectrometer. After a fast cooling from 20 K to 4.9 K, populations of the nuclear spin species did not follow the Bolztmann distribution due to slow nuclear spin conversion. Following the time evolution of the transitions associated with the one or the other species, we have measured characteristic times of nuclear spin conversion in various conditions. At 4.9 K in Ar matrices, we observed an acceleration of the nuclear spin conversion of methane as the concentration of molecules in the sample increased. We expect to observe the same phenomenon for other rare gas matrices. Calculations performed by our group in the case of H2O show clearly that intermolecular magnetic interactions are responsible for this concentration dependence. For more diluted samples, we measured a characteristic times (100-700 minutes) depending of the molecule and the rare gas atom. In case of methane, we observed that rare gas can be stabilized in FCC or HCP crystalline structures for which the measured times are clearly different. The environment of the molecule seems to play a crucial role on the nuclear spin conversion of hydrogenated molecules. It is then surprising that characteristic times in cryogenic matrices are much shorter than months estimated in ice by Tikhonov and Volkov [5] at 77 K.

References

[1] J. Crovisier, Faraday Discuss. 109, 437 (1998).
[2] H. Kawakita et al., Astrophys. J. 623, L49 (2005).
[3] J. E. Dickens, and W. M. Irvine, Astrophys. J. 518, 733 (1999).
[4] X. Michaut, A.-M. Vasserot, and L. Abouaf-Marguin, Vib. Spectrosc. 34, 83 (2004).
[5] V. I. Tikhonov, and A. A. Volkov, Science 296, 2363 (2002).

Collision-induced thermodynamic evolution of planetesimals in the primordial Edgeworth-Kuiper Belt

U. Marboeuf, J.-M. Petit and O. Mousis
(Institut UTINAM - Osbervatoire de Besancon)

Kuiper Belt Objects and cometary nuclei are considered to be among the most primordial objects of the outer Solar system. However, the composition of these bodies may not reflect that of the primordial planetesimals since they might have experienced some physico-chemical differentiation, due to the heating of impacts. Here, we examine the implications of collisional effects on the physical and chemical differentiation of the planetesimals located in the primitive Edgeworth-Kuiper Belt by using a cometary nucleus model that ensures conservation of mass and energy during and after the impact. We then discuss the influence of the composition (dust fraction and CO/H2O ratio) and of the adopted values for heat capacity and conductivity within the matrix.

Photochemical Enrichment of Deuterium in the Atmosphere of Titan - New lights from Cassini-Huygens

Moudens A., Cordier D., Mousis O., Lunine J.I., and Vuitton V.
(Institut de Physique de Rennes, Equipe Astrochimie Expérimentale)

The interpretation of the D/H ratio measured in methane in the atmosphere of Titan is not straightforward. All the determinations indicate values substantially higher than the protosolar value, namely the value in the hydrogen of the solar nebula, but less than the values in water in the Earth's oceans (SMOW) and in comets. Here, we reinvestigate the scenario of photochemical enrichment of deuterium in the atmosphere of Titan initially proposed by Pinto et al. (1986) and Lunine et al. (1999), which is based on the possibility that the initial methane reservoir accessible to the atmosphere was larger than what is seen today, in light of the recent Cassini-Huygens measurements. We use the methane mole fraction and density atmospheric profiles resulting from data collected by the Huygens probe during its descent in Titan's atmosphere (Niemann et al. 2005 ; Fulchignoni et al. 2005) to better constrain the actual mass of methane. Moreover, we utilize the most recent determination of D/H from Cassini/CIRS infrared spectra (Bézard et al. 2007). All these considerations, together with the use of a rate coefficient for methane loss reactions derived from recent photochemical models, allow us to show that the photochemical enrichment of deuterium is not efficient enough in the atmosphere of Titan to explain its current D/H value, even if the current atmospheric reservoir of methane is postulated to exist since 4.5 Gyr. This requires that the D/H ratio in methane was already higher than the protosolar value at the time of its trapping in the ices ultimately accreted by proto-Titan, or that unknown fractionation processes occurred in the satellite's interior.

Aurores polaires UV comparées de Jupiter et Saturne

Laurent Pallier, Renée Prangé
(Observatoire de Paris-Meudon)

La mise en orbite autour de Saturne de la sonde Cassini en 2004 et les nombreuses images UV de la planète aux anneaux réalisées par le télescope spatial Hubble ont permis de faire progresser nos connaissance des conditions physiques qui conditionnent les aurores polaires UV kroniennes. Nous résumerons les caractéristiques des aurores UV de Saturne et nous les comparerons à celles de Jupiter, "archétype" des aurores des planètes géantes du Système solaire.

Session PNST

Oral contributions

Ejections Coronales de Masse : premiers résultats de STEREO
F. Auchère
(Institut d'Astrophysique Spatiale)
The STEREO mission, launched in october 2006, produces continuous stereoscopic observations of the Sun and the inner heliosphere. After a year an a half of operations and the separation angle of the two probes being now about 55 degrees, we can make a first review of what STEREO is telling us about coronal mass ejections.

TARANIS : a microsatellite project dedicated to the study of impulsive transfers of energy between the Earth atmosphere, the ionosphere and the magnetosphere
E. Blanc, F. Lefeuvre, J.L. Pinçon
(CEA/DASE/LDG)
Taranis (Tool for the Analysis of RAdiations from lightNIngs and Sprites) is a CNES microsatellite project in phase B. The main scientific objective is to compare observations of TLEs (Transient Luminous Events) with observations of terrestrial TGFs (Transient Gamma Flashes), electromagnetic and electrostatic emissions, and energetic electrons, in order to investigate physical mechanisms allowing impulsive transfers of energy between the neutral atmosphere and the ionospheric and magnetospheric plasmas. The science objectives include : characterization of TLEs (Transient Luminous Events including sprites, jets elves and halos) and TGFs (Terrestrial Gamma ray Flashes), global mapping and occurrence rates, relation of TLEs, TGFs, associated electromagnetic emissions and high energy electrons in order to determine the source mechanisms, determination of triggering factors and formation conditions, characterization of the parent lightning that cause TLEs and TGFs and precipitate electrons, investigation of Wave Plasma Interactions leading to precipitated (LEP) and accelerated (runaway) electrons, effects on the radiation belt of low altitude sources, tracking of the variability of the radiation belts from electron and wave measurements, effects on thermospheric parameters (ionisation rate, NOx, O3). Measurements on board the satellite will be associated with ground based observations. The scientific payload includes two imagers and three photometers with observation bandwidths in UV and IR, selected to differentiate lightning and TLEs by their different atmospheric absorption. It also includes an X and gamma ray detectors, electric and magnetic sensors and two high energy electron detectors.

The physical interface and code coupling project in solar physics : a first step toward linking the inner and outer solar magnetism
A.S. Brun and the working group on the solar physical interface
(DSM/IRFU/SAp & UMR AIM)
We will present a recent effort within the national Sun-Earth program to progress toward a dynamical coupling of multi-D simulations of the inner and outer solar magnetism. This talk will present a group effort over the last two years to identify test cases that we believe will improve our understanding of the physical interface found at the solar surface. The main purpose is to understand how the dynamo generated inner magnetic field emerge and influence the external dynamics.

Coupling two MHD domains : the case of solar dynamo and corona
roland grappin, rui pinto
(Observatoire de Paris - Luth)
How does the evolving magnetic field produced by solar activity (the solar dynamo) change the atmosphere (corona and solar wind) ? We consider here both stationary states and time-dependent coupling What are the best (ideal) methods ? Wrong ones ? Compromises ? Some previous works are criticized, and some new results presented.

Wave coupling in the solar wind during a type III

P. Henri, C. Briand, A. Mangeney, K. Goetz
(LESIA, Observatoire de Paris, CNRS, UPMC, Université Paris Diderot - Università di Pisa)

The TDS (Time Domain Sampler) observation mode of the SWAVES experiment on board STEREO enables to study high resolution in-situ electric field waveforms in the solar wind. We focus here on a type III event which electron beams crossed the STEREO spacecrafts.
Locally, there is evidence for three-wave coupling involving langmuir waves, the pump being generated by type III electron beams, and ion acoustic waves.
On several TDS events, the three waves show the expected resonant relations on doppler-shifted frequencies in case of three wave interaction, and bicoherence studies show a good phase coupling between the three waves. On each event, the whole coupling is entirely covered by TDS measurements, which gives the spatial dimension of the coupling.

Flux emergence in a 3D spherical convective shell : the role of surface boundary conditions

L. Jouve and A.S. Brun
(DSM/IRFU/SAp & UMR AIM)

We present the first 3D MHD study of the non-linear dynamical evolution of magnetic flux tubes in a turbulent rotating convection zone in spherical geometry, using the ASH code. In rotating convection, mean flows such as differential rotation and meridional circulation are naturally present and potentially influence the evolution of the tube-like structure. We seek to understand the mechanism of emergence of strong toroidal fields through a turbulent layer from the base of the solar convection zone to the surface as active regions. We find that if the tube is sufficiently strong, it rises almost radialy independently of the initial latitude. In weaker B cases, downflows and upflows control the rising velocity of particular regions of the rope and could in principle favour the emergence of flux in Omega-loop structures. We compare the dynamical and morphological properties of emerging regions in a case where the surface boundary condition is an impenetrable wall and in a case where we introduce an isothermal atmosphere at the top. We find that in both cases, bipolar spots are being created and present particular orientation that depends on how much the structure is arched. We also find that the pressure drop and the subsequent decrease in the plasma beta influence the rise velocity of the tube, its expansion in the upper layers of the domain and the intensity of the magnetic field in the emerging bipolar spots.

Flux emergence, MHD reconnection and accelerated particles

S. Masson,G. Aulanier,E. Pariat, K-L. Klein
(Observatoire de Paris-LESIA)

To perform a MHD simulation of the evolution of the corona driven by the evolution of a photospheric boundary, a key aspect is the definition of the boundary conditions in order to reach a good compromise between physical conditions and numerical constraints.
In this work we focused in the simulation of a confined flare observed on the Nov 16, 2002.
We took an initial uniform temperature corona with a potential magnetic field calculated by extrapolation from SOHO / MDI magnetogramm.
Then, we introduced a photospheric velocity field at the bottom boundary of the numerical box associated to the photosphere so as to mimic the flow pattern associated to the flux emergence observed in MDI's data.
The combination of "slipping reconnection" in a halo of QSLs surrounding a 3D null point through which a "fan reconnection" regime takes place, which explains both the circular and the elongated nature of the EUV flare ribbons observed with TRACE as one assumes that the latter are due to the chromospheric impact of particules accelerated while field lines pass through the reconnection layers.
This approach, imposing a velocity field at photospheric level, has successfully reproduced the observed characteristics of this event.
Moreover, with this kind of approach we should also be able to simulate the evolution of a magnetic topology with opened lines and so have a better understanding of the temporal evolution of the injection in the interplanetary medium of particles accelerated during the reconnection.

The magnetic field of solar prominences

Frédéric Paletou
(Université de Toulouse, LATT, CNRS)

Solar prominences (filaments) are dense and cool structures hanging in the hot and tenuous corona. They are often at the source of coronal mass ejections, and their magnetic field very likely plays a major role in the triggering of those instabilities leading to the initiation of such large plasma ejections. Recent results upon the magnetic field pervading solar prominences will be reviewed.

Le micro-satellite DEMETER : 4 ans en orbite
Michel PARROT
(LPCE/CNRS)
DEMETER is an ionospheric micro-satellite launched on a polar orbit at an altitude of 710 km. Its main scientific objective is to study the ionospheric perturbations in relation with seismic activity, and then, its scientific payload allows to measure electromagnetic waves and plasma parameters all around the Earth except in the auroral zones. In a first time, the paper will briefly describe the payload, the operations, and the scientific mission center where the data are processed. Then, the main scientific results obtained since 4 years will be shown : 1) decrease of the electric field intensity in the frequency range 1 - 2.4 kHz a few hours before earthquakes, 2) characterisation of the waves emitted by the electric networks at the surface of the Earth, 3) role of the VLF transmitters in the ionospheric perturbations, 4) study of HF and VLF waves linked to the thunderstorm activity and of their effects on the energetic particles, 5) identification of a new type of waves observed during large magnetic storms, and 6) study of waves observed during HF ionospheric heating at high latitudes.

Energetic particles in the inner Heliosphere
M. Pick, D. Lario
(Observatoire de Paris)
The energetic particle populations in the heliosphere include particles from different origins. The Ulysses spacecraft, with its eccentric orbit over the solar pole, allows studying the characteristics of these populations at low and high latitudes and their variations over the solar cycle. During the solar minimum, the structure of the inner heliosphere is simple and the energetic particles find predominantly their origin in Coronal Interaction Regions (CIRs) formed at the interface between fast and slow solar wind streams. Near the maximum, the heliospheric structure is much more complex. Many Solar Energetic Particle events (SEPs), which originate near the sun are observed in association with Coronal Mass Ejections (CMEs) and flares. The particle fluxes measured simultaneously in the late phase of large SEP events by widely separated space crafts often present equal intensities and evolve similarly in time ("reservoirs"). The observations of energetic particle reservoirs suggest an efficient distribution of particles in the inner heliosphere.

Photospheric Flows around a quiescent filament, effects on filament destabilization
Roudier Th, Molodij G., Meunier N., Malherbe JM, Rieutord, M Schmieder B, Bommier V, Keil S, Svanda M.
(Observatoire Midi Pyrénées)

We study the horizontal photospheric flows below and around a filament and alos the large scale motions on the destabilization on that filament. We show that the photospheric motions contribute to form parasitic polarities. We find some link between changes in surface flow and the disappearence of the eruptive filament.

Possible creation of net circular polarization and not only depolarization of spectral lines by isotropic collisions
Jiri STEPAN (1) (2) et Sylvie SAHAl-BRÉCHOT (1) (1) Observatoire de Paris, LERMA UMR CNRS 8112, 5 Place Jules Janssen, 92195 Meudon CEDEX, FRANCE (2) Astronomical Instiute, Academy of Sciences of the Czech Republic, v.v.i. Fricova 298, 25165 Ondrejov, Czech Republic
(Observatoire de Paris-LERMA)
We will show that isotropic collisions of electrons and protons with neutral hydrogen in the presence of a magnetic field can lead to creation of net orientation of the atomic levels. Consequently, the emitted Stokes-V profile of the spectral lines can be almost symmetric in contrast to the typical antisymmetric signature of the Zeeman effect. Moreover, the amplitude of the symmetric lobe can be significantly higher than the amplitude of the antisymmetric components. This mechanism is caused by a symmetry breaking of the collisional transitions between different Zeeman sublevels. We will show an example of our first results for the H-alpha line. This new mechanism could perhaps explain the net circular polarization of spectral lines observed in some solar limb observations and which are currently not understood. However, our results are very preliminary and more developments are needed for going further on.

Role of the helicity in the filament formation

Schmieder,B., Aulanier, G.
(LESIA Observatoire de Paris)

A very simple law does exist for the chirality of filaments : commonly dextral/sinistral filaments are in the North/South hemisphere. Different methods are proposed to measure the chirality of filaments such as the orientation of feet, barbs, fibrils. Observations show that segments of the same chirality join together and form a long filament, segments of different chiralities never merge. With flux tube models of filaments, it was suggested that the dextral filament, as we saw in our observations, has negative helicity and a relationship between its formation and the close by sunspot with the same sign of helicity. This was confirmed by MHD simulations of the intersection between a pair of distinct prominences formed by photospheric line-tied shearing of 2 separated dipoles. One case was typical of solar observations of prominences merging, in which the prominence have the same axial field direction and sign of magnetic helicity

The PICARD Mission

Gérard Thuillier and the PICARD team
(Service d'Aéronomie du CNRS)

The PICARD mission will measure the total and spectral solar irradiance, solar diameter, limb shape, solar asphericity, and helioseismic waves. These measurements are key inputs to validate solar models and to understand the origin of the solar activity, in particular the role of the magnetic fields. These measurements will be carried out by two absolute radiometers, three sunphotometers, and an imaging telescope onboard a microsatellite built by the French Space Agency CNES. The radiometers are similar to the ones on board SOHO, and will contribute to understand the discrepancy (5 W/m^2) between the SORCE measurements and all other measurements obtained at the same time. The imaging telescope contains an angular reference allowing a permanent control of the instrument geometric scale, which is referred to angular stars distances by rotating the spacecraft. Optical distorsion and flatfield of the imaging telescope are regularly measured. The measurements carried out by the sunphotometers and the imaging telescope use the same wavelengths. Past and present solar diameter measurements on the ground revealing discrepancies among results with solar activity, to understand the role of the atmosphere, ground-based instruments will be also run during the mission allowing PICARD to extent its domain of interest to atmospheric physics by comparing ground and space simultaneously measured as well as the atmospheric turbulence by a dedicated instrument. The state of development of the instruments will be presented as well as the PICARD mission center, which will process data to generate preliminary results for scientific analysis. In parallel with the instrumental preparation, solar and climate modeling are in development, in particular the latter by implementation of the solar variability in a GCM coupled stratosphere model. PICARD and the NASA Solar Dynamics Observatory will be in space at the same period for complementary and simultaneous measurements. Given the specific observations of each mission, a strong synergy exists between these two programs. PICARD is scheduled for launch in June 2009.

The GOLF-NG first light : a new exploration of the solar atmosphere

S. Turck-Chièze and the international GOLF-NG team
(Commissariat Energie Atomique)

In complement to the PICARD mission, a french-spanish consortium has developed a prototype of the instrument called GOLF-NG, the successor of GOLF.
It is the first resonant multichannel spectrometer which can observe the Sun in the sodium line every second at eight heights in the atmosphere with two objectives : - a better detection of the low degree helioseismic modes in reducing the influence of the granulation noise, - a better description of the characteristics of the granulation in the solar atmosphere and its time variation along the solar cycle between 200 and 700 km above the photosphere.
The prototype is now sent to Tenerife for a day after day observation of the Sun. These observations will begin in June so we shall show in the meeting the first performances of this prototype. We will illustrate the information we will study thanks to the use of 1 solar cycle observations of the GOLF data.
Finally we will recall the final scientific performances we hope to get with GOLF-NG II and how we hope to observe during the PICARD mission to progress on the Sun-Earth relationship with the different instruments available.

The Ulysses contribution to our knowledge of the heliosphere

I. Zouganelis
(LESIA - Observatoire de Paris / CNES)

Understanding of the integrated Sun-heliosphere system has been transformed by the European-built Ulysses spacecraft, the only mission to explore the heliosphere in three dimensions and overcome the limitations of measurements restricted to the vicinity of the ecliptic plane. After more than 17 years in space? almost four times its expected lifetime? the mission came to an end in 2008 and scientists are trying to squeeze the very last drops of science out of it.

In this review, I will summarize the groundbreaking discoveries of Ulysses, some in areas that were not even imagined when this visionary solar mission was first planned in the 1970s. Some exciting topics including unexpected magnetic field topology, composition and ionization state, particle acceleration and dust dynamics will be discussed. I will show the knowledge state of the heliosphere after a solar cycle with Ulysses and insist on what we still have to learn.

Poster contributions

Explosive events in the not-so-quiet Sun : the Hinode view.
Raphael ATTIE, Dr. Davina INNES.
(Max Planck Institute for Solar System Research)
Coaligned observations between Hinode and Soho were made from the photosphere to the lower corona in the quiet Sun. We present a new description of the couplings between the plasma and the magnetic field during explosive events. They are first detected using transition region lines in SUMER/Soho spectra and in X-ray images with XRT/Hinode. Photospheric flows are then calculated using the FG-SOT/Hinode images of the granulation in Blue Continuum. They are compared with the magnetic data from both MDI/SoHo and CaII images from FG-SOT. In this way, we reveal an important contribution of quiet-Sun eruption events in coronal heating.

Bipolar electrostatic structures in the solar wind
Briand C., Mangeney A., Bougeret J-L., Goetz K.
(LESIA, Observatoire de Paris)
Bipolar electrostatic structures are frequently observed in magnetospheric environment. They were also detected in the solar wind and associated with local potential jumps. We present here new observations of bipolar electrostatic structures obtained with STEREO in the quiet solar wind. A preliminary analysis of the characteristics of the structures is presented together with a comparison with observations with WIND.

Turbulence in anisotropic MHD plasmas
E. Buchlin, A. Verdini, M. Velli, P. J. Cargill
(IAS)
An alternative approach is presented to overcome the limitations of Direct Numerical Simulations (low Reynolds numbers and small statistics for any reasonable computational cost), providing insight into the statistical properties of highly-turbulent, intermittent, anisotropic MHD turbulence : a set of shell-models coupled by Alfvén waves travelling along the axial magnetic field and which interact non-linearly, producing perpendicular fluctuations of the fields at small scales. This model can be applied to different physical situations ; we present the cases of heating in solar coronal loops, and of turbulence in open coronal regions at the base of the solar wind. In these cases, different profiles of the heating and of the properties of turbulence are obtained, depending on the imposed stratification of the solar atmosphere (density and axial magnetic field).

Detection of a plasmaspheric wind in the Earth's magnetosphere
Iannis Dandouras
(CESR)
The existence of a plasmaspheric wind in the Earth's magnetosphere, steadily transporting cold plasmaspheric plasma outwards across the geomagnetic field lines, has been predicted on theoretical basis (Lemaire and Shunk, 1992 ; André and Lemaire, 2006). Direct detection of this wind has, however, eluded observation in the past. Analysis of ion measurements, acquired in the outer plasmasphere by the CIS experiment onboard the four Cluster spacecraft, provide now the first experimental confirmation of a plasmaspheric wind. This wind was systematically detected during quiet and moderately active conditions, and could provide a substantial contribution to the magnetospheric populations outside the Earth's plasmasphere.

Impact of Large-Scale Magnetic Fields on Solar Structure
Duez V., Mathis S., Le Poncin-Lafitte C., Brun A.S. & Turck-Chièze S.
(CEA Saclay - AIM)
With the ongoing development of the Sun-Earth interaction studies and the coming launch of PICARD, it is of primordial importance to constrain the processes at the origin of the solar variability. We here focus on the impact of large scale magnetic fields on the solar structure from its core up to its surface, by treating (semi) analytically the MHS equilibria of a self-gravitating spherical shell. Then, the modifications of the internal structure of the Sun introduced by such a field are deduced, and the resulting multipolar gravitational moments are obtained.

Extension of the Kolmogorov 4/5's theorem to Hall-MHD with an application to the solar wind
Sébastien Galtier
(IAS, Université Paris-Sud)

The 630 nm Fe I line formation depths measured by interspectral analysis with SOT instrument.
Grec C., Faurobert M., Aime C., Uitenbroek H.
(UMR 6525 H. Fizeau, Univ. Nice Sophia Antipolis, CNRS, OCA)
To be given.

Low-Frequency Solar p Modes in Spatially Resolved Observations using m-Averaged Spectra
D. Salabert, J. Leibacher, T. Appourchaux
(IAS et National Solar Observatory)
The GONG and MDI global helioseismology pipelines provide solar acoustic mode parameters for 108- and 72-day time series respectively by fitting the $2\ \ell + 1$ individual-m spectra of a given (n, l) multiplet either individually (GONG) or simultaneously (MDI). Our knowledge of the variable solar interior through helioseismic observations derives primarily from these two analysis pipelines. We have developed a new method to extract the mode parameters by adjusting the rotation- and structure-induced frequency shift for each m-spectrum to minimize the mode width in the m-averaged spectrum. The m-averaged spectrum appears to be a powerful tool for low signal-to-noise-ratio modes in the low-frequency range where the modes have very long lifetimes. Indeed, in the case of spatially-resolved helioseismic data (MDI, GONG, HMI), for a given multiplet (n, l), there exist $2\ \ell + 1$ individual- spectra, which can result in an average spectrum with a SNR $\gg 1$ even when the individual-m spectra have a SNR < 1. We show here that the m-averaged spectrum technique, applied to the GONG 108-day and MDI 72-day time series, gives us access to a whole new range of predicted, low-SNR modes that had not been success fully fitted by the current MDI and GONG peak-fitting pipelines. We show that the modes that are measured by both techniques are extracted without bias. We apply this technique to 360-, 720-, 1080-, and 1440-day long GONG time series to infer the variability of the mode parameters with solar activity in the low-frequency range below approximately 1500 microHz.

Non stationarity of quasi-perpendicular collisionless shocks : comparison between observations and simulations
Christian Mazelle, Bertrand Lembège and Audrey Morgenthaler
(CESR / Univ. Toulouse - CNRS)
Both numerical simulations and experimental observations (CLUSTER) have evidenced that the front of quasi perpendicular shocks may be strongly stationary or nonstationary according to the plasma conditions. Simulations have evidenced several different mechanisms responsible for this nonstationarity both on macro- (ion) and micro- scales. The fact that several mechanisms can coexist together make a clear diagnosis quite difficult. The present work focuses on experimental CLUSTER data where macroscale nonstationarity is evidenced and identified as being due to the shock front self reformation driven by the accumulation of reflected ions. Detailed analysis is performed based on many criteria accumulated from a collection of previous 1D and 2D PIC simulation. In particular, it accounts the surprising experimental results where the shock ramp can be very thin and access to a few inertial electron lengths only. Present detailed results are also completed by an additional statistical analysis.

Time-Dependent Hydrodynamical Simulations of Slow Solar Wind, Coronal Inflows, and Polar Plumes
Pinto R., Grappin R., Wang Y.-M., Léorat J.
(Observatoire de Paris-Meudon – LUTh)
We use a one-dimensional, time-dependent hydrodynamical code to explore the effects of varying the expansion factor of a coronal flux tube and coronal heating function on the solar wind flow. The computational domain extends from near the photosphere, where nonreflecting boundary conditions are applied, to 30 $R_\odot$, and includes a transition region sustained by the equilibrium between thermal conduction, radiative losses and a prescribed mechanical heating flux. We recover the observed inverse relationship between asymptotic wind speed and expansion factor if the coronal heating rate is a function of the local magnetic field strength. We show that inflows can be generated by suddenly increasing the rate of flux-tube expansion, and suggest that this process may be involved in the closing-down of flux at coronal hole boundaries. We also simulate the formation and decay of a polar plume, by including an additional, time-dependent heating source near the base of the flux tube.

Magnetic reconnection by alfvén waves

Pinto R., Grappin R., Léorat J.
(Observatoire de Paris-Meudon – LUTh)

We investigate the effects of the injection of alfvén waves into the solar corona using an axi-symmetric 2.5 MHD numerical model extending from the top of the transition region to about 15 solar radii. Transparent boundary conditions are applied at both the upper and lower limits of the numerical domain and waves are injected by perturbing the alfvénic characteristic at the bottom boundary. We study two kinds of magnetic configuration : a) a quadrupolar region inside an equatorial streamer and b) a small bipole within an unipolar flux polar coronal hole region. In the configuration a), waves generate a pattern of convective flows (10-50 km/s) inside the streamer and, simultaneously, slow reconnection around the magnetic null point, which continuously rises upwards ($\sim$ 25 km/s). Also, wave pressure pinches the streamer in the latitudinal direction. In the configuration b), we observe an increase in density, wind speed and mass flux along its central axis, in a behaviour which resembles that of polar plumes in coronal holes. Current density accumulates quickly around the magnetic null point.

Electron acceleration in connection with long duration radio emissions

N. Vilmer, G. Trottet LESIA, Paris Observatory
(LESIA- Observatoire de Paris)

Radio noise storms are radiated by suprathermal electrons accelerated continuously over time scales of hours to days in the vicinity of active regions. Such long-duration electron acceleration may be related to emerging magnetic loops interacting with overlying loops leading to magnetic reconfiguration in the corona. A close spatial and temporal relationship is also sometimes observed between noise storm onsets or enhancements and white light transient activity. For a few cases, noise storm enhancements were found to be associated with flare like sudden energy release in the active region, either as a fully developed flare or, more often as a microwave or soft X-ray brightening without Halpha signature. A few cases have also been reported in which 10-30 keV X-rays from a superhot flaring plasma or from non-thermal electrons have been observed at the onset of the noise storm confirming that a flare-like signature in the low corona could be a necessary condition for noise storms to start. Most of these results were however obtained with no spatial resolution at X-ray wavelengths allowing us to confirm that the flare-like signature was indeed related to the radio noise storm onset. We shall present here some results of a search of X-ray counterparts (observed by RHESSI) at the onset or enhancements of a few radio noise storms observed with the Nançay Radioheliograph or in connection with long duration post-flare radio emissions. We shall investigate whether X-ray flare-like signatures are seen in close temporal and spatial association with these emissions and briefly discuss the thermal or non thermal nature of the emission as well as its energy content.

Session PCMI

Oral contributions

Mechanical energy dissipation in H2 luminous galaxies

François Boulanger, Pierre Guillard, Guillaume Pineau des Forets, Phil Appleton, Edith Falgarone, Nicole Nesvadba, Patrick Ogle, Philippe Salomé
(Institut d'Astrophysique Spatiale)

The Spitzer Space Telescope has opened a new perspective on the energetics of the multi-phase interstellar medium in galaxies with direct observations of
extragalactic H2 through its mid-IR rotational lines. The newly disclosed H2 luminous sources include active galactic nuclei galaxies, cooling flows, star-burst winds, colliding galaxies and mergers. H2 emission is observed to be a main contributor to the interstellar medium cooling in this diverse set of objects. Detailed studies of a few H2 luminous galaxies contribute to define a physical framework to interpret the observations. We propose that the exceptional H2 luminosity traces a burst of mechanical energy dissipation on galactic scales. The energy release creates a multi-phase interstellar medium where molecular gas clouds form within a hot X-ray emitting plasma. Only a fraction of the energy is used to heat the hot plasma. A large fraction of the energy is stored in high velocity (several hundred km/s) relative motions between the clouds and the hot intercloud plasma. The H2 emission is powered by a slow transfer of the corresponding bulk kinetic energy into low velocity ($<$ 50 km s-1) turbulent motions within the molecular gas clouds. The ratio between the gas kinetic energy and the H2 lines luminosity gives an estimate of the kinetic energy dissipation timescale of a few 10^8 yrs. This may represent the timescale necessary for the H2 gas to settle in gravitationally bound clouds and form stars.

Molecular jets from young stars : coupled chemical-dynamical models and comparison to observations

Panoglou, D., Cabrit, S., Garcia, P., Pineau des Forets, G., Ferreira, J., Casse, F.
(LERMA, Observatoire de paris)

While it is established that collimated jets in young stars are accretion-powered and magnetically collimated, the precise launch region (star, magnetosphere, inner disk) remains a matter of hot debate.
In the youngest stars, jets exhibit an elevated abundance of molecules such as H2, CO, H2O, and SiO, moving at speeds of up to 100-150 km/s. How molecules can be accelerated to such speeds without being destroyed is another open question that may hold an important clue to the jet origin.
Here we will present new thermo-chemical calculations showing for the first time that molecular jets can be launched magnetically from the disk surface at radii $\sim$ 0.5-2 AU. Heating by ion-neutral drift, and photodissociation by stellar UV and Xrays, strongly affect the final abundances of species along the streamlines. For high accretion rates characteristic of Class 0 protostars, the jet is almost entirely molecular. First comparisons with observations will also be presented.

Disks around CQ Tau and MWC 758 : Dense PDRs or gas dispersal ?

E. Chapillon, S. Guilloteau, A. Dutrey, V. Piétu
(LAB)

The Herbig Ae stars are the massive analogs of the T-Tauri. Very few disks surrounding these stars have been studied in detail. To better constraint the disks parameters (temperature and density) we observed the disks around CQ Tau and MWC 758 with the IRAM array in continuum and CO line emissions. The disks properties are derived using our standard parametric model. We use the Meudon PDR code to study the chemistry. The two sources show a surprising low CO abundance (assuming a standard gas-to-dust ratio). Modeling the chemistry we found that photodissociation of CO is a viable mechanism to explain the CO depletion without modifying the gas-to-dust ratio. In addition the low inclination of the CQ Tau disk challenges the UX Ori classification of this star. We conclude that CO does not appears as a direct tracer of the gas-to-dust ratio.

Bending the way of protostellar jets
A. Ciardi & C. Stehle
(Observatoire de Paris, LERMA)
The jets and outflows produced during star-formation are observed on many scales : from "micro-jets" extending a few hundred AU to the "super-jets" propagating to parsec distances. A "class" of short-lived (hundreds of nano-seconds) centimetre-long jets are now created in the laboratory as a complementary new tool to study astrophysical flows. By appropriately scaling the flow parameters, the laboratory "simulated" protostellar jets can be interactively tailored to include/modify rotation, magnetic fields, radiative cooling rates, etc., and may serve to test astrophysical simulations and models. We present simulations of laboratory and astrophysical curved jets, and related laboratory experiments illustrating how the break-up of the bow-shock and the formation of "knots" in the flow may be produced without invoking jet variability as an intial condition. Additionally, we discuss the effects of rotation on the development of the observed instabilities and how to test the predictions in the laboratory. We shall also present results of using laboratory flow conditions as input to astrophysical models.

Dust processing in photodissociation regions. IR emission modelling
M. Compiègne, A. Abergel, L. Verstraete, E. Habart
(CITA)
This study is done in the context of dust evolution and its interaction with the gaseous phase throughout the interstellar medium evolution cycle. We focus on the mid-IR spectral variations of the dust emission across photodissociation regions (PDRs), observed with both ISO and Spitzer. We use a dust emission model coupled with a radiative transfer model in order to study the excitation effects on these spectral variations. We show that in both the two studied regions (NGC2023N and the Horsehead nebula), radiative transfer effects cannot account for the observed spectral variations. Thus, we interpret these variations in term of changes of the relative abundance between Polycyclic Aromatic Hydrocarbons (PAHs, mid-IR band carriers) and very small grains (VSGs, mid-IR continuum carriers). We conclude that the PAH/VSG abundance ratio is 2.4 smaller at the mid-IR peak emission of the Horsehead nebula than in the diffuse high galactic latitude medium (Cirrus). For NGC2023 North, this ratio is about 5 times lower in the dense cold zones of the PDR than in its diffuse illuminated part where dust properties seem to be the same as in Cirrus. We conclude that dust in PDRs evolve from "dense properties" to "diffuse properties" at the small spatial scale of the dense illuminated ridge.

Formation and Properties of Dense Cores in Molecular Clouds
Sami Dib, Jongsoo Kim, Enrique Vazquez-Semadeni, Patrick Hennebelle, Edouard Audit
(Service d'Astrophysique, CEA, Saclay)
After introducing some of the proposed mechanisms for the formation of molecular clouds, we describe three-dimensional numerical simulations of magnetized, turbulent, and self-gravitating clouds and present the properties of clumps and dense cores formed within them. Issues that are addressed are : the lifetimes of the cores, their virial balance and gravitational boundedness, the star formation efficiency, scaling relations and the mass spectrum of dense cores, and the role of the magnetic field in the cores.

Les grandes échelles du milieu interstellaire
Katia Ferrière
(Observatoire Midi-Pyrénées)
I will present the three basic constituents of the interstellar medium of our Galaxy, namely, the ordinary matter (made of gas and dust), the cosmic rays, and the magnetic field. I will review their respective detection methods, their observed physical
characteristics, and their spatial distributions at large scales. I will also discuss the physical processes that play an important role in the interstellar medium as well as the dynamical interactions between its three constituents.

Turbulence MHD
Sébastien Galtier
(IAS, Université Paris-Sud)

Radiative transfer revisited for emission lines in photon dominated regions.
Manuel Gonzalez Garcia
(LUTh Observatoire de Paris)
Transfer in lines controls the gas cooling of photon dominated regions (PDR) provides many of the observational constraints that are available for their modelling. The interpretation of infrared and radio observations by the new generation of instruments, such as Herschel, requires sophisticated line radiative-transfer methods. The effect of dust emission on the excitation of molecular species in molecular regions is investigated in detail to explicitly show the origin of various approximations used in the literature. Applications to H_2O is emphasised. The standard 1D radiative transfer equation is written as a function of the space variable (as opposed to the usual optical depth). This permits to simultaneuosly consider all pumping contributions to a multi-level species in a non-uniform slab of dust and gas. This treatment is included in the Meudon PDR Code (available at http ://aristote.obspm.fr/MIS/). Infrared emission from hot grains at the edge of the PDR may penetrate deep inside the cloud, providing an efficient radiation source to excite some species at a location where cold grains no longer emit. This leads to non-negligible differences with classical escape probability methods for some lines, e.g. water. Cooling efficiency does not follow directly from line emissivities. The infrared pumping contribution leads to a higher excitation that enhances collisional de-excitation and reduces cooling efficiency.

HI and CO study of circumstellar environments
Y. Libert, T. Le Bertre, E. Gérard, J.M. Winters
(LERMA)
Circumstellar shells around red giants are built over long periods of time that may reach several 10^6 years. They may therefore be extended over large sizes ($\sim$ 1 pc, possibly more) and different complementary tracers are needed to describe their global properties. We are engaged in a programme designed to gauge the properties of matter in the external parts of circumstellar shells around AGB stars and to relate them to those of the central sources. We will present 21-cm HI and CO rotational line data obtained on an oxygen-rich semi-regular variable. These emissions indicate a stellar outflow at a velocity of $\sim$ 4 km/s and a rate of $\sim$ 2 10^{-7} Msol/yr, for a duration of 5 10^4 years. The modelling of the HI line-profiles obtained at several different positions suggests that the outflow is slowed-down by the ambient ISM, and that the external parts of the circumstellar shell are dominated by gas at $\sim$ 200 K, as in the well-known detached shell around the carbon star Y CVn. The HI source is elongated in a direction compatible with the central-star proper motion, as it is being recognized in more and more cases.

The interplay of cosmic rays in astrophysical systems dynamics.
A.Marcowith
(LPTA)

Mobility of D atoms on porous amorphous water ice surfaces under interstellar conditions.
E. Matar, E. Congiu, F. Dulieu, A. Momeni, and J. L. Lemaire
(Obspm - LERMA)
Mobility of hydrogen atoms on the icy mantles of interstellar dust grains has been at the centre of numerous debates over the years, since it is crucial for the formation of the H2 molecule and hydrogenated species in the interstellar medium. Some theoretical works have predicted that atoms are mobile on amorphous surfaces, which have been corroborated by modelling of experimental data. However, there is not a general consensus on these results, neither theoretically nor experimentally. We present here direct experimental evidence of the mobility of hydrogen atoms on porous water ice surfaces at 10 K.
In a UHV chamber, O2 molecules are deposited on a porous amorphous water ice substrate. Secondly, D atoms are exposed to the surface held at 10 K. Temperature-Programmed Desorption(TPD) is used and both desorptions of O2 and D2 are monitored.
We find that the amount of O2 that desorbs during the TPD diminishes if we increase the deposition time of D atoms. O2 molecules are thus destroyed by D atoms even though these molecules have previously diffused inside the pores of thick water ice. The experimental data we present are best explained if D atoms are mobile on the ice surface during the time of the experiment (before the TPD heating ramp), thus supporting the chemical models that include the mobility of H atoms at 10 K.
Therefore hydrogenation can take place efficiently on interstellar dust grain. It is in line with most of calculations and validates the hypothesis used in several models.

Eta-Chamaeleontis : abnormal IMF or dynamical evolution ?
Moraux, Lawson, Clarke
(LAOG)
Eta Chamaeleontis is a unique young ($\sim$ 9 Myr) association with 18 systems concentrated in a radius of $\sim$ 35 arcmin. No other members have been found up to 1.5 degrees from the cluster centre. Although the cluster mass function is consistent with the IMF of other rich young open clusters in the higher mass range, it shows a clear deficit of low mass stars and brown dwarfs with no objects below 0.1 Msun.
In this contribution, I present N-body numerical simulations that we performed to test whether this peculiar mass function could result from dynamical evolution, despite the young age of the cluster.
We found that it is possible to reproduce Eta Cha when starting with a very compact configuration which suggests that the IMF of the association might not be abnormal. The high initial density might also explain the deficit of wide binaries that is observed in the cluster.

A full (stellar and nebular) model for PN IC418
C. Morisset L. Georgiev
(IA-UNAM Mexico)
I will present a full model for the Planetary Nebula IC418. The stellar model is obtain using CMFGEN stellar atmosphere code and reproducing all the emission and absorbtion lines. The nebular model is performed by *Cloudy*$_{3D}$ and fitting more the 130 emission line intensities, surface brightness maps and absolute fluxes.

The 1 million model mexican database for photoionized regions.
C. Morisset
(IA-UNAM Mexico)
I will present the mexican "1 million models" database of photoionization models. A genetic algorythm is used to determine the input parameters (some 15 free parameters) and new results on emission line diagnotics are obtain.

Abundance and chemistry of H2D+ and D2H+ in L183 : constraints on the ortho/para H2 ratio
Pagani, L., Vastel, C., Hugo, E., Kokoouline, V., Greene, C., Bacmann, A.,Schlemmer, S., Ceccarelli, C.
(Observatoire de Paris)
Deuterium chemistry is highly dependent upon the H2 o/p ratio and therefore we can, via a chemical model treating ortho and para species as independent species (H2,H3+,H2D+,D2H+,etc...) and observational constrains from H2D+, D2H+, N2H+ and N2D+ derive the ortho/para ratio of H2 across the L183 prestellar core. We show that this ratio varies from 0.02-0.1 at low density to a few 10^{-3} in the core. We believe that this is the first time that the H2 o/p ratio is shown to vary across a cloud and we conclude that this ratio is higher than usually assumed in chemical models.

Isotopic substitution in nitrogen molecules. New observations and models.
M. Gerin, E. Roueff
(LUTh, Observatoire de Paris)
We report new detections on ^{15}N substituted molecules in cold interstellar environments. Comparison between observed and modelled isotopic ratios will be discussed.

Galaxy formation and evolution.
B. semelin
(LERMA)

The Herschel Key Project "Gas in Protoplanetary Systems" (GASPS)
Wing-Fai Thi and the GASPS team
(Insitute for Astronomy, University of Edinburgh)
I will describe the GASPS project, an Open Time Key Project for the Herschel Space Observatory. Our goal is to study the evolution of gas in young circunstellar disks in members of stellar associations up to 10 million years and very well characterized isolated stars. The GASPS data will be made available to the general community as a legacy after the propriety period.

Poster contributions

Disks around CQ Tau and MWC 758 : Dense PDRs or gas dispersal ?

E. Chapillon, S. Guilloteau, A. Dutrey, V. Piétu
(LAB)

The Herbig Ae stars are the massive analogs of the T-Tauri. Very few disks surrounding these stars have been studied in detail. To better constraint the disks parameters (temperature and density) we observed the disks around CQ Tau and MWC 758 with the IRAM array in continuum and CO line emissions. The disks properties are derived using our standard parametric model. We use the Meudon PDR code to study the chemistry. The two sources show a surprising low CO abundance (assuming a standard gas-to-dust ratio). Modeling the chemistry we found that photodissociation of CO is a viable mechanism to explain the CO depletion without modifying the gas-to-dust ratio. In addition the low inclination of the CQ Tau disk challenges the UX Ori classification of this star. We conclude that CO does not appears as a direct tracer of the gas-to-dust ratio.

INFRARED ANALYSIS OF CO ICE PARTICLES IN THE AEROSOL PHASE

E. Dartois & S. Bauerecker
(IAS-CNRS)

We explore the nucleation behaviour of CO aerosols with a low temperature cooling-cell. Large compact aerosol particles produced enable to determine the CO ice optical constants, free of substrate interfaces and complementary to thin films. Discrete Dipole Approximation models offer the possibility to predict shape effects on the spectra and to get nucleation tendencies.

INTERSTELLAR DUST GRAINS COMPOSITION THE HYDROGENATED AMORPHOUS CARBON CONTRIBUTION

E.Dartois, G.M. Munoz-Caro T.R. Geballe, T.Pino
(IAS-CNRS)

Infrared dust absorption features observed in the diffuse interstellar medium (DISM) trace the solid state matter composition, evolution, and the cycling of matter in the Milky-Way. The composition of the DISM dust observed in extinction is a subject of long standing debate. A 3.4 microns absorption feature observed against background sources has received particular attention since its discovery in the early eighties (Allen & Wickramasenghe 1981, Nature 294, 239). Extension to the mid-infrared by satellites gave insight into additional features at 6.8 and 7.25 microns (e.g. Chiar et al. 2000, ApJ 537, 749 ; Spoon et al. 2004, ApJS 154, 184).

At IAS in the laboratory we produced a hydrogenated amorphous carbon (a-C :H) via the photolysis of methane (or another C :H precursor) at low temperature, resulting in a network made of CH2 and CH3 groups with some contribution of unsaturated bonds (C=C, Fig 1). This solid provides an excellent fit to the DISM 3.4, 6.85 and 7.25 microns features, as observed in our Galaxy. The photoproduction of this a-C :H made under conditions that resemble those of the DISM (low temperature, UV field) are relevant for astrophysical applications. The profiles of the absorption bands of this material are closer to the astrophysical ones than any previously reported carbonaceous analogs of the DISM organics. This a-C :H has been characterized by performing a series of laboratory analyses (Infrared and Raman spectroscopy, Photoluminescence and UV-visible absorption spectroscopy) which allow a full characterisation of such amorphous phase (Dartois et al. 2005, A&A 432, 895).

Spitzer reveals a-C :H is an abundant and ubiquitous DISM component, through the a-C :H mid-IR features observed in about 70 external galaxies. These extragalactic obscured AGNs lines of sight probe large dust column densities in front of an extended infrared continuum. One takes advantage on the absence of the local circumstellar contamination and the parsec scale IR probing pencil. In addition, moderate galaxy redshifts shift observations to favorable atmospheric windows, giving access to aromatic stretching mode regions. Some LOS are also free of dense cloud absorptions (ice free clear mid-IR , continuum). The aromatic versus aliphatic content of interstellar HACs.

H2 Formation and Excitation in the Stephan's Quintet Galaxy-Wide Shock

P. Guillard, F. Boulanger, G. Pineau des Forêts, P.N. Appleton
(Institut d'Astrophysique Spatiale)

Spitzer has detected an extremely powerfull (L $> 10^{41}$ erg s-1),shock-powered, mid-IR H2 emission towards the Stephan's Quintet (SQ) galaxy group (Appleton et al. 06). This is the first time an almost pure H2 line spectrum has been seen in an extragalactic object. The luminosity in the H2 lines exceeds by a factor of ~ 2 the surface brightness in X-rays.

How can we explain such a huge amount of molecular gas ($M_{H_2} \sim 4\ 10^7\ M_{sol}$) coexisting with a X-ray emitting plasma ? How come there is no star formation associated with H2 ?

We summarize in this poster the main results of a scenario (P. Guillard et al. 08) where the molecular gas is formed in the shock. The pre-shock gas is assumed to be inhomogeneous because the shock has induced formation of both hot (5 10^6 K) plasma and warm (10^{2-3} K) H2. Our model (P. Guillard et al. 2008) computes the physical and chemical evolution of the shock heated gas, including density inhomogeneities in the pre-shock medium and dust destruction. Schematically, low density preshock gas (nH $<$ 0.01-0.001 cm-3) is shocked at high speed ($\sim$ 1000 km/s for SQ) and becomes a dust-free X-ray emitting plasma. Denser gas (nH $>$ 0.1 cm-3) is heated at lower temperatures and dust survives. In the context of the SQ shock, this gas had time to cool and become molecular.

Only a fraction of the collision energy is used to heat the hot plasma. Therefore, a large fraction of the gas energy is stored in bulk gas motions. We propose that, in such conditions, the H2 emission must be powered by a slow transfer of energy from fast bulk gas motions into low velocity ($<$ 40 km/s) supersonic turbulent motions within the molecular gas. We phenomenologically model this turbulent motions by J-type and magnetic C-type shocks into the newly-formed molecular gas. We show that the observed H2 line fluxes are very well reproduced for densities nH=10^3- 10^4 cm^{-3} and shock velocities within the 5-35 km/s range.

SQ is a unique object for studying the physics of galaxy-wide shocks and understanding their key-role in the formation and excitation of H2. This detailed study of the SQ shock defines a physical framework to interpret observations of H2-bright galaxies in general.

On the presence of cold gas phase CO in circumstellar disks

F. Hersant, V. Wakelam, A. Dutrey, S. Guilloteau
(LAB, Obs. Bordeaux)

Carbon monoxide condenses on grains at a temperature of about 17 K. However, in circumstellar disks, a significant amount of gaseous CO is observed at a temperature as low as 10 K. We studied the chemistry of these disks, including photodissociation, grain surface reactions, vertical turbulent mixing and different desorption mechanisms. We show that the presence of cold CO on a large range of distances from the central object requires a combination of vertical mixing with some non thermal desorption mechanism.

Nuclear spin conversion of a molecule of astrophysical interest in rare gas matrices : methane

Anica Lekic, Joël Stienlet, Cédric Pardanaud, Xavier Michaut, Jean-Hugues Fillion, Anne-Marie Vasserot and Luce Abouaf-Marguin

(LPMAA - Université Paris 6)

Methane and other hydrogenated molecules of astrophysical interest like H2, H2O, H2CO, NH3, CH3OH, or C2H4 play an important role for the chemistry in the insterstellar medium (ISM) and in the protosolar nebula. Because of the spin $\frac{1}{2}$ of the protons, these molecules exist in different nuclear spin configurations. In case of four protons as it is for methane, they are called ortho, para and meta isotopomers depending whether the total nuclear spins are I=1, I=0 or I=2, respectively. Due to the Pauli's exclusion principle and the properties of symmetry of the rovibrational molecular wave functions of the molecule, each species can be identified by its own rotation-vibration spectrum. In gas phase, each rotational state is then associated with only one of the nuclear magnetic species. In the high temperature limit (>50 K), it is known that 56.25% of the molecules are ortho, 31.25% are meta while 12.5% are para. Below 50 K, the E/A and F/A ratios become strongly temperature dependent. From these ratios of molecules measured in cometary comae [1, 2] or in dark clouds [3], it is expected to determine the formation conditions of molecules in space, and especially the formation temperature. As a first step before studying ices of astrophysical interest, we have investigated the parameters involved in the nuclear spin conversion of methane isolated in rare gas matrices at low temperatures (between 4.9K and 20 K). In these environments, the hydrogenated molecule vibrates and rotates almost freely within the cage made of rare gas atoms [4]. We present here a study, in the mid-infrared, of CH4 in rare gas matrices. The spectra were recorded in the frequency range 400-4000 cm-1 with resolution of 0.15 cm-1 using a Bruker 113V FTIR spectrometer. After a fast cooling from 20 K to 4.9 K, populations of the nuclear spin species did not follow the Bolztmann distribution due to slow nuclear spin conversion. Following the time evolution of the transitions associated with the one or the other species, we have measured characteristic times of nuclear spin conversion in various conditions. At 4.9 K in Ar matrices, we observed an acceleration of the nuclear spin conversion of methane as the concentration of molecules in the sample increased. We expect to observe the same phenomenon for other rare gas matrices. Calculations performed by our group in the case of H2O show clearly that intermolecular magnetic interactions are responsible for this concentration dependence. For more diluted samples, we measured a characteristic times (100-700 minutes) depending of the molecule and the rare gas atom. In case of methane, we observed that rare gas can be stabilized in FCC or HCP crystalline structures for which the measured times are clearly different. The environment of the molecule seems to play a crucial role on the nuclear spin conversion of hydrogenated molecules. It is then surprising that characteristic times in cryogenic matrices are much shorter than months estimated in ice by Tikhonov and Volkov [5] at 77 K. References

[1] J. Crovisier, Faraday Discuss. 109, 437 (1998).

[2] H. Kawakita et al., Astrophys. J. 623, L49 (2005).

[3] J. E. Dickens, and W. M. Irvine, Astrophys. J. 518, 733 (1999).

[4] X. Michaut, A.-M. Vasserot, and L. Abouaf-Marguin, Vib. Spectrosc. 34, 83 (2004).

[5] V. I. Tikhonov, and A. A. Volkov, Science 296, 2363 (2002).

Session GRAAPH

Oral contributions

GAP, a accelerometer package for Laplace and Tandem missions

B. Christophe, Dr. B. Foulon, A. Levy (ONERA, Châtillon), Dr. J.D. Anderson (Global Aerospace), Prof. T.J. Sumner (Imperial College), Prof. O. Bertolami, Prof. P. Gil, Dr. Jorge Paramos (Instituto Superior Technico), Dr. S.V. Progrebenko, Dr. L. Gurtvis (JIVE), Prof. S. Reynaud, Prof. J-M Courty (LKB), Dr. S.W. Asmar (JPL), Dr. G. Métris, Dr. P. Bério (OCA), Dr. R. Bingham, Dr. B. Kent (RAL), Dr. O. Olsen, Dr. P.H. Andersen (Univ. Oslo), Dr. H. Dittus, Dr. C. Lämmerzahl, Dr. S. Theil, B. Rievers, S. Bremer (ZARM)
(ONERA)

For space Fundamental Physic experiments, an accelerometer is mandatory, either to control the spacecraft to follow a geodesic, as in the case of Microscope and LISA missions, either to measure the non-gravitational forces acting on the spacecraft, in order to reconstruct the geodesic motion of the spacecraft by on ground processing. The verification of the General Relativity at Solar System scale also needs accurate acceleration measurement at low frequency. Beyond the fundamental physic objectives, such accelerometer could also be used for planetary aeronomy or gravity tests.
In the frame of Cosmic Vision selection, the Fundamental Physic Advisory Group of ESA suggested to use an accelerometer, as presented in Odyssey mission proposal, on the future interplanetary mission, Laplace or Tandem mission, pre-selected by ESA.
This paper will describe the scientific objectives of the GAP (Gravity Advanced Package) proposed to fly on Laplace or Tandem mission. Then, the main instrument of the GAP, the μSTAR electrostatic accelerometer with its bias calibration system, will be presented. The paper will conclude on the constraints of implementation of such instrument in the spacecraft, and the way to overpass it.

A few decades of slr data for the long wavelenghts of the earth's gravity field.

Florent Deleflie et al;
(OCA)
Florent Deleflie Observatoire de la Cote d'Azur, Grasse, France, florent.Deleflie@obs-azur.fr Philippe Berio UNSA/CNRS UMR6526/OCA, Grasse, France, philippe.berio@obs-azur.fr Olivier Laurain Observatoire de la Cote d'Azur, Grasse, France, Olivier.Laurain@obs-azur.fr Dominique Feraudy Observatoire de la Cote d'Azur, Grasse, France, Dominique.Feraudy@obs-azur.fr Pierre Exertier Observatoire de la Cote d'Azur, Grasse, France, pierre.exertier@obs-azur.fr Jean-Michel Lemoine Centre National d'Etudes Spatiales (France), Toulouse, France, jean-michel.lemoine@cnes.fr

In this paper, we draw an assessement of the temporal variations of the Earth's gravity field determined from space thanks to SLR satellites, and we quantify the accuracy of that determination. We use SLR data tracked by the ILRS network since more than 20 years to derive long time series of the low wavelenghts of the Earth's gravity field. The work is based on post-fit residuals analyses, performed with the computation of orbit of geodetic satellite (LA-1 and LA-2 in particular). Two approches are led in parallel and then combined, to decorrelate in an efficient way seasonal effects (mainly annual and semi-annual periods) from long periodic and secular ones (mainly due to the post-glacial rebound, and the 18.6 year tide). On the one hand, osculating orbital arcs are propagated over short periods of time (typically : one week) and adjusted on tracking data. Normal matrices are deduced from that adjustment. On the other hand, mean orbital arcs, containing only the long periodic effects acting on the satellite motion are propagated over the whole period where tracking data are available. The advantage of such a method lies on the fact that small but cumulative variations of the gravity field can be enlightened explicitly, whereas they are too small to be detected through short periods of time. As a result, the parameters characterizing these effects (namely, the post glacial rebound, and the 18.6 year tide) can be inserted explicitly in the corresponding normal matrices. Then normal matrices deduced from both approaches are then mixed, then inversed to performe time series of each parameter, and then analyzed.

High area-to-mass ratios GEO space debris : stability and secondary resonances (MEGNO and frequency analysis).

N. Delsate, S. Valk, T. Carletti, A. Lemaitre
(FUNDP - Département de Mathématique)

Recent optical surveys in high-altitude orbits, performed by the European Space Agency 1 m telescope in Tenerife Canary islands), have discovered a new unexpected population of 10 cm size space debris near the geostationary orbit (GEO). These objects sometimes present highly eccentric orbits with eccentricities as high as 0.55 (Schildknecht et al., 2004, 2005). Recent numerical and analytical investigations (Anselmo and Pardini, 2005 ; Liou and Weaver, 2005) prove that this new population consists of near geosynchronous objects with high area-to-mass ratios. The large area-to-mass ratios space debris have a dynamical behavior dominated by the solar radiation pressure. These uncommon objects dynamics has been treated by a number of authors. However, no concern about the intrinsic stability of such uncharacteristic orbits has been given so far. We propose an analytical investigation and a systematic numerical study : chaos indicator (MEGNO) and frequencies analysis. We show large chaotic zones and small islands of stability, identified as "secondary resonances". We compare the results gived by the frequencies analysis and the MEGNO's method.

Short-period planetary contributions in the rotation of Mercury

Julien Dufey, Benoît Noyelles, Nicolas Rambaux, Anne Lemaître
(University of Namur)

The space missions MESSENGER and BepiColombo require precise short-term studies of Mercury's rotation. In this scope, we performed analytically and numerically by a Hamiltonian approach a synthetic 2-dimensional representation of its rotation, using complete ephemerides of the orbital motions of the planets of the Solar System. This representation allowed us to derive the librations in longitude and latitude of the planet. We point out that the contributions of Venus and Jupiter cannot be neglected in the study of the librations in longitude. We also show that the librations in the difference of the orbital and rotational nodes are much smaller, with an amplitude of about 0.2 arcsec, whereas the librations in longitude have an amplitude of about 40 arcsec. Moreover, we enlighten the possibility of a resonance involving the free libration in longitude and the orbital motion of Jupiter. All these results are compared to the ones given by the SONYR model, which integrates simultaneously the orbital motions of the planets and the spin of Mercury, and therefore gives the full spin-orbit coupling motion of Mercury.

Formation Flying for space geodesy

J. Fontdecaba, G. Métris, P. Exertier
(Observatoire de la Côte d'Azur)

In this paper, I present the last results of my Ph.D. work concerning the detection of a central gravity field using a formation of satellites. The basis of our study is the analytical determination of a set of equations describing the relative motion around a central body perturbed by the whole gravity field. These equations enable to connect the observables with the coefficients of the gravity field through the covariance matrix. The analysis of different covariance matrices corresponding to different configurations of the formation shows the interest of each configuration for the detection of the gravity field.

Earth's interior with VLBI : pushing the limits

S. B. Lambert (OP/SYRTE), A.-M. Gontier (OP/SYRTE)
(SYRTE - Observatoire de Paris)

Though VLBI is known, within the astrophysical community, as a high angular resolution radio technique for observing quasars, it is also a precious instrument for geodetic and geophysical research : plate motion, crustal displacement, determination of Earth's interior by means of very accurate nutation angle measurements... But VLBI is nothing but building a virtual, but solid, brigde between the crust and the far universe ! This ambitious link brings out some problems, among which the realization of an inertial reference frame. In this paper, we discuss the current situtation of the geodetic VLBI, its capacity to reveal subtle Earth's interior parameters describing the outer and inner cores, and our current research for building a quasar-based inertial frame as best as possible.

Present status and perspectives of relativistic fundamental astronomy

C. Le Poncin-Lafitte
(SYRTE, Observatoire de Paris)

Nowadays it is well known that consistent relativistic modelling are required in the field of fundamental astronomy. However if the theoretical foundations of relativistic modelling have been carefully elaborated twenty years ago, numerous open questions remain when we speak about practical implementations of these foundations. In this work we will give an overview of what is now well controled and about what is ongoing for the next years.

The Pioneer data analysis with ODYSSEY software

A. Levy, P. Berio, J-M. Courty, G. Metris, S. Reynaud, B. Christophe
(ONERA)

The Pioneer Anomaly refers to the difference between the expected theoretical trajectory of the Pioneer 10 and 11 spacecrafts and the observed trajectory through Doppler measurements. It has been interpreted by the Jet Propulsion Laboratory (JPL) as a constant anomalous acceleration. In France, several laboratories (Observatoire de la Côte d'Azur, Laboratoire Kastler Brossel, Onera, Institut d'Optique, Syrte) with CNES support formed the Groupe Anomalie Pioneer (GAP) to analyse the same data set as used by the JPL. For this analysis, the GAP has developped a specific trajectography software, ODYSSEY, which enables to test different anomaly models.
The paper will present, after a brief description of the software and the implemented models, the last results obtained : in addition to the constant anomaly, time dependent signatures of the anomaly have been noticed which can be described geometrically. The fit of the Pioneer 10 data with these new models yields a reduction of the standard deviation of the residual by a factor 2 with respect to the simple constant anomaly.

Titan's forced rotation - Part II : The resonant wobble

B. Noyelles, A. Lemaitre and A. Vienne
(University of Namur)

Our knowledge of the gravity field of Titan has been recently improved thanks to the fly-bys of Cassini spacecraft who gave us first values of Titan's J22 and C22, unfortunately without any indication of the polar inertial momentum C. Anyway, these data allowed us to give last year a first 3-dimensional description of the rotation of Titan, seen as a rigid body. In particular, we pointed out an interesting phenomenon forcing the wobble, that we suspected to be nearly resonant. This year we present a study of this resonance, involving a free libration around the Cassini equilibrium and a proper mode given by the orbital ephemerides. The resonant argument has been clearly identified, and its behaviour has been investigated using the Second Fundamental Model of the Resonance. We show that in case of capture, the wobble might be forced by several degrees. Moreover, we propose an original formula to estimate the contribution of the wobble in the tidal internal dissipation of a synchronous satellite. A significant wobble might cause a wrong estimation of the rotation of Titan.

Hydrological excitation of polar motion derived from GRACE and LAGEOS observation

L. Seoane , J. Nastula, C. Bizouard and D. Gambis
(Observatoire de Paris)

Degree-2, order-1 harmonics of the gravity field, derived from the Gravity Recovery and Climate Experiment (GRACE), and processed at different institutes, are used to compute the so-called gravimetric equatorial excitation functions of polar motion. Time-variable gravity field solutions are tide free and free from modeled non-tidal atmospheric and oceanic effects. Consequently, the polar motion excitation computed from gravimetric solutions reflects unmodelled variations like hydrological processes, snow cover, post-glacial rebound or earthquakes. We assume that gravimetric data might improve the understanding of the hydrological process. For this purpose, we compare this gravimetric-based excitation to the hydrological excitation computed from three different hydrologic models. We can also assess the polar motion excitation from the geodetic observations of the pole coordinates. For comparing this observed excitation to the gravimetric and modeled hydrological excitations we have to remove both atmospheric and oceanic effects. We confirm that the seasonal residuals of the geodetic excitation are fully explained neither by hydrological models nor by the gravimetric data. We also computed long period variations, i.e, greater than 1 year. All series show oscillations of 0.6-0.8 cycles per year in both equatorial components. After 2004 there is a polar motion drift in agreement with the hydrological models and confirmed by gravimetric observations. Over this period polar motion drift is well explained by the Earth's geophysical fluids. The influence of post-glacial rebound cannot appear due to the predominant decadal effect.

Les catalogues de quasars et le LQAC (Large Quasar Astrometric Catalogue) : vers une densification de l'ICRF

J. Souchay,S. Bouquillon*,C. Barache*,C. Le Poncin-Lafitte*,S. Lambert*, A-M. Gontier*, F.Taris*,A.H.Andrei** *SYRTE ** Univ.-Obs. Rio de Janeiro*
(SYRTE, Observatoire de Paris)

The drastically increasing number of recorded quasars from various surveyus and catalogues leads to the question of homogeneity of the data, especially in an astrometric and photometric point of view. After dealing with the most important optical and radio surveys of quasars, we discuss this homgeneity and we present the LQAC (Large Quasar Astrometric Catalog) which has just been achieved at SYRTE (Paris Observatory). The LQAC is the largest compiled catalogue of quasars with 113 666 objects.

Determination of the corrections to the IAU 2000A-2006 X,Y coordinates using LLR observations

Wassila Zerhouni, Nicole Capitaine, Gérard Francou
(Observatoire de Paris, SYRTE)

The Lunar Laser Ranging (LLR), which is one of the most accurate astrometric technique, has many applications in various domains including astronomy, gedoynamics and gravitational physics. It consists in determining the round-trip travel times of light pulses between stations on the Earth and reflectors on the surface of the Moon. Analysis of LLR observations allows us to determine many parameters of the Earth-Moon system, such as station coordinates on the Earth, coordinates of the retro-reflectors on the lunar surface, lunar gravity field parameters,... Here, we focus on the determination of the Earth Orientation Parameters (EOP) especially, the direction towards the Celestial Intermediate Pole (CIP) in the Geocentric Celestial System. We have, first, calculated the LLR residuals over a period of more than 37 years, using IAU 2000A-2006 as a model of precession nutation (i.e MHB 2000 nutation of Mathews et al. 2002 and P03 precession of Capitaine et al. 2003) and the CIO based procedure. Second, we have determined the corrections to the the IAU 2000A-2006 X and Y coordinates every 70 days. The results obtained give an interesting estimation of the celestial pole coordinates, even if the accuracy is not at the same order as in VLBI because of the insufficient density of the observations.

Poster contributions

Proposed upgrade of the IAU2000 metric at the 2PM level : application to the TIPO project

O. Minazzoli, B. Chauvineau
(OCA/Artemis)

The TIPO project involves laser links between stations distant each form other by interplanetary distances (typically some hundred million kilometers). The level of precicion required by the experiment is such that describing the laser link using 1PM (PM = post-Minkowskian, 1PM represents then the first relativistic corrections for light propagation) effect would not be sufficient, in such a way that 1.5PM, and even 2PM, effects have to be taken into account. The IAU2000 metric, recommanded by the International Astronomical Union, includes 1.5PM terms, but is not complete at the 2PM level. In this poster, we propose an upgrade of the IAU2000 metric at the 2PM level.

The Bordeaux VLBI Image Database

COLLIOUD Arnaud, CHARLOT Patrick
(Laboratoire d'Astrophysique de Bordeaux (LAB))

As part of its contribution to the International VLBI Service for Geodesy and Astrometry (IVS), the VLBI group at the Laboratoire d'Astrophysique de Bordeaux (LAB) produces VLBI images of reference frame sources. These sources are observed on a regular basis with a VLBI network of 15 to 20 radiotelescopes in order to monitor their structural evolution and positional stability. The images are used to derive structure correction maps and "structure indices" that characterize the astrometric suitability of the sources, with the aim to maintain, improve and extend the International Celestial Reference Frame (ICRF).
The Bordeaux VLBI Image Database (BVID) provides the community with more than 1000 VLBI images at 8.4 GHz and 2.3 GHz for 264 different reference frame sources, as well as more than 5000 structure correction maps and structure indices. The amount of data available is constantly increasing with the processing of additional VLBI experiments. Present data will be soon supplemented with structure correction maps and structure indices derived for higher VLBI frequencies (24 and 43 GHz). We also plan to integrate this database into the Virtual Observatory in order to facilitate access to the BVID data.
The Bordeaux VLBI Image Database is available through the following web address : http ://www.obs.u-bordeaux1.fr/m2a/BVID/.

Comparison of fast Lyapunov chaos indicators for Celestial Mechanics

Julien Frouard
(IMCCE (Observatoire de Paris))

For a long time, the estimation of the Lyapunov Characteristic Exponents (LCEs) had been used in Celestial Mechanics to caracterize the chaoticity of orbits. With the aim of gaining speed and accuracy in detecting this chaoticity, several indicators based on the theory of Lyapunov exponents have been developped. Here we present a comparison in terms of precision, CPU speed, and practicability of several of these indicators ; the FLI, MEGNO, and the GALI. While the two firsts have been commonly used, the GALI has not yet been applicated to Celestial Mechanics. However, this indicator has its own qualities and specificities. The final aim of the comparison of these indicators is the production of stability maps in the case of irregular satellites of giant planets, the examples and applications are shown in this way.

DORIS-derived geocenter variations : A new approach to detect and to remove periodic systematic errors

M-L Gobinddass, (1, 2), P. Willis (1, 2) ; (1) Institut Géographique National ; (2) Institut de Physique du Globe de Paris
(Institut National Géographique)

Earth's crust is considered has a reference to obtain geodetic positions and velocities. These types of data are necessary for numerous scientific and practical applications (plate tectonics, deformations, car navigation, mapping, surveying?). However, in this terrestrial reference frame (3D), mass variations in the Earth-Atmosphere-Ocean system create temporal displacement of the center of gravity toward the conventional geodetic origin, as detected in the daily or weekly tracking station position which are fixed on the crust. Since the past few years, a few satellite geodetic systems are now capable of measuring these geocenter variations to a few mm-precision (Satellite Laser Ranging, GPS, and DORIS). However, recent studies using the DORIS system at the IPGP showed that the estimated geocenter variations are currently affected by large systematic errors, especially for the Z-component (up to 3-4 cm compared to the actual geophysical signal at the 3-5 mm level). After a brief description of the physical reasons for the geocenter variations, we will describe the technical characteristics of the French DORIS Doppler tracking system, mostly used for precise orbit determination of Low Earth Orbiting Satellites. In a first step, we will characterize the systematic errors observed in geocenter time series (1993.0-2008.0) as satellite-dependent and mostly periodic : artifact signal at 118 days-period for TOPEX/Poseidon and at 1 year-period for SPOT satellites, both related to their draconitic period. In a second step, using for each satellite mean values of solar pressure coefficients, estimated over the whole period (1993.0-2008.0), we will show that improved methods in orbit determination (fixing the solar pressure coefficient to a best-fit value) remove a large part (about 50%) of these systematic effects observed in DORIS-derived geocenter variations.

An estimate of the relativistic parameter γ using geodetic very long baseline interferometry

S. B. Lambert (OP/SYRTE), C. Le Poncin-Lafitte (TU Dresden/Lohrmann Observatorium)
(SYRTE - Observatoire de Paris)

We reanalyzed almost 4000 geodetic very long baseline interferometry (VLBI) observing sessions ($\sim$ 5 million delays) to estimate the gravitational light deflection by Solar System bodies of radio waves emanating from distant compact radio sources. This bending is characterized by the post-Newtonian parameter γ within the standard parametrized post-Newtonian formalism, which is unity in General Relativity. We studied the stability of the analysis and discussed possible issues concerning systematic biases from our analysis of subgroups of data.

PROPER TIME VERSUS TCB USED FOR TIME DELAY INTERFEROMETRY IN THE LISA MISSION

Sophie Pireaux
(Observatoire Royal de Belgique)

The three spacecraft of the LISA (Laser Interferometer Space Antenna) mission aim at the detection of gravitational waves in the [10^{-4}, 10^{-1}] Hz frequency band. They are to be launched in 2015, 5 million kilometers apart, in a triangular configuration, inter-connected by double laser links. Laser frequency (LF) and optical bench (OB) noises are several orders of magnitude larger than gravitational wave signals to be detected. Hence, a Time Delay Interferometry (TDI) data pre-processing method has been developed to reach the gravitational wave detection level, allowing to get rid of (most of) the LF and OB noises. TDI combination algebra, to be applied on the data, is in terms of the coordinate time corresponding to the Barycentric Coordinate Reference System (BCRS), TCB. However, local data is recorded in terms of spacecraft proper time at each of the three LISA spacecraft, requiring the use of relativistic time scales transformations. We here provide such transformations and show that the difference in rate of spacecraft proper time versus TCB is of the order of 5.10-8. The difference between spacecraft proper times and TCB exhibits an oscillatory trend with a maximum amplitude of about 10-3 s. We also summarize the TDI data pre-processing and TDI ranging which are novel metrology techniques that might be relevant for further satellite constellation space missions.

Main bibliography reference : "Time scales in LISA", S. Pireaux, Classical and Quantum Gravity, Volume 24, 2271-2281, 2007 ; arXiv :gr-qc/0703119

Relativistic orbit determination with the rmi (relativistic motion integrator) software for the lisa mission

Sophie Pireaux
(Observatoire Royal de Belgique)

The LISA mission is an interferometer that aims at the detection of gravitational waves in the $[10^{-4}, 10^{-1}]$ Hz frequency band. LISA is formed by three spacecraft. Those are to be launched in 2015, 5 million kilometers apart, in a triangular configuration, inter-connected by double laser links. Precise ephemerides of LISA spacecraft are needed not only for the sake of orbit determination but also to compute the photon flight time in laser links between spacecraft, required in data TDI (Time Delay Interferometry) pre-processing in order to reach the gravitational wave detection level.

The Relativistic Motion Integrator (RMI) consists in integrating numerically the EXACT relativistic equations of motion (geodesics), for a given metric (corresponding to a gravitational field at first post-Newtonian order or higher), instead of Newtonian equations plus relativistic corrections. The RMI approach can be applied to compute either planetocentric or barycentric orbits for different space missions.

LISA is a relevant example to use RMI. Moreover, before the present work, only CLASSICAL ephemerides for its satellites were available. Hence, relativistic effects in LISA orbit determination needed to be considered and quantified. Using RMI with a BCRS (Barycentric Coordinate Reference System) metric, as recommended by the IAU (International Astronomical Union), we show that the numerical classical model for LISA orbits in the gravitational field of a non-rotating spherical Sun without planets can be wrong, with respect to the numerical relativistic version of the same model, by as much as about ten kilometers in radial distance during a year and up to about 60 kilometer in along track distance after a year... with consequences on estimated photon flight times.

Main bibliography reference :

"Relativistic versus Newtonian orbitography : RMI software, illustration with the LISA mission", S. Pireaux, B. Chauvineau, submited to Celestial Mechanics, January 2008 ; arXiv :0801.3637

Session AS-OV

Oral contributions

EuroPlaNet : from IDIS towards a European Planetary VO

G. M. Chanteur (CNRS/IPSL, France) and Maria-Teresa Capria (INAF/IASF, Italy)
(CNRS/IPSL/CETP)

As a Coordination Action of the 6th Framework Programme of the European Commission, EuroPlaNet has designed and begun to implement IDIS, the Integrated and Distributed Information Services, that will provide the community of planetary sciences with a unique portal to access all types of information related to planetology : ground and space based observations, both remote and in situ, instrumentation onboard spacecraft, laboratory experiments, models and simulations. Planetary sciences are at the meeting point of several different fields : astrophysics, space physics, fundamental physico-chemistry, and geosciences. This peculiarity implies a tremendously large scope of observational, experimental and theoretical approaches : this results in an extreme diversity of scientific tools and data requiring the elaboration of complex data models and the absolute necessity to accommodate different protocols to access all the available repositories. We will show the present status of IDIS and discuss its expected evolution into a Planetary VO during the 7th Framework Programme if EuroPlaNet is selected as I3 after having successfully passed the first step of the selection process.

Horizon GalMer Database and Access to the Theoretical Data in the Virtual Observatory

Igor Chilingarian, Paola Di Matteo, Anne-Laure Melchior, Francoise Combes, Benoit Semelin
(LERMA - Observatoire de Paris)

We present the Horizon Galmer database, containing the results of N-body simulations of galaxy interactions. Tree-SPH code allows to trace star formation and chemical enrichment histories of the galaxies. We provide a comprehensive WEB-interface to access the data as well as a set of value-added services for data manipulation and analysis. We use PEGASE.HR to model spectrophotometric properties of the interacting galaxies. In this project we implement a number of IVOA standards and make use of existing VO tools for data manipulation.

Theory in the Virtual Observatory ? Example of NISM an e-Science platform for the interstellar medium

Franck Le Petit et al.
(LUTH - Paris Observatory)

Thanks to the Virtual Observatory and Grid technology, it is becoming possible to share online theoretical services : codes and simulation results, with on demand computing resources to get a faster scientific return of large instruments.

VO-Paris datacentre is strongly implied in the efforts to develop VO-Theory standards and to deploy theoretical applications in the VO and on the EGEE Grid via the A&A Cluster of EGEE III. We will present the recent achievements concerning some VO-Theory services. In particular wee will present the development of a portal based on the Astrogrid infrastructure providing to the community online state-of-the-art simulation codes with computing resources. We will also present what can be expected in the near future for theoretical services with the example of the NISM project (Numerical Interstellar Medium), a collaboration of three French laboratories : LERMA, LUTH, IAS, and the applied mathematic department of Ecole Centrale Paris, aiming at developing a public platform of interoperable theoretical services (online simulation codes and databases) linked to the EGEE grid. This new infrastructure aims at providing all the required tools to facilitate the interpretation of observations and the preparation of missions of large instruments as HERSCHEL and ALMA in the ISM context. It also aims at contributing to the development of the VO-Theory standards to permit the coupling of simulation codes in workflows. This will permit to develop complex science cases to refine the modeling of the physics and chemistry of the interstellar medium and so, to push further our understanding of the Universe. This federation of laboratories working on different aspects of the ISM to provide an e-Science platform of numerical tools could be considered as an example for other communities to provide high-level services to the A&A community.

Poster contributions

Simulation Databases & Services in VO using the Simulation data model (SimDB)

L. Bourgès, G. Lemson, H. Wozniak, J. Blaizot, F. Le Petit, I. Chilingarian
(LUTh, Observatoire de Paris)

The IVOA & EuroVO Theory Interest Group is working on the Simulation Data Model & Data Access Protocols (SimDB / SimDAP) in order to publish simulation & post processing products in the virtual Observatory. The poster will present the Simulation Data Model and several french implementations : - Horizon Galmer (galaxy mergers) - Horizon GalIcs (halo & galaxy catalogs & light cones) - Meudon PDR databases (interstellar medium) Those simulation databases are already online or in near future.

Update on interoperability developments for Atomic and Molecular Data : Standards, Services and Tools

M.L. Dubernet, N. Moreau, E. Roueff
(LERMA, Observatoire de Paris)

Scientific analysis of observed spectra and modeling of MIS, planetology atmospheres ou surfaces, cometary, stellar atmospheres require the availability of micro-physics data such as spectroscopic linelists, collisional excitation rate coefficients, reaction rates, photo-reaction cross-sections for gas and solid phase (and others). Part of the scientific work consists in collecting and evaluating those data, which might be obtained from measurements, ab initio calculations or semi-empirical calculations. The next step leads to the building of databases and recently to software developments in order to easily access these databases within the context of Virtual Observatory [1, 2, 3].
We will inform on the latest developments concerning standardisation of atomic and molecular data [4] : we will describe the efforts conducted within the IVOA to access linelists [5] and efforts on developping a complete schema for all processes [6] in a collaboration between NIST/ORNL/IAEA/Paris Observatory . We will present the services developped to access the CDMS and BASECOL databases as well new standalone tools [4].
References
[1] M.L. Dubernet, "The Virtual Observatory : its goals and the relevance of atomic and molecular data", 5th International Conference on Atomic and Molecular Data and their Applications (ICAMDATA), held in Meudon, France, 15-19 October 2006., Ed : E. Roueff, AIP Conference Proceedings, 2007, Vol. 901.
[2] N. Moreau, M.L. Dubernet, H. Müller, "VO access to CDMS spectroscopic database", Astronomical Spectroscopy and Virtual Observatory », held at ESAC, Villafranca, 21-23 Mars 2007, ESA Proceedings 2007.
[3] N. Moreau, M.L. Dubernet, "Automatic access to BASECOL database and scientific applications", - SF2A-2006, Paris, France, Proceedings of the Annual meeting of the French Society of Astronomy and Astrophysics Eds. : D. Barret, F. Casoli, G. Lagache, A. Lecavelier, L. Pagani, 2006, p. 95
[4] http ://voparis-molecular.obspm.fr
[5] http ://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/IvoaDAL
[6] http ://www-amdis.iaea.org/xml/

VOParis Portal

Pierre Le Sidaner, Jonathan Normand
(Observatoire de Paris)

We are presenting VO-Paris Data Centre Portal. We present a new portal for data and services proposing web access via VO protocols to all data from Observatoire de Paris and partners reachable via VO Protocols.
The aim of this portal is to give higher visibility to all data provided. Moreover we have installed calculation services capability over the data. It uses the cluster to distribute jobs and support multiple access. Some services are already available (sextractor, swarp, astrocheck).
Some of the future evolutions will be presented.

A sky browser in Aladin

Oberto A., Boch T., Bonnarel F., Bot C., Fernique P., Genova F.
(CDS - Observatoire de Strasbourg)

We present a new functionnality in progress in Aladin software : an interactive sky browser. The aim is to give a way to browse the sky as easily as outreach softwares can do, but geared for astronomers. The user can visualise a wide field and move seamlessly on the whole sky. This navigation mode will be available for some Aladin archive surveys, the needed images are automatically downloaded by the Aladin client. The images for such a view have been preprocessed using the HEALPix scheme, providing a multiresolution pixelization. Usual Aladin features (overlay of catalogs or images) remain available in this visualisation mode.

Session ASA

Session ASSNA

Session AS-GAIA

Invited talks

3D hydrodynamical simulations of stellar surfaces

L. Bigot
(Observatoire de la Cote d'Azur)

The photospheres of late type stars are really dynamic and inhomogeneous. The convective transport of heat manifests at the surface as granules evolving on short time scales. This rapidly changing medium affects the formation of spectral lines and thereby the information we can extract from them. In order to obtain reliable stellar parameters such as the chemical abundances or the radial velocities, a realistic modeling taking into account the coupling of hydrodynamics with radiation is mandatory. Such models have been developed during the last two decades and are now able to reproduce with success observed spectral lines, granulation properties as well as helioseismic data. In this talk I will briefly present these simulations and discuss the applications for Gaia.

The future of optical reference systems

P. Charlot
(Laboratoire d'Astrophysique de Bordeaux)

Optical reference frames have been traditionally limited in astrometric accuracy compared to radio reference frames which have long reached a sub-milliarcsecond accuracy. The next decade holds promises for big changes in this area with the launch of the GAIA space astrometric mission which unlike Hipparcos will be able to observe several hundred thousands of QSOs with an astrometric accuracy of a few tens of microarcseconds. The presentation will review the prospects for building the GAIA optical frame and its alignment with the current International Celestial Reference Frame (ICRF) based on radio measurements.

The thin and thick galactic disks : some recent results and pending questions

Misha Haywood
(Observatoire de Paris)

More than 900 millions of stars in the GAIA catalogue (or a fraction greater than 90%) will be stars of the thin or thick disks. For several tens of millions of stars, age, metalicity and kinematics will be measured up to a few kpc from the solar neighbourhood, wherea this is presently achieved only on about 10000 stars nearer than a hundred pc. Three years before the launch of the
satellite, where are we in our understanding of these two populations, their connections and scenario of formation? I'll give a brief account of recent results and pending questions.

Relativistic aspects of the GAIA mission

C. Le Poncin-Lafitte, S. Klioner, F. Mignard
(SYRTE, Observatoire de Paris)

Given the extreme accuracy reached in future global space astrometry, a mission such that GAIA will need a global relativistic modelling of observations. Outlining the importance of having a consistent relativistic approach all the way through the data analysis, we present also why GAIA observations will lead, in return, to an improvement of some General Relativity tests much beyond the current level.

From Hipparcos to Gaia : The Golden Age of Astrometry

F. Mignard
(OCA)

Over the past twenty years global astrometry has been revolutionised thanks to the access to space, well outside our turbulent atmosphere. This is not commonplace in science to have the possibility to witness during the few decades of an active carreer an improvement of more than four orders of magnitude in the measurement accuracy. However this is becoming true with Gaia entering its final years of preparation for a launch in 2011. Twenty years after Hipparcos, Gaia will create an extraordinarily precise three-dimensional map of about one billion stars throughout our Galaxy and beyond from repeated astrometric and photometric observations over about five years. In early 2007 ESA has entrusted a European Consortium of scientists and engineers with the challenging task of designing, implementing and carrying out the processing of the Gaia raw data. In this presentation I will outline the scientific objectives of the mission, and the overall principles of the instruments and of the measurement procedures in astrometry and photometry. I will stress more on the organisation of the data processing that has been put in place with the Data Processing and Analysis Consortium (the DPAC) and show the deep implication of the French groups and funding structures at different levels of this consortium. This is also a part of Hipparcos legacy.

Gaia : The industrial point of view

X. Moisson
()

The Gaia program has been officialy kicked off beginning 2006 by ESA, following several years of advanced study to demonstrate the feasibility of the mission. Since that time, the project has run through preliminary design review and is now following its development and integration programm. This presentation gives an overview of the spacecraft design, the industrial organisation of the project as well as the present status of the spacecraft and paylod development.

The Galactic bulge as seen in optical surveys

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

The bulge is a region of the Galaxy of tremendous interest for understanding galaxy formation. However measuring photometry and kinematics in it raises several inherent issues, like severe crowding and high extinction in the visible. Using a stellar population synthesis model of the Galaxy and a 3D extinction map, we estimate the stellar density as a function of longitude, latitude and apparent magnitude and we deduce the possibility of reaching and measuring bulge stars with Gaia. We also present an ongoing analysis of the bulge kinematics using the Canada France-Hawaii Telescope Legacy survey and proper motion surveys in the optical.

Gaia in the European context

C. Turon
(Observatoire de Paris, GEPI)

The ESA's mission Gaia will be placed in the context of the European and worldwide astronomy : what is its place within the space missions planned or in operation? what is its place within the Astronet roadmap context ? which actions should be supported or started for taking full advantage of this ambitious mission ? more specifically, which actions should be supported or started in France for enhancing the scientific return from the mission ?

Oral contributions

The GAIA satellite : a tool for the emission line stars and hot stars.

C. Martayan, Y. Frémat, R. Blomme, A. Jonckheere, M. Borges, R. Sordo, J.-C.Bouret, F. Martins, A. Miroshnichenko, J. Zorec, B. de Batz, B. Leroy, C. Neiner, Y. Naze, E. Alécian, D. Briot, M. Floquet, A.-M. Hubert, I. kolka, P. Stee, G. Meynet

(Royal Observatory of Blegium)

The GAIA satellite will be launched in 2012. It will observe at least one billion of stars and among them respectively several 100000s and millions of emission line stars and hot stars. GAIA will provide parallaxes for each star, spectrophotometry and spectra for stars till magV $\sim$ 17. After a general description of GAIA, we shall present the codes and models, which are currently developed in order to provide automatically the astrophysical parameters and spectral classification for the hot and emission line stars in the Milky Way and other local group galaxies such as the Magellanic Clouds.

A library of synthetic galaxy spectra for GAIA

P. Tzalmantza, M. Kontizas, B. Rocca-Volmerange (presentation) and 8 authors

(Institut d'Astrophysique de Paris/ Univ. Paris sud)

Among the objectives of Gaia, to identify morphology and the main parameters of the surveyed galaxy populations is essential. A basic library of 3600 (z=0) synthetic spectral templates is built on robust galaxy evolution models by using the code PEGASE.2. Evolution parameters of stellar populations, metallicity, extinction, mass and nebular emission are identified. Classifiers and parametrizers are from Support Vector Machines models. Extension to stellar and galaxy libraries of higher spectra resolution (ELODIE, Kurucz, etc) is in progress.

Complementarity of ground astrometry and the GAIA mission

F.Taris, S. Bouquillon*, J. Souchay*, A.H.Andrei**, A. Albert-Aguilar*, *SYRTE ** Univ.-Obs. Rio de Janeiro*

(Observatoire de Paris/ SYRTE)

The use of the GAIA catalogue as a reference catalogue in the astrometric reduction of the CCD mosaic obtained with ground telescopes will improve astrometric reduction by a factor of 50 compared to what would be obtained by using present reference catalogues. We plan to transfer that astrometric precision, around one mas, to fainter objetcs up to the 25th magnitude in the ecliptic fields with the help of the CFHT-LS VW survey. It will permit us to densify the GAIA catalogue. In parallel the observation of GAIA with ground based telescopes will allow us to determine with optimal accuracy the positions and the velocities of that probe. As a consequence, the modelisation of aberrations will be corrected at best and this will contribute to the improvement of the GAIA catalogue itself.

The galactic kinematics from RAVE to GAIA-RVS data

L.Veltz,O.Bienaymé

(Astrophysikalisches Institut Potsdam)

RAVE data have provided new results on Galactic kinematics like the kinematical decomposition of the Galactic disk. This decomposition permits to identify the different components of the disk and to characterize them in term of scale height, density scale length and kinematical scalelength. With the data provided by GAIA and in particular the RVS, we will have a completly renewed view of the Galaxy. The precision of the RVS will permit to undertake a precise analysis of the kinematics of the disk. This knowledge will give significant clues to constrain the scenarios of the Galactic disk formation.

Poster contributions

Gaia, matériel pour l'animation scientifique auprès du grand public

F. Arenou, C. Turon, ESA, pour l'AS Gaia
(GÉPI/UMR CNRS 8111, Observatoire de Paris)

From solar system dynamics to extragalactic astronomy, measurement of distances or detection of extra-solar planets, Gaia has a large potential for public outreach. Accordingly, ESA has prepared online material as well as posters, flyers or animations, the french translation of which is presented.

Multi-step VLBI observations of weak extragalactic radio sources to align the ICRF and the future GAIA frame

G. Bourda, P. Charlot, R. Porcas & S. Garrington
(Laboratoire d'Astrophysique de Bordeaux)

The space astrometry mission GAIA will construct a dense optical QSO-based celestial reference frame. For consistency between optical and radio positions, it will be important to align the GAIA frame and the International Celestial Reference Frame (ICRF) with the highest accuracy. Currently, it is found that only 10% of the ICRF sources are suitable to establish this link, either because they are not bright enough at optical wavelengths or because they have significant extended radio emission which precludes reaching the highest astrometric accuracy. In order to improve the situation, we have initiated a VLBI survey dedicated to finding additional suitable radio sources for aligning the two frames. The sample consists of about 450 sources, typically 20 times weaker than the current ICRF sources, which have been selected by cross-correlating optical and radio catalogues. This paper presents the observing strategy to detect, image, and measure accurate positions for these sources. It will also provide results about the VLBI detectability of the sources, as derived from initial observations with the European VLBI Network in June and October 2007. Based on these observations, an excellent detection rate of 89% is found, which is very promising for the continuation of this project. Additionally, VLBI positions are deduced in order to improve the current astrometry available for these radio sources.

Radial velocity standards for the GAIA-RVS

F. Crifo, G. Jasniewicz, C. Soubiran, L. Veltz, D. Hestroffer, D. Katz, A. Siebert, S. Udry
(GEPI/UMR 8111)

The ESA GAIA mission (launch expected end 2011) , besides the 5 astrometric parameters and photometry for some 10^9 objects, will also produce radial velocities and short spectra for a few 10^8 stars, with a 1 to 15 km/s accuracy.

The calibration of radial velocities in the integral-field spectrograph will rely on a set of some 1000 bright RV-stable stars already observed with a much higher accuracy from the ground, on a set of some 10^5 stable stars selected from the RVS measurements themselves, as well as on a few bright enough asteroids. We describe the construction and properties of this list.

Ground-based observations of solar system bodies in complement to the Gaia mission.

D. Hestroffer, W. Thuillot, S. Mouret, F. Colas (IMCCE/Observatoire de Paris), P. Tanga, F. Mignard, M. Delbò (Laboratoire Cassiopée/OCA) B. Carry (ESO, Santiago, Chili ? LESIA/Observatoire de Paris)
(IMCCE-Observatoire de Paris)

The ESA cornerstone mission Gaia, that will be launched in 2011, has the aim to provide a 3D census of the Milky Way. In addition to the observation of the stars in our galaxy or extra-galactic QSOs, Gaia will also observe a large number of small solar system bodies (approx. 250,000). These are mostly main belt asteroids, but also Near-Earth objects, Trojans, and a few comets, or planetary satellites. The scientific harvest that Gaia will provide ? given the high astrometric accuracy (at sub-milli-arcsec level), valuable photometric measurements (at milli-mag level), and moderate imaging (about 2,000 objects will be resolved) ? will have a major impact on our knowledge of this population in terms of composition, formation and evolution. There are nevertheless some intrinsic limitations in particular due to the unavoidable limited duration of the mission (5 years), the peculiar observing strategy that is not optimised to the observation of solar system objects, and last, the limited imaging possibilities. Besides, some aspects or spectral bands of possible interest for a few cases or objects are out of the scope of the basements of the Gaia mission ; they are not mandatory for the data reduction but can still provide valuable data for the general scientific output. We can thus identify two kind of complementary data and ground-based observations, whether they are part of the DPAC (the Gaia Data Processing and Analysis Consortium, PI. F. Mignard) consortium, or not, but provide a strong leverage to the Gaia science.

We discuss different aspects of additional observations from ground (yet not exclusively) either in preparation to the Gaia mission, in alert during the mission, or after the mission as additional complementary information. We are already participating to the GBOG group (Ground-Based Observations for Gaia, PI C. Soubiran) for ground-based observations in preparation to Gaia (see Soubiran et al., this meeting), either for the observations in alert, or for the observations and analysis of asteroids for the validation of the RVS calibration (Radial Velocity Spectrometer, see Crifo et al., this meeting). Additional observations ? of a set of well defined and selected targets ? with different telescopes and instrumentation will also increase the scientific output in three particular and important topics : mass of asteroids, their bulk density and possible link to their taxonomy, and non-gravitational forces.

Astrometric measures before and after Gaia of about 50 target asteroids will increase the number of derived asteroids masses (adding more than 25 bodies to the list of approx. 150 from Gaia observations alone). Subsequently high angular resolution imaging (Adaptive Optics and interferometry) which combined to the photometry will yield a precise volume and bulk density of the body. Last, astrometry and radiometric size measurements of about 20 selected NEOs will enable the detection of the Yarkovsky effect and possibly measure their thermal inertia. Moreover, let us stress that these additional information will also enable us to better understand and model possible bias in the global adjustment to the Gaia observations, avoiding hence a degradation of the general quality of any global parameter estimation (test of General Relativity, link of the dynamical reference frame to the optical ICRF, ...). Another point of interest that is discussed concerns the observations performed after the Gaia astrometric catalogue will be made available to the community, or the possible re-reduction of anterior observations. In particular, the predictions of the path of stellar occultations or appulses by asteroids and satellites will be dramatically improved with the Gaia catalogue, as was already the case after 1997 with the availability of the TYCHO-2 catalogue. Eventually, the topics developed here will also be discussed during a fore-coming workshop opened to the community interested in participating in such ground-based observation campaigns.

GUMS : simulation des étoiles visibles par Gaia

A.C. Robin, C. Reylé, X. Luri, et al.
(Institut UTINAM, Observatoire de Besançon)

We shall present the distribution in space, in physical parameters and observational parameters, of the stars which will be seen by Gaia. The simulations are done using GaiaSimu, a tool developed by DPAC consortium for preparing the Gaia mission. Stellar distributions are based on the Besancon Galaxy model for a large part, while also taking into account binary stars and variabilities.

Ground-Based Observations for Gaia

Soubiran et al
(Laboratoire d'Astrophysique de Bordeaux)

A coordinated plan of ground-based of observations has been organised to obtain the mandatory calibration data for Gaia. Although Gaia is usually qualified as a self calibrating instrument, this is not fully true in photometry and spectroscopy where reference data are needed to fix the zero-point of the magnitude system and radial velocities, and to calibrate the classification / parametrization algorithms. Observations have already started on national facilities in the participating countries, and at ESO and CFHT, in order to have the full data set ready at the start of the Gaia processing in 2012.

Les activités du Centre de Produit ICRS (SYRTE/USNO) en lien direct avec la préparation de GAIA.

J.Souchay,A-M.Gontier,S.Lambert,S.Bouquillon,G.Francou, C.Barache,S.Bouquillon,F.Taris,C. Le Poncin-Lafitte, A.Fienga,F.E.Arias,A.H.Andrei
(SYRTE, Observatoire de Paris)

After explaining the various activities of the ICRS Product Centre which is monitored both by Paris Observatory and the US naval Observatory, we are showing the direct and close links between this actvities and the GAIA mission : densification of the ICRF from ground-based observations, astrometric follow-up of artifical satellites (WMAP,GAIA), compilation of catalogues of quasars, VLBI analysis at the astrometric level of GAIA mission, link between the ICRS and the dynamical system through pulsar timing and and LLR etc...

Détermination de vitesses radiales pour le spectromètre de Gaia

Yves Viala, on behalf of GAIA DU650, "single transit analysis"
(Observatoire de Paris - GEPI)

We describe four methods which are being developed for the determination of the radial velocities for the Gaia RVS spectrometer.

Simulating Charge Transfer Inefficiency Effects on Future Gaia Data

M. Weiler, C. Babusiaux
(Observatoire de Paris-Meudon)

The European space mission Gaia will perform an all-sky survey of astronomical sources with a brightness down to 20 mag. For all observed sources high-precision astrometric measurements as well as spectrophotometric and spectroscopic observations for the brightest will be done. The accuracy of these measurements is affected by charge transfer inefficiency (CTI) in CCDs. CTI results in a smearing of the observed PSFs and in charge loss, in degree depending on the history of observed sources. Simulations of CTI-affected Gaia astrometric observations are presented, employing the first available basic CTI models. The effects of CTI upon the PSF is studied and the influence of the observation history is evaluated.

Session Enseignement

Oral contributions

Les stages d'initiation à l'observation astronomique

J.E. Arlot
(IMCCE/observatoire de Paris/CNRS)

Starting 1994, training to astronomical observation of the students in DEA "Astronomie fondamentale, Mécanique Céleste et Géodésie" started at the observatory of Haute Provence. In 2008, all the french DEA in astronomy, now named Master 2 Recherche, organize their training to astronomical observation. More, teachers in high schools as students from the Diplome Universitaire of Paris observatory wish to participate to training to professionnal astronomical observations. This success brings its problems with it and we should solve them as soon as possible avoiding the disappearance of such a useful teaching.

Diplômes d'Université en présentiel à l'Observatoire de Paris

C. Balkowski
(Observatoire de Paris)

The Observatoire de Paris offers two Diplômes d'Université at the level of the scientific baccalauréat. All the astronomical subjects are presented through lectures and conferences once a week, a data reduction workshop is proposed in Meudon as well as a week in Haute Provence observatory.

Deux parcours astro en master 2 à Marseille, un parcours "recherche" en astrophysique (AER) et un parcours "professionnel" en instrumentation optique pour l'astrophysique (IOL).

Russeil D., Adami C., Amram P., et al.
(LAM)

Marseille et sa region ont une longue tradition de formation en astrophysique et en instrumentation qui s'appuie sur un héritage ancien et la dynamique du regroupement de l'astronomie marseillaise dans de nouveaux bâtiments (l'OAMP/LAM).

Dans le cadre de l'universite unique "aix-marseille université" (qui va naître de la fusion de 3 Universites actuelles, ce qui en fera la plus grande université de France), nous présentons l'offre moderne de formation en astrophysique et en instrumentation pour l'astrophysique au travers les deux parcours de Master deuxième année AER et IOL.

Après avoir présenté les formations, nous illustrerons notre propos sur un exemple original de formation des étudiants sur toute la chaîne de production en astrophysique : définition des buts scientifiques (objet des recherche), adéquation de l'instrument avec les objectifs scientifiques, conception instrumentale pour répondre à ces objectifs, définition de la stratégie observationelle, choix des cibles à observer, réalisation des observations (à travers un stage a l'OHP qui comprend des observations sur le T120 pour réaliser de la photométrie de surface et de la spectroscopie sur Carelec au T193), reduction et analyse des données d'imagerie et de spectroscopie, modélisation des données (lors d'un ou plusieurs projets numériques connexes). Les différentes phases de ce projets sont introduites lors des différentes unités d'enseignement. Cette formation est largement mutualisée pour les 2 parcours (IOL et AER), la formation astro mettant l'accent sur l'aspect programme scientifique et modélisation des résultats et la formation instrumentale mettant l'accent au contraire l'accent sur la conception et la réalisation instrumentale.

Un autre exemple sera donné sur la mise en place d'un parcours cosmologie qui associe au compétences du LAM, à la fois les compétences de la physique théorique du CPT et celle des astroparticules du CPPM.