Journées de la SF2A 2011
20-23 juin, Paris
Liste des abstracts
Book of abstracts

June 16, 2011

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1 A00 - Séance plénière SF2A

Invited talks

Stellar Physics with GAIA
B. Plez
(LUPM (Laboratoire Univers et Particules de Montpellier))

GAIA will provide a three-dimensional map of our Galaxy, with unprecedented positional and radial velocity measurements for about one per cent of the Galactic stellar population. Combined with astrophysical information for each star, derived from spectroscopy and photometry, this will lead to a detailed understanding of the formation, and dynamical and chemical evolution of our Galaxy. Other scientific products include extra-solar planets, minor bodies in the solar system, or distant quasars. The contribution of GAIA to stellar physics is less publicized. I will show a number of illustrative examples. E.g., we will have access to very precise HR diagrams with very large sample of stars allowing extensive tests of fine effects in stellar evolution. Accurate parameters (e.g. luminosities, masses) will allow the independent determination of surface gravities, the characterization of non-LTE effects, the derivation of more accurate chemical abundances, We will be able to quantify transport processes in various populations of stars, or get a new view on abundance anomalies. Interesting side-effects of the preparation of GAIA are the large effort devoted to homogenize the stellar parameters of a large number of reference stars, and the development of performant tools designed to automatically extract parameters from tremendous amounts of spectra.

CFHT en route to a new era
Christian Veillet
(Canada-France-Hawaii Telescope)

For more than three decades, CFHT has been constantly evolving: an evolution which allowed the observatory to stay at the forefront of today's astronomy. This presentation will focus on recent or forthcoming evolutionary steps, such as: remote operations, dome venting, observatory automation, two new instruments being developed and a third one under study, China now collaborating with the observatory alongside Taiwan and Brazil, and the old idea, recently gaining momentum, of replacing the 3.6-m by a larger telescope dedicated to wide-field multi-object spectroscopy, opening a potential for new partnerships and an exciting future.

ALMA early science cycle 0 : et après ?
J. Pety
(IRAM & Obs. de Paris)

Le premier appel à observations ALMA (dit early science cycle 0) a pour date limite le 30 juin 2011. Si c'est une étape importante pour ALMA, cela n'est qu'un début pour une grande partie de la communauté astrophysique française. Je présenterai l'état actuel du projet, le calendrier jusqu'à la fin de la période de construction et la montée en puissance des capacités d'observation. Je ferai aussi le bilan des activités de l'Action Spécifique ALMA dont le mandat actuel se termine fin 2011.

Quoi de neuf sous le soleil ?Observations spatiales récentes et perspectives
Frédéric Auchère
(Institut d'Astrophysique Spatiale)

Ces dernières années ont vu des percées importantes dans la compréhension des processus physiques à l'oeuvre dans la couronne solaire et l'héliosphère interne. Nous présenterons ainsi quelques uns des résultats récents obtenus par les missions STEREO, et plus récemment SDO. Ces résultats, que l'anniversaire des l'observation des taches solaires par Gallilée ou l'année STEREO permettent de mettre en perspective, montrent à la fois les avancées effectuées et le chemin restant encore à faire. A l'avenir, de par son profil unique permettant simultanément la résolution spatiale extrême des régions sources et la mesure des conditions héliosphériques, Solar Orbiter permettra d'adresser certaines des questions fondamentales ne pouvant être résolues depuis le point de vue Terrestre.

Astrochimie: chimie des origines?
Louis d'Hendecourt
(IAS-CNRS-UPS)

Si l'astrochimie a beaucoup oeuvré pour la compréhension physique et chimique du milieu interstellaire, elle a jusqu'ici été peu prise en considération pour l'origine de la complexité moléculaire, un pré-requis de la chimie réellement prébiotique. Pourtant, l'apparition de cette complexité moléculaire, dans les environnements extraterrestres, du milieu interstellaire, aux enveloppes circumstellaires et aux disques protoplanétaires ne fait aucun doute. Photochimie des analogues de glaces en laboratoire, formation de matière organique macromoléculaire et abondance de matière organique soluble dans les météorites primitives, tout semble indiquer que l'évolution moléculaire vers la complexité est un phénomène universel, propice à poser la question de la possibilité d'étudier une chimie réellement prébiotique aux origines de la vie, tout au moins sur la Terre, seul exemple connu à ce jour.

Le programme Cosmic Vision de l'ESA
Athena Coustenis
(LESIA, Observatoire de Paris-Meudon)

Je ferai le point sur le programme Cosmic Vision de l'ESA actuel qui reflète la science spatiale prévue à l'horizon 2015-2025 en Europe. J'indiquerai les thématiques mis en avant lors des récents appels de 2007 et 2010. Je parlerai des missions actuellement à l'étude suite à ces appels et décrirai le paysage de l'exploration spatiale en Europe comme il se profile au cours des prochaines décennies.

Space Time Explorer & Quantum Test of the Equivalence principle
A. Landragin & STE-QUEST team
(SYRTE- Observatoire de Paris)

La proposition de mission STE-QUEST a été présélectionnée comme mission M3 lors de l'appel COSMIC vision 2011 avec 3 autres propositions.

Elle propose de tester le principe d'équivalence faible (universalité de la chute libre) et l'invariance locale de position (test du red shift) à l'aide de capteurs atomiques : interféromètre atomiques et horloges atomiques. L'expérience propose d'utiliser une orbite très elliptique et un lien satellite-sol de très haute performance pour tester le red shift entre l'horloge spatiale et le sol à un niveau 50 fois meilleur que celui qui sera réalisé dans le projet ACES.

Par ailleurs une mesure différentielle de l'accélération ressentie par deux espèces atomiques permettra un test du principe d'équivalence à 10-15 .

Comptes rendu du colloque RetD INSU
Pierre Kern
(IPAG)

a compléter plus tard.

Migration planétaire et couplage migration/accrétion
Aurélien Crida
(Université de Nice Sophia-antipolis / Observatoire de la Côt)

Planetary migration is a process whose importance for the evolution of planetary system is now well recognized. In this talk, I will first explain how migration works, review the various types of migration, and their consequences.

Then, I will focus on recent results on type I migration, which open the possibility for outward migration of planetary embryos and giant planet cores located in the inner part of the disk. The consequences of this result on the accretion of giant planets cores will be discussed. We expect the existence of a sweet spot for accretion (possibly even two) to appear in the disk. This opens interesting perspectives towards a better understanding of the formation and evolution of giant planets.

Champs Magnétiques à la surface des étoiles géantes et supergéantes avec Narval et ESPaDOnS
Michel Aurière
(IRAP)

Lorsqu'une étoile plus massive que le soleil quitte la séquence principale, son diamètre augmente, sa vitesse de rotation diminue, et une enveloppe convective est créée et se creuse: des paramètres dont dépend directement la production de champ magnétique à la surface de l'étoile sont ainsi grandement modifiés. Les étoiles géantes et supergéantes sont donc d'excellents laboratoires pour étudier l'interaction entre champs magnétiques et évolution stellaire.

Les spectropolarimètres de nouvelle génération ESPaDOnS (@CFHT) et Narval (@TBL) sont parfaitement adaptés à l'étude des champs magnétiques à la surface de ces objets brillants, en rotation lente et fournissant des milliers de raies photosphériques utilisables dans les méthodes de corrélation et d'imagerie Zeeman-Doppler. Je présenterai les résultats obtenus par l'étude de plusieurs dizaines d'étoiles évoluées de masse plus grande que solaire avec ces instruments. Les étoiles évoluées observées avec la meilleure précision possible avec ESPaDOnS ou Narval présentent en général un champ magnétique à leur surface, le plus faible détecté correspondant au niveau d'activité magnétique du soleil.

Les résultats seront illustrés par des études plus approfondies de quelques étoiles évoluées caractéristiques: V390 Aur (rotateur rapide de masse intermédiaire: champ magnétique dynamo de type solaire?), EK Eri (descendante d'une étoile Ap?), Pollux (rotateur lent au champ magnétique très faible), Bételgeuse (supergéante M) .

The Spanish Astronomical Society. Present and Future
Emilio J. Alfaro
(Sociedad Española de Astronomía (SEA-IAA-CSIC))

Accélération de particules aux chocs non-relativistes et relativistes
Guy Pelletier
(IPAG)

La génération de particules de haute énergie aux chocs

non-relativistes, notamment ceux des Restes de Super-Nova, accompagnée d'une amplification du champ magnétique, a inspiré une généralisation au cas des chocs relativistes, notamment ceux des Sursauts Gamma. En effet, le succès de cette démarche a conforté l'idée que les plus hautes performances seraient réalisées dans le régime relativiste. En réalité, des rebondissements ont marqué ces études au cours des dernières années, mettant en évidence le caractère particulier du régime relativiste, où structure de choc non-collisionnel, accélération de particules et génération de la turbulence sont intimement liés. L'état de cette recherche sera présentée, ainsi que les performances attendues dans les écoulements relativistes ou sub-relativistes émanants des objets compacts et des sursauts gamma.

Etude des amas de galaxie par effet SZ avec Planck
M. Douspis pour la collaboration Planck
(IAS)

Construire l'égalité professionnelle entre les femmes et les hommes au CNRS
Pascale Bukhari
(CNRS)

The Virtual Observatory in action
E. Solano
(Centro de Astrobiologia (INTA-CSIC). Spanish VO)

The Virtual Observatory (VO) is a research infrastructure that facilitates the discovery, access and analysis of the information hosted in astronomical archives and services distributed worlwide. After several year of development, VO has become nowadays a robust and powerful instrument for the astronomical community.

In this talk I will present some examples of VO-science,i.e., projects that have strongly benefited from using a VO methodology. Other VO-related aspects like VO-tools and VO-outreach will also be outlined.

Poster contributions

ECHO : The Exoplanet CHaracterization Observatory
Beaulieu J.P., Coudé du Forresto V., Ollivier M., ECHO consortium
(Institut d'Astrophysique de Paris)

A dedicated mission to investigate exoplanetary atmospheres is a major milestone in our quest to understand our place in the Universe by placing our Solar System in context and by addressing the suitability of planets for the presence of life. EChO –the Exoplanet Characterisation Observatory– is a mission concept fine-tuned to this purpose. EChO will provide high resolution, simultaneous multi-wavelength spectroscopic observations on a stable platform that will allow very long exposures. The use of passive cooling, few moving parts and well established technology gives a low-risk and potentially long-lived mission. EChO will build on observations by Hubble, Spitzer and ground-based telescopes, which discovered the first molecules and atoms in exoplanetary atmospheres. However EChO's configuration and specifications are designed to study a number of'systems in a consistent manner that will eliminate the ambiguities affecting prior observations. EChO will simultaneously observe a broad enough spectral region to constrain from one spectrum the temperature structure of the atmosphere, the abundances of the major carbon and oxygen molecules, the expected photochemically-produced species and magnetospheric signatures. The spectral range and resolution of the 4 channels are tailored to separate bands belonging to up to 30 molecules and retrieve the composition and temperature structure of planetary atmospheres.

Properties of unusual void LSBDs versus cosmological simulations predictions
S.A.Pustilnik (SAO, N.Arkhyz)J-M.Martin (OdP, GEPI)Kniazev A.Y. (SAAO, Cape Town; SAI, Moscow)
(Observatoire de Paris, GEPI)

Till the recent time model simulations of galaxy formation and evolution were limited by too coarse mass resolution, corresponding to DM halos of $\sim$ 1010 Mo (and typical $M\_\{baryon\}$ of several 108 to 109 Mo). The important issue of relationships between galaxy formation, evolution and environment was also limited, in particular, in voids, both observationally and in models, by objects of this mass range. From general principles, the less is mass of a galaxy, the more it is susceptable to external perturbations and its evolution is more sensitive to the environment. Therefore, the properties of the least massive galaxies in voids provide an interesting opportunity to check the validity of basic assumptions of modern models.

We present the study of several unusual galaxies – low-mass (M_bar $\sim$ 3*107 to *sim* 109 Mo, and M_Bsim -(12-14.5)) Low Surface Brightness Dwarfs (LSBD) residing in a nearby Lynx-Cancer void. We confront their properties with results of recent cosmological simulations, predicting both dynamical properties of low-mass objects and connecting their formation and evolution. In particular, we compare V_rot, baryon mass $M\_\{bary\}$, total dynamical mass within R(HI) - $M\_\{dyn\}$, with predictions of Hoeft & Gottloeber (2010), which account for the suppression of gas accretion to the low-mass DM halos. We also use for comparison the lower resolution "Bolshoj" simulations by Trujillo-Gomez et al. (2010), well matching galaxy dynamical properties in a wide range of $V\_\{rot\}$. For both simulations, we find that for some of our void LSBDs, the observed parameters roughly match the predictions. However, for the others, the differences are very large and suggest either atypical evolutionary history of the studied LSBDs, or probable caveats in models, or both. More work, both observations and modelling, is necessary to resolve these apparent inconsitencies.

Effects of asteroids on the orbital motions of ter-

restrial planets
S. ALJBAAE, J. SOUCHAY
(SYRTE)

Ce travail est présenté dans le but d'essayer d'évaluer de la manière la plus détaillée possible les effets des gros astéroïdes présents dans le système solaire sur les orbites des planètes telluriques Mercure, Venus, la Terre et de Mars. Pour cela notre méthodologie a consisté en plusieurs étapes : l'intégration numérique du mouvement des planètes avec ou sans l'astéroïde perturbateur dont on veut connaître l'effet ; la détermination du signal représentant cet effet, par simple soustraction ; l'analyse de ce signal par FFT (Fast Fourier Transform/ Transformée de Fourier Rapide) permettant de localiser les oscillations sinusoïdales les plus importantes ; l'ajustement du signal par un jeu de sinusoïdes, en utilisant l'algorithme des moindres carrés. Ce type d'étude peut s'avérer très intéressant dans la perspective du raffinement des éphémérides planétaires, ainsi qu'en navigation spatiale, pour mieux connaître les effets des gros astéroïdes sur les planètes telluriques. On montrera pourquoi notre étude spécifique par astéroïde est sensiblement plus détaillée et complète que les études précédentes (Williams 1984, Mouret et al 2009) et peut s'appliquer à n'importe quel objet.

Caractérisation orbitale de *beta* :Pictoris B et conséquences sur les modèles existants
Hervé Beust, Gael Chauvin, Anne-Marie Lagrange
(Institut de Planétologie et d'Astrophysique de Grenoble (IPA)

La planète *beta* :Pictoris B a été imagée à plusieurs reprises depuis 2003. Le nombre de points astrométriques dont nous disposons sur sa position par rapport à l'étoile permet aujourd'hui une première caractérisation orbitale. Nous avons effectué un ajustement de l'orbite par une méthode de moindres carrés et une méthode statistique MCMC (Markov Chain Monte-Carlo). Nous présentons ici le premier résultat de détermination orbitrale. Nous examinons la compatibilité de l'ensemble des solution trouvées avec i) l'hypothèse d'un transit planétaire fin 1981 du à cette même planète (Lecavelier et al. 2009), ii) l'hypothèse comme quoi cette même planète pourrait être à l'origine des FEBs (Falling Evaporating Bodies, des comètes star-grazers; Beust & Valiron 2007 et refs. plus anciennes). Nous montrons aussi que la poursuite du suivi astrométrique de cette planète dans les années à venir sera cruciale pour contraindre ces modèles.

2 A01 - Les Grands Relevés Extragalactiques et Cosmologiques

Invited talks

Extragalactic Science with EMIR/GTC
R. Pello & the GOYA collaboration
(IRAP)

EMIR is a wide-field, near-IR spectrograph currently under development for the Nasmyth focus of the Spanish 10.4m GTC at Canary Islands. EMIR will provide imaging and multi-slit spectroscopy in the ∼1-2.5 micron domain for up to 50 targets using cryogenic multi-slit masks, at a resolution of R∼5000-4000. The status of this project will be reviewed, including instrumental developments and main science drivers. I'll concentrate on the GOYA Survey, a scientific program to be developed mainly using the guaranteed time of the international consortium building EMIR. The GOYA project addresses the formation and evolution of galaxies, in particular the structure, dynamics and integrated stellar populations of galaxies at high redshift.

One of the main goals of the GOYA survey is the identification and study of z 7 sources, both in lensing clusters and in the field. The aim is to build up a statistically significant sample of galaxies at redshift z>7 with secure redshifts, and to study their physical properties using their broad-band spectral energy distribution in one hand, and their emission line properties on the other hand. The first results obtained from our photometric CFHT WIRCAM Ultra Deep Survey (WUDS), which is intended to provide a robust selection of targets for GOYA, in particular for z>7 candidate sources, will be also presented. WUDS and the complementary photometric survey in lensing clusters are specifically tailored to set strong constraints on the cosmic SFR and the bright end of the LF, taking advantage from our privileged access to EMIR/GTC for a precise redshift determination and subsequent emission-line studies.

Dernières nouvelles des programmes spatiaux en Astronomie-Astrophysique
Fabienne Casoli
(CNES)

Physics of the Accelerating Universe (PAU) and Dark Energy Survey (DES)
Francisco J CastanderPAU collaboration DES collaboration
(ICE, IEEC/CSIC)

I will review the major science drivers of the PAU and DES surveys. Th ephysics of the Accelerating Universe (PAU) is building a new wide field camera to be installed at the WHT prime focus to carry out a survey in narrow and broad band filters. The Dark Energy Survey is also building a camera to be installed an the prime focus of the Blanco CTIO 4.0m telescope to conduct a large area survey in broad band filters. Both surveys aim to constrain our cosmological model.

The QUIJOTE CMB Experiment
Rubino-Martin, for the QUIJOTE Collaboration
(Instituto Astrofisica de Canarias (IAC))

I will review the current status of the QUIJOTE (Q-U-I JOint Tenerife) CMB Experiment, a new experiment that will operate at the Teide Observatory with the aim of characterizing the polarization of the CMB and other processes of galactic and extragalactic emission

in the frequency range of 10-40 GHz and at large angular scales. The first of the two QUIJOTE telescopes and the first instrument will start operations soon at the Teide Observatory. QUIJOTE will be a valuable complement at low frequencies for the PLANCK mission, and will have the required sensitivity to detect a primordial gravitational-wave component if the tensor-to-scalar ratio is larger than r=0.05.

Planck: the largest extragalactic and cosmological survey in the sub-millimeter!
G. Lagache, on behalf of the Planck collaboration
(IAS)

Planck is a satellite mission operating since August 2009, and the two instruments will yield 4 all-sky surveys at 9 frequency bands (30-857 GHz) with 30-5' resolution. In January 2011, the Planck collaboration released the first results, based on the first 10 months of survey data. These results do not address the cosmology yet but they cover a wide range of topics, from galaxy clusters, radio and dusty star-forming galaxies to interstellar dust.

After briefly introducing the Planck mission, I will detailed a subset of the Early Results focusing on the extragalactic science. I will present the galaxy sample and first identifications that shed new light on the structure formation process. I will then spend more time on the Cosmic Infrared Background anisotropies that probe the clustering properties of dusty star-forming galaxies at high redshift. In this talk, I will not present any results obtained on SZ clusters, as they will be detailed in the plenary session (talk by M. Douspis).

Review of Herschel HerMES and ATLAS Results
I. Pérez-Fournon (on behalf of the HerMES and H-ATLAS consortia)
(Instituto de Astrofísica de Canarias)

This talk will describe the two largest extragalactic surveys being carried out with the Herschel Space Observatory: the Herschel Multi-tier Extragalactic Survey (HerMES) and the Herschel-ATLAS survey and present a summary of the main results.

Oral contributions

The formation of large galactic disks: survival or revival?
Hammer
(GEPI)

Using the deepest and most complete observations of distant galaxies, we investigate how large disks could have been formed. Observations include spatially-resolved kinematics, detailed morphologies and photometry from UV to mid-IR. Six billions years ago, half of the present-day spirals were experiencing major mergers, evidenced by their anomalous kinematics and morphologies as well as their relatively high gas fractions. They are consequently modelled using the state of the art hydrodynamics models. This provides a new channel of disk formation, e.g. disks reformed after gas-rich mergers. Then one may estimate which fraction of the stellar mass density has been formed during mergers. This will be compared to expectations from nearby galaxies, including the Milky Way and M31.

Empreintes de l'énergie noire sur la formation des grandes structures
Vincent Bouillot
(LUTH - UMR 8102)

Récemment la compilation de plusieurs catalogues de champ de vitesse a permis de mesurer les champ de vitesse jusqu'à une distance de $60h^{\{} - 1\}$ Mpc (bulk flow). Cela a mis en évidence un excès significatif dans le bulk flow. Cela a été interprété comme une déviation par rapport au modèle standard de la cosmologie, LCDM. En ce sens, les champs de vitesse constituent une sonde unique pour la cosmologie. Durant cette présentation, je discuterais les causes possibles de cette anomalie dans le champ de vitesse local.

The Orbital distribution of the satellite galaxies:Cosmological correlations and Origin
LATIFA Benjouali, MARIA ANGELES Gómez Flechoso2, and ROSA Doménguez-Tenreiro
(UNIVERSITÉ AUTONOME MADRID)

The knowledge of the distribution, the number and the characteristics of the satellite galax- ies can provide important information about the cosmological phenomena involved in the formation of the galaxies and their assembly processes. The observational data about the distribution of the satellite galaxies in the Local Group show that some dwarf galaxies and globular clusters (that could be residuals of accreted satellite galaxies) orbit the main galaxies in common planes. The origin of these co-planar orbits are still unknown. In this paper, we present our results on hydrodynamical cosmological simulations. We have ana- lyzed the orbital distribution of the satellite galaxies, focusing in their correlations and the cosmological origin of the co-planar orbits.

The Effect and Influence of Star Formation and Gas Accretion on the Turbulence in the ISM, on Self-regulation and on the IMF.
Loic Le Tiran, Matthew Lehnert
(GEPI - Observatoire de Paris)

I will present results from observations of more than 50 galaxies as seen as they were 9 to 12 Gyrs ago with integral-field spectroscopy. Taking advantage of this large sample, I will first paint a brief picture of the very particular physical nature of these galaxies. These observations reveal a surprisingly high amount of random motions in the gas inside these galaxies. I will explain why this effect is real (not due to observational limitations) and why it is probably a consequence of the intense star formation in these objects, outlining why we conclude that star formation is self-regulated. Using additional rest-frame UV observations in a subsample of these objects, we also suggest that their Initial Mass Function is flatter than Salpeter at the high mass end, an effect that may be due to the high turbulence, as

has been suggested by some theories of star-formation. I will also discuss our conclusions within the context of cosmological (quasi-)adiabatic gas accretion: is there a phase in galactic evolution where we could detect the effects and rate of gas accretion in our studies of the rest-frame optical emission lines?

The Influence of the Environment in Compact Galaxy Groups
V. Charmandaris, T. Bitsakis
(Univ. de Crete)

We present a comprehensive study on the influence of the environment of compact galaxy groups to the evolution of their members using a multi-wavelength analysis, from the UV to the far-IR, on a sample of 32 Hickson Compact Groups (HCGs) containing 135 galaxies. Fitting the SEDs of all galaxies with the state-of-the-art model of da Cunha (2008) we can accurately calculate their mass, SFR, and extinction, as well as estimate their infrared luminosity and dust content. We contrast our findings with control samples of field galaxies, early-stage interacting pairs, and galaxies in clusters.

We find that classifying the evolutionary state of HCGs as dynamically "old"or "young" depending on whether or not they contain more than 25% or early-type galaxies is physical and consistent with past classifications based on their gas content. Late-type galaxies in dynamically "young" groups have sSFR, as well as NUV-r and mid-infrared colors, which are similar to those of field and early stage interacting pairs. However, late-type galaxies in dynamically "old" groups have redder NUV-r colors, as they have likely experienced several tidal encounters in the past and built up their stellar mass, and they display lower sSFRs. Finally our model suggests that in 13 groups, 10 of which are dynamically "old", there is diffuse dust in the intragroup medium.

All these evidence point to an evolutionary scenario in which it takes time for the group environment to visibly affect the properties of its members. Early on the influence of close companions to group galaxies is similar to the one of galaxy pairs in the field. However, as the time progresses, the effects of tidal torques and minor merging shape the morphology and star formation history of the group galaxies, leading to an increase of the fraction of early type members and a rapid built up of the stellar mass in the remaining late type galaxies.

Galaxy & AGN Evolution through Large Redshift Surveys or the Need for upgrading VIMOS towards the NIR
Tresse, Laurence & VIMOS-IR Team
(Laboratoire d'Astrophysique de Marseille)

The understanding of galaxy and AGN evolution is linked to the ability to find these galaxies out to increasingly large distances, and to measure key tracers of the physical conditions in galaxies and their environment, from the local to the very distant Universe. Going to increasingly large distances, key spectral features are redshifted into the near infrared, and dedicated instrumentation is necessary to a number of investigations. A major development in Astrophysics in the last 15 years has been the ability to assemble measurement of large samples of galaxies or AGNs, from large deep redshift surveys with multi-object spectrographs (MOS), as a needed counterpart of large deep multi-band imaging surveys. While imaging surveys in the infrared are well underway, large spectroscopic surveys of galaxies and AGNs in the near-IR are still not possible at ESO. We are proposing a fast and easy instrument concept to provide ESO with a competitive edge in MOS in the near-IR.

Non-thermal physics of galaxy clusters
C. Ferrari
(Observatoire de la Côte d'Azur)

Deep radio observations of galaxy clusters have revealed the existence of diffuse radio sources related to the presence of relativistic electrons and weak magnetic fields in the intracluster volume. Intracluster relativistic electrons can also give rise to hard X-ray emission through Compton scattering of CMB photons. I will show the importance of combining galaxy cluster observations by new-generation radio, optical Gamma- and X-ray instruments. A deeper knowledge of the non-thermal cluster component, together with statistical studies of radio halos and relics, will allow to test the current cluster formation scenario and to better constrain the physics of large scale structure evolution.

Tracing a coherent picture of the Cosmic Star Formation Rate Density in the past $\sim$ 12 Gyr with the VVDS Deep and Ultra-Deep spectroscopic surveys
Cucciati, Tresse, Ilbert, Le Fevre et al.
(INAF-Osservatorio Astronomico di Trieste)

The determination of the Cosmic Star Formation Rate Density History is crucial to understand how stellar mass has been assembled in galaxies. I will present the Cosmic SFRD History derived from the global FUV Luminosity Function with the VVDS Deep (I_AB=24) and Ultra-Deep (I_AB=24.75) spectroscopic data, in the redshift range 0

The ALMA capabilities for observing dust settling in protoplanetary disks
Yann Boehler
(Laboratoire d'astrophysique de bordeaux)

Mm and sub-mm interferometers are particularly adapted to probe the interior of protoplanetary disks as they appear of moderate opacity at these wavelengths. Thanks to large arrays such as the PdBI (IRAM), observations of TTauri disks have allowed us to constrain for the first time the dust radial distribution (Guilloteau et al, 2011). I will present the main results of this survey. Although dust settling has been inferred at infrared wavelengths in the disk atmospheres, this is still difficult to observe it at longer wavelength due to the lack of angular resolution. This problem will be solved with the interferometer ALMA. To study dust settling, we developed a model making submm images of the dust thermal emission and included the settling by using predictions given in the framework of the MRI. We made ALMA pseudo-observations of settled disks

(using the ALMA simulator) and compare them to homogeneous cases. I will present then the observational strategy we deduce from our simulations.

The Polar Large Telescope, an Infrared Large Synoptic Survey Telescope
N. Epchtein et le consortium PLT
(UMR6525)

Progress in exciting areas of astrophysics depends on our ability to probe the sky at improved angular and time resolution seeking fainter objects in new spectral ranges. Large synoptic surveys will be key elements of next generation observational facilities complementary to the unique breakthroughs that ALMA, JWST and E-ELT will produce. The aim of the Polar Large Telescope PLT is to exploit the high altitude and dry, cold, stable atmosphere of the Antarctic continent. It would produce the first surveys in the largely unexplored 2-5 m thermal infra-red (TIR) wavelength range as an extension to the work of the LSST The PLT consists of a wide field $\sim$ 2.5m telescope that will produce repeated deep diffraction limited images of $\sim$5000 sq. deg. in 4 broad bands of the TIR. It will also explore the time domain in the TIR at an unprecedented depth (down to mAB =25.5 in K_dark) and angular resolution (0.3") and will generate alerts of transients and react quickly to alerts from other facilities. The legacy will consist of $\sim$1 Pbyte of catalogues, maps and alert records accessible through a VO model. A concept Design Study (DS) proposal encompassing all aspects of requirements capture, design, construction, operation, maintenance and data exploitation of the PLT was recently submitted to the European Commission. The scientific evaluation by the experts panel was very positive, but funding of the DS is still pending.

SC0028-0003 un superamas de galaxies exceptionnel à z $\sim$ 0.23 pour tester le modèle de collapse gravitationnel.
Dominique Proust, Gastao Lima-Neto, Laerte Sodré, Hugo Capelato.
(GEPI)

TBD

Properties of LBGs from redshift 4 to 6
Stéphane De BarrosDaniel SchaererDan Stark
(Observatoire de Genève-Université de Genève)

CFHTLS: The Distant Universe
Hervé Aussel on behalf of the Steering Group
(AIM Paris-Saclay)

I will review the scientific results obtained in extragalactic astronomy from the Deep, Wide and Very Wide CFHTLS surveys and the possibilities opened by the final T0007 data release to the community.

The Next Generation Virgo Cluster Survey
Mei, Simona; Ferrarese, L. & the NGVS team
(GEPI - Observatoire de Paris - Universite de Paris D. Didero)

We present recent results from the Next Generation Virgo Cluster Survey (NGVS). NGVS is a CFHT MegaPrime large program to observe the Virgo Cluster from its core to virial radius, for a total coverage of 104 square degrees. The survey is performing deep imaging (10 sigma detection for point sources of 25.7 mag in the g-band) in five band-passes (u*,g',r',i',z'). The program's main scientific objectives are: the characterization of the faint-end shape of the galaxy luminosity function, the characterization of galaxy scaling relations over a factor 107 in mass, the cluster/intracluster medium/galaxy connection, the role of environmental effects in galaxy evolution,and the fossil record of star formation and chemical enrichment in dense environments. Details about the survey can be found at http://astrowww.phys.uvic.ca/ lff/NGVS.html

Toward a Universal Formulation of the Halo Mass Function
P.S. Corasaniti, I. Achitouv
(Observatoire de Paris -LUTh)

We compute the dark matter halo mass function in the context of the Excursion Set formalism for a diffusive barrier model with linearly drifting average, which captures the main features of the ellipsoidal collapse. We use a path-integral method to evaluate the corrections due to the sharp filtering of the linear density fluctuation field in real space. This allows us to consistently confront the model predictions with N-body simulation data. We find a remarkable agreement with the numerical results of Tinker et al. (2008) with deviations no greater than 5% over the range of masses probed by the simulations. This indicates that the Excursion Set in combination with an accurate modelling of the halo collapse threshold can provide a robust estimation of the mass function.

Early-type galaxies: mass-size relation at z$\sim$1.3 for different environments
A. Raichoor, S. Mei, F. Nakata, S. A. Stanford, B. P. Holden, A. Rettura, M. Huertas-Company, M. Postman, P. Rosati, J. P. Blakeslee, R. Demarco, P. Eisenhardt, H. Ford, G. Illingworth, M. J. Jee, T. Kodama, M. Tanaka, and R. L. White
(INAF - Osservatorio Astronomico di Brera)

We combine multi-wavelength data of the Lynx superstructure and GOODS/CDF-S to build a sample of 75 early-type galaxies (ETGs), spanning different environments (cluster/group/field) at z$\sim$1.3. By estimating their mass, age (SED fitting, with a careful attention to the stellar population model used) and size, we are able to probe the dependence on environment of the mass-size relation.

A Bayesian Approach to Gravitational Lens Model Selection
Irène Balmès, Pier-Stefano Corasaniti
(LUTH-Observatoire de Paris-Meudon)

Over the past years, advancements in the understanding of astrophysical phenomena have allowed us to infer a concordance cosmological model that successfully accounts for most of the observations of our universe.

This has opened up the way to studies that aim to better determine the constants of the model, and confront its predictions with those of competing scenarios. Here, we use strong gravitational lenses as cosmological probes. Strong lensing, as opposed to weak lensing, produces multiple images of a single source. Extracting cosmologically relevant information requires accurate modeling of the lens mass distribution, be it a galaxy or a cluster. A variety of models are available for this, but it is hard to choose between them, as they fit the data equally well. This is a model selection problem that we address in the Bayesian framework. Using simple test cases, we show that the assumption of more complicate lens models may not be justified given the level of accuracy of the data.

Readying ALMA for extragalactic observations
Pere Planesas
(OAN, IGN)

Intensive work is being carried out at the Joint ALMA Observatory in order to bring four bands of a 16-antenna mm/submm interferometer into scientific operation. Specific tests of the advertised capabilities for Early Science are being tested and more, in order to bring ALMA into full operation as planned. Some of the measurements are taken towards extragalactic objects. In fact, the high sensitivity, high angular resolution, and high mapping speed, together with a large frequency coverage, will make ALMA the right instrument for high redshift studies, and detailed dynamical and chemical studies of nearby galaxies.

The Mass-Size Relation in High Redshift Clusters
Lauriane Delaye, Marc Huertas-Company, Simona Mei
(GEPI, Observatoire de Paris-Meudon)

In the local Universe, elliptical galaxies present very homogeneous properties which suggest that their stellar populations were very likely formed at the same epoch in a relatively short timescale. This is confirmed in studies of high redshift clusters which show that stellar populations of massive ellipticals are already in place from at least z $\sim$ 1 (e.g. Mei et al. 2009, Lidman et al. 2008, Huertas-Company et al. 09) and even from z *sim* 2 (Andreon and Huertas-Company 2010). The mass assembly however seems to be more extended in time as revealed for instance by the strong evolution in size reported in several works (Daddi et al. 2005, Trujillo et al. 2006) but the detailed mechanisms are still unknown. Semi-analytical models (e.g. De Lucia et al. 2006) predict that the assembly of massive ellipticals in clusters is mainly driven by dry mergers at z $\sim$ 1. Other models suggest AGN feedback (Fan et al. 2008) and/or minor mergers (Hopkins et al. 2009) as the main responsables for the evolution in size obsereved in early-type galaxies. Recently, Trujillo et al. 2011 have shown that minor mergers are more probably causing this evolution. However no systematic studies of the mass assembly of cluster galaxies at those redshifts exist. We are studying the mass-size relation of cluster galaxies at a key epoch between z=0.8 and z=1.5 using the HAWK-I Cluster Survey (HCS) and its multi-wavelength coverage (NIR (J and K band) from HAWK-I/VLT + WFC3/HST, ACS/HST (i_775, z_850), IRAC/Spitzer when available). As a matter of fact, the mass-size relation is a powerful indicator of the mass assembly of galaxies, since it measures how a galaxy is growing at a given stellar mass. Here, we will present our first results, and discuss them in comparison to previous studies.

The Next Generation CFHT: A Wide-Field Spectroscopic Facility for the Coming Decade
P. Cote on behalf of the ngCFHT Concept Study Team
(Herzberg Institute of Astrophysics)

For more than 30 years, CFHT has been a highly productive and versatile telescope, making excellent use of one of the world's premier astronomical sites. Although CFHT has enjoyed recent success by focusing on wide-field imaging, the coming decade will see an explosion of new wide-field imaging facilities, as well as the launch of the GAIA astrometric satellite. At present, there is no telescope suitable for a comprehensive spectroscopic follow up of these missions and surveys. In this talk, I describe a plan to upgrade CFHT to a 10m-class telescope equipped with a highly multiplexed, wide-field spectrograph. Dedicated to high- and low-resolution spectroscopy of faint stars and extragalactic sources, this "Next Generation CFHT" would build upon the many imaging and astrometric surveys planned for the coming decade and enable a comprehensive investigation of two of the most pressing scientific questions of our time: the nature of dark energy and the formation history of the Milky Way.

Distinctive rings in the 21-cm signal of the epoch of reionization
Patrick Vonlanthen & Benoît Semelin
(LERMA, Observatoire de Paris)

It is predicted that sources emitting UV radiation in the Lyman band during the early phases of the epoch of reionization showed a series of discontinuities in their Lyman-alpha flux radial profile as a consequence of the thickness of the Lyman lines in the primeval intergalactic medium. Through unsaturated Wouthuysen-Field coupling, these spherical discontinuities are expected to be present in the redshifted 21-cm signal of neutral hydrogen. We have used realistic 3D numerical simulations with full Lyman line radiative transfer in order to study the properties of these discontinuities and the possibility for detection with the future Square Kilometre Array. Although challenging, these observations could provide a diagnostic to disentangle signals of cosmological origin from residual from imperfect foreground removal.

The DAFT/FADA Survey status and latest results
Guennou L., Adami C., Ulmer M.P., Clowe D., Durret F. et al
(LAM)

We present here the latest results obtained from the American French collaboration called the Dark energy American French Team/French American DArk energy Team (DAFT/FADA). The goal of the DAFT/FADA

collaboration is to carry out a weak lensing tomography survey of z = 0.4-0.9 rich clusters of galaxies. Unlike supernovae or other methods such as cluster of galaxy counts, weak lensing tomography is purely based on geometry and does not depend on knowledge of the physics of the objects used as distance indicators. In addition, the reason for analyzing observations in the direction of clusters is that the shear signal is enhanced by about 10 over the field. Our work will eventually contain results obtained on 91 rich clusters from the HST archive combined with ground based work to obtain photo-zs. This combination of photo-z and weak lensing tomography will enable us to constrain the equation of state of dark energy. We present here the latest results obtained so far in this study.

Assessing the masses of black holes in obscured environments: prospects for JWST and SPICA
K. Dasyra, L. Ho, H. Netzer, F. Combes, B. Traktenbrot, E. Sturm, L. Armus, D. Elbaz
(SAp, CEA Saclay & LERMA, Observatoire de Paris)

We queried the entire Spitzer archive for high-resolution spectra of optically selected active galactic nuclei with black hole mass estimates, and examined the properties of their mid-infrared fine-structure lines that are emitted from gas clouds photoionized by the active nucleus. We present a calibration of the luminosity-corrected line widths to the black hole masses and demonstrate how this can be used to assess black holes in obscured environments. This calibration can help us create mass functions of obscured black holes with the next generation infrared telescopes JWST and SPICA out to z $\sim$ 1 and z $\sim$ 4, respectively.

Querying for heavily obscured AGN via high 9.7 micron optical depths:results from the 12-micron, GOODS, and FLS Spitzer spectroscopic samples.
K. Dasyra, I. Georgantopoulos, E. Rovilos, A. Pope, Y. Wu
(SAp, CEA Saclay & LERMA, Observatoire de Paris)

To optimally identify in IR surveys candidates of the Compton-thick AGN that contribute to the unresolved X-ray background, a tracer of column density is desirable in addition to an AGN indicator. I will present results from a recent study (Georgantopoulos et al. 2011) that aimed to test whether the 9.7 micron silicate absorption feature can be used for this purpose. We found that the extreme criterion of optical thickness (tau>1) at 9.7 micron is efficient in identifying Compton-thick objects locally. Two thirds of the AGN in the 12 micron flux-limited sample with tau_9.7>1 and X-ray spectroscopy are Compton thick. We expanded this analysis at intermediate/high z, using all GOODS and FLS sources with Spitzer spectra and X-ray observations. We found 12 sources with tau_9.7>1 that host an AGN between z of 0.6 and 3. Four of them are Compton-thick according to their X-ray to 6 micron luminosity ratio.

Search and analysis of strong lenses in large surveys
F. Brault
(Institut d'Astrophysique de Paris)

'IMAKA: a new powerful survey instrument for CFHT.
Burgarella, Cuillandre et al.
(Laboratoire d'Astrophysique de Marseille)

Mapping local properties and submm excess in nearby galaxies with Herschel and LABOCA
Maud Galametz, Marcus Albrecht, Robert Kennicutt, Franck Bertoldi, Axel Weiss, Bruce Draine ...
(Institute of Astronomy, Cambridge)

Observing thermal dust emission enables us to study the history of star formation in galaxies as well as physical processes that drive their evolution. It is also a gas tracer with which it is closely mixed.

The Herschel Space Observatory is currently producing maps of thermal dust emission of nearby galaxies with a resolution never reached before up to 500um. It allows us to make an inventory of the different grain populations, especially of the coldest phases of dust.

We combined Spitzer data, Herschel observations of the Kingfish key programme and LABOCA data at 870um to quantify the dust mass and temperature distribution within 11 nearby galaxies. We study the possible changes in dust properties, in particular the emissivity, implied by the use of submm constraints. The good resolution of our maps from near-IR to submm wavelengths enables us to study and resolve for the first time 870um submm excess in some of our galaxies.

Etude des galaxies hôtes des SuperNovae de type Ia dans le projet The Nearby SuperNovae Factory (SNfactory)
Rigault Mickael
(IPNL)

Les supernovae de type Ia, compte tenue de la faible dispersion de leur luminosité maximale, sont utilisées comme chandelles standards pour la mesure des paramètres cosmologiques. Des études récentes semblent mettre en évidence une corrélation entre les résidus du diagramme de Hubble et les propriétés des galaxies hôtes. Le projet « The Nearby SuperNovae Factory » a acquis un échantillon de plus de 200 séries temporelles spectro-photométriques de SNe Ia proches, et dispose ainsi de la spectrographie à champ intégral de leur environnement immédiat. L'analyse des propriétés galactiques de l'environnement des SNe nous apportera des informations telles l'histoire de la population stellaire, la métallicité du gaz et des étoiles, l'absorption du gaz interstellaire, et permettra de mettre en évidence d'éventuelles corrélations entre ces propriétés et celles des SNe Ia. Il sera présenté ici les résultats préliminaires de ces recherches.

A new method for the cosmological analysis of X-ray galaxy cluster surveys.

Nicolas Clerc, Marguerite Pierre et al.
(Service d'astrophysique, CEA/Saclay)

Galaxy clusters are the most massive virialized objects in our observable Universe, and as such they are powerful probes of its large-scale structure. The detection of these particularly rare objects through the X-ray radiation emitted by their hot intra-cluster medium (ICM) allows to build large, well-controlled samples of galaxy clusters in a very efficient way. I will describe a new method jointly taking into account ICM properties and cosmological parameters with minimal assumptions and show how this method can be applied to the analysis of large cosmological X-ray surveys. I will then briefly present the results we obtained from a large, serendipitous cluster survey, X-CLASS.

Star formation in chemically young Local Group galaxies
P. Gratier
(IRAM)

The Local Group variety of galaxies enables the study of the interstellar medium and star formation under conditions different from those found in the Milky Way, while retaining a good spatial resolution due to their proximity. I will present results combining large scale sensitive surveys of the molecular and atomic gas, and the infrared dust emission of two Local Group sub-metallic galaxies, M33 and NGC6822. Two features stand out for these environments: the H2-to-CO conversion factor is higher than in the Milky Way and the star formation efficiency is greater than in local universe large spirals. I will also present results concerning the Giant Molecular Cloud properties in these environments. From the molecular gas observations, we derive the largest catalog of GMC in an external galaxy. From this large sample, we highlight a change of the cloud mass function with galactocentric radius and a classification of clouds by star formation properties.

A new explanation for the Disk of Satellite
Sylvain Fouquet
(GEPI)

More than 20 dwarf galaxies are around the Milky Way. Metz et al 2007 found out the fact that, for a part of them, their distribution seems to be not isotropic, forming a thick plane called the Disk Of Satellite. In my work, I have rederived the properties of this plane, and compare its perpendicular vector with the angular momentum of some dwarf galaxies whose the 3D velocity is known. Then, I'm trying to reproduce this plane assuming that these dwarf galaxies were formed in a tidal tail coming from a fusion, which has created M31, and interacting with the Milky Way.

Bulge formation patterns in AP3M-SPH simulations - questions to be answered by future extragalactic missions
A. Obreja, R. Domínguez-Tenreiro, M. Doménech-Moral, F. J. Martínez-Serrano and A. Serna
(Universidad Autónoma de Madrid)

We have analyzed the bulges of five early type spiral galaxies emerging from high resolution hydrodynamical simulations in a cosmological context,

where chemical evolution has been followed in detail through a statistical $Q\_\{ij\}$ formalism implementation of the stellar yields. The sizes, masses and luminosities of our simulated bulges, as well as those of their hosting galaxy disks, and each corresponding B/T ratio, were found to be consistent with observations.

Studying the mass-averaged kinematics, shapes, stellar ages and metallicities of these bulges we found a satisfactory agreement with the latest observational data for the Milky Way as well as for other external bulges.

In fact, our results indicate that bulges in our sample have a mass-dominant old stellar population, formed at high z in a fast collapse-like event. A second phase, with lower mass assembly and star formation rates follows, phase which shows only minor merger without further significant SF bursts (two cases), major mergers with secondary SF burst either at high redshift (z $\sim$ 1, two cases) or later on (z $\sim$ 0.4). In some cases, this latter phase can also be influenced by secular evolution of the galactic disk. When a secondary peak in the SF history is present, we consider the corresponding stellar population as a third,intermediate bulge component, distinct from the old and young ones.

The kinematics, shapes, stellar ages and metal contents of the stellar populations formed in these distinct phases, as well as their correlations, can be nicely distinguished in simulated bulges, although they still can hardly be separated observationally. In this perspective, and considering the different populations to be part of bulge substructures, we found the youngest component to be disky-like, more rotationally supported, with supra-solar metallicity (or only slightely sub-solar) and with an alpha-element enhancement less than the solar value, while the oldest one is spheroidal, has clearly sub-solar metallicity and a higher alpha-element abundance. The metal abundance also appears to be correlated with the violent or quiet history of the bulge as a whole in the sense that the objects having a more peaceful formation pattern with only two distinct star formation modes have the [Fe/H] peak at $\sim$ -0.15 dex, while the others, where mergers have an important role, have their maximum at $\sim$ 0.25 dex. As a general trend, we found correlations between abundances, ages and total mass. Thus, the gas and stellar metallicities increse while the average bulge star age slightely decreases with the average velocity dispersion.

If indeed real bulges follow a similar formation pattern as simulated ones, the mixing of the young and old stellar bulge components provides a possible explanation for some apparently paradoxical observations, like for i.e. bulge rejuvenation and metal-content gradients observed in some spirals. Current and future missions like SAURON, Gaia or CANDLES, among others, can effectively help in proving or disproving this scenario

by measuring with great accuracy the positions and velocities of large samples of bulge stars or their integrated spectra.

Finally, by constructing the mass aggregation tracks along the main branch of the merger trees we observed a close correlation between the evolution of the dark matter dominated halo and that of the stellar dominated bulge, therefore reinforcing the importance of

the cosmological driven processes

in the formation of such low mass galactic substructures as the latter are.

We conclude that bulges can follow different assembly patterns, which can be summarised as two-phase processes (as in ellipticals) with the additional effects of disk secular instabilities, in different proportions.

Morphological classification of galaxy clusters
F. Rostagni, C. Benoist and S. Maurogordato
(Université de Nice-Sophia Antipolis, Observatoire de la Côte)

We perform a quantitative morphological classification of a sample of low redshift galaxy clusters extracted from the SDSS C4 cluster catalogue. Clusters with a high spectroscopic coverage were selected. A wavelet based algorithm was applied allowing to detect and quantify 3D substructures and the large scale environment of these clusters. Based on this classification, we study the correlation between morphology and spectral properties of galaxy members.

Clustering of galaxies in the Cosmic Infrared Background
Aurélie Pénin, Guilaine Lagache, Olivier Doré
(IAS)

The Cosmic Infrared Background (CIB) is the contribution of infrared (IR) galaxies integrated on the whole history of the Universe. The Universe went trough an IR era billions of year ago. Indeed, the star formation rate was dominated by IR galaxies at $0.5 < z < 3$. In the far-IR data are limited by confusion which makes impossible the study of the clustering of IR galaxies using the correlation function. A way of circumventing confusion is the study of the anisotropies of the CIB as they contain the clustering. Moreover it enable us to have access to the properties of faint galaxies under the flux detection. I have measured the power spectra of the anisotropies of the CIB at 100 and 160 um. These meaurements require a model. I will present a clustering model of IR galaxies based on a dark matter distribution model linked to a model of the evolution of IR galaxies. The whole is parametric which enables me to carry a qualitative study of the degeneracies of the free parameters as well as investigating which kind of halo contribute to the power spectrum or the evolution of the linear bias of these galaxies.

Unveiling the dusty star formation history of the Universe at z $\sim$ 2
Laurie Riguccini, Emeric Le Floc'h, Marc Sauvage
(CEA-Saclay, AIM)

During my talk I will focus on the luminous star-forming galaxies at $1.5 < z < 3$ potentially missed by the traditional color selection techniques because of dust extinction.I apply to this mid-IR selected sample the BzK and BM/BX criteria as well as the selections of the "IRAC peakers " and the "optical ly-faint IR-bright " galaxies, and I analyze the fraction of sources identified with these techniques. I will quantify the fraction of these sources and their contribution to the IR luminosity and cosmic star formation density at high redshift. The major conclusion of this work is that traditional UV/optical selections are incomplete and suffers from a lot of biases and have to be use with caution. I will also briefly introduce some new results I have obtained thanks to Herschel data on constraining the IR luminosity of the sources from the COSMOS field.

Selection, characterization and photometric redshift determination for QSOs in the ALHAMBRA survey.
Matute, I., Márquez, I., Masegosa, J., del Olmo, A., Perea, J, Husillos, C. + ALHMABRA team
(IAA-CSIC)

Photometric redshift (photo-z) determination for galaxies has been drastically improved over the last decade, with precisions and outliers of only a few percent. They have become a perfect complement to spectroscopic z and a valuable tool for any present or future survey. I will briefly review the status of the ALHAMBRA survey and characterize the efficiency of its optical-NIR photometry to derive highly accurate photometric redshift for AGN. In particular we will present the accuracy results for the most luminous of these sources (the QSOs) over an area of $\sim$ 2.5 sq. degrees. This will provide the basis for the compilation of a complete sample of QSOs (up to z $\sim$ 4.5) based on their ALHAMBRA SEDs and the search of more exotic candidates like red QSOs, BALQSOs or very high-z (z > 5) objects

The Crab Nebula at high energy: recent variability and flares
M. Lemoine-Goumard for the Fermi-LAT collaboration
(CENBG - CNRS - IN2P3)

We report recent gamma-ray (photon energy >100 MeV) flares from the Crab Nebula detected by the Large Area Telescope on board the Fermi Gamma-ray Space Telescope. Three major flares occured since Fermi was launched, making the Crab nebula the brightest source in the gamma-ray sky during these outbursts. Observation by the Gamma-ray burst monitor aboard Fermi will also be presented. Dense x-ray observations by the Chandra satellite show no clear correlation with the gamma-ray flux. These observations suggest that the gamma-ray emission originates from a small region within the inner nebula.

Coincident searches for neutrinos and gravitational waves with the ANTARES and LIGO/VIRGO detectors
B. Bouhou et al
(APC)

A multimessenger approach with gravitational waves (GW) and high-energy neutrinos (HEN) is expected to open new perspectives in the study of the most violent astrophysical processes in the Universe. Several experiments (e.g. ANTARES, IceCube, LIGO and VIRGO) are currently recording data and searching for astrophysical sources. We present in this talk a joint analysis effort and some recent progresses using data from the GW detectors LIGO and Virgo, and from the HEN detector ANTARES.

Results from the first 3 years of operation of the Supernova Legacy Survey (SNLS)
Balland, C. and the SNLS collaboration
(LPNHE et Université Paris 11)

Type Ia supernovae (SNe Ia) currently provide the most direct evidence for an accelerating Universe and for the existence of an unknown dark energy driving this expansion. The Supernova Legacy Survey (SNLS) is a five-year project which has delivered around 500 high-redshift SNe Ia light curves and spectra in the redshift range $0.3 < z < 1.0$ in order to constrain the dark energy equation of state, w. I will present the cosmological results obtained with the data of the first 3 years of the survey.

XXL - An overview of the ultimate XMM extragalactic survey
M. Pierre
(Service d'Astrophysique du CEA)

In December 2010, the XXL survey, an XMM Very Large Programme, has been granted time to map two extragalactic regions of 25 deg^2, at a depth of $\sim 5\ 10^{\{} - 15\}$ $erg/s/cm^2$ (i.e. using 10 ks XMM observations). This is the largest XMM programme ever allocated.

The main goal of the project is to constrain the Dark Energy equation of state using clusters of galaxies. This survey will also have lasting legacy value for cluster scaling laws and studies of AGNs, galaxies and XRB.

We present the layout of the some 450 XMM observations. We discuss the most relevant science topics along with the associated multi-*lambda* surveys. We give an overview of the working organisation of the project as well as plans for the catalogue releases. We'll be happy to discuss the future involvement of French and Spanish scientists in the project.

New diagnostics of Lyman-alpha blobs - implications for massive high-redshift haloes and galaxy formation
Matthew Hayes
(IRAP, Toulouse)

Radio quiet Lyman-alpha blobs remain among the most enigmatic objects in the high redshift universe: bigger and brighter than almost anything else, yet with powering mechanisms that are far from understood. I will discuss a unique new set of deep Ly-alpha observations performed at ESO/VLT. These new data enable us to immediately rule out a number of the hypothesized mechanisms by which these objects could be powered, leaving effectively just one. They further provide a probe of the geometry of neutral gas in adjacent circum-galactic medium. I will discuss the implications of this detection, with relevance to galaxy evolution scenarios and how massive high-redshift galaxies acquire the gas they need to form stars. Further I will discuss the possibilities for large-scale observations in this field if polarized cameras can be constructed for ELTs.

Poster contributions

Looking for high-redshift galaxies behind the lensing cluster A2667.
Nicolas Laporte, Roser Pello, Daniel Schaerer, Johan Richard, Jean-Paul Kneib, Frederic Boone
(IRAP - Observatoire Midi-Pyrénées)

One of the most important goal in modern Astrophysics is undoubtedly the study of the young Universe, when the first galaxies formed. During the last decade, considerable advances have been made in the research and study of distant galaxies. Our project aimed at setting constraint on the abundance of star-forming galaxies at z $\sim$ 6-10, taking benefit from magnification in lensing cluster in order to improve the search efficiency and subsequent spectroscopic studies. I will present the most popular method used to identify high-z galaxies, our first results around the lensing cluster A2667(expected number of objects, sources, Luminosity Function at z $\sim$ 7,8 and 9, and implications during the reionization epoch).

A reionization scenario from HII regions merging histories
Jonathan Chardin, Dominique Aubert
(Observatoire astronomique de strasbourg)

Nous présentons une nouvelle méthode pour analyser et contraindre la période de réionisation modélisée par des simulations numériques. En construisant un arbre de fusions des régions HII, on s'attache à décrire leur histoire de percolation. En appliquant cette technique à une simulation test et en se focalisant sur des propriétés telles que la taille des régions ionisées, l'intensité du processus de fusion, ou encore leur taux de création en fonction du redshift, nous proposons un scénario de la période de réionisation vu dans ce contexte.

"Cinématique du nuage moléculaire en effondrement"
Amaury de Kertanguy
(MEN)

J'ai développé un programme de N

Early-type galaxies at z$\sim$1 : Morphologies and colors
S. Mei, S. A. Stanford, Raichoor, A., Rettura, A., Shankar, F., F. Nakata, B. P. Holden, M. Huertas-Company, M. Postman, P. Rosati, J. P. Blakeslee, R. Demarco, P. Eisenhardt, H. Ford, G. Illingworth, M. J. Jee, T. Kodama, M. Tanaka, and R. L. White
(GEPI - Observatoire de Paris - Universite de Paris D. Didero)

We discuss how the fraction of early-type galaxies on the red sequence decreases (with respect to the local fraction) to $\sim$50% for the two Lynx clusters at z$\sim$1.3. We compare their morphology distribution to that of the groups that surround them. The lack of early-type galaxies is balanced by an increase of early spirals.

Evolution as a counfounding parameter in scaling relations for galaxies

Didier Fraix-Burnet
(IPAG)

Early-type galaxies are characterized by many scaling relations. Evolutionary classifications find that some of these correlations are indeed generated by diversification. With a simple mathematical formalism, we show that even the so-called fundamental plane can be easily explained as the artifact of the effect of another parameter influencing all, without any physical hypothesis. In other words, the fundamental plane is probably a confounding correlation, i.e. not physically causal. The complexity of the physics of galaxies and of their evolution suggests that the confounding parameter must be related to the level of diversification reached by the galaxies. Galaxy mass, central black hole mass or the gas fraction during the last big merger are shown to be possible confounding factors. Consequently, many scaling relations for galaxies are probably evolutionary correlations that are explained by the statistical general evolution of most properties of galaxies. This effect makes the observables not independent, so that it must be removed before statistical and physical inferences could be made.

Intra cluster light in z=[0.4 - 0.8] clusters of galaxies

Guennou L., Adami C., Durret F., Ulmer M.P., et al
(LAM)

The search for intra cluster light (named thereafter ICL) is a new way to a better understanding of the mechanisms happening inside the clusters as well as a way to get new insights to constrain some of their parameters and their formation history. The ICL traces the evolution of baryonic substructures in dense environments and can thus be used to constrain some aspects of cosmological simulations that are uncertain, such as the modeling of star formation and the mass distribution of the baryonic light emitting component in galaxies. We studied the diffuse light in 10 different clusters in one band up to z∼0.8 thanks to our deep HST ACS images and of 3 of these clusters up to z∼0.58 in 2 bands thanks to FORS2 data using the a trous wavelet transform. We present here the latest results we obtained: the first detection of ICL at redshift larger than 0.4.

A panchromatic study of two pairs of galaxy clusters

Florence Durret, Tatiana F. Lagana, Markus Haider, Christophe Adami, Emmanuel Bertin
(IAP)

We have analysed the properties of two pairs of intermediate redshift clusters Abell 222/223 and Abell 1758 North/South, based on XMM-Newton data, deep multi-wavelength optical imaging with CFHT/Kegacam, and, for the second pair, numerical simulations. Temperature and metallicity maps of the X-ray gas show striking features, particularly in one of the members of each pair, implying ongoing mergers at least in Abell 223 and in Abell 1758 North. For the latter cluster, the comparison of the metallicity map with the results of numerical simulations suggests that in the metal rich regions, winds have been more efficient in transporting metal enriched gas to the outskirts than ram pressure stripping. Optical galaxy luminosity functions (GLFs) tend to show dips and wiggles, as well as an excess of bright galaxies over a Schechter function fit, confirming the merging structure of each of these four clusters, both at optical and X-ray wavelengths.

The baryon fraction in five galaxy groups

Nicolas Martinet, Florence Durret, Tatiana F. Lagana and Gastao B. Lima Neto
()

Using ESO 2.2m/WFI optical data in two bands, we computed the galaxy luminosity functions of five groups of galaxies, selecting group members with the color-magnitude relation. By integrating the luminosity function, we calculated the stellar masses of our groups. We then calculated the X-ray gas mass and the total group mass from the density and temperature profiles obtained from XMM-Newton X-ray data. This enabled us to derive the fraction of baryons in our groups and to compare it with those from other studies of groups and clusters.

Dust-Obscured star formation and the contribution of galaxies escaping UV/optical selections at z∼2

Laurie Riguccini, Emeric Le Floc'h, Olivier Ilbert, Hervé AUssel, Mara Salvato, Peter Capak, Henry McCracken, Jeyhan Kartaltepe, Dave Sanders, Nick Scoville
(CEA-Saclay, AIM)

Morphological classification of galaxy clusters

F. Rostagni, C. Benoist and S. Maurogordato
(Université de Nice-Sophia Antipolis, Observatoire de la Côte)

We perform a quantitative morphological classification of a sample of low redshift galaxy clusters extracted from the SDSS C4 cluster catalogue. Clusters with a high spectroscopic coverage were selected. A wavelet based algorithm was applied allowing to detect and quantify 3D substructures and the large scale environment of these clusters. Based on this classification, we study the correlation between morphology and spectral properties of galaxy members.

The universality of galaxy colours and star formation histories

I. Chilingarian, I. Zolotukhin
(CDS Observatoire de Strasbourg)

Although the optical colour-magnitude diagram of galaxies allows one to select red sequence objects, neither can it be used for galaxy classification without additional observational data such as spectra or high-resolution images, nor to identify blue galaxies at unknown redshifts. We show that adding the near ultraviolet colour to the optical CMD reveals a tight relation in the three-dimensional colour-colour-magnitude space smoothly continuing from the "blue cloud" to the "red

sequence". Using Virtual Observatory technologies, we compiled a sample of 225,000 multi-wavelength spectral energy distributions of low-redshift galaxies (Z

Study of physical properties of type Ia supernovae and cosmological applications : comparison between observations and simulations
Flora Cellier-Holzem
(LPNHE)

The use of type Ia supernovae (SNeIa) for cosmology is limited today by systematic uncertainties. To reduce these uncertainties and standardize these objects, we have to better understand their physical properties.

For this purpose, I compare SNeIa observed spectra and light-curves from the SuperNova Legacy Survey (SNLS) and SuperNova Factory (SNF) with the predictions of various supernova formation models (W7, delayed detonation models) in order to constrain and improve them.

On the evolution of the distribution of baryons in a simulated local group univers
S. Peirani
(IAP)

Using an hydrodynamical zoom simulation in the standard LCDM cosmology, we investigate the evolution of the distribution of baryons in a simulated local group univers. We found that the baryonic fractions inside the virial radius of each main objects (i.e. the Milky Way and Andromeda) are about 10-15% lower than the universal value. This is mainly due to merger processes that expel the gas in the outskirts of the galaxies.

Instrumental calibration of wide field imagers.
Francesca Villa (LPNHE) for the SNDice Collaboration
(LPNHE)

Type Ia Supernovae (SNe Ia) are one of the most powerful cosmological probes to study the properties of Dark Energy.The next generation of very large surveys (DES, Euclid, LSST) will detect and study thousands of SNe Ia. The measurement of the Dark Energy Equation of State will reach a statistical precision of 1% or better.

The challenge is now the reduce systematic uncertainties to a comparable level. The dominant contribution to systematic error budget is the photometric calibration of the imagers. The future surveys will require a flux calibration accurate at the per-mil level. This seems difficult to obtain with the traditional techniques relying on standard star observations.For this reason supernova surveys are exploring alternative approaches. For instance, the SNLS collaboration began to invest in the SNDice project. SNDice is a demonstrator, designed and built at LPNHE in Paris, which was installed in 2008 in the enclosure of the Canada-France-Hawaii Telescope (CFHT) in Mauna Kea (Hawaii). The goal is to show that it is possible to obtain an accuracy of 0.1% or better. The instrument is a light source composed of 24 LEDs whose fluxes, from the UV to the IR, have been calibrated with a precision of 0.01% using a NIST photodiode.

In this poster, we review the many applications of the SNDice instrument, such as the monitoring of the telescope readout electronics, the study of the camera uniformity and the measurement of the imager passbands. We detail the analysis of the SNDice data and explain how this strategy may be an alternative to the traditional calibration techniques.

SNFactory spectral data
A.Canto, S.Bongard
(LPNHE)

We present a selection of 186 type Ia supernovae spectral time series among the whole data sample of the Nearby Supernova Factory. A spectral analysis concerning the study of dusty environment around the SNe will be shown as well, trying to separate CSM and ISM components. We focus on the Na ID absorption feature to extract a correlation between its measured EW and the color of the objects. A few examples of time variating Na ID (accounting for CSM dust and SD scenario) will be presented as well.

The ALMA capabilities for observing dust settling in protoplanetary disks
Yann Boehler
(Laboratoire d'astrophysique de bordeaux)

Mm and sub-mm interferometers are particularly adapted to probe the interior of protoplanetary disks as they appear of moderate opacity at these wavelengths. Thanks to large arrays such as the PdBI (IRAM), observations of TTauri disks have allowed us to constrain for the first time the dust radial distribution (Guilloteau et al, 2011). I will present the main results of this survey. Although dust settling has been inferred at infrared wavelengths in the disk atmospheres, this is still difficult to observe it at longer wavelength due to the lack of angular resolution. This problem will be solved with the interferometer ALMA. To study dust settling, we developed a model making submm images of the dust thermal emission and included the settling by using predictions given in the framework of the MRI. We made ALMA pseudo-observations of settled disks (using the ALMA simulator) and compare them to homogeneous cases. I will present then the observational strategy we deduce from our simulations.

3 A02 - Helio et asterosismologie, avancées et perspectives dans le contexte des nouvelles missions spatiales et instruments terrestres

Invited talks

Red-giant seismology
Benoit Mosser, CoRoT and Kepler red-giant working groups
(LESIA, Observatoire de Paris)

The CoRoT and Kepler missions provide us with thousands of red-giant light curves that allow a very precise asteroseismic study of these objects. Before these space missions, the red-giant oscillation patterns remained obscure. Now, these spectra are completely clear. Moreover, they unveil many crucial interior structure properties. For thousands of red giants, we can derive from the seismic data: - precise estimates of the stellar mass and radius, - the evolutionary status of the giants (with a clear difference between clump and RGB stars), - the internal differentiel rotation, - the mass loss, - the distance of the stars, - ages of open-cluster members.

Les missions CoRoT et Kepler nous abreuvent de données photométriques très longues et très précises, qui permettent à l'astérosismologie de donner toute sa mesure de puissant outil pour la physique stellaire. De nombreuses cibles observées sont des géantes rouges. Avant CoRoT et Kepler, on ne comprenait rien à leur spectre d'oscillation. Depuis, non seulement on a une idée très précise de leurs propriétés sismiques, par une compréhension de plus en plus fine des spectres d'oscillation, mais on en apprend aussi énormément sur leur structure interne. Les données sismiques permettent d'estimer les masse et rayon de l'étoile à quelques pourcents près, déterminer si l'étoile est sur la branche des géantes ou a passé le flash de l'hélium. Leurs périodes de rotation peuvent être mesurées avec précision. Au sein de la Galaxie, on détermine leur distance et on localise différentes populations. Pour celles qui peuplent un amas ouvert, on commence à mesurer des âges précisément.

Simuler en 3-D le magnétisme interne du Soleil: rôle du couplage entre l'enveloppe convective et l'intérieur radiatif
Allan Sacha BRUN
(AIM - CEA-Saclay)

Nous presentons nos derniers efforts pour modéliser dans sa globalité et en 3-D la magnétohydrodynamique (MHD) interne du Soleil depuis le coeur nucléaire jusqu'à sa surface. Nous porterons une attention particulière sur le couplage nonlinéaire, mécanique, thermique et magnétique entre l'intérieur radiatif et l'enveloppe convective et le rôle de la tachocline dans l'organisation du champ magnétique à grandes échelles.

Sunspot waves: propagation, refraction and mode conversion
Elena Khomenko, Tobias Felipe and Manuel Collados
(Instituto de Astrofisica de Canarias)

Sunspot waves are challenging due to their complex spatial pattern, non-linear behaviour and non-acoustic nature, intimately related to the properties of the magnetized atmospheres where they propagate. Correct interpretation of the observed variations in terms of different modes, and understanding of the role of the mode conversion will lead to advances in sunspot seismology, helping to recover sub-surface structure of sunspots. In this talk I will describe our recent advances in numerical simulations of sunspot waves from below the photosphere to the chromosphere. I will discuss the efficiency of the mode conversion in different situations, including the conversion to Alfven waves. Our numerical simulations give clear indications that waves, observed in the photosphere and chromosphere of sunspots, are slow mode (acoustic-like) waves, propagating tied to the magnetic field lines.

Observations of the dynamic of the solar photosphere
Roudier Thierry
(IRAP/OMP/CNRS)

The organization of mass transport of convective flows and magnetic field generation by surface movements are one of the current problems in solar physics. Indeed, the Sun is best the "laboratory" for studying the magnetic field generation and its dynamics in an astrophysics plasma (high Reynolds number) at very high spatial resolution. Thus, the study of the photosphere is important to understand the action of these motions on solar activity and magnetic field diffusion on the surface of the Sun. Knowledge of large-scale dynamic and action of turbulent motions in the photosphere is also crucial to understand the energy transfer to the outer layers (i.e. corona) which are the seat of cataclysmic events such as flares. I shall introduce in this talk the various scales of dynamic surface and the new measurements we can do with the satellite SDO over the full Sun with high temporal and spatial resolutions.

Rotation in the oscillation spectrum of solar-like stars
J.C. Suárez, M.J Goupil, D.R. Reese, R. Samadi, F. Lignières, M. Rieutord, J. Lochard
(IAA-CSIC)

One of the main sources of uncertainty in the asteroseismic models of solar-like stars is the poor match between predicted oscillation frequencies and observed ones in the very high frequency domain. Today, such deviation is usually corrected by fitting the affected frequencies with polynomials which are then physically explained by possible effects of turbulence, diffusion, etc., i.e., the so-called "surface effects". In this work, I show that the effect of the stellar deformation due to rotation is of the same order or even larger than the aforementioned surface effects. Moreover, I show that rotation effects, even for the low velocities generally observed in solar-like stars, becomes important for the asteroseismic analysis and cannot be neglected when modeling such stars.

Stellar activity cycles and asteroseismology
David Salabert
(Observatoire de la Cote d'Azur)

The success of helioseismology is due to its capability to accurately measure the p-mode parameters of the solar eigenmode spectrum, which allow us to infer unique information about the internal structure and dynamics of the Sun from its surface all the way down to the core. It has contributed greatly to a clearer understanding of the Sun and provided insights into the complex solar magnetism, by means for instance of the variability of the characteristics of the p-mode spec-

trum. Indeed, variations in the mean strength of the solar magnetic field lead to significant shifts in the frequencies of even the lowest-degree p modes with high levels of correlation with solar surface activity proxies. These frequency shifts are explained to arise from changes in the outer layers of the Sun along the 11-year cycle. However, clear differences between p-mode frequencies and solar surface activity during the unusually extended minimum of cycle 23 were observed. The origin of the p-mode variability is thus far from being properly understood and a better comprehension of its relationship with solar (and stellar) activity cycles will help us in our understanding of the dynamo processes.

Spectroscopic measurements of Ca H and K emission lines revealed magnetic activity variations in a large sample of solar-type stars with timescales ranging from 2.5 and 25 years. This broad range of cycle periods is thought to reflect differences in the rotational properties and the depths of the surface convection zones with various masses and ages. However, spectroscopic measurements are only good proxies of surface magnetic fields. The recent discovery of variations with magnetic activity in the p-mode oscillation frequencies of the solar-like star HD 49933 observed by CoROT, with a frequency dependence comparable in shape to the one observed in the Sun, opens a new era in the study of the physical phenomena involved in the dynamo processes. Current and future asteroseismic observations (CoROT, Kepler, PLATO, SONG) will contribute to probe stellar cycles in a wide variety of solar-type stars.

Seismic analysis of 4 solar-like stars observed during more than 8 months by Kepler mission
S. Mathur, T.L. Campante, R. Handberg, and the KASC WG#1
(NCAR/High Altitude Observatory)

After more than one year of operation, the Kepler photometer has already provided exquisite data of solar-like stars. For the calibration of the CCD, 42 stars have been continuously observed during the survey phase. It appeared that 5 stars show evidence of oscillations, even though they are rather faint (magnitude from 10.5 to 12). We will show the results of the seismic analysis of the light curves of 4 of these stars, which have been observed during more than 8 months. This analysis led to the determination of the acoustic modes global parameters (mean large separation, mean small separation), lists of frequencies built by comparing the results of several teams, some parameters of the modes, and the rotation period of the stellar surface.

Challenges in the development of new instrumentation for Helio- and Asteroseismology ?
Pere L. Pallé
(Instituto de Astrofísica de Canarias (IAC))

The great advances in the knowledge of structure and dynamics of stellar interiors over the past 30 years, in particular of the Sun, is primarily due to novel specific instrumentation and techniques conceived and tested back in the late 70's and early 80's. Thanks to the new observational data gathered with this instrumentation, it was possible to improve the current solar models and the development of powerful inversion techniques . In the non-solar domain, Asteroseismology, the situation is quite different as the limitation imposed by earth atmosphere and the lack of uninterrupted observations has seriously constraint the achievements on this field until the advent of devoted space instrumentation in recent years. It is a matter of thought the fact that, particularly in the Helioseismology domain, current operating instruments on ground and space, are completely based in the concepts and techniques conceived more than 30 years ago. In this respect, despite some attempts, no new instrumental concepts for improving detection of oscillatory signals in the Sun have been yet implemented in working instruments. In broad, it can be stated that the development of instrumentation in Helioseismology has been at a standstill for the last decades. In the case of Asteroseismology, the great success of present space missions and of the ground high precision spectrometers promises and active development of new instrumental concepts. In this contribution, an overview of the development of instrumentation (past, present and future) in the two fields will be given and some questions to stimulate a broad discussion will be posed.

Seismic diagnostics of stellar cores
S. Deheuvels
(Yale University)

Stellar cores have a great influence on the evolution of stars since nuclear reactions take place in these regions. Their properties (radiative or convective transport of energy, size...) depend on processes of transport (e.g. overshooting) which remain ill-described by theoretical models. This generates large uncertainties about the stellar parameters of the observed stars (age, mass, evolutionary stage...).

Space missions CoRoT and Kepler provide us with oscillation spectra of unprecedented quality for a large number of targets and give us the opportunity to obtain observational constraints on these processes.

We here give an overview of the techniques which were developed to derive seismic diagnostics on the stellar cores from these spectra and we present the results obtained for the first targets of CoRoT and Kepler. In particular, we emphasize the high potential of the detection of mixed modes (which are sensitive to both the superficial and the deepest layers of the star) in the spectrum of evolved stars.

JPAS: The Javalambre-PAU Astrophysical Survey
Txitxo Benitez for the JPAS and ALHAMBRA collaborations
(IAA(CSIC))

JPAS is a narrow band, 8000 sq.deg. survey which will be carried out from the Javalambre Observatory, in Spain, using a new, dedicated 2.5m telescope and a camera with a pixel-covered FOV of 5 sq.deg. The main goal of the survey is measuring the scale of Baryon Acoustic Oscillations (BAOs). It can be shown that using a set of narrow band filters it is possible to obtain photometric redshifts with enough precision, delta_z=0.003 (1+z), to measure BAOs along the line of sight, what provides a direct measurement of the

Hubble parameter at different redshifts, a very sensitive probe of Dark Energy. The higher precision provided by spectroscopic surveys will produce an oversampling of the BAO peak without a significant improvement on its detection. JPAS, which is scheduled to start in late 2013, will use 54 filters with a 100A width, covering the interval from 3700 to 9100 A plus two broad U and Z band filters and will reach a 5sigma, 3 arcsec aperture magnitude depth of AB= 21.5-22.5. The NB filter photometry, combined with a proper photo-z algorithm, will provide dz $\sim$ 0.003(1+z) for $\sim$ 100M galaxies, both early types (up to z $\sim$ 1.05) and late types (up to z$\sim$1.3) reaching an effective volume to measure radial BAOs of $\sim$ 13 Gpc^3. In addition, PAU will yield high-quality photo-z (dz $\sim$ 0.01(1+z)) and low-resolution spectroscopy for hundreds of millions of other galaxies, including a very significant high-redshift population. This survey will have an enormous legacy value, providing unique data for a wide range of astronomical areas. I also briefly describe the ALHAMBRA project, a 4sq, 20 medium band filter survey which is serving as a testbed for many of the techniques which will be used by JPAS.

Oral contributions

Convection de surface et rayon des géantes rouges
Laurent PiauPierre Kervella
(LATMOS-IPSL)

Je présenterai des calculs d'évolution stellaire sur la séquence principale et la branche des géantes et montrerai comment les observations interférométriques de rayon et de température peuvent être utilisées pour déterminer les paramètres libres des modèles phénoménologiques de convection de surface. Notre échantillon regroupe 38 étoiles proches (moins de 110 pc) de type spectral G5 à M0 dont le rayon linéaire connu à mieux que 10%. Deux prescriptions de convection ont été explorées: le modèle habituel de la longueur de mélange et celui plus récent de Canuto, Goldman et Mazzitelli. Des modèles d'étoiles avec différentes masses, métallicité et fractions en hélium ont été construits. Un soin particulier a été donné à la modèlisation atmosphérique. Dans les trois cas où l'astérosismologie a permis une détermination de la masse, nous avons combiné cette contrainte sismologique à la mesure de rayon pour tester la convection de surface avec des modèles dédiés.

Nonlinear simulations of the convection-pulsation coupling
T. Gastine ; B. Dintrans
(Max-Planck-Institut für Sonnensystemforschung)

In cold Cepheids close to the red edge of the classical instability strip, a strong coupling between the stellar pulsations and the surface convective motions occurs. This coupling is by now poorly described by 1-D models of convection, the so-called "time-dependent convection models" (TDC). The intrinsic weakness of such models comes from the large number of unconstrained free parameters entering in the description of turbulent convection. A way to overcome these limits is to compute two-dimensional direct simulations (DNS), in which all the nonlinearities are correctly solved.

I will present the first two-dimensional DNS of the convection-pulsation coupling. In an appropriate parameter regime, convective motions can actually quench the radial pulsations of the star, as suspected in Cepheids close to the red edge of the instability strip. These nonlinear simulations can also be used to determine the limits and the relevance of the TDC models: a recent comparison with two widely used TDC models emphasises the non-universality of such descriptions.

Bilan GOLF/SOHO : Dynamique de la région radiative, Physique fondamentale et Energétique
Sylvaine Turck-Chièze et consortium GOLF
(CEA)

SoHO a permis d'accumuler 15 ans de données sur les modes globaux de bas degré. Ces modes, acoustiques ou de gravité sont de plus en plus observés en Physique stellaire pour l'étude du coeur des étoiles et comme indicateurs d'activité.

Aussi il est intéressant d'examiner les contraintes qu'ils imposent sur la région radiative solaire en termes d'énergétique, de processus dynamiques et de physique fondamentale: neutrinos et matière noire.

L'ensemble aboutit à de nouvelles questions sur l'évolution du champ magnétique interne, le rôle des ondes internes mais aussi sur les neutrinos stériles (récemment potentiellement présents dans les mesures de détection des neutrinos) et certaines propriétés de la matière noire.

Ces résultats permettent de définir de nouvelles orientations pour les analyses des données de SOHO, SDO et PICARD mais aussi permettent de définir une perpective pour les données ultérieures solaires ou stellaires dans le domaine de l'astérosismologie et d'autres indicateurs d'activité.

The diameter of the CoRoT target HD49933
L. Bigot, D. Mourard, F. Thévenin
(UNS/OCA/CNRS Lab. Fizeau)

Using the VEGA/CHARA visible interferometric instrument, we derive an estimation of the radius of the CoRoT target HD49933 with an accuracy of 2%. This measurement is used in stellar evolution model to fit both the large and small frequency separations. This work leads us to an independent determination of the stellar fundamental parameters of this star, such an its age and its effective temperature.

Etude sismique de la stratification chimique dans les étoiles de séquence principale
Sylvie Théado
(IRAP)

Les propriétés des oscillations stellaires ainsi que leurs mécanismes d'excitation sont souvent très sensibles à la distribution des éléments chimiques dans les étoiles. Leur étude offre par conséquent une opportunité unique de sonder la stratification chimique et d'en déduire

des informations sur la physique stellaire. Dans cette présentation je passerai en revue les cas où la stratification agit comme un agent stabilisateur ou déstabilisateur pour les oscillations. Nous verrons comment la confrontation permanente entre les modèles stellaires et les observations sismiques permet d'améliorer notre connaissance des étoiles. Je discuterai ensuite les effets sur la stratification et les pulsations, d'un processus souvent oublié dans les étoiles de séquence principale : la convection thermohaline. Enfin, je présenterai les tests astérosismiques possibles de la composition interne des étoiles ainsi que les premières tentatives réalisées pour rechercher ces signatures.

Poster contributions

Towards a global 3D MHD model of the sun's convection zone and chromosphere
Rui Pinto, Sacha Brun
(AIM, CEA Saclay, DSM/Irfu/SAp, France)

We present a new 3D MHD numerical model extending from the bottom of the sun's convection zone up the chromosphere using the ASH code. The transition from a convectively unstable region to an atmospheric stable layer (emph{i.e} not convective) happens as the radiative flux increases at the photosphere and the radial entropy gradient becomes positive. The chromospheric layer extends up to $r = 1.1rsun$ and presents a wide range of densities, temporal and spatial scales while verifying the anelastic approximation validity limits. In the hydrodynamical background model, convective overshoot into the stable atmospheric layer is observed in a region ~ 0.01 rsun thick, exciting waves that propagate upwards into the atmosphere. In the MHD case, the magneto-convective motions sustains a dynamo and current sheets continuously form in the atmospheric layers.

Sensibilité de la période du cycle magnétique aux variations des paramètres physiques dans les étoiles de type solaire.
Olivier DO CAO, Sacha BRUN
(CEA Saclay / Service d'astrophysique)

Les étoiles de type G & K, semblables au Soleil, présentent une enveloppe convective couplée à un coeur radiatif. Cette zone convective turbulente et son couplage à une possible tachocline (zone de fort cisaillement à la base de celle-ci) semblent être à l'origine par effet dynamo d'une activité magnétique cyclique.

La simulation numérique 2D en champ moyen avec le code STELEM permet d'étudier les caractéristiques du champ magnétique à grandes échelles et les effets induits par les variations des différents ingrédients physiques (rotation, circulation méridienne, turbulence, etc.) sur la période du cycle magnétique.

Alors que la plupart des études se sont principalement focalisées sur le Soleil, l'extension des modèles à d'autres étoiles et/ou possédant des caractéristiques différentes, reste moins étudiée, du aux difficultés d'acquisition de données observationnelles. En particulier, de plus en plus d'observations semblent indiquer que la période du cycle magnétique diminue avec le taux de rotation (Saar 2009), alors que les modèles de Babcock-Leighton dit de transport de flux prédisent plutôt le contraire (Jouve, Brown & Brun 2010). Ce désaccord repose sur la trop forte dépendance du cycle magnétique à la circulation méridienne qui, seule, ne semble donc pas suffire à comprendre les données de physique stellaire.

Pour enrayer cette difficulté, nous proposons la prise en compte d'un nouveau processus, le turbulent pumping, qui peut être décrit comme l'advection effective du champ magnétique par les plumes convectives froides vers le centre de l'étoile. Peu de travaux ont étudié ses effets, et uniquement dans des cas très particuliers (Guerrero & de Gouveia Dal Pino 2008). En réalisant une étude plus complète avec le code STELEM, nous montrons que le turbulent pumping devient un paramètre clé régissant la période du cycle magnétique, et à même de rétablir l'accord avec les observations.

The helium HeI and HeII shells at solar minimum: New results from eclipse flash spectra
C. Bazin, S. Koutchmy, P. Lamy, E. TavabiIAP-UMR7095-CNRS&UPMC; LAM/OAMP-CNRS; Payame Noor Univ. Zanjan- Iran
(IAP)

Flash spectra taken at high frame rate during the total solar eclipse of August 1st 2008 in Siberia and recently during the July 11th 2010 in French Polynesia are compared in the context of the quiet Sun near the minimum of activity. They both reveal the Paschen alpha 4686 ionised helium line, seen as a helium shell in layers up to the 8 Mm heights. The preliminary evaluated thicknesses of the He I 4713 shell is 15 Mm and approximately 17 Mm for the He II 4686. These lines can be measured only in eclipse conditions, when the parasitic scattered light is negligeable for low fluxes corresponding to coronal levels. Many faint lines are also seen in emission such as Ba +, Ti +, Fe +, but much lower. They were observed to be superposed to F-lines when defining the solar limb. A cartoon is proposed to describe the structuration of these low layers and to illustrate the contribution of the magnetic field. Prominences simultaneously seen in the He II and He I lines are studied to deduce a 20x20 Mm map of the ratio He II/He I distribution. We also measured the true continuum corresponding to these helium prominences, estimated at 4.10-6 units of the average solar disk brightness. These ionised helium shells and prominences are compared with TRACE images and AIA images of SDO images. These observations are important new insights for understanding the magnetic field distribution in the low layers of the solar transition region and the ionisation mechanisms producing the big jump of temperature towards the corona.

GOLF velocity time series after 15yrs of observation.
Guy R. Davies, Rafael A. Garcia, and the GOLF team.
(CEA Saclay)

The GOLF resonant scattering spectrophotometer aboard SoHO has now provided 15 years of high precision Sun-as-a-star radial velocity measurements of the

Sun. This length of time series provides very high resolution in the frequency domain and is combined with good long-term instrumental stability. These are the requirements for measuring the low-l low-frequency global oscillations of the Sun that will unlock the secrets of the solar core. However, before the scientifically interesting gravity and mixed modes of oscillation fully reveal themselves, an appropriate correction and calibration of the whole data set is required. Here we present work towards producing a 15 yr GOLF data set corrected for instrumental effects.

g modes detected by CoRoT in the Oe star HD 51452
C. Neiner, M. Floquet and the CoRoT Be team
(LESIA - Observatoire de Meudon)

HD 51452 is a O9e star observed by CoRoT in its LRA2 field. This star shows pulsation p modes of beta Cep type as expected for this spectral type, as well as g modes with lower frequencies, which are not expected in such stars. We investigate whether this is due to the rotational flattening of the star, allowing for cooler regions at the equator from which SPB -type g-modes could arise, or whether the detected modes are stochastic g-modes rather than modes excited by the kappa mechanism.

Confinement magnétique de la tachocline solaire : le couplage à la zone convective
Strugarek, A ; Brun, A. S. ; Zahn, J.-P.
(CEA)

Nous présentons des résultats numériques tridimensionnels, non-linéaires et auto-consistants du soleil complet dans le formalisme MHD. Le scénario magnétique de confinement de la tachocline (Gough & McIntyre, Nature 1998) est mis à l'épreuve dans ce modèle réaliste. Il est montré qu'un champ magnétique fossile confiné dans la zone radiative ne permet pas d'expliquer la faible épaisseur de la tachocline que l'on observe aujourd'hui. En effet, ce champ magnétique ne reste pas confiné, il pénètre dans la tachocline puis dans la zone convective sous l'effet de l'entrainement par les mouvements convectifs tri-dimensionnels dans la zone de pénétration. La loi d'iso-rotation de Ferraro s'établit alors, ralentissant la zone radiative à haute latitude sous l'effet de torques magnétiques, ce qui est en complète contradiction avec les observations du profil de rotation solaire.

Cascade d'énergie magnétique en géométrie sphérique : interactions triadiques
A. Strugarek ; S. Mathis ; A.S. Brun ; Y. Sarazin
(CEA)

Nous présentons un méthode d'analyse spectral type "shell-to-shell" basée sur les harmoniques sphériques vectorielles pour étudier les cascades d'énergie magnétique dans les codes MHD. Cette méthode est appliquée de manière démonstrative au code "Anleastic Spherical Harmonics" (ASH) dans le cas d'une simulation de dynamo convective stellaire. Elle permet de caractériser le phénomènes de cascade, de transfert d'énergie et d'interactions inter-échelles.

Convection and Differential Rotation Properties of G and K Stars
S. P. Matt, O. Do Cao, A. S. Brun
(CEA Saclay DSM/IRFU/SAp)

The stellar luminosity and depth of convective envelopes varies rapidly with mass for G- and K-type main sequence stars. In order to understand how these properties influence the convective turbulence, differential rotation, and angular momentum transport, we are developing 3D dynamical simulations of the interiors of rotating main sequence stars, using the ASH code. The stars in our simulations range in mass from 0.5 to 1.1 Msun, and each model includes a dynamically-self-consistent radiation zone and convection zone, possibly resulting in the appearance of a tachocline at the interface between the two. We present the results of the hydrodynamic simulations to date, which will also be used as a basis for magnetic dynamo models.

4 A03 - Stellar and Interstellar physics for the modelling of the Galaxy and its components

Invited talks

Stellar ages in the context of GAIA
D. Valls-Gabaud
(Observatoire de Paris)

After a short review on past and current techniques, the Bayesian statistical framework for the inference of stellar parameters –such as ages– is presented and applied to the three key cases of single stars, detached binaries, and stellar clusters. The rôle of prior probability distribution functions in parameters which are not measured for some subsets of the catalogue is illustrated through simulated samples and discussed.

Perspective in detailed element abundance determination
Elisabetta Caffau
(ZAH - Landessternwarte Heidelberg)

Observed spectra of stars betray the presence of elements in stellar atmospheres by the presence of absorption/emission lines. To quantify the amount of a certain element in a particular stellar atmosphere, knowledge of atomic/molecular data and a physical model of the photosphere are necessary. Depending on the quality of the spectra the requested precision in the knowledge changes. In the analysis of low resolution, low signal-to-noice spectra, traditional 1D-LTE analysis is sufficient for most purposes. There are some particular situations in which we think that the use of 3D models is to be preferred over the use of traditional 1D model atmospheres. To make few examples I worked on 1.The abundance investigation of the solar photosphere. 2.The 6Li/7Li isotopic ratio. 3.Detailed abundances in metal-poor stars. Also deviations from local thermal equilibrium in high quality spectra some-

times cannot be neglected. I will consider the analysis of low resolution and high resolution spectra, according my experience.

Collision rates and the determination of atmospheric parameters
A. Spielfiedel and N. Feautrier
(LERMA Observatoire de Paris)

La modélisation hors ETL des atmosphères stellaires nécessite une connaissance précise des processus collisionnels (principalement avec l'hydrogène atomique) qui entrent en compétition avec les processus radiatifs pour peupler les niveaux. Dans le cadre du projet SAM-GAIA, nous développons une thématique pluridisciplinaire combinant chimie quantique, physique des collisions et modélisation astrophysique. Les travaux en cours concernent l'excitation par H du magnésium et de l'oxygène. Pour le magnésium, 15 états électroniques ainsi que les couplages associés ont été calculés. Les premiers résultats montrent la sensibilité des résultats aux données de chimie quantique. Une comparaison avec les méthodes approchées montre que les taux d'excitation calculés par méthode approchée sont en erreur d'un facteur allant de 2 jusqu'à 105 par rapport aux calculs quantiques utilisant les bonnes données moléculaires.

- M. Guitou, A. Spielfiedel and N. Feautrier, Chem. Phys. Letters 488 (2010) 145 - M. Guitou, A.K. Belyaev, A. Spielfiedel and N. Feautrier, J. Phys. B 44 (2011) 035202 - P.S. Barklem, A.K. Belyaev, N. Feautrier, F.X. Gadea, M. Guitou and A. Spielfiedel, A&A 2011 sous presse

Chemodynamical modelling of the Galaxy
Paola Di Matteo
(Observatoire de Paris - GEPI)

We are entering a new era in the study of our Galaxy. Current and future surveys (like Gaia) will enlarge significatively the horizon we know, from few hundreds of parsecs (the so called "solar neighborhood") to a global vision of the Milky Way, up to tens of kiloparsecs from the Sun. The large amount of data soon available requires to be interpreted at the galactic scale, through models that have to take into account the complex interplay between dynamical and chemical processes, between secular evolution and the role of the environment. In this talk I will review the most recent results N-body simulations have achieved in the effort to understand the formation of the different galactic components, discussing some possible directions for future models, to be robustly compared to the Gaia data.

Determination of stellar parameters and their uncertainties
C. Allende Prieto
(Instituto de Astrofisica de Canarias)

A number of ongoing and planned large surveys of Milky Way stars require efficient algorithms to derive stellar parameters from photometry, spectra, astrometry, or a combination. This talk will give an overview of the strategies in use or under consideration, and the possible pitfalls for their successful application.

Kinematic imprints from the bar and spiral structures in the galactic disk
F. Figueras, T. Antoja, S. Roca, O. Valenzuela, M. Romero-Gómez, B. Pichardo, E. Moreno
(Universitat de Barcelona)

At 140 years of the discovery of the moving groups, these stellar streams are emerging as powerful tools to constrain the models for the spiral arms and the galactic bar in the Gaia era. From the kinematic-age-metallicity analysis in the solar neighborhood it is now well established that some of these kinematic structures have a dynamical origin, different from classical cluster disruption hypothesis. We will show how both test particle and N-body simulations allow us to definitively establish that these local structures can be created by the dynamical resonances of selft-gravitating spiral arms and not exclusively by the Galactic bar. Work in progress will be presented to map the evolution of these moving group at large scale on the galactic disc and to show future Gaia capabilities to detect and characterize them at 2-4 kpc from the solar neighborhood.

Luminosity calibrations and distances in the Galaxy and Local Group
X. Luri
(Universitat de Barcelona)

The upcoming availability of the Gaia mission data will prompt a significant advancement in many areas of astrophysics and will specially have a huge impact in the determination of luminosity calibration and distances, thanks to the availability of very precise parallaxes.

Already the Hipparcos mission made a huge improvement in these areas with respect to the previous eras, but the advent of Gaia will represent an even larger improvement: the Gaia catalogue will contain about a billion objects, with more than 100 million of them with distances known to better than 10%, all over the Galaxy. All stellar distance indicators will be directly measured in very large number, providing a direct calibration of their luminosity and making possible detailed studies of the impacts of various effects linked to chemical element abundances or cluster membership.

In this talk we will review with the help of simulations the potential contributions of Gaia in these areas.

Stellar census and early dynamical evolution of open clusters
Estelle Moraux
(Institut de Planetologie et d'Astrophysique de Grenoble)

In this talk, I will present recent results of the mass function (MF) in open clusters down to the substellar and planetary mass domain. Down to 30 Jupiter masses, the IMF seems to be universal while at lower masses the tendency is not so clear. I will then discuss how the cluster dynamical evolution may affect the shape of the MF, even at young ages, and especially in the low mass domain. This needs to be taken into account if we want to obtain reliable estimate of the IMF and I will discuss how Gaia and complemen-

tary kinematic follow-up will improve the situation.

Four years of actions in AS Gaia
Catherine Turon & Frédéric Arenou
(GEPI, Observatoire de Paris)

The Action Spécifique Gaia (AS Gaia) has been created mid-2007 by the French National Institute for the Sciences of the Universe with the aim of coordinating the French activities related to Gaia, the next ESA (European Space Agency) cornerstone mission, planned for launch by mid-2013. Various actions have been conducted in order to support 1) studies and ground-based observations mandatory for the calibration of Gaia instruments and for Gaia data analysis and 2) preparatory modelling and observations in view of enhancing the scientific return expected from Gaia data.

The Gaia mission: status and expected performance:
F. Mignard
(OCA)

The Gaia mission is in a very advanced state of preparation, with the integration of most of the spacecraft subsystems under-way in Toulouse, and a launch scheduled in 2013. Regarding the data processing, the European consortium DPAC is putting in place a massive system able to ingest and process the 40 GB of telemetry expected every day. I will summarise the current mission status and recall the major scientific objectives of the mission and the consolidated performance in astrometry, photometry and spectroscopy, together with an indication of a possible scenario for the release of the results, intermediate or final. I will also explain how the community at large is also preparing the arrival of this huge volume of accurate data, in particular by designing complementary ground based programs.

Constraining the merger history of the Milky Way and its neighbours
Rodrigo Ibata
(Observatoire de Strasbourg)

Recent studies of the Milky Way and its neighbours in the Local Group have unveiled a complex network of accretion remnants. I will present some on-going surveys to understand these structures, as well as some very recent advances in modelling them, with the particular aim of trying to recover the probability distributions of possible orbits and the distribution of the dark matter. I will discuss our prospects of derive the merger history of nearby galaxies in the Gaia era.

Towards a 3D view of the Galactic interstellar medium with Planck, Herschel and Gaia
D.J.Marshall
(Institut de Recherche en Astrophysique et Planétologie)

Thanks to the spatial missions Planck and Herschel, we are currently exploring a previously unknown part of the Galaxy: the cold and dense interstellar medium (ISM). The interpretation of these results requires detailed knowledge of the spatial distribution of its dust and gas, as well as the surrounding stars. Accurate distance and extinction measurements from the Gaia satellite will allow us for the first time to truly explore the ISM, and therefore stellar birthplaces, in three dimensions.

Oral contributions

A signature of the internal reionisation of the Milky Way in the radial distribution of its satellites?
P. Ocvirk & D. Aubert
(Observatoire astronomique de Strasbourg)

We present a new semi-analytical model of the population of satellite galaxies of the Milky Way, aimed at estimating the effect of the geometry of reionisation at galaxy scale on the radial distribution of the satellites. In this model reionisation can be either: (1) externally driven by a bright but remote source such as the progenitor of Virgo, or (2) internally-driven, by the most massive progenitor of the Milky-Way. In scenario (1), satellites see a uniform UV background, while in scenario (2), the intensity of the UV background decreases with the distance to the center of the Milky Way. As a consequence, the gas of the inner satellites photo-evaporates faster than in the outer halo. We use simple recipes to model star formation, photo-evaporation and observational biases as in Koposov et al. (2009). Both scenarios yield a model satellite population that matches the observed luminosity function and mass-to-light ratios. However, the predicted population for scenario (2) is significantly more externally distributed than for scenario (1) by about 0.1-0.2 dex in radius, resulting in a better match to the observations. This shows that the present radial distribution of satellites still bears the signature of the structure of the local UV field at reionisation. Therefore it is a promising tool for studying the reionisation epoch at galaxy-scale in the Milky Way and nearby galaxies resolved in stars with forthcoming large surveys.

Building part of the Galactic halo from globular clusters
T. Decressin, C. Charbonnel, G. Meynet, H. Baumgardt, P. Kroupa
(Geneva Observatory)

Globular clusters are known to harbor several populations of stars which differ from their chemical composition. A first generation of stars shows similar chemical pattern than halo field stars. Besides stars of second generation display strong variations in light elements (C to Al) while they have similar abundances in heavy elements than first generation stars. This chemical pattern can be explain by a pollution of the intercluster medium by massive stars of first generation during the birth of the proto-globular cluster. One important feature of globular clusters observed today is that 50 to 80% of the low mass stars still evolving in the cluster are second generation starts whereas, with a standard IMF, these stars should be at most 10% of the cluster stars. This strong discrepancy can be solved if the proto-globular clusters were more massive (up to a fac-

tor 20-30) and mass-segregated during their formation. In this case a strong loss of first generation stars occupying the outer part of the cluster is possible through the dynamical history of the cluster. Those escaping stars now populate the halo of the Galaxy.

Study of the stellar populations of the Milky Way in CFHTLS fields.
Mélanie Guittet, Misha Haywood, Mathias Schultheis
(GEPI - Observatoire de Paris)

The galactic thick disk has characteristics intermediate between the thin disk and the halo but no consistent description has been given so far, even though recent studies with the Sloan Digital Sky Survey (SDSS) has improved our understanding. The Canada-France-Hawaii Telescope Legacy Survey (CFHTLS) has provided accurate photometry in four wide and deep fields. Here we present an analysis of the Milky way stellar populations in CFHTLS high latitude wide fields complemented to bright magnitudes with SDSS data. We compare the Besançon model of stellar population synthesis, considered as a standard view of our Galaxy, with metallicity distributions and distances to the Galactic plane. We discuss the differences and in particular the fact that a clearly distinct thick disk component is not seen in the data.

Feedback Regulated Star Formation: From star Clusters to Galaxies
Sami Dib, Subhanjoy Mohanty, Laurent Piau, Jonathan Braine, George Helou
(Astrophysics Group, Imperial College London)

We present a model which explores how the star formation efficiency in a protocluster clump is regulated by metallicity dependent stellar winds from the newly formed OB stars (M* > 5 Msol). The model describes the co-evolution of the mass function of gravitationally bound cores and of the IMF in a protocluster clump. Dense cores are generated uniformly in time at different locations in the clump, and contract over lifetimes that are a few times their free fall times. The cores collapse to form stars that power strong stellar winds whose cumulative kinetic energy evacuates the gas from the clump and quenches further core and star formation. This sets the final star formation efficiency, SFEexp. Models are run with various metallicities in the range Z/Zsol=[0.1,2]. We find that the SFEexp decreases strongly with increasing metallicity. The implications of these results are far reaching: First we show that the clump mass-cluster mass relations we find for all of the different metallicity cases imply a negligible difference between the exponent of the mass function of the protocluster clumps and that of the young clusters mass function. Secondly, by normalizing the SFEs to their value for the solar metallicity case, we compare our results to SFE-metallicity relations derived on galactic scales and find a good agreement. Thirdly, in the framwork of this feedback regulated mode of star formation, we construct the star formation laws on galactic scales (Kennicutt-Schmidt laws) and find excellent agrement with the observations from the low surface densities regime and up to the starburst regime.

Evolution of our Galaxy with the high-resolution version of the code PEGASE
B. Rocca-Volmerange, A. Sourie, M. Kontizas, P. Tsalmantsa, A. Karampelas, R. Sordo, A. Vallenari
(Institut d'Astrophysique de Paris et U. Paris-SUD)

We propose a new high-resolution version of our evolutionary code PEGASE adapted for the RVS/Gaia. Preliminary results on the evolution of metallicity and links with the already-published low-resolution libraries will be discussed.

Simulating the Galaxy and applications to the preparation of the Gaia mission
Annie Robin, Céline Reylé, and the Gaia-DPAC-CU2
(Institut Utinam)

The preparation of the Gaia mission requires simulations of the stellar content of the Galaxy with detailed estimates of the intrinsec properties of the stars, as well as the overall structure of the Galaxy. I shall present recent developments of the Besancon Galaxy model, and applications to Gaia preparation.

Properties of the thick disc far from the Solar neighborhood
Kordopatis G., Recio-Blanco A., de Laverny P., Gilmore G., Hill V., Wyse RFG.
(Observatoire de la Côte d'Azur – Cassiopée)

The understanding of the formation of the Milky Way requires to characterize the kinematical and metallicity gradients in the Galaxy. For that purpose, we used the LR8 grating of the ESO GIRAFFE-FLAMES spectrograph to obtain a sample of ∼700 spectra, observed towards the Galactic coordinates l∼277°, b∼47°. The atmospheric parameters, including the stellar metallicity, have been obtained using the automated pipeline presented in Kordopatis et al. (2011a). Using the proper motions of Ojha et al. (1996), our derived Vrad and line-of-sight distances, the 6D phase-space coordinates and the eccentricities of the targets have been computed. We present here the study of the kinematic and the metallicity properties of the Galactic components (thin disc, thick disc, halo), spanning distances up to Z∼10kpc above the Galactic plane.

Galactic dust properties
Deborah Paradis, et al.
(IRAP)

Recent studies have shown evidence for variations of the dust emissivity law with temperature and wavelength. Paradis et al. (2009), using Dirbe, Archeops and WMAP data, have shown that the observed emissivity law exhibits a break around 500 m, with a steeper index (beta=2.4) in the FIR and a flatter index (beta=1.5) in the submillimeter. Moreover, they evidenced a FIR emissivity excess in the cold molecular phase of dense molecular clouds, probably resulting from grain coagulation. Using Herschel data in 2 SDP fields, as part of the Hi-GAL program, Paradis et al. (2010) have found an inverse relationship between the dust temperature and beta, with the local variations going from 2.6 to 1.8 for temperatures be-

tween 14 and 23 K, shown for the first time in the inner Galactic plane. As opposed to a two dust component model, the TLS model (Mény et al, 2007) is the first physically-motivated model able to explain recent observational data. This model has been developed to describe the FIR to mm continuum interstellar dust emission, taking into account the effect of the disordered internal structure of the amorphous dust grains. In Paradis et al. (2011), the model has been compared to FIRAS/WMAP and Archeops compact sources data to derive the best parameters characterizing the interstellar medium. Analyzing the newly available Hi-GAL data over 37 fields, we observe changes in the dust properties from the inner to the external parts of the Galactic plane, that can be interpreted in term of the TLS model.

DANCE: Dynamical Analysis of Nearby ClustErs

Herve Bouy, Emmanuel Bertin, Estelle Moraux, Jean Charles Cuillandre, Jerome Bouvier
(CAB - CSIC)

Le projet DANCE (Dynamical Analysis of Nearby ClustErs) a pour objectif de faire une etude systematique de la cinematique et de la dynamique des amas et associations jeunes proches, et de completer la future mission GAIA dans les regions a forte extinction et jusqu'au domaine des masses planetaires.

En utilisant des images d'archives et des images obtenues plus recemment, nous parvenons a mesurer le mouvement propre de millions de sources sur des regions couvrant plusieurs dizaines et parfois centaines de degres carres, avec une precision

Poster contributions

Stellar parameters and chemical tagging of nearby FGK stars: testing membership to stellar kinematic groups

D. Montes, H.M. Tabernero, J.I. González Hernández, et al.
(UCM, Universidad Complutense de Madrid)

During the last years our group have undertake several high resolution spectroscopic surveys of nearby FGK stars. A large number of stars have been already observed and we have already determine spectral types, rotational velocities as well as radial velocities, Lithium abundance and several chromospheric activity indicators. We are working now in an homogeneous determination of the fundamental stellar parameters (Teff, log g, metallicity, [Fe/H], and microturbulent velocity) and differential abundance analysis (chemical tagging) of all these stars. All this information will allowed us to ascribe these stars to moving groups and associations of different ages, and could lead to a better understanding of star formation history in the solar neighborhood discerning between field-like stars (associated with dynamical resonances (bar) or spiral structure) and young coeval stars (debris of star-forming aggregates in the disk). In addition, all this work and methods will be very useful for preparation for the huge amount of data will be available with Gaia.

SPADES: a Stellar PArameter DEtermination Software

Posbic , H. ; Katz, D. ; Gómez , A. ; Caffau , E. ; Bonifacio , P. ; Sbordone , L. ; Arenou , F.
(Observatoire de Paris - Meudon - GEPI)

With the large amounts of spectroscopic data available today and the very large surveys to come (e.g.Gaia), the need for automatic data analysis softwares is unquestionable. We thus developped an automatic spectra analysis program for the determination of stellar parameters: radial velocity, effective temperature, surface gravity, micro-turbulence, metallicity and most of all elemental abundances. Target stars for this software should include all types of stars. The analysis method relies on a line by line comparison of the spectrum of a target star to a library of synthetic spectra. The idea is built on the experience acquired in developing the TGMET (Katz et al., 1998, A&A,338,151; Soubiran et al., 2003, A&A,398,141), ETOILE (Katz 2001, Journ. Of Astron. Data , 7 ,8) and Abbo (Bonifacio & Caffau, 2003, A&A,399,1183B) softwares. This poster presents the method behind our software. The performances are illustrated with GIRAFFE-like simulated spectra in high resolution (R = 25000), in high and low signal to noise ratios (down to SNR= 30). These spectra should be close to what could be targeted by the Gaia Chemo-Dynamical Survey (GCDS).

New SB2 for accurate masses with Gaia

J.-L. Halbwachs, F. Arenou, B. Famaey, P. Guillout, Y. Lebreton, D. Pourbaix
(Observatoire Astronomique de Strasbourg)

The forthcoming Gaia mission will make possible the derivation of accurate stellar masses of binary components, by combining the astrometric measurements and the elements of SB2 orbits. We present a list of long period SB1 systems observed with the T193/Sophie, and for which we measured the radial velocity of the secondary component, changing them in SB2.

The physical parameters of the low-mass triple system LHS1070 from spectral synthesis analysis

A. S. Rajpurohit, C. Reyle, M. Schultheis, C. Leinert, F. Allard
(Observatoire de Besancon)

We present the comparision of the observed spectra in the optical and near-IR with synthetic spectra computed from the recent BT-Settl' Model (Allard et al. 2011) for the low-mass triple system located at a distance of 7.72+-0.15 pc from the sun (Seifahrt et al. 2008). We also compared the observed photometry in the range of 0.9-6 micron and found good agreement with the synthetic spectra. Using a chi-square minimization technique we determine the effective temperature, log g and radius for each of the component.

Different methods to determine the ages of stars from their position in the HR diagram.

Guédé Céline, Lebreton Yveline
(Observatoire de Paris - GEPI)

The determination of stellar ages is fundamental to understand the formation and evolution of the Galaxy. We discuss and compare different methods to determine the age of stars combining their position in the HR diagram and stellar evolutionary tracks. We focus on Bayesian methods. The goal of this study is to prepare the tools that will be used to age-date stars after the Gaia mission.

Planck Early results: The first all-sky survey of Galactic cold clumps
I. Ristorcelli, Planck collaboration
(IRAP -CNRS/UPS)

We present the statistical properties of the first version of the Cold Clump Catalogue of Planck objects (C3PO), in terms of their spatial distribution, temperature, distance, mass and morphology. The temperatures range from 7K to 17K, with a peak around 13K and a dust emissivity spectral index varying from 1.4 to 2. For one third of the objects the distances are derived using methods based on the extinction signature and association with known molecular complexes and infrared dark clouds. Most of the detections are within 2kpc in the solar neighbourhood, but a few are at distances over 4kpc. The sources are distributed over the whole range of longitude and latitude, from the deep Galactic plane to high latitudes. The associated mass estimates derived from dust emission range from 1 to 10^5 solar masses. These cold clumps are not isolated but mostly organized in filaments associated with molecular clouds. The C3PO gives an unprecedented statistical view of the galactic cold clumps including a number of potential pre-stellar objects and offers the possibility of their classification based on their intrinsic properties and environment.

Calibration of the Gaia RVS: ground-based radial velocities observations of the candidate reference stars
L. Chemin, C. Soubiran, F. Crifo, G. Jasniewicz, D. Katz, D. Hestroffer, S. Udry
(GEPI - Observatoire de Paris)

The Radial Velocity Spectrometer (RVS) on board Gaia will perform a large spectroscopic survey to determine the radial velocities of some 2*10**8 stars. We present the status of ground-based observations of the 1420 reference stars candidates, performed with the SOPHIE, NARVAL and CORALIE spectrographs. Each candidate star has to be observed several times before Gaia launch (and at least once during the mission) to ensure that its radial velocity (RV) remains stable during the mission. About 7-8% of the current catalogue exhibits variations larger than the initially adopted threshold of 300 m/s during an average elapsed time of 3 years, and will be dropped. Emphasis is also put here on our 150 observations of bright asteroids to calibrate our ground-based RVs by a direct comparison with velocities predicted by celestial mechanics. The zero points of Sophie, Narval and Coralie are consistent with each other within the uncertainties. Despite some scatter, their temporal variations remain small.

Evidence for dust emission in the ionized medium of the Large Magellanic Cloud
Deborah Paradis, Roberta Paladini, Alberto Noriega-Crespo, Guilaine Lagache, Akiko Kawamura, Toshikazu Onishi, Yasuo Fukui
(IRAP)

The Large Magellanic Cloud (LMC) is the nearest galaxy external to the Milky-Way, and its favorable viewing angle offers a direct view of the processes taking place in the diffuse ISM. Dust emission associated with ionized gas has so far been detected in our Galaxy and for wavelengths longer than 60 mic. Spitzer data now offer the opportunity to carry out a similar analysis in the LMC. We performed a correlation study using the Spitzer data from the SAGE Legacy program, combined with the ATCA/Parkes HI data tracing the atomic phase, the NANTEN 12CO data tracing the molecular phase, and both the SHASSA Halpha and the Parkes 4.75 GHz data tracing the ionized phase. We evidence for the first time dust emission associated with the ionized phase of the gas, from 3.6 to 160 mic. Using a dust emission model, we show that dust in the ionized gas is warmer than dust associated with the other gas phases (atomic and molecular). In addition, we report in the ionized phase a decrease of the PAH relative abundance with respect to BGs, probably due to PAH destruction, and an increase of the near- infrared continuum, which does not seem to correlate with PAH emission. These results are found consistently for the diffuse gas, the typical and bright HII regions. However, the molecular phase indicates good environmental conditions for the subsistence of the PAH component. Furthermore, as opposed to the PAHs, the VSG relative abundance tends to increase in the ionized phase, especially in bright HII regions. We also evidence a low emissivity value in the ionized phase of the LMC, with respect to our Galaxy.

Dust mass in chemodynamical simulations
Nicolas Gaudin and Hervé Wozniak
(Observatoire de Strasbourg)

We present a model to compute dust mass in bi-phasic fluid (cold and warm/hot medium) in self-consistent medium resolution (10–20 pc) chemodynamical simulations of Milky Way size disc galaxies. Dust is produced by metallicity dependant condensation from asymptotic giant branch stars and SNe [1]. Another source of dust production in the model is the grain growth by accretion in molecular clouds [2], using the abundances of C, O, Mg, Si, and Fe. Destruction of dust occurs in shocks produced by supernovae [3]. The destroyed dust mass is computed from the schocked mass of gas known using the injected SNe energy.

We use the [O/gaz] – [dust/gaz] diagram as diagnostic for our model. In this diagram we reproduce the expected linear relation at high metallicity. At low metallicity the mass of dust is sub-linear with an increasing dispersion. This break in the slope comes from the destruction and by our accretion recipe affected by the *alpha*/Fe ratio. Both linear relation and break in the slope fits well observations, if we assume reasonable systematic error from oxygen abundance calibrations.

We also show other diagnostics (both observational and theoritical). For the future we will run simulations for a grid of galaxies and get more insight in the evolution of the dust mass.

(1) Zhukovska, Gail & Trieloff 2008, A&A (2) Draine, B. T. 2009, ASPCS (3) Jones, Tielens, & Hollenbach 1996, ApJ

Chemical abundances for A and F dwarfs in the young open cluster M6

Kılıçoğlu, T., Monier R., Fossati, L.
(Ankara University)

Stars member of an open cluster are generally assumed to share common properties: same initial chemical composition, same age and same distance. Thus, open clusters appear to be unique laboratories to constrain evolutionary models via abundance determinations. Differences in chemical composition with the main sequence stars inside a given cluster are probably due to differences in their masses, initial chemical compositions, ages and the other effects such as magnetic field, rotation, mixing mechanisms, mass loss, accretion and multiplicity. The early type main-sequence members of open clusters of different ages are excellent laboratories to study the competition between radiative diffusion and mixing mechanisms. We present here abundance determinations for five members of the open cluster M6 (age ∼100 myr) using FLAMES-GIRAFFE spectra mounted on 8-meter class VLT telescopes. The abundances of the 14 chemical elements were derived. We used Johnson and Geneva photometry, hydrogen line profile fittings, ionisation and excitation equilibria to derive the atmospheric parameters. Computed theoretical models were compared to the observed spectra to obtain chemical abundances. The difficulties in deriving atmospheric parameters, and the effects of the effective temperature and the microturbulence on the abundances of the stars are discussed.

The Halpha Balmer line as an effective temperature criterion I. calibration using 1D stellar atmospheres

R. Cayrel, C. Van't Veer, N. Allard, C. Stehle
(Observatoire de Paris GEPI)

Nous montrons que les profils observés de Halpha dans les étoiles naines et sous-géantes de température effective entre 5000 et 7000 K sont reproduits avec une grande précision par des modèles 1D du code ATLAS9 de Kurucz et BALMER9, ce dernier modifié pour tenir compte des plus récents travaux sur l'élargissement de cette raie. Les températures effectives des modèles donnant le meilleur accord avec l'observation ont été comparées à celles obtenues pour les onze étoiles dont la température effective vraie est obtenue par la méthode fondamentale utilisant le diamètre apparent et la magnitude bolomètrique de l'objet. Les températures ne sont pas égales, mais sont liées par une relation linéaire avec un coefficient de corrélation de 0.9976 ce qui fourni une excellent calibration des températures déduites de Halpha.

Carbon-enhanced metal-poor stars: witnesses of the first generation of stars

T. Masseron
(Universite Libre de Bruxelles)

Carbon-enhanced metal-poor stars are now accepted to be mass-transferred binary member of the first generation of stars. Indeed, the peculiar chemical fingerprints revealed by their spectra represent a unique opportunity to study their now extinct progenitor (basically all low-metallicity stars with M>0.8 solar masses). I will show recent results on detailed abundance determination of such spectra obtained with high resolution spectrograph mounted on 10m-class telescopes. In particular, I will focus on Lithium, Fluorine and s-process elements which allow us to give strong constrain on stellar structure and nucleosynthesis models. I will also highlight an ongoing work on building accurate molecular linelists, crucially needed to derive accurate abundances, using a technique which combine laboratory and stellar spectra.

Orbits of Potentially Hazardous Asteroids using Gaia and ground-based observations

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

Gaia is an astrometric mission that will be launched in spring 2013 and will observe a large number of Solar System Objects down to magnitude V 20. During the 5-year mission, Gaia will continuously scan the sky with a specific strategy. The purpose here is to study the statistical impact of Gaia data on the collision probability, especially for Potentially Hazardous Asteroids. We will also analyse the advantage of combining space-based to ground-based observations over long term, as well as in short term from observations in alert.

NLTE determination of the Calcium abundance in the very metal-poor stars

Spite M., Spite F., Bonifacio P., Caffau E., Cayrel R., Francois P., Andrievsky S., Korotin S.
(GEPI Observatoire de Paris-Meudon)

During the Galactic evolution calcium is formed in massive stars (mainly during oxygen burning) at variance with iron mainly ejected by less massive SNI.

Thus in the old stars, formed at the very beginning of the Galaxy, from a matter only enriched by massive stars, the abundance of calcium is enhanced relative to iron. From the point of view of the chemical evolution of the Galaxy calcium should be a better "reference element" than iron because its abundance should be a better chronometer.

But the abundance of calcium can be affected by NLTE effects which are generally neglected. For the first time we have attempted a NLTE analysis of the calcium abundance in a a sample of extremely metal-poor stars of our Galaxy, dwarfs and giants most of them with [Fe/H]

5 A04 - Atmosphere-Ionosphere coupling: atmospheric electricity (TLEs, TGFs, lightning) and the upper atmosphere physics and chemistry

Invited talks

Natural lightning flashes : from observation to modelling
Eric Defer (LERMA), Thomas Farges (CEA), Christelle Barthe (LACy), Christophe Bovalo (LACy), Jean-Pierre Pinty (LA), Michel Chong (LA), Serge Soula (LA), Pascal Ortéga (UPF)
(LERMA-CNRS/Observatoire de Paris)

Different ground-based and space-based sensors are used to characterize and locate Earth lightning flashes like VHF mappers, VLF systems with short or long baseline, optical CCD camera and more recently microphone arrays. Concurrent observations with such equipments offer a unique description of the different processes occurring during the life of a lightning flash (triggering, leader development and junction phase). While the detection of lightning flashes becomes mature, more challenging investigations are needed on i) Nitrogen Oxyde (NOx) production and on ii) the modeling of natural lightning discharges, even if "engineer" lightning schemes combined with electrification schemes are already implemented in numerical cloud resolving models. We will give an overview of the detection techniques with detailed examples. Needs in terms of discharge modeling and NOx production will also be discussed. Finally we will present a selection of upcoming instrument projects and field campaigns.

Modeling of electrical discharges in the atmosphere
A. Bourdon, (EM2C, France), S. Célestin (CSSL, USA), V.P. Pasko (CSSL, USA)
(Laboratoire EM2C, UPR CNRS 288, Ecole Centrale Paris)

In this talk, we will give an overview of the state of art on the modeling of electrical discharges in the atmosphere. First, we will discuss fluid models used to simulate filamentary discharge structures observed for example in sprites. We will show that similar filamentary structures, called streamers are observed in laboratory scale experiments at ground pressure. Among the different important processes for the discharge propagation, we will particularly focus on the influence of photoionization, which is a source of seed charges ahead of discharge fronts. Recent developments on the derivation of the electric field in discharge fronts from optical emission measurements will also be discussed. Second, we will present new theoretical results on the production of energetic electrons by filamentary discharges involved in lightning propagation processes. These energetic electrons result in the production of X-rays and gamma-rays observed from ground- and by space-based detectors.

TARANIS: a microsatellite project dedicated to the study of impulsive transfers of energy between the Earth atmosphere, the ionosphere and the magnetosphere
Elisabeth Blanc et Jean Louis Pinçon
(CEA)

Sprites, jets and elves called Transient Luminous Events (TLE), observed in the middle and upper atmosphere above thunderstorms, are the manifestation of intense energy exchanges between the troposphere, stratosphere and mesosphere. Different types of luminous emissions have been identified by ground based observations, showing the complexity of these phenomena. Other, possibly related, transient emissions in the Earth atmosphere include high energy electrons, radio emissions in a broad frequency range from ELF up to VHF, luminous emissions in FUV, X-gamma ray emissions called Terrestrial Gamma Flashes (TGF) with energies which could reach 100 Mev. The purpose of the microsatellite TARANIS (Tool for the Analysis of RAdiations from lightNIngs and Sprites) is to study simultaneously these emissions above the thunderstorm areas with complementary instruments including: micro cameras and photometers, X and gamma detectors, high energetic electrons spectrometers, electric and magnetic sensors. The presentation will review the new challenges opened by the most recent observations related to these phenomena.

L'ionosphère : un intermédiaire très réactif de l'environnement terrestre
Pierre-Louis BLELLY
(Institut de Recherche en Astrophysique et Planétologie)

L'environnement terrestre auquel notre communauté s'est intéressée jusqu'à présent se situe au-dessus de 100 km. La perspective de TARANIS nous amène à nous préoccuper des régions plus profondes, où les couplages deviennent plus complexes, tant par le nombre d'espèces impliquées, que les par les processus mis en jeu, avec par exemple, la présence de réactions ternaires. La présentation fera un état des lieux de nos connaissances sur ces régions intermédiaires entre la basse et moyenne atmosphère et la magnétosphère, en portant une attention particulière aux problèmes nouveaux posés par les observations spatiales, pour lesquels seule une approche « globale » de l'environnement terrestre permettra d'apporter des solutions. Ainsi, on s'intéressera au rôle « d'intermédiaire » joué par l'ionosphère dans le couplage du système atmosphérique (en dessous) et du système magnétosphérique (au-dessus), par le biais des processus chimiques et du transport (notamment l'électrodynamique).

Electrical phenomena and chemistry in the middle atmosphere
S. Bekki (1), J.-J. Berthelier (1), F. Duruisseau (2), A. Hauchecorne (1) , N. Huret (2), F. Leblanc (1), S. Payan (3), J.-B. Renard (2), E. Seran (1),

S. Soula (4), R. Thiéblemont (2) (1) LATMOS-IPSL, UVSQ/UPMC/CNRS, Guyancopurt/Paris, (2) LPC2E, CNRS,
(LATMOS-IPSL)

We will present French activities devoted to the study of high energy phenomena, in particular electrical (Transient Luminous Events, Terrestrial Gamma-ray Flashes, ..), in the stratosphere and mesosphere. The potential impacts of those phenomena on the physics and chemistry of those regions will be briefly discussed. Future lines of research will also be mentioned.

6 A05 - Relations soleil-terre et météorologie de l'espace

Invited talks

Projet FEDOME - Application opérationnelle de la météorologie de l'espace dans le cadre des missions de la Défense
Adjudant Lionel BIREE
(Division Surveillance de l'Espace - CDAOA - Armée de l'Air)

L'activité du Soleil à une influence sur la technologie d'aujourd'hui. Celle-ci générant de nombreuses perturbations sur les moyens de communications, de détections et de navigations sol ou GPS. La Défense n'est pas épargnée. Les missions s'exécutent par l'intermédiaire d'instruments qui peuvent être gênés voire interrompus par les caprices du Soleil. De telles contraintes ont des conséquences importantes sur les opérations militaires. Afin d'éviter ou de minimiser ces contraintes, le projet FEDOME (FEDération des DOnnées de Météorologie de l'Espace) se développe dans ce cadre. Le but est de démontrer la faisabilité d'assurer un service d'alerte opérationnel des évènements de météorologie de l'espace au profit des unités de la Défense. Cette présentation fera le point sur l'état d'avancement du projet et des ententes scientifico-militaires.

Utilisation des mesures magnétiques au sol pour la météorologie de l'espace dans le cadre du projet FEDOME
Arnaud Chulliat, Luc Decker, Benoit Heumez, Xavier Lalanne
(Institut de Physique du Globe de Paris)

Le Bureau Central de Magnétisme Terrestre, dont le siège est à l'IPGP, et auquel participent plusieurs autres institutions françaises (IRD, EOST et IPEV pour la partie opérationnelle), maintient un réseau de 18 observatoires magnétiques dans le monde. Ces observatoires font partie du réseau mondial INTERMAGNET (www.intermagnet.org) et enregistrent les variations du champ géomagnétique à la fréquence 1Hz (pour la plupart d'entre eux). Un projet démarré en 2010 vise à transmettre les données des observatoires du BCMT en temps réel pour les besoins de la météorologie de l'espace, notamment le projet FEDOME de l'Armée de l'Air. Cette présentation fera le point sur l'état d'avancement du projet, ainsi que sur les autres volets de la participation du BCMT à FEDOME (installation d'une station magnétique dans la zone équatoriale, mise en place d'un service d'alerte géomagnétique).

Service opérationnel d'estimation du risque d'évènements à particules énergétiques
Philippe Yaya, Jean-Jacques Valette
(CLS)

CLS, filiale du CNES, a développé un service quotidien de prévision de l'activité solaire relatif au risque d'éruption à particules très énergétiques (plusieurs dizaines de MeV), susceptible de perturber, voire endommager, les composants électroniques à bord des véhicules spatiaux. Ce service a été mis en place suite à une étude conjointe avec le CNES, le LESIA (Obs. de Paris/Meudon) et l'ONERA. Il est actuellement opérationnel pendant toute la durée de la mission ATV-2 de l'ESA. La méthode repose sur des critères empiriques élaborés statistiquement sur le dernier cycle solaire à partir d'observations et constats de l'évolution des régions actives du Soleil, et de précurseurs dans diverses longueurs d'onde. Nous présenterons les besoins en termes d'outils et de prévisions.

Le point sur les activités de l'ESA en météorologie de l'espace
A. Hilgers
(ESA)

Le point sur les activités de l'ESA en météorologie de l'espace

A. Hilgers (Agence Spatiale Européenne)

L'Agence Spatial Européenne (ESA) est impliquée dans des activités de météorologie de l'espace depuis de nombreuses années en raison de sa mission d'ingénierie, de développement de programme, et de développement d'application. Du point de vu ingénierie il s'agit de dimensionner les systèmes spatiaux et de développer les outils pour tenir compte des contraintes et des risques liés à la météorologie de l'espace. Du point de vu programmatique il s'agit d'identifier les nouveaux programmes et les nouvelles missions motivées par les besoins de recherche et de développement dans ce domaine. Depuis l'approbation du programme Space Situational Awareness par le conseil de l'ESA fin 2008, l'ESA a dorénavant également la mission de développer un système couvrant le suivi des objets (satellites et débris) en orbite autour de la terre, le suivi des astéroides géocroiseurs, et la surveillance de la météorologie de l'espace. Une première phase préparatoire de 4 ans inclue la mise en place de services précurseurs dans le domaine de la météo de l'espace et le développement de centres de données. Par ailleurs des activités préparatoires au déploiement d'un segment spatial sont en cours notamment dans le cadre du programme GSTP de technologie de l'ESA. Cette présentation fera le point sur les différentes activités de l'ESA en météorologie de l'espace et sur l'état d'avancement de l'état d'avancement du programme Space Situational Awareness concernant ce domaine.

Oral contributions

The Journal of space weather and space climate : un outil pour la météorologie de l'espace en Europe.
Jean Lilensten
(IPAG - CNRS)

La météorologie de l'espace s'est structurée, en Europe, autour de deux pôles : l'ESA d'une part, et la structure COST de coordination de la Commission d'autre part. Dès le démarrage de cette structuration, il a été clair que l'Europe devait se doter de plusieurs outils - Un centre européen de météorologie de l'espace. C'est chose faite avec le STCE à Bruxelles. Il s'agit d'un centre distribué, tel que nous savons les construire en Europe. - Un portail européen avec des composantes scientifiques et grand public. Après beaucoup d'allers et retours, ce Portail entre enfin en phase opérationnelle (http://www.spaceweather.eu) - Un meeting européen annuel. Il a eu sa 7ème édition à Bruges en 2010, et connaît un succès croissant (il a presque doublé le nombre de participants depuis sa création) - Un journal européen de météorologie de l'espace. Le journal a été la partie la plus longue à mettre en place. En raison de l'ouverture de la météorologie de l'espace au climat de l'espace et au climat tout court (acceptation d'un nouveau COST dévolu au forçage solaire sur le climat en Novembre 2010), nous l'avons appelé « The Journal of space weather and space climate ». Il s'agit d'une revue internationale multidisciplinaire et interdisciplinaire en open access, qui publie des articles sur tous les aspects de la discipline tels que : - Recherche fondamentale et appliquée, y compris la théorie, l'observation, l'analyse des données, la modélisation et la prédiction

- Les applications techniques et des solutions d'ingénierie - Impact sur l'homme et sur la technologie dans l'espace, dans l'air, en mer et sur terre - Enjeux sociétaux et économiques - Education, diffusion des savoirs, expériences - Développement de produits opérationnels - Initiatives scientifiques, techniques, politiques et commerciales

SWSC accepte des manuscrits liés à la météorologie et au climat de l'espace dans un large éventail de domaines, physique solaire, des plasmas spatiaux, aéronomie, planétologie, radiosciences, informatique, géophysique, biologie, médecine, astronautique, ingénierie aéronautique et électrique, météorologie, climatologie , mathématiques et économie.

Il s'agit naturellement d'un journal à comité de lecture. Notre comité est fait de dix collègues couvrant les domaines cités ci-dessus. Nous nous sommes également entourés d'un conseil d'une quinzaine de collègues des cinq continents. Après avoir mis en concurrence 4 éditeurs, nous avons opté pour EDP Sciences (http://maj.edpsciences.org/). Notre éditeur finance les premiers mois du lancement du journal (un à deux ans), en collaboration avec la Commission Européenne et le Solar Terrestrial Centre d'excellence (http://www.stce.be/). EDP Sciences maintient le site web (http://www.swsc-journal.org/) ainsi que l'archive ouverte pour l'accès électronique à tous les documents publiés. SWSC est indexé à CrossRef et par conséquent apparaît dans de nombreux systèmes numériques internationaux de référence bibliographique.

Avec Anna Belehaki (Observatoire d'Athènes), j'en suis le co-rédacteur en chef.

Au cours de cette conférence, je présenterai comment l'Europe se structure pour la météorologie de l'espace, en présentant plus en détail ce nouveau journal international, sans équivalent en Europe, et fortement lié au PNST et à ses thématiques.

Radioastronomie solaire et météorologie de l'espace - une contribution au projet FEDOME
Alain Kerdraon, Gabriel Auxépaules, Karl-Ludwig Klein
(Observatoire de Paris)

Dans le cadre du projet de démonstrateur de météorologie de l'espace FEDOME de l'Armée de l'Air, la station de radioastronomie de Nançay fournira des données en temps réel des instruments existants (radiohéliographe et réseau décamétrique). D'autre part, un spectrographe dans la gamme 130-1000 MHz est en cours de construction, pour un début d'opération en septembre 2011. Par ce projet la station de radioastronomie de Nançay se dote d'un outil complet pour la météorologie de l'espace et pour la recherche scientifique. Nous présenterons les motivations et l'état d'avancement du projet, ainsi que les produits de données qui seront fournis en temps réel.

La mesure du rayonnement cosmique et ses applications en météorologie de l'espace
N. Fuller
(Observatoire de Paris / LESIA)

L'observatoire de Paris à la responsabilité scientifique de deux moniteurs à neutrons français, l'un aux iles Kerguelen, l'autre en Antarctique. Ils mesurent le rayonnement cosmique, d'origine galactique ou solaire, qui présente plusieurs intérêts dans le cadre des activités du pôle solaire du LESIA: - Son flux varie principalement en fonction du cycle solaire, - Le spectre des particules et leur temps d'arrivée à la Terre peuvent contraindre les modèles d'éruptions solaires, - La disponibilité des mesures en temps réel permet la réalisation de systèmes d'alerte en cas d'évènement à particules majeur, - Cette mesure permet également d'estimer la dose de radiation reçue par le personnel navigant (système SIEVERT). Ces deux derniers aspects, qui rentrent dans le cadre particulier de la météorologie de l'espace, seront présentés ici. Ils impliquent des partenariats au niveau français, avec des acteurs externes tels que l'IRSN ou l'IPEV, et également international dans le cadre du réseau mondial des moniteurs à neutrons (NMDB) auquel participe activement le LESIA.

Détection et suivi automatisés des structures solaires et héliosphèriques dans le cadre du projet d'observatoire virtuel européen HELIO
Xavier Bonnin, Jean Aboudarham, Nicolas Fuller, Christian Renié, André Csillaghy, et Bob Bentley
(LESIA - Observatoire de Paris)

Dans le cadre du projet FP7 d'observatoire virtuel européen HELIO, le Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique (LESIA) de

l'Observatoire de Paris, développe et maintien un catalogue, le Heliophysics Feature Catalogue (HFC), ayant, entre autre, vocation à fournir à la communauté scientifique une base de données la plus exhaustive possible de structures solaires et héliosphèriques. Afin d'alimenter le HFC en contenu, le LESIA, en collaboration avec le Trinity College of Dublin, exploite ainsi un nombre croissant d'outils dédiés à la détection et au suivi automatisés de structures telles que filaments, protubérances, régions actives, trous coronaux, mais également sursauts radio solaires de type II et III. La réalisation et l'exploitation de tels outils, que nous nous proposons de présenter ici, s'accordent particulièrement avec les besoins grandissants en météorologie de l'Espace, et étude des relations Soleil-Terre.

Détection automatisée de filaments à partir des données SDO
Éric Buchlin, Claude Mercier, Jean-Claude Vial, Christian Madsen
(IAS)

Pour la météorologie de l'espace, il est important de comprendre l'évolution des filaments, et si possible d'anticiper leurs éruptions. Celles-ci peuvent en effet emporter des milliards de tonnes de matières dans l'espace interplanétaire, avec des effets géophysiques et sur les activités humaines. Le volume de données disponibles (en particulier depuis le lancement de SDO) et les contraintes temporelles de la météorologie de l'espace rendent indispensable l'automatisation de la détection des filaments et de leurs éruptions. Nous présentons un nouveau code de détection de filaments, s'appuyant principalement sur les images SDO/AIA à 30.4nm et sur les magnétogrammes de SDO/HMI. Nous avons essayé plusieurs méthodes, dont nous comparons les résultats. Enfin, nous discutons de la possible utilisation d'un tel code pour la détection en temps réel des éruptions.

Des cartes de température de la couronne solaire par une méthode Bayesienne de séparation aveugle de sources
Thierry Dudok de Wit, Luis Vieira, Gaël Cessateur, Jean Lilensten, Matthieu Kretzschmar
(OSUC / CNRS et Université d'Orléans)

Le téléscope AIA sur SDO observe en permanence la courone solaire dans 6 raies du spectre EUV. Or, en raison de sa résolution spectrale finie, ses 6 voies ont des réponses en température qui se chevauchent considérablement. Remonter à des cartes de température par l'inversion de la mesure d'émission différentielle est une tâche délicate, qui ne se prête pas à une analyse en temps réel.

Nous proposons une approche différente, qui est empirique et s'appuise sur une méthode Bayesienne de séparation de sources aveugle. Chaque image EUV est supposée résulter de la combinaison de quelques images "source" indépendantes. Celles-ci présentent une réponse en température plus étroite que les images de départ et se prêtent donc mieux à une analyse de strauctures coronales. La même approche est aujourd'hui couramment utilisées pour l'extraction du fond cosmologique à partir d'images multispectrales de Planck.

Diverses applications aux données AIA seront illustrées.

Near real-time reconstruction of the solar irradiance
L.E.A. Vieira, T. Dudok de Wit, M. Kretzschmar, G. Cessateur, L.A. Da Silva
(CNRS)

The solar irradiance is the main external energy source of the Earth's system. Its variability on time-scales ranging form days to millennia drives the evolution of the several components that constitute this system. Consequently, the total and spectral solar irradiance are key input parameters for atmospheric/oceanic and space weather mod-els. Here, we discuss a procedure to compute the evolution of the solar total and spectral irradiance based on solar disk magnetograms and continuum images employing a neural network model. In this work, we use full disk magnetograms from HMI instrument on board of the Solar Dynamics Observatory (SDO) spacecraft. The preliminary results, uncertainties and operational issues are discussed in details. This work was supported by the European Commission's Seventh Framework Programme (FP7/2007-2013) under the grant agreement no. 218816 (SOTERIA project).

Poster contributions

Coupling the solar dynamo and the corona: wind properties, mass and momentum losses during an activity cycle
Rui Pinto, Sacha Brun, Laurène Jouve, Roland Grappin
(AIM, CEA Saclay, DSM/Irfu/SAp, France)

We study the connections between the sun's convection zone and the solar wind and corona. Magnetic fields generated by a 2.5D axisymmetric kinematic dynamo code (STELEM) evolve in a 2.5D axisymmetric coronal MHD code (DIP). The computations cover an 11 yr cycle. The solar wind's velocity varies in latitude and in time in good agreement with the known time-latitude asymptotic wind speed diagram. Overall sun's mass loss rate, momentum flux and magnetic braking torque vary considerably throughout the cycle. This cyclic modulation is mostly determined by the latitudinal distribution of the sources of open magnetic flux (and solar wind) and closed flux, which in turn results from the interplay between the dynamo generated field and the solar wind flow.

Large-scale variation of solar wind electron properties: Ulysses measurements
G. Le Chat, K. Issautier, N. Meyer-Vernet, S. Hoang
(LESIA, Observatoire de Paris)

The transport of energy in space plasmas, especially in the solar wind, is far from being understood. Measuring the temperature of the electrons and their non-thermal properties is essential to understand the transport properties in collisionless plasmas. Quasi-thermal

noise spectroscopy is a reliable tool for measuring the electron temperature accurately since it is less sensitive to the spacecraft perturbations than particle detectors. We apply this method to Ulysses radio data obtained during the first pole-to-pole fast latitude scan in the high-speed solar wind, using a kappa function to describe the electron velocity distribution. We deduce the variations with heliocentric distance between 1.5 and 2.3 AU in the fast solar wind at high latitude of the 3-fitted parameters: the electron density, the electron temperature, and the kappa index. These observations agree with the predictions of the exospheric theory.

Neutralization of coronal electric currents from THEMIS photospheric observations and MHD simulations

V. Bommier, G. Aulanier, V. Joulin, B . Schmieder-LESIA, Observatoire de Paris
(LESIA, Observatoire de Paris)

In the last years, spectropolarimetric observations of several active regions, with the ground-based THEMIS/MTR, have been succesfully complemented by a last, but crucial, step in the derivation of the photospheric magnetic field:∼solving the $180^{c}irc$ ambiguity in the direction of the horizontal fields. In every single observed active region, a single field vector has therefore been obtained for each pixel. Thus we were able to deproject the vector observations from the plane of the sky to the local solar photospheric plane and to derive the vector magnetic field, electric current density, and Lorentz force maps. In this talk we focus on the observations of one active region from our database, which we followed in november 2010, during most of its passage on the solar disc, and from which a filament erupted, that turned into a CME. We use numerical MHD models for twisted magnetic fields to guide us in the interpreting of the observed current patterns, and in the understanding of which process allows the currents to be non-neutralized, since simple analytical models predict neutralized currents.

Une nouvelle action européenne COST sur l'impact de la variabilité solaire sur le changement climatique

Thierry Dudok de Wit et membres de l'action COST ES1005
(OSUC / CNRS et Université d'Orléans)

L'action COST ES1005 est un projet européen intitulé "Towards a more complete assessment of the impact of solar variability on the Earth's climate", qui a démarré en mai 2011. Ce projet réunit des physiciens solaires, de l'héliosphère, de l'atmosphère et des climatologues; il a pour objectif de progresser sur ce problème controversé par la mise en commun des compétences. Ce projet est ouvert à toute personne enthousiaste désirant y contribuer.

Compressible Turbulence

Sébastien Galtier & Supratik Banerjee
(IAS)

Compressible isothermal turbulence is analyzed under the assumption of homogeneity. An exact relation is derived for some two-point correlation functions which reveals a fundamental difference with the incompressible case. The main difference resides in the presence of a new type of term which acts on the inertial range similarly as a source or a sink for the mean energy transfer rate. When isotropy is assumed, compressible turbulence may be described by the relation, $-2/3epsilon\_\{eff\}r = F\_r(r)$, where F_r is the radial component of the two-point correlation functions and epsilon_eff is an effective mean total energy injection rate. As expected the exact relation converges on the Kolmogorov's law when the incompressible limit is taken. By dimensional arguments we predict that a spectrum in $k^{\{} - 5/3\}$ may still be preserved if the density-weighted fluid velocity, $rho^{\{}1/3\}u$, is used. The implication for solar wind turbulence is discussed.

Étude des poussières interplanétaires mesurées par STEREO/Waves

Belheouane Soraya, Zaslavsky Arnaud, Mann Ingrid, Meyer-Vernet Nicole, Issautier Karine, Maksimovic Milan, Zouganelis Ioannis, Le Chat Gaétan
(LESIA, Observatoire de Paris, CNRS, UPMC, Université Paris D)

Les poussières représentent une composante importante de la matière qui constitue du milieu interplanétaire. Une partie de celles-ci se divise en Béta météorites et en poussières interstellaires qui pénètrent dans l'héliosphère. En entrant en collision avec les satellites STEREO, ces poussières créent un nuage de plasma produisant ainsi un champ électrique qui est mesuré par les antennes électriques reliées au récepteur radio Swaves à bord de STEREO.

Dans notre étude, nous présenterons les flux de poussières nanométriques et micrométriques ainsi que leurs variations temporelles et longitudinales. Nous montrerons que le flux de poussières interstellaires et de Béta météorites à 1 UA présente un niveau constant auquel s'ajoute une composante qui varie par rapport à la longitude.

SOHO observations of oscillatory motions in an eruptive filament: intensity and velocity variations.

Karine Bocchialini, Serge Koutchmy and Jacques Solomon
(IAP)

We examine the dynamical behaviour of the filament region observed on May 30, 2003 where reconnection and dissipation of the turbulent plasma are occurring. The link between the observed oscillatory motions and the eruption is investigated, using CDS measurements and EIT 30.4 nm images. The filament is analysed from a spectroscopic time series using a transition region line He I and a coronal line Mg X. The oscillatory content is investigated using wavelet analysis and is compared to different models. Finally, the He II sequence at 12 minute cadence is used to examine the dynamics of the filament channel several hours before the eruption. Oscillations are clearly observed, in intensity and velocity in the He I and Mg X lines, with similar periods from a few minutes to a few tens of minutes, co-temporal

with the eruption. Vertical oscillating motions of the filament are revealed . We provide evidence of damped velocity oscillations before its disappearance.

Le projet FP7 ATMOP (Advanced Thermosphere Modelling for Orbit Prediction)
Menvielle, Michel, LATMOS, CNRS/IPSL, FRANCE ;Sánchez-Ortiz, Noelia, DEIMOS Space, ESPAGNE ; Aylward, Alan, University College London, UK ; Bruinsma, Sean, CNES, FRANCE ;Jackson, David, Met Office, UK ; Lathuillère, Chantal, IPAG, UJF-CNRS, FRANCE ;
(LATMOS)

Une prédiction précise des orbites exige un suivi et une prévision précise du comportement spatio-temporel de la thermosphère, qui peut varier rapidement et de façon significative en réponse à l'activité solaire et à l'activité géomagnétique. Le projet ATMOP a pour objectif le développement d'un modèle de prédiction en quasi-temps réel du comportement de la thermosphère, grâce : * à la définition et l'évaluation de nouveaux 'proxis' permettant de décrire les forçages externes de la thermosphère ; * au développement d'une nouvelle version du modèle semi-empirique DTM (Drag Temperature Model) qui satisfasse aux exigences du calcul opérationnel en orbitographie ; * à l'amélioration de la modélisation physique de la thermosphère, afin de soutenir le développement d'un nouveau modèle DTM ainsi que celui d'un modèle physique global avec assimilation de données, qui pourrait dans le futur remplacer les modèles semi-empiriques ; * au développement de processus d'assimilation en quasi-temps réel de données thermosphériques et ionosphérique dans un modèle DTM prédictif et dans le modèle physique CMAT2 (Coupled Middle Atmosphere-Thermosphere 2).

Relationship between active region, CME and magnetic cloud of November 20 2003
Schmieder,B., Pariat E., Chandra R., Mandrini C.
(Observaoire de Paris)

The more geoeffective magnetic cloud of November 20, 2003 has been associated with the CME of November 18 2003 at 08:50 UT. The magnetic cloud has a positive helicity and its mean radial velocity was about 600 km/s. The AR 10501 crossing the central meridian between 17 and 18 November is believed to be the source origin of the halo CME of 18 November travelling at the velocity of 1650 km/s. We will discuss on the role of the solar wind reducing the speed of the ejection of material. The global magnetic helicity of the source is negative and the association of the CME with the MC is in contradiction with what we expect from the magnetic conservation; a detailed analysis of the 2D maps of magnetic helicity of the region show how an emerging flux of positive helicity progressively built a complete part of the region with positive helicity which is expelled through the CME.

Caractérisation de l'activité magnétique avec une meilleure résolution spatiale et temporelle applications en météorologie de l'espace
Menvielle, Michel, LATMOS, CNRS/IPSL, FRANCE ;Lathuillère, Chantal, IPAG, UJF-CNRS, FRANCE ;Mazouz, Farida, LATMOS, CNRS/IPSL, FRANCE
(LATMOS)

Les indices planétaires d'activité magnétique aa, am, et Kp sont des indices tri-horaires, basés sur des indices K mesurée aux latitudes sub-aurorales. Il est souvent nécessaire de décrire plus précisément la modulation en longitude et/ou la variation temporelle de l'activité géomagnétique. Par conséquent, le SIIG, hébergé par LATMOS, a développé de nouveaux indices d'activité magnétique : - des indices sectoriels, basés sur des indices K des observatoires du réseau am ; - des indices basés sur un autre proxy de l'énergie magnétique, la moyenne quadratique (rms) des variations irrégulières dans les composants horizontale. L'utilisation de ce proxy n'impose pas des contraintes sur la longueur de l'intervalle de temps sur lequel les indices sont calculés : ces indices sont ainsi calculés sur des intervalles de quelques dizaines de minutes. De tes indices locaux peuvent être calculés pour chaque observatoire, ainsi que des indices régionaux ou planétaires. Les contributions des indices sectoriels et des indices rms sont illustrées par des exemples tirés d'études de la réponse thermosphère à l'activité géomagnétique.

7 A06 - La Terre primitive comme planète en devenir

Invited talks

The age and nature of the earliest proto-crust and first continents
Janne Blichert-Toft
(Ecole Normale Superieure de Lyon)

We analyzed >100 single detrital Hadean zircons (JHZ) from the Jack Hills in the Archean Pilbara Craton of Western Australia for their U-Pb and Lu-Hf isotope systematics by solution MC-ICP-MS. The data indicate the presence of normal continental crust at 4.1 pm 0.1 Ga preceded by a 4.35 Ga proto-crust formed from KREEPy upper mantle. Whereas most of the zircons analyzed display predominantly enriched signatures indicating massive crustal recycling and reworking during the Hadean and the Archean, a small sub-population of the JHZ attests to the existence also of a depleted reservoir in the Hadean mantle. We conclude, therefore, that, although the JHZ protolith seems to have been largely enriched, it also contained undifferentiated and depleted components. The uppermost KREEPy mantle likely held enough radioactive elements and water to have outlasted the crystallization of the magma ocean for 100s of Ma. If embedded within magma ocean cumulates and a thin hydrous lithosphere, such material may have jump-started early plate tectonics.

Origine biologique de la matière organique archéenne ? L'analyse chimique moléculaire, un outil de réponse
Sylvie Derenne
(CNRS / UPMC)

Cherts are amongst the oldest sedimentary rocks on Earth and Archean cherts contain traces of organic matter the origin of which is highly debated: abiotic formation under hydrothermal conditions or organic microfossils?. This organic matter occurs as both solvent soluble and insoluble (kerogen) fractions. To assess the biological origin of such sediments on the only basis of the occurrence of organic biomarkers in the soluble fraction is often disputable as this fraction may easily be contaminated through migration of more recent organic matter. In contrast, insoluble molecular structures characterized by covalent bonds are, in all likelihood, of the same age as the host rock. We have therefore investigated the chemical structure of the kerogen from a series of cherts covering a large range in ages down to 3.5 Ga. Comparison with the organic matter from meteorites and abiotic syntheses show that this approach can lead to a biogenicity marker.

Géodynamique précambrienne: hyperactivité infantile ou adolescence turbulente?
Nicholas Arndt
(ISTerre)

The emerging bank of U-Pb and Hf isotope analyses of zircons in granitoids and sediments provides an intriguing record of growth of the continental crust. In the first Hadean stage, recorded only in Jack Hills zircons, a single enriched source, or enriched sources of uniform composition, repeatedly melted to produce the granitoids that formed the first continental crust. The Hf isotope record shows no juvenile input from the mantle, a pattern very different from the post-Hadean record, and very surprising for this stage of Earth history when hot mantle would have produced abundant magmas. Two explanations are proposed: 1) the source was abundant KREEPy oceanic crust that yielded granitoid magma in subduction zones until it was exhausted; 2) the enormous contents of heat-producing isotopes in the earliest granitoids maintained temperatures near the solidus and facilitated repeated remelting. The Archean and Proterozoic U-Pb zircon record is dominated by pronounced peaks that are variously interpreted as periods of accelerated crustal growth or periods of enhanced survival potential linked to the assembly of supercontinents. Analysis of the Hf isotope data, particularly those from granitoids, shows that the peaks are populated by abundant zircons whose positive epsilon Hf values match those of subduction-zone mantle. They provide evidence of massive input of juvenile crust. Drawing a parallel with Cretaceous periods of enhanced LIP emplacement linked to accelerated plume activity, and enhanced granitic magmatism linked to accelerated subduction, we defend the hypothesis that the Precambrian peaks record periods of accelerated crustal growth.

L'origine de l'eau terrestre
Francis Albarede
(ENS Lyon)

L'océan et l'atmosphère apparaissent se former à partir des gaz volcaniques et entretiennent l'idée d'un intérieur riche en éléments volatils. Cependant, les roches du manteau sont pauvres en eau, les géochimistes évaluent sa concentration à 150 à 350 ppm, de même que la Terre est pauvre en éléments volatils comme le soufre, le zinc, le plomb et le potassium par rapport au Soleil. Ceci nous montre que notre planète est née très pauvre en volatiles, simplement parce que, lors de la formation du Système Solaire interne, la température n'est jamais descendue suffisamment bas pour que ces éléments puissent se condenser avec le matériau planétaire. L'arrivée de l'eau sur Terre correspond donc un épisode tardif. L'arrivée du dernier des gros objets qui a contribué à la formation de la Terre correspond à l'impact lunaire 30 millions d'années après la formation du Système Solaire. La livraison majeure des éléments volatils sur notre planète correspond, quelques 100 millions d'années plus tard, au grand nettoyage du Système Solaire externe par les planètes géantes qui envoient dans toutes les directions les derniers gravats couverts de glace.

Origine et Evolution précoce de l'atmosphere terrestre
Bernard Marty et Magali Pujol
(CRPG-CNRS)

L'origine de l'atmosphère terrestres est un problème important qui n'a pas encore trouvé de solution unique satisfaisante. Récemment la conjonction de résultats issus de missions spatiales (Genesis, Stardust) et de l'analyse de roches très anciennes permet d'apporter des informations uniques. L'atmosphère terrestre au sens large (incluant roches sédimentaires et océans) semble issue de matériel analogue aux météorites primitives, une contribution cométaire potentielle étant limitée à quelques %. L'atmosphère a été profondément modifiée dans le premier milliard d'années par son intéraction avec le rayonnement du Soleil jeune. Elle était encore en évolution durant la période archéenne (3.5-2.4 Ga).

La température des océans au Précambrien indiquée par la composition isotopique de l'O et du Si des cherts
Marc Chaussidon
(CRPG-CNRS)

La Terre a connu au Précambrien de grands changements environnementaux comme par exemple l'oxygénation de son atmosphère mais aussi probablement des changements de grande ampleur de la température des océans, tels qu'enregistrés par les compositions isotopiques (O & Si) des cherts Précambriens. Encore faut il pouvoir démontrer que ces cherts sont bien des roches sédimentaires marines dont les compositions isotopiques ont été préservées depuis leur formation. Une des avancées récentes en la matière est la mise en évidence de la présence de grandes hétérogénéités isotopiques (O et Si) à l'échelle du micromètre dans le microquartz des cherts. L'origine de ces hétérogénéités est liée au fait que les cherts sont effectivement des roches sédimentaires contenant plusieurs composants d'origines différentes avec un composant diagénétique dont l'hétérogénéité isotopique reflète la température de l'eau de mer mais aussi les conditions (température, système ouvert ou fermé, ...) de la diagenèse.

Oral contributions

Evaporation atmosphérique des neptunes chauds
David Ehrenreich
(Institut de Planétologie et d'Astrophysique de Grenoble)

Les neptunes chauds sont une classe d'exoplanètes modérément massives (10-20x Terre). Elles sont le lien entre les géantes chaudes gazeuses et les super-terres rocheuses (1-10x Terre). Ces dernières pourraient être des résidus d'évaporation dont les atmosphères auraient été érodées par l'extrême irradiation stellaire. Cependant, les jupiters chauds sont stables par rapport à l'évaporation de leur atmosphère. Dans ce cas, quels peuvent être les progéniteurs des coeurs rocheux récemment détectés par Corot et Kepler ? Avec leurs enveloppes d'hydrogène et d'hélium et leurs masses intérmédiaires, les neptunes chauds sont de bons candidats. Détecter leurs atmosphères étendues et mesurer leurs taux d'échappement, ainsi que l'efficacité de ce processus, sont des étapes-clefs vers notre compréhension de la dynamique atmosphérique des exoplanètes de faible masse. J'illustrerai ces notions avec l'exemple du neptune chaud GJ 436b en orbite autour d'une étoile M récemment observée avec HST.

Ghosts in Saturn's rings
Kévin BAILLIE, Joshua E. COLWELL, Larry W. ESPOSITO
(University of Central Florida)

Using UVIS stellar occultation data, we identified holes in ringlets or plateaus through which we directly observed the star. These "ghosts" are characterized by an isolated peak in photon counts with a height equal to photon counts in places without ring material.

We suggest that ghosts are the signatures of ephemeral structures in the rings that could be due to particularly large clumps of material or small moonlets. The usual S-shape around a "propeller" moonlet coincides with the presence of a depletion zone around the clump: these moonlets are probably not massive enough to open full gaps, but could produce azimuthally limited holes in the rings like those seen in the UVIS occultation data.

Numerical simulations of the interaction of a moonlet with ring particles have been conducted for different sizes of moonlets and particles, making it possible to extrapolate a relation between the radial extension of the depletion zone and the moonlet Hill radius. This model and our observed ghost widths allowed us to estimate an initial boulder size distribution following a power-law with a cumulative index Q=0.8. This boulder size distribution appears not to match the particle size distribution models from Zebker et al., 1985 (Q=1.75 in the Cassini Division). Cutoff particle radii have also been reestimated lower than they were, therefore validating the existence of a second population of bigger boulders in the C ring and the Cassini Division.

Poster contributions

Transiting planets characterization with the SOPHIE spectrograph at OHP
G. Hébrard, C. Moutou, F. Bouchy, A. Santerne, R.F. Diaz, J.M. Almenara, A. Bonomo, M. Deleuil
(IAP/OHP)

The SOPHIE environmentally stabilized echelle spectrograph at Haute-Provence Observatory, France, is widely used for the radial velocity follow-up of space- and ground-based photometric surveys for transiting planets. Such spectroscopic observations are mandatory to establish the planetary nature of transiting candidates then to characterize the detected planetary systems. In particular, SOPHIE is a key-instrument in the CoRoT ground-based follow-up.

Traversée d'une atmosphère primitive par des poussières d'origine cométaire : effet de leur structure sur leur température.
Yann Brouet, Anny-Chantal Levasseur-Regourd, J. Lasue, P. Encrenaz
(LERMA/Observatoire de Paris)

Il y a environ 4 milliards d'années, la Terre a dû recevoir un énorme bombardement de poussières interplanétaires d'origine cométaire, dont on comprend aujourd'hui qu'elles sont largement constituées d'agrégats poreux de composés carbonés complexes (Nesvorny et al., 2010 ; Lasue et al., 2007). Nous simulons par une méthode de Monte-Carlo l'entrée de particules sphériques et d'agrégats fractals de taille inférieure ou égale à 2 mm dans une atmosphère primitive de CO2. Pour plusieurs vitesses d'entrée testées (12, 30 et 71.5 km/s), une différence marquée apparaît, la structure fractale favorisant l'apparition d'une région de température moins élevée que dans le cas d'une sphère vers l'arrière de la particule. Cette région est d'autant froide que la vitesse d'entrée est petite. Ces modélisations suggèrent que des composés carbonés nécessaires à l'apparition de la vie ont pu survivre à la traversée atmosphérique.

8 A07 - Solar physics at the advent of the European Solar Telescope

Invited talks

TUNIS: A spectroimager for THEMIS and EST
A. Lopez Ariste, C. Le Men, B. Gelly
(CNRS THEMIS)

TUNIS is a new spectroimager based upon the concept of subtractive double pass. A working proof-of-concept has been built in THEMIS and it has been proposed for EST. We will present its main characteristics and some observational results. TUNIS makes use of spectral multiplexing through Hadamard matrices, a concept that we will introduce and demonstrate.

Multiplexing imaging polarimetry
A. Asensio Ramos
(Instituto de Astrofisica de Canarias)

Imaging polarimeters are typically based on several Fabry-Perot etalons acting as filters. We present a prototype of an imaging polarimeter based on the idea of multiplexing using only one etalon. The signal is reconstructed based on the their verified compressibility.

Multiscale convection & MHD in the quiet photosphere
F. Rincon, M. Rieutord, Th. Roudier
(IRAP, CNRS et Universite de Toulouse)

Magnetic fields of the quiet solar photoshere are intimately linked to multiple scale convection at the solar surface. In this talk, I will briefly review recent observations and modelling efforts on this problem and will discuss the origins and organization of turbulent quiet Sun magnetism from supergranulation to subgranulation scales.

The stochastic, intermittent nature of the quiet Sun magnetism
M. J. Martinez Gonzalez
(Instituto de Astrofisica de Canarias)

The quiet Sun (the 99%, or more, of the solar surface not covered by sunspots or active regions) is receiving increased attention in recent years; its role on the global magnetism and its complexity are being increasingly recognised. A picture of a rather stochastic quiet Sun magnetism is emerging. From these recent works, the quiet Sun magnetism is presented as a myriad of magnetic field vectors having an isotropical distribution with a cascade of scales down to the mean free path of the photon. But this chaotic representation also shows clear signs of intermittency: at a low frequency rate (0.022 events h-1 arcsec-2) the magnetic field appear in the quiet Sun forming well-organised loop structures at granular scales. More interesting, these loops rise to higher layers and their energy input into the chromosphere can be important for the heating of this layer. In the talk, I will present pedagogic view of the quiet Sun magnetism. I will focus on the ascent of the smallest ever observed magnetic flux emergence through the solar atmosphere. More specifically, I will show how to infer from high resolution, spectro-polarimetric observations (taken with the SOT instrument onboard Hinode) the magnetic topology of the fields, how they rise through the photosphere to the chromosphere, and the implications of this phenomena for chromospheric (and coronal) heating.

Reconstructing the Solar Coronal Magnetic Field from active region scale to large scale.
Tahar Amari
(Centre de Physique Théorique. Ecole Polytechnique. CNRS.)

The low solar corona is dominated by the magnetic field which is created inside the sun by a dynamo process and then emerges into the atmosphere. This magnetic field plays an important role in most structures and phenomena observed at various wavelengths such as prominences, small and large scale eruptive events, and continuous heating of the plasma, and therefore it is important to understand its three-dimensional properties in order to elaborate efficient theoretical models. Unfortunately, the magnetic field is difficult to measure locally in the hot and tenuous corona. But this can be done at the level of the cooler and denser photosphere, and several instruments with high resolution vector magnetographs are currently available (THEMIS, Imaging Vector Magnetograph (IVM), the Advanced Stokes Polarimeter (ASP), SOLIS, HINODE , Solar Dynamics Observatory (SDO), or will be shortly available and future future telescopes and missions such as EST and SOLAR-ORBITER. This has lead solar physicists to develop an approach which consists in " Reconstructing" the coronal magnetic field from boundary data given on the photosphere.

We will discuss some of the issues encountered in solving this problem as well our recent progress and results at the scale of active region or larger one such as full sun scale.

Oral contributions

Simulation de la magnétoconvection de surface solaireet limbe solaire
Laurent PiauPeter HauschildtRobert F. Stein
(LATMOS-IPSL)

Le code Stagger permet de simuler durant quelques heures et en 3D l'hydrodynamique radiative et le magnétisme de la surface solaire. Stagger inclu une physique élaborée: les équations du transfert radiatif et de l'induction sont résolues, l'équation d'état tient compte des effets d'ionisation, la compressibilité de l'écoulement est prise en compte. Je présenterai nos modèles d'atmosphère solaire calculés avec l'équation d'état OPAL et la composition solaire la plus récente. Ces modèles permettent de suivre les effets directement observables de l'activité solaire en modifiant l'intensité du champ magnétique injecté dans la simulation. Ils sont de tout premier intérêt pour l'interprétation des données des missions spatiales Picard et SDO. Dans cette perspective, je présenterai les profils d'assombrissement au limbe de l'étoile aux longueurs d'ondes où l'instrument SODISM à bord du satellite Picard mesure le rayon solaire.

Silver celebration of French-Spanish collaboration in spectropolarimetry
J.C. del Toro Iniesta
(IAA (CSIC))

I will review the past twenty five years of collaboration between France and Spain in the field of spectropolarimetry and solar magnetic fields. The very first steps in the discipline were guided in Spain by French experts, most notably by M. Semel, from Paris-Meudon Observatory, who deserve a special tribute from the Spanish community in the field.

Observation of supersonic flows in the non-magnetized solar granulation
Luis Bellot Rubio
(Instituto de Astrofísica de Andalucía - CSIC)

Hydrodynamic simulations of granular convection predict the existence of supersonic flows covering 3%-4% of the solar surface at any time, but these flows have escaped detection until very recently. Using data from the spectropolarimeter aboard the Hinode satellite, I present direct evidence of fast horizontal plasma motions in quiet Sun granules. Their visibility increases toward the limb due to more favorable viewing conditions. At the resolution of Hinode, the horizontal flows give rise to asymmetric intensity profiles with very inclined blue wings and even line satellites located blueward of the main absorption feature. Doppler shifts of up to 9 km/s are observed at the edges of bright granules. The strongest velocities occur in patches of 0.5" or less and tend to be associated with enhanced continuum intensities, line widths, and equivalent widths. Time series of spectropolarimetric measurements show the transient nature of the strong horizontal motions, which last for a fraction of the granule lifetime only. Supersonic flows are expected to produce shocks at the boundaries between granules and intergranular lanes, and may also play a role in the emergence of small-scale magnetic fields in quiet Sun internetwork regions.

Data-driven 3D MHD simulations of the energy storage and release of a solar active region
Etienne Pariat, Sophie Masson, Guillaume Aulanier, Ludwig Klein
(LESIA, CNRS, Observatoire de Paris)

In order to understand the underlying mechanism of the solar activity, a world-wide effort is being pursued in order to simulate the active events occurring in the solar atmosphere. The path to more realistic models involves the inclusion of observational information more and more directly within the numerical simulations. During this presentation, I will present a serie of recent 3D magnetohydrodynamics (MHD) numerical simulations which includes magnetic field measurements as initial condition and an observationally-based synthetic velocity field as boundary driving constraint. We will look at the storage of magnetic energy in a solar active region. We will study the development of 3D electric current sheets building-up along a 3D serpentine magnetic-field structure. We will then follow how some of the thin and intense current sheets are dissipated by a generalized 3D reconnection mode. Finally we will discuss how this type of reconnection can explain one of the most classical observational features of flare, the ribbons, and its implication for particle injection in the Heliosphere.

The solar internetwork magnetic field: why a larger photon collector ?
V. BommierLESIA, Observatoire de Paris
(LESIA, Observatoire de Paris)

In a recent paper (Bommier, 2011, A&A, accepted), the structure of the internetwork magnetic field was statistically derived from THEMIS spectropolarimetric observations, to which Milne-Eddington inversion was applied, together with an independent magnetic filling factor evaluation (like in Bommier et al., 2009, A&A 506, 1415). Thus the magnetic field strength and inclination were obtained, and they are found dependent in an organized manner and not in a turbulent manner: the weakest fields are the most horizontal ones, so that the field is organized as scattered fluxtubes widening with height and forming a canopy, a structure already known higher in the transition zone or corona and found here also at the photospheric level. This does not contradict the limb polarization observations interpreted in terms of the Hanle effect of a turbulent field, because the Hanle effect is insensitive to the vertical component of the field. In this presentation, it will be shown how this result is at the limit of the present polarimetric accuracy, and why improving this accuracy is only possible with a larger photon collector.

Integral-Field Spectrographs for the European Solar Telescope
M. Collados, A. Calcines, R. López
(Instituto de Astrofísica de Canarias)

To achieve the science goals of the EST, it must possible to obtain simultaneous high-resolution spectropolarimetric measurements of a two-dimensional field of view on the solar surface and with different spectral lines formed at various heights in the solar atmosphere. This way, the retrievement of the temporal evolution of the thermodynamic, dynamical and magnetic properties of the solar plasma will be studied. In this communication, the description of spectrographs, with integral-field units and especially designed for the EST, will be described. This is the first time that such type of instruments are devised for solar observations, allowing to improve the observational performance of the EST when compared to present telescopes.

Polarization in Coronal EUV lines
R. Manso Sainz
(Instituto de Astrofísica de Canarias)

Scattering polarization at visible and infrared forbiden lines can be collisionally up-converted to EUV coronal lines. The ensuing polarized EUV emission would be sensitive to the electronic density and to the magnetic field orientation although not to the field strength. Direct scattering of photons in EUV transitions can also generate polarization which sensitive to the geometrical configuration of scattering process, and hence, to the structure of the corona. I will show that these mechanisms are fairly efficient generating polarization at EUV wavelengths. This polarized emission can be observed from space and might be very useful to diagnose the corona.

AO performances and large FOV spectropolarimetric observations
G. Aulanier, G. Molodij
(Observatoire de Paris, LESIA)

In the context of the increasing interest for large aperture telescope dedicated to the Sun, we present a study

to evaluate the adaptive optics system performances in regard of the scientific requirements expected for magnetic field extrapolations and data-driven MHD simulations of active regions. The questions we address are: What is the size of the field of view at high spatial resolution for a 4 meter class telescope with a spectrograph ? What is the impact of the selected spectral domain on the performances in relation to the scientific goals aforementioned ? We show that the visible wavelength domain still remains difficult to explore with ground-based telescope using a classical adaptive optics system. The field of view obtained will be only few arcsec at diffraction limit for the most part of the observation time. We review alternative configurations of adaptive optics system for different telescope apertures and wavelength domains, which could be considered for practical implementation on derivations of the magnetic field from polarimetric observations.

Poster contributions

2D versus 3D MHD turbulence
Sébastien Galtier & Barbara Bigot
(IAS)

The dynamics of the two-dimensional (2D) state in driven 3D incompressible MHD turbulence is investigated through high-resolution direct numerical simulations and in the presence of a coronal magnetic field at various intensities. For such a flow the 2D state (or slow mode) and the 3D modes correspond respectively to spectral fluctuations in the plane k_//=0 and in the area k_//>0. It is shown that if initially the 2D state is set to zero it becomes non negligible in few turnover times particularly when the coronal magnetic field is strong. The maintenance of a large scale driving leads to a break for the energy spectra of 3D modes; when the driving is stopped the previous break is removed and a decay phase emerges with alfvénic fluctuations. For a strong coronal magnetic field the energy at large perpendicular scales lies mainly in the 2D state.

New generation MSDP with a beam-slicer
Jacques Moity, Pierre Mein, Frédéric Sayède
(Observatoire de Paris-Meudon _ LESIA)

We recall the basic principles of existent MSDP spectroimagers and their limitations. We expose the expected advantages of the new MSDP concept with a beam-slicer that we are developing for the Meudon Solar tower. We present the main characteristics of this prototype and those of the similar project we suggest for the EST.

Modeling scattering polarization of molecular solar lines in spherical geometry
Ivan Milic & Mariane Faurbert
(Université de Nice. Observatoire de la Côte d'Azur)

Molecular lines formed in the upper photosphere of the Sun show linear scattering polarization, when observed close to the solar limb. This provides us with a diagnostic tool for measuring weak magnetic fields in the solar photosphere through the differential Hanle effect observed in these lines. However, in order to interprete polarization ratio observed in different lines of different optical thickness, one has to model accurately enough the line formation processes. In particular, the line optical thickness is affected by geometrical effect due to spherical symmetry, when they are observed close to the solar limb. Here we investigate this effect and we show that it strongly affects the scattering polarization observed both in the lines and in the continuum close to the solar limb.

9 A08 - Circumstellar matter with ALMA and HERSCHEL

Invited talks

Evolved stars as seen by Herschel/HIFI
J. Alcolea on behalf of the HIFIStars consortium
(Observatorio Astronómico Nacional)

In this contribution I will summarize the results from the Herschel/HIFI GTKP HIFIStars (PI V.Bujarrabal). This program, with a total of about 200 allocated hours of telescope time, is aimed to the study the warm gas and water content of the envelopes of evolved stars CSEs and their descendants (pPNe and PNe). The program is about 95% complete so far. I will review some of the main results of the program, such us the detection of lines from the acceleration region, the detection of widespread water emission from both O-rich and C-rich sources, and the strong and yet unexplained emission from ammonia.

Emission moleculaire dans les flots protostellaires chimiquement actifs
B. Lefloch
(IPAG)

Protostellar outflows play an important role in the understanding of molecular cloud evolution and star formation by transferring momentum and energy back to the ambient medium through shocks. In the early protostellar stages, fast jets powered by the nascent star, possibly surrounded by a wider angle wind, are seen to interact with the parental medium through molecular bowshocks, producing a slower moving molecular outflow "cavity". Outflow shocks have a deep impact in the chemical evolution of protostellar gas through temperature and density changes resulting from the activation of endothermic reactions, ionization, and dust destruction. These various processes lead to abundance enhancements up to several orders of magnitude, as reported for various molecular species in "chemically active" outflows, like the low mass Class 0 protostar L1157 or the intermediate-mass protostar Cep E.

The opening up of the full far-infrared and submillimeter wavelength domains by Herschel has deep impact in the field by providing access to key spectral diagnostics of shock dynamics and chemistry at very high spectral resolution with HIFI and permitting to map the brightest features with the PACS and SPIRE

multi-pixel spectrometers. I will present the results of the spectral survey of the Cep E protostellar outflow and the shock region L1157-B1, carried out with the instruments onboard Herschel and with the IRAM telescopes. The unprecedented sensitivity of these instruments brings new insight both on the molecular content and the physical conditions of these long studied regions, thanks to the detection of hydrides (H2O, NH, HCl, …) and of the high-excitation lines of heavy molecules (CO, CS, HCO+, HCN,..). I will discuss the molecular content and the properties of the warm chemically enriched gas (abundance, excitation conditions). I will show how multi-transition analysis of the line profiles allows to constrain the shock physical conditions, the formation scenarios of various molecular species, including water, in relation with the predictions of MHD shock models.

Observational studies of intermediate-mass protostars with PdBI, 30m, and Herschel
A. Fuente, T. Alonso-Albi
(Observatorio Astronómico Nacional (OAN))

Intermediate/high mass stars are poorly understood, since they are formed in far and complex regions and evolve faster than their low-mass counterpart the T Tauri stars. In this contribution I will summarize the recent results of our work in intermediate-mass (IM) stars and our prospective work with ALMA.

Combining IRAM 30m and Herschel observations we have studied the CO, N_2H$^+$ and N_2D$^+$ chemistry in the envelopes of class 0 IM sources. Our results showed a lack of CO in the warm (T_k > 20 – 25 K) inner region of the youngest protostellar envelopes. This low CO abundance was interpreted as the consequence of CO being processed in the icy mantles to form complex molecules before its evaporation. This explanation is however rather speculative and alternative explanations involving different geometries, physical conditions and dust properties can not be discarded. The high angular resolution and mapping capability of ALMA will be key to determine the origin of the underabundance of CO in young stars. The CO abundance is a key ingredient to predict the subsequent evolution of the protostellar envelope.

We have carried out a survey at mm and cm wavelengths of disks around Herbig Ae/Be (HAaBe) stars. Our sample consists of 11 HAeBe stars that have been observed using the PdB and VLA telescopes. Our results proved that the higher mass stars (>7 M_⊙) are surrounded by disks 1 order of magnitude less massive than those around solar mass stars, in agreement with recent theoretical models of disk photoevaporation. We did not found however any trend with the age of the star. Our conclusions are limited by the low number of observed stars that does not allow a complete statistical study by separating the stars in different bins according to their masses, ages and type of environment (cluster vs isolated). The high sensitivity provided by ALMA would allow to study large samples of disks and investigate the influence of the different parameters in the disks frequency and life-time.

Probing circumstellar environments with combined HI and CO observations
Libert Y., Le Bertre T., Gérard E., Winters J.M., Matthews L.D.
(IRAM)

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 tracers are needed to describe their global properties. We designed a program to gauge the properties of matter in the external parts of circumstellar shells around AGB stars and to relate them to those of the inner envelope, using the complementarity of the 21-cm HI line and the CO rotational line. With millimeter observations at high spatial resolution, we find structures that could be the precursors of the complex morphologies observed for several planetary nebulae. And owing to the 21,cm observations, we discovered evidence that the gas outflow is slowed-down by the ambient interstellar medium. In some cases, the HI source is elongated in a direction compatible with the central-star proper motion, a phenomenon that is being recognized in more and more cases and that is in favor of an interaction with the local material. We will illustrate these properties with several objects that have been well observed in CO and HI.

Oral contributions

Towards understanding the formation of multiple systems and circumstellar disks : a high angular resolution PdBI survey of Class 0 protostars, and a pathfinder to ALMA studies
A. Maury, P. André, F. Gueth, S. Cabrit, P. Hennebelle, S. Maret, C. Codella, A. Bacmann, L. Testi, R. Launhardt, S. Botinelli
(ESO Garching)

Despite some progress in the past two decades, the physics of the youngest protostars (Class 0 objects) remains poorly understood. Indeed, several fundamental questions still remain largely open, such as the formation mechanisms of accretion disks and multiple systems at the Class 0 stage. In order to address these crucial questions of star formation, we are currently carrying out a comprehensive and systematic study of the nearest low-mass Class 0 objects with the Plateau de Bure Interferometer. This Large Observing Program targets a unprecedented sample of 17 nearby (< 300 pc) low-mass Class 0 protostars, and will ultimately provide us with a large homogeneous dataset covering both a large dynamical range of physical scales (from ∼50 AU to ∼5000 AU) and a wide variety of molecular and dust continuum tracers. I will present the first results from this Class 0 protostars interferometric survey, and the new questions raising from these observations. I will also show that this project is a perfect pathfinder to help us using efficiently ALMA capabilities to address these issues, and extend this pathfinder survey to the new large unbiased sample of Class 0 protostars unveiled by the Herschel Gould Belt survey.

3D simulations of Rossby vortices with Adap-

tive Mesh Refinement
H. Meheut & W. Benz
(Institut de physique, Université de Bern)

One of the most delicate step in planet formation consists in the formation of the planetesimals. The difficulty resides in the coupling between the gas and the solids that induces the migration of the grains toward the central star. The solution that appears more and more convincing is the presence, in the protoplanetary disc, of vortices that concentrates solids in their centres. The Rossby Wave Instability (RWI) is an hydrodynamical instability that induces the formation of Rossby vortices in a disc in differential rotation, and it has been proposed as a mechanism to form and sustain the vortices. We will present new 3D numerical simulations of this instability, that were done with an Adaptive Mesh Refinement code (AMRVAC). This code allowed to improve the previous simulations and to show new structures of the instability that can have interesting consequences in the context of planetesimals formation.

Synergie VLTI/ALMA
O. Chesneau, O. Suarez, Ph. Benjoya
(Observatoire de la Côte d'Azur)

Dans cet exposé seront presentées les activités d'observations des environnement des étoiles évoluées au sein du département Fizeau.

En particulier, un effort important est mis sur l'utilisation conjointe d'ALMA avec d'autres techniques observationnelle comme l'optique adaptative ou l'interferométrie dans l'infrarouge thermique.

D'ores et déjà, des observations radio sont régulièrement obtenues et exploitées de manière conjointes aux observations optiques.

Poster contributions

An HI 21-cm line survey of evolved stars
Gérard, E., Le Bertre, T., & Libert, Y.
(CNRS)

The HI line at 21 cm is a tracer of circumstellar matter around AGB stars, and especially of the matter located at large distances (0.1-1 pc) from the central stars. It can give unique information on the kinematics and on the physical conditions in the outer parts of circumstellar shells and in the regions where stellar matter is injected into the interstellar medium. However this tracer has not been much used up to now, due to the difficulty of separating the genuine circumstellar emission from the interstellar one.

With the Nançay Radiotelescope we have started a survey of the HI emission in a large sample of evolved stars. We will report on the recent progress of this long term programme, with emphasis on S-type stars.

Stripping a debris disk by gravitational interaction with an inner planet
Etienne Morey & J-F Lestrade, LERMA/Observatoire de Paris
(Observatoire de Paris, LERMA)

Debris disks are detected through scattered light or thermal emission of their dust, produced by collisions or erosion of planetesimals. The rate of collisions depends on the number density of planetesimals and on the dynamical excitation and geometry of the whole disk. We have studied a debris disk gravitationally perturbed by a single inner planet, by using a numerical integration over a large parameter space for both the orbital elements of the planet and the disk geometry. We discuss our findings in the context of observed orbital elements for exoplanets and plausible disk geometries. We have studied whether or not a disk can be significantly disrupted, and stripped of its planetesimals, because of this interaction. We have focused on how the depletion of the disk depends on the masses of the central star and planet. We have found that this dependence is not monotonous, except for low mass stars.

10 A09 - questions générales PNST

Poster contributions

Current density and boundaries localisation in the ring current region
S. Grimald, I. Dandouras E. Lucek
(IRAP / CNRS)

The existence of a ring current around the Earth was established at the end of the 50's. Since then, the calculation of the current density and the study of the changes in the ring current is an active field of research as it is a good proxy for the magnetic activity. In order to calculate the current density, several methods were developed. The most common one is to deduce the perpendicular component of the current from the particle pressure gradient measurement. Another method developed is using four points' measurements: the curlometer technique. This method uses the magnetic field data from four satellites located in the same current sheet and was first used by Vallat et al. (2005) using the CLUSTER satellites data at 4.1 RE. This allows a direct measurement of the total current density. This method also allows the calculation of div B which allows testing the accuracy of the method. Since 2008, the CLUSTER satellites enter deeper inside the inner magnetosphere. Using the curlometer technique, it is possible to use the curlometer technique deeper inside the inner magnetosphere, where the pressure gradient is expected to invert direction. Some first results will be presented in this presentation.

Study of non-thermal continuum patches: wave propagation and plasmapause study
S. Grimald (1), F. El-Lemdani Mazouz (2), C. Foullon (3), P. M. E. Décréau (4), Scott A. Boardsen (5, 6), Xavier Vallières (4)
(IRAP / CNRS)

Non-thermal continuum (NTC) radiation is believed to be emitted in the plasmapause and at the magnetic equator. It is the signature of a particular shape of the plasmapause in the source region which has been shown

to be very small. We present a very particular NTC signature which appears as wide frequency range and short lasting time here refer as patches. Those patches are observed everywhere along the Cluster orbit and represents a quarter of the NTC events observed in 2003. A detailed study of the frequency pattern shows that it can be divided in two classes: the plasmaspheric ones, which appear to be banded, and the magnetospheric ones, which appear to be similar to trapped NTC. A statistical study performs on the WHISPER data highlight that the plasmaspheric patches are only observed close to the source region and disappear during propagation. In an event, on 26 September 2003, we localize the sources positions and study the propagation of the beams of wave. We show the sources are located very close to the satellite and to each other. They emit beams of waves with very similar frequencies. Because the satellite is very close to the source region, it observed all ray at the same time and it overlap in the spectrogram making up the patch. After the satellite crossing, each ray follows its own path and separate. The plasmaspheric patches are the signature of a close and distorted source region.

Electron whistler dispersion law in a plasma with light ions and heavy charged particulates
C. Krafft, B. Lundin
(LPP, Ecole Polytechnique)

The dispersion equation of electron whistler waves in a cold plasma with two light ions of comparable gyrofrequencies and heavy charged particulates is derived. It is valid in a very wide frequency range above the highest ion cutoff frequency when the wave frequency is essentially less than the electron plasma frequency. The derived electron whistler dispersion law is expressed through the relative contents of the two light ions and the electrons, as well as the characteristic frequencies of the magnetized plasma, as the lower hybrid resonance frequency, the two highest ion cutoff frequencies, the gyrofrequencies of the light ions and the electron gyro- and plasma frequencies. The approximation of vanishingly small gyrofrequencies of the heavy ions permits to determine, with a relevant accuracy, the electron whistler dispersion law using the features of electron whistler spectrograms only. Estimates of the relative charge density of the light ions are obtained and the dispersion laws of the adjacent branches, i.e. the electron whistler waves and the so-called ion cyclotron whistlers, are calculated. For the electron whistler waves, the presence of negative ions can be the origin of a manyfold increase of the lower cutoff frequency; a merging effect of the cutoff frequencies of the adjacent branches can also appear.

Determination of the averaged charge-to-mass ratio of the heavy charged constituents of a magnetoplasma using whistler wave measurements
C. Krafft, B. Lundin
(LPP, Ecole Polytechnique)

In a cold magnetized plasma with two light ions of comparable gyrofrequencies and any species of heavy ions and/or charged dust particulates, a technique is developed to recover the relative charge density of the heavy plasma population and to estimate its effective averaged charge-to-mass ratio. Such results can be obtained without using mass spectrometer data but only the measurements of the ion plasma frequency, the electron gyro- and plasma frequencies as well as the two highest ion cutoff frequencies.

V shaped streaks recorded on board DEMETER above powerful thunderstorms: a statistical study
Farida EL-LEMDANI MAZOUZ , Hervé de FERAUDY, Jean Louis PINCON, Michel PARROT.
(latmos-cnrs)

We report here observations of both symmetric and asymmetric forms of V shaped streaks on VLF spectra observed on board the low altitude satellite DEMETER during orbits above highly active thunderstorms region. At satellite altitude, wave activity is mainly dominated by upcoming whistler waves. The V-shaped streaks are associated with intense and numerous 0+ whistlers in the VLF range. To understand the origin of the different spectral forms of the V shaped emissions, we performed a systematic survey of these observations via a visual inspection of the VLF spectrograms covering 5 years and an half of DEMETER data. Asymmetric events are more frequently observed for high latitude regions, where the inclination of the magnetic field is more important than for medium latitude regions. We checked the modes and the direction of propagation of the waves transmitted from troposhere to satellite altitude using Budden's radio window theory. The results show that the waves propagate in a quasi parallel mode with respect to the magnetic field. Finally, we performed a detailed analysis of an asymmetric V-shaped emission for which the corresponding Meteorage data were available. From the knowledge of the precise localization of the active thunderstorm associated with the V shaped emission, it becomes possible to confirm the importance of the local B field orientation.

11 A10 - questions générales PNPS

Oral contributions

Long-term magnetic monitoring of Sun-like stars
A. Morgenthaler, P. Petit, M. Aurière, C. Catala, B. Dintrans, R. Fares, T. Gastine, R. Konstantinova-Antova, J. Lanoux, N. Letourneur, F. Lignières, S.C. Marsden, J.-P. Michel, J. Morin, F. Paletou, J. Ramirez, S. Saar, S.K. Solanki, S. Théado, V. Van Gr
(Institut de Recherche en Astrophysique et Planétologie)

A sample of 19 Sun-like stars, probing masses between 0.7 and 1.4 solar mass and rotation rates between 1 and 3 solar rotation rate, was regularly observed using the NARVAL spectropolarimeter at Telescope Bernard Lyot (Pic du Midi, France) between 2007 and 2011. The Zeeman-Doppler Imaging technique allows us to reconstruct the large-scale photospheric magnetic field

structure of the targets and study the long-term temporal evolution of the geometry. Simultaneously, the sets of high-resolution spectra enable us to monitor the rotational and long-term evolution of indirect activity indicators such as the chromospheric emission in the cores of the CaII H and Halpha lines, the width of several magnetically-sensitive lines and the activity-induced fluctuations of the stellar radial velocity. I present here the main results of this monitoring, including the observation of several polarity reversals, and highlight links between the magnetic behaviour of the stars and some of their fundamental parameters.

Evidence for dynamo bistability among very low mass stars

J. Morin; X. Delfosse; J.-F. Donati; E. Dormy; T. Forveille; M. Jardine, M. Schrinner
(Dublin Institute for Advanced Studies)

Dynamo action in fully convective stars is a debated issue that also questions our understanding of magnetic field generation in partly convective Sun-like stars, and in particular the validity of the interface dynamo paradigm. During the past few years, spectropolarimetric observations have demonstrated that fully convective objects are able to trigger strong large-scale and long-lived magnetic fields. I will present the first spectropolarimetric study of a sample of late M dwarfs (M5-M8) carried out with ESPaDOnS@CFHT. It reveals the co-existence of two distinct types of magnetism among stars having similar masses and rotation rates. A possible explanation for this unexpected discovery is the existence of two dynamo branches in this parameter regime.

Periodic magnetorotational dynamo action as a prototype of nonlinear magnetic field generation in shear flows

F. Rincon, J. Herault, C. Cossu, G. Lesur, G. I. Ogilvie, P.-Y. Longaretti
(IRAP, CNRS et Universite de Toulouse)

This talk will report on ongoing theoretical and numerical efforts to understand the nature of dynamo action (magnetic field generation) in shear flows prone to local MHD instabilities, using the magnetorotational dynamo as a prototype problem. I will first present an accurate, exactly time-periodic, magnetorotational dynamo solution to the fully three-dimensional dissipative incompressible MHD equations with rotation and shear and explain the complete physical mechanism of the process. I will show that the dynamics of this cyclic dynamo relies on fairly simple physical principles but is intrinsically nonlinear. I will further demonstrate that this solution is not reducible to a standard mean-field dynamo and therefore constitutes a very interesting prototype of a generic, fully nonlinear generation mechanism of time-dependent, coherent large-scale magnetic fields in shear flows. Some possible implications of these findings in the context of stellar dynamos will finally be discussed.

Advances in the global modelling of angular momentum transport in stellar interiors

Stéphane Mathis
(UMR AIM Paris Saclay CEA/DSM/IRFU/SAp)

Helio and asteroseismology associated to powerful ground-based instrumentation dedicated to surfacic chemical and magnetic properties of stars give tight constraints on their internal stucture and dynamics in all the Hertzsprung-Russel diagramm. These lead to a new vision of stellar interiors and evolution where it is necessary to understand the rotation history and the internal differential rotation. Here, I will present the state of the art in the modelling of transport processes for angular momentum and the most recent advances we achieved in their description, in particular for internal waves and fossil magnetic fields. Moreover, I will show the importance of the interactions between stars and their environment.

Infrared excess and extended emission around Cepheids from diffraction-limited 10um imaging with VLT/VISIR

A. Gallenne;P. Kervella;A. Mérand
(observatoire de paris/LESIA)

Since the discovery in 2006 that some Cepheids have a circumstellar envelope, the search for infrared excess and extended emission is an active topic in our team, combining several observation techniques over a large wavelength range. These envelopes are particularly interesting for two reasons: their presence could induce a significant bias to distance determination using Baade-Wesselink methods (particularly using JWST), and they could be related to past or ongoing stellar mass loss. We present here a sample of the recent results of our team regarding the detection of circumstellar envelopes around nearby Cepheids using diffraction-limited imaging with the VLT/VISIR instrument at 10um.

Propriétés de la convection et du magnétisme dans les étoiles pré-séquence principalede faible masse avec le code ASH 3-D.

Nicolas Bessolaz et Sacha Brun
(DSM/IRFU/SAp CEA Saclay)

On étudie l'influence de la taille de la zone convective sur les propriétés de la convection proche de la surface de l'étoile et en profondeur en effectuant des simulations hydrodynamiques globales 3-D à haute résolution avec le code ASH. Pour cela, on part du même modèle sous-jacent représentant une étoile pré-séquence principale de 0,7 M_sol presque complètement convective agée de 4 millions d'années. On met en évidence la présence de cellules de convection géantes à partir d'une analyse en ondelettes dès la surface, qui autrement restent masquées par la convection à petite échelle assimilable à la supergranulation stellaire. On analyse alors leurs propriétés avec en particulier la caractérisation de leur cohérence temporelle et spatiale en les suivant au cours de la rotation de l'étoile. On propose différents proxys pour les observations comme la mesure de la rotation différentielle ou le suivi des cellules géantes à haute latitude qui pourraient permettre de déduire en particulier la taille de la zone convective, un des paramètres clés pour la compréhension du

magnétisme de ces étoiles. Finalement, on présente les résultats préliminaires d'une simulation dynamo pour cette étoile, se rapprochant de l'étoile cible BP Tau observée en spectro-polarimétrie (Donati et al. 2009), en utilisant un contraste de densité réaliste pour résoudre 90% de sa zone convective. On compare en particulier les propriétés du champ magnétique obtenu après saturation de la dynamo avec les contraintes observationnelles.

Characterisation of SPH noise in simulations of protoplanetary discs

ARENA Serena Emily, GONZALEZ Jean-Francois, CRESPE Elisabeth
(CRAL-Observatoire de Lyon)

The evolution of dust grains in gaseous protoplanetary discs (PPD) is one of the major topics in the field of pre-planetesimal formation. Among the several mechanisms the dust is subject to, turbulence is expected to be of relevant importance. Current observations have not yet reached the resolution necessary to directly study the effects of turbulence. In addition, given the complex interplay between dust and gas, the problem can be only addressed by numerical simulations.

We performed 3D Smoothed Particle Hydrodynamics (SPH) simulations of gaseous accretion discs in order to determine if the numerical noise present in SPH simulations of accretion discs can mimic the effects of turbulence and to what extent.

We found that SPH noise is connected to the artificial viscosity term present in SPH equations and that this term can have effects similar to a subgrid scale turbulence model, however intermittency is not present and velocity fluctuations are weak.

Planetary migration in weakly magnetized turbulent discs

Clement Baruteau, Sebastien Fromang, Richard P. Nelson, Frederic Masset
(DAMTP, University of Cambridge)

The migration of low-mass planets in their nascent protoplanetary discs has recently received detailed attention. It may be directed inwards or outwards, depending on the magnitude of the corotation torque, the torque exerted on the planet by its coorbital region. The corotation torque is intimately related to viscous and thermal diffusion processes in the planet's coorbital region. Its long-term behavior in the presence of realistic turbulence is so far unknown. In this communication, I will present the results of the first 3D MHD simulations aimed at studying the corotation torque in weakly magnetized turbulent discs.

SPEC3D: a Three-Dimensional Radiative Transfer Code for Astrophysical and Laboratory Applications

Laurent Ibgui (LERMA, Observatoire de Paris, CNRS, UPMC, France), Ivan Hubeny (Steward Observatory, Tucson, AZ, USA), Thierry Lanz (University of Maryland, MD, USA), Chantal Stehlé (LERMA, CNRS, Observatoire de Paris, UMPC, ENS, UCG, France)
(LERMA - Observatoire de Paris)

Many celestial objects - e.g., stellar and planetary atmospheres, jets, and accretion disks - are in essence complex three-dimensional inhomogeneous structures. However, due to limitations of computer resources that were available in the past, theoretical models assumed one-dimensional geometries. Today's modern powerful computers offer possibilities to develop three-dimensional models. Since radiation is the only source of information that we get from most astrophysical objects, it is crucial to have reliable models that enable us to predict theoretical spectra for further comparison with observations. To this end, we have developed a generic three-dimensional radiative transfer code, SPEC3D, aimed at post-processing 3D hydrodynamical simulations. The numerical approach and the major features of the code are presented. The wide range of applications includes the modeling of a number of astrophysical objects and structures, such as accretion shocks around young stellar objects, stellar and exoplanets atmospheres, cosmological structures, but also laboratory astrophysics experiments such as magnetohydrodynamics jets and radiative shocks.

Low-velocity large-scale shocks tracing the formation of the W43-MM1 and W43-MM2 massive protostars

Quang Nguyen Luong
(Sap CEA Saclay)

Recent results from our IRAM 30 m Large Program dedicated to the W43 molecular cloud complex can be interpreted with respect to the "converging flow picture", featuring velocity shears and global infalls. The most surprising result is extended SiO emission observed along the two densest filaments of W43 ($>$ 2 Kkm s$-$1 along 5 pc) that we interpret as partly tracing low velocity shocks created by converging flows. Within these ridges, W43-MM1 and MM2 are among the brightest, cold submm sources of our Galaxy, qualifying them as the best candidates to be precursor of the most massive stars in their earliest phase. We provoke that colliding flows play a major role in the star formation processes associated with the W43 filaments.

Evolution of large-scale magnetic fields in accretion disks

Jérôme Guilet
(DAMTP, Cambridge University)

A large-scale magnetic field threading an accretion disk is a crucial ingredient of many models for jets and winds from accretion disks. It is however unclear whether significant magnetic fields can be formed and sustained. Early theoretical works have indeed suggested that the turbulence diffuses the field much faster than it can be brought in. We study how the vertical structure of the disk can change these results.

Poster contributions

Chemical abundances of A and F dwarfs in the young open cluster M6

Kilicoglu, T., Monier, R., Fossati, L.
(Laboratoire H. Fizeau, Universite de Nice Sophia Antipolis)

Will be updated later on

Bilan GOLF/SOHO : Dynamique de la région radiative, Physique fondamentale et Energétique

ylvaine Turck-Chièze et consortium GOLF
(CEA)

SoHO a permis d'accumuler 15 ans de données sur les modes globaux de bas degré. Ces modes, acoustiques ou de gravité sont de plus en plus observés en Physique stellaire pour l'étude du coeur des étoiles et comme indicateurs d'activité. Aussi il est intéressant d'examiner les contraintes qu'ils imposent sur la région radiative solaire en termes d'énergétique, de processus dynamiques et de physique fondamentale: neutrinos et matière noire. L'ensemble aboutit à de nouvelles questions sur l'évolution du champ magnétique interne, le rôle des ondes internes mais aussi sur les neutrinos stériles (récemment potentiellement présents dans les mesures de détection des neutrinos) et certaines propriétés de la matière noire. Ces résultats permettent de définir de nouvelles orientations pour les analyses de SOHO, SDO et PICARD mais aussi permettent de définir une perpective pour les données ultérieures solaires ou stellaires dans le domaine de l'astérosismologie et d'autres indicateurs d'activité: Espadon, jeunes étoiles.

The fluid equilibrium tide in stars and giant planets

F. Remus, S. Mathis, J.-P. Zahn
(OBSPM - Luth)

Many extrasolar planets orbit very close to their parent star, so that they experience strong tidal interactions; by converting mechanical energy into heat, these tides contribute to the dynamical evolution of such systems. This motivates us to acquire a deeper understanding of the processes that cause tidal dissipation, which depend both on the structure and the physical properties of the considered body. Here we examine the equilibrium tide, i.e. the hydrostatic adjustment to the tidal potential, in a rotating fluid planet or star. We first present the equations governing the problem, and show how to rigorously separate the equilibrium tide from the dynamical tide, which is due to the excited eigenmodes. We discuss in particular how the quality factor Q is linked whith the turbulent viscosity of the convection zone. Finally we show how the results may be implemented to describe the dynamical evolution of the system.

The elasto-viscous equilibrium tide in exoplanetary systems

F. Remus, S. Mathis, J.-P. Zahn, V. Lainey
(OBSPM - Luth)

Earth-like planets have viscoelastic mantles. Moreover, giant planets may have viscoelastic cores. As for the fluid parts of a body, the tidal dissipation of such solid regions, gravitationally perturbed by a companion body, highly depends on its internal friction, and thus on the rheology, as well as on its size. Therefore, modelling this kind of interaction presents a high interest to provide constraints on planets properties. Here, we examine the equilibrium tide in the solid part of a planet, taking into account the presence of a fluid envelope. We first present the equations governing the problem, and show how to obtain the different Love numbers that describe its deformation. We discuss how the quality factor Q depends on the chosen viscoelastic model. Finally we show how the results may be implemented to describe the dynamical evolution of planetary systems.

The complex circumstellar environment of Betelgeuse

Pierre Kervella, Guy Perrin, Miguel Montargès
(LESIA - Observatoire de Paris)

Mass-loss occurring in red supergiants (RSGs) is a major contributor to the enrichment of the interstellar medium in dust and molecules. The physical mechanism of this mass loss is however relatively poorly known. Betelgeuse is the nearest RSG, and as such a prime object for high angular resolution observations of its surface by interferometry, and close circumstellar environment using single-pupil instruments. We recently obtained diffraction-limited images of Betelgeuse and a PSF calibrator (Aldebaran) using NACO and VISIR, and the interferometric beam combiner AMBER. The resulting images show an inhomogeneous circumstellar envelope, extending to at least 80 R*. Based on these images, I will briefly discuss our current view of the mass-loss processes occurring in Betelgeuse.

MiMeS: Magnetism in Massive Stars

C. Neiner, E. Alecian, G. Wade and the MiMeS collaboration
(LESIA - Observatoire de Meudon)

We present an overview of the MiMeS (Magnetism in Massive Stars) project and its most recent results. Dozens of magnetic massive stars have been discovered since the beginning of the MiMeS project and are studied in great details by the collaboration. Statistics related to the inference of magnetic field in various types of massive stars also start to emerge from the large survey dataset.

The formation of active protoclusters in the Aquila Rift : a millimeter continuum view

A. Maury, P. André, A. Men'shchikov, V. Könyves, S. Bontemps
(ESO Garching)

Improving our knowledge of the earliest phases of clustered star formation is crucial for understanding the origin of the stellar initial mass function and the efficiency of the star formation process. Using the MAMBO camera, we carried out a 1.2 mm dust continuum mapping of the two prominent clumps in the Aquila Rift complex: the Serpens South and W40 protoclusters. These observations, complemented by the Herschel Gould Belt survey maps of the region, were used to characterize the evolutionary stage of the protostel-

lar populations in these two protoclusters. From this analysis, we find a low ratio of Class 0 to Class I protostars, which supports a scenario of relatively fast accretion at the beginning of the protostellar phase. We also show that the two protoclusters have large fractions of protostars and high star formation rates, in agreement with the idea that they are active sites of clustered star formation currently undergoing bursts of star formation. We argue that, while the formation of these two protoclusters is likely to have been initiated in a very different manner, the resulting protostellar populations are observed to be very similar. This suggests that the detailed manner in which the gravitational collapse has been initiated does not affect much the ability of a clump to form stars.

Absorption Profiles of potassium in Brown Dwarf Spectra
N. F. Allard
(observatoire de paris)

A unified theory of collisional line profiles has been applied for the evaluation of the absorption coefficients of potassium perturbed by helium. Results will be reported for a study of the far wings from the optical range to the near-infrared.

Theoretical analysis of the He2 line at 585 A
N. F. Allard, F. X. Gadea, A. Monari, B. Deguilhem
(observatoire de paris)

In this poster we will present a determination of the He2 line profiles at 585 A using very recent ab initio potential energies. Results are reported for the conditions prevailing in brown dwarf atmospheres.

The critical layers for internal waves in stellar radiation zones
L. Alvan, S. Mathis
(CEA Saclay)

Internal waves are known as candidates for explaining stellar radiation zone angular velocity profiles in solar-type stars. The differential equation describing the evolution of such waves is singular at a level where the fluid rotation frequency is equal to the wave frequency. These 'critical levels' have been studied in geophysics (Booker and Bretherton 1966) but, until recently, they have received less attention in stellar physics. Here, we generalize previous studies to the stellar case taking the spherical geometry into account. This analysis reveals two cases depending on the value of the Richardson number : a stable one where the waves are attenuated as they pass through a critical level, and an unstable case where they can be reflected by the critical level with a coefficient larger than 1. This process is called over-reflection (Lindzen and Barker 1984).

Etudes des chocs d'accrétion radiatifs dans les variables cataclysmiques magnétiques en astrophysique de laboratoire des hautes densités d'énergie
C. Busschaert, E. Falize, C. Michaut, B. Loupias,A. Ravasio, A. Dizière, H. C. Nguyen, S. Pikuz, A. Pelka, M. Koenig
(LUTH - UMR8102 - Observatoire de Paris / CEA)

Les variables cataclysmiques magnétiques sont des systèmes binaires contenant une naine blanche fortement magnétisée qui accréte de la matière provenant d'un compagnon, dirigée selon les lignes de champs magnétiques de l'étoile. Cette matière forme, au niveau du pôle magnétique de la naine blanche, une colonne d'accrétion. Grâce aux lasers de puissances, il est désormais possible de produire en laboratoire des phénomènes présentant des propriétés de similarité avec les colonnes d'accrétion et qui permettent d'en reproduire une maquette à des échelles diagnosticables en laboratoire autorisant ainsi une meilleure compréhension des mécanismes en action. C'est tout l'enjeu du projet POLAR dont nous détaillerons ici la justification théorique et présenterons les premiers résultats expérimentaux. Ces expériences permettent ainsi de tester les modèles astrophysiques et les codes visant à simuler ces processus d'accrétion.

A Bi-fluid module for MPI-AMRVAC
H. Meheut & Z. Meliani
(Institut de physique, Université de Bern)

MPI-AMRVAC (Message-Passing Interface-Adaptive Mesh Refinement Versatile Advection Code) is a state-of-the-art relativistic hydro and magnetohydrodynamics code (Keppens et al. 2011). We have developed a new module for this versatile code in order to consider multiples fluids, with applications to different domains of astrophysics such as protoplanetary discs or late-stage stars. We present here the characteristics of this module and tests to validate it.

Quantifying Magnetic Stellar Wind Torques
Sean Matt, K. B. MacGregor, M. H. Pinsonneault, T. P. Greene
(CEA Saclay DSM/IRFU/SAp)

In order to be able to understand the evolution of stellar spin rates and differential rotation, it is necessary to have a rigorous theory for predicting angular momentum loss via magnetic stellar winds that is applicable over a wide range of conditions. Based upon the results of multidimensional, numerical simulations and semi-analytic calculations, we present an improved formulation for predicting the stellar wind torque. This formula is valid for varying degrees of magnetization in the wind, as well as for stellar spin rates that range from the slow- to the fast-magnetic-rotator regimes. The new torque formulation should be used in all future studies of stellar angular momentum loss.

Rapid inward migration of planets formed by gravitational instability
Clement Baruteau, Farzana Meru, Sijme-Jan Paardekooper
(DAMTP, University of Cambridge)

The observation of massive exoplanets at large separation from their host star challenges theories of planet formation. A possible formation scenario involves the fragmentation of massive self-gravitating discs into clumps. While the conditions for fragmentation

have been extensively studied, little is known of the subsequent evolution of these giant planet embryos, in particular their expected orbital migration. In this communication, I will discuss the migration properties of a single planet embedded in its nascent gravitoturbulent disc, following the assumption that the planet has formed by gravitational instability.

The Open-source Pipeline for ESPaDOnS Reduction and Analysis (OPERA)
Eder Martioli, Daniel Devost, Nadine Manset, Doug Teeple.
(Télescope Canada-France-Hawaii)

Opera (Open-source Pipeline for Espadons Reduction and Analysis) is an Open Source software reduction pipeline for ESPaDOnS at CFHT. There will be multiple contributors from various Universities and Institutions each contributing a part of the overall pipeline. CFHT will host the project. As it is an Open Source project, the source code will be hosted on the Internet in a SourceForge-style of team development.

The Rossby Wave Instability in 2D viscous protoplanetary discs
CRESPE Elisabeth,GONZALEZ Jean-Francois, ARENA Serena Emily.
(CRAL-Observatoire de Lyon)

In the current scenario of planetary formation one of the major problems is the growth of dust grains to meter-sized objects. Since the involved collisional velocity is high, it favors the destruction of dust aggregates preventing the formation of pre-planetesimals. The Rossby Wave Instability (RWI) is a possible solution to solve this problem. In fact, a consequence of this instability is the formation of vortices where dust particles can accumulate, collide at low relative velocity and stick together.

We use a 2D hydrodynamics (SPH) code that models an unmagnetized protoplanetary disc containing only gas around a one-solar mass star. We implement a dead zone (DZ) to examine how SPH simulations can develop the RWI following Varnière & Tagger (2006). The DZ allows to create a maximum in the density profile at its edge. This condition permits to satisfy the necessary criterion to develop the RWI in the disc.

Results clearly show the presence of Rossby vortices that survive during a few hundred years. Further work is needed to investigate the growth of modes and the behaviour of dust in the disc. We also plan to study the growth of the RWI in a 3D viscous disc.

A Herschel view of massive star formation in G035.39-00.33, afilament in the W48 molecular cloud complex
Quang Nguyen Luong
(Sap CEA Saclay)

Stars are formed in dense and cold structures of molecular cloud which are probably created through the collision of gas flows. Using images from the PACS (70 and 160 m) and SPIRE (250, 350 and 500 m) cameras of the Herschel Space Observatory, we investigate the star formation activity in the filament IRDC G035.39-00.33, one of the darkest cloud as observed with Spitzer. The filament has average density of that of IRDCs in the Galaxy, but its temperature is much lower than the average one. We find a number of dense cores and classify them as starless/prestellar cores, IR-quiet (class 0-like) cores and IR-brights (protostellar cores). Among them, cores with mass larger than 50 solar mass and are potentially forming high-mass stars. We also correlate the Herschel images with extended SiO emission previously found and show that high-mass class 0 protostars are probably responsible for most of the SiO emission.

12 A12 - Atelier GdR PCHE

Invited talks

Détection par Fermi d'un cocon de jeunes rayons cosmiques dans la superbulle de Cygnus X
Isabelle Grenier & Luigi Tibaldo (pour la Collaboration Fermi LAT)
(Université Paris Diderot & CEA Saclay)

Il existe des preuves indirectes de l'accélération des rayons cosmiques par l'onde de choc des restes de supernova mais leur injection et leur évolution dans le milieu turbulent qui entoure les étoiles massives restent inconnues. Les rayons gamma permettent de sonder leur diffusion dans le gaz et le champ de rayonnements ambiants. Le télescope LAT de Fermi a observé la région de formation d'étoiles de Cygnus X. Les images de 1 à 100 GeV révèlent un cocon de jeunes rayons cosmiques qui remplissent les cavités sculptées par les vents stellaires et fronts d'ionisation des jeunes amas stellaires. Ces images fournissent un premier exemple d'étude de la jeunesse des rayons cosmiques dans l'environnement turbulent d'une superbulle avant qu'ils ne se fondent dans la population Galactique.

The future of X-ray astronomy
Didier Barret
(IRAP)

In this paper, I will review the main features of X-ray/hard X-ray missions that are currently being built (ASTRO-H, eROSITA, NuSTAR, SVOM) or that are proposed for the ESA Cosmic Vision 2015-2025 program (ATHENA/IXO and LOFT).

Oral contributions

Magnetic Accretion Processes in Laboratory Astrophysics: the POLAR project
E. Falize et al.
(CEA-DAM-DIF)

Magnetic cataclysmic variables are binary systems containing an accreting magnetic white dwarf which accretes matter from a late type Roche-lobe filling secondary star. The presence of intense magnetic field, radiation and hydrodynamics implies a rich range of behaviours at different spatial and time scales. The radiation collected from these objects mainly comes from

complex areas (the accretion column) near the white dwarf surface where the matter is heated by a stand-off shock to a temperature of around 10-50 keV, then cools by bremsstrahlung emission and other cooling processes that lead to the formation of a cooling layer. Unfortunately, the size scales associated with these radiative zones are on the order of the white dwarf radius or smaller, which complicates their direct observation. Thus, the possibility of reproducing these phenomena in the laboratory is a real opportunity to increase our understanding of the physics of accretion processes. We proved theoretically that by using an adapted scaling law we can reproduce, with powerful lasers, a laboratory accretion column at diagnosable spatial scales. Recently we have investigated this experimentally with the LULI2000 facility. The recent experimental, theoretical and numerical results and their connection with astronomical observations will be presented and discussed.

Collective excitations in the neutron star crust
L. Di Gallo, M. Oertel, M. Urban
(Luth (Observatoire de Paris))

Shortly after its formation the neutron star temperature becomes sufficiently low for parts of the matter inside the star to be superfluid and/or superconducting. The first observational evidence for superfluidity were given by glitches and more recently discussions about the surface thermal emission are in that sense. Thermal properties of neutron stars are very sensitive to superfluidity and superconductivity effects. Here we will focus on the inhomogeneous "pasta phases" in the inner crust.

The spectrum of collective excitations will be discussed within a superfluid hydrodynamics approach. This approach allows to describe wavelengths longer than the size of the Wigner-Seitz cell, thus the low energy part of the spectrum is included. As an application, we will discuss the contribution of these collective modes to the specific heat in comparison with other known contributions.

Les sursauts gamma avec Fermi, Swift et X-Shooter : situation et perspectives
Frédéric Daigne, Frédéric Piron et Jean-Luc Atteia
(Institut d'Astrophysique de Paris - Université Pierre et Mar)

La discussion sera également l'occasion de faire un compte-rendu de l'atelier "Les sursauts gamma avec Fermi, Swift et X-Shooter : situation et perspectives" qui s'est tenu à Toulouse les 23-24 septembre 2010 avec le soutien du PPF "Astroparticules Montpellier Toulouse", du GDR PCHE et du GDRE "Exploring the dawn of the universe with gamma-ray bursts".

Spectroscopie en rayons X de MXB 1728-34 avec XMM-Newton
E. Egron, T. Di Salvo, L. Burderi, A. Papitto, L. Barragan, T. Dauser, J. Wilms, A. D'Ai, A. Riggio, R. Iaria, et N. R. Robba
(Università di Cagliari)

Nous avons analysé une observation du système binaire X de faible masse MXB 1728-34 détecté par XMM-Newton. La source présente une faible luminosité bolométrique durant l'observation, correspondant à L = 5 x $10^3$6 d2 erg/s, avec d la distance dans l'unité de 5.1 kpc. Le spectre X de cette source obtenu en combinant les données provenant des 5 instruments X à bord du télescope est fitté par une composante de Comptonisation. Des résidus présents à 6-7 keV, associés à la raie d'émission du fer, sont fittés par une raie relativiste ou par un modèle de réflexion. Dans l'hypothèse de la formation de la raie du fer par réflexion dans les parties internes du disque d'accrétion, nous pouvons déduire d'importantes informations sur les paramètres du système, tels que le rayon interne du disque d'accrétion (25-100 km) et l'inclinaison du système (44 $^c irc<$ i).

Prospects for dark matter searches with CTA
Pierre Brun
(Irfu, CEA Saclay)

CTA is the next generation of ground-based Cherenkov telescopes, it will allow a deeper look into the gamma-ray sky in the 10 GeV-100 TeV range. Beside the conventionnal physics program, CTA will be adapted to search further for particle dark matter. Under the assumption that dark matter is made of new particles, their annihilations are required to reproduce the correct dark matter abundance in the Universe. This process is expected to occur in dense regions of our Galaxy such as the Galactic center, dwarf galaxies and other types of sub-haloes. High-energy gamma-rays are produced in dark matter particle collisions and could be detected by CTA. In this talk we will recall the pros and cons of this technique and review the different strategies that are foreseen.

Importance of the radiative losses and other key physical parameters in the dynamical evolution of Sgr A*
Salomé Dibi, Samia Drappeau, Sera Markoff, Chris Fragile
(Astronomical Institute "Anton Pannekoek", University of Am)

We present general relativistic magneto- hydrodynamic (GRMHD) numerical simulations of the accretion disk around the Galactic Centre black hole Sgr A*. The simulations include the radiative cooling processes (Synchrotron, Bremsstrahlung, and Compton) self consistently in the dynamics allowing us to overcome the common simplification consisting of ignoring the cooling processes in the modelling of Sgr A*. Using a new version of the code COSMOS++, we made a parameter study of an axi-symmetric two dimensional torus of gas accreting around the 4.4 x 10^6 M super-massive black hole of the Galactic Centre.

We show that the initial magnetic field configuration in the torus influences strongly the nature of the accretion disk and outflow: the simpler this configuration, the more powerful the resulting jet and the emission from the disk. With a more sophisticated configuration, it is difficult to generate high Lorentz Factors, even with very high spins. Nevertheless, the value and the sign of the spin make a significant contribution to the physics and the dynamics of the system as well.

We further show that the accretion rate is a key parameter, influencing the dynamics and the resulting spectrum. This accretion rate sets the regime where the cooling losses can be neglected or not. We can confirm that for SgrA*, neglecting the cooling losses is not a bad approximation because the limit at which the radiative losses should be taken into account is about the upper limit of the accretion rate detected in Sgr A* ($10^{\{} - 7\}$ M/year). But, for higher accretion rate, we see significant differences in the dynamics and in the resulting spectra between the cooling versus non cooling runs, showing the limitation of over- simplification of numerical simulations. Moreover most nearby low-luminosity active galactic nucleus are in this regime where cooling should not be neglected.

Multi-component spectral analysis of bright GRBs observed with the Fermi Gamma-ray Space Telescope
Sylvain Guiriec on Behalf of the Fermi/GBM Collaboration
(NASA Marshall Space Flight Center)

The recent observations of Gamma-Ray Bursts (GRBs) with the Fermi Gamma Ray Space Telescope, open a new window in the understanding of their prompt emission. Prior to Fermi, GRB prompt emission spectra in the keV-MeV energy range were adequately fit with the empirical Band function, which is usually associated to non-thermal emission processes. We present here, for the first time, the simultaneous identification of multiple components in the prompt emission spectra of some bright GRBs observed with Fermi: a photospheric thermal component, a broken PL most likely associated with synchrotron emission from electrons propagating in the GRB jet, and an additional PL. Using time integrated and detailed time-resolved spectroscopy, we tracked the evolution of the various components as a function of time and energy. We will discuss the interpretation of the various components in terms of emission mechanisms and acceleration processes, and we will examine the consequences on the central engine and jet properties.

Modélisation de la polarisation en UV, optique et X de Noyaux Actifs de Galaxie radio-faibles
Frédéric Marin
(Observatoire de Strasbourg)

Depuis la découverte de signatures de polarisation dans les AGN, la spectropolarimétrie est devenue un puissant outil capable de sonder les régions intérieures de ces objets. Toutefois, l'interprétation du flux polarisé observé en UV/Optique est rendu ardu par le couplage radiatif non trivial des différentes régions de diffusion internes au système. Le code de transfert radiatif multi-longueurs d'ondes STOKES propose d'étudier une large gamme de modèles théoriques en termes de spectres de polarisation et d'imagerie de flux polarisé, couvrant simultanément les bandes UV, Optique et X. J'étudie donc les réponses des différentes régions de diffusions à une émission primaire et compare les résultats des modèles en UV/Optique aux observations spectropolarimétriques de la galaxie Seyfert-2 NGC 1068. Le modèle multi-longueur d'ondes offre dès lors des prédictions normalisées pour les futurs observatoires X incluant la polarisation (GEMS).

Some recent results of the CODALEMA Experiment
Rebai Ahmed on behalf the Codalema Collaboration
(Ph.D student in astroparticle)

CODALEMA is one of the experiments devoted to the detection of cosmic rays of ultra high energy by the radio method. Its main objective is not to understand the existence of the ultra high energy cosmic rays (UHECR), but to study the features of the radio signal that accompanies the development of the extensive air shower (EAS) initiated by this ray in the energy range of $10^{\{}16\}$ eV - $10^{\{}18\}$ eV. After a brief presentation of the features of the detection apparatus, the main results obtained so far will be reported (emission mechanism, lateral distribution of the electric field, energy calibration, etc.). The first studies of the characteristics of the radio wave front and of the procedures of calculation (using non-linear chi^2 methods) of the curvature will be then discussed as new preliminarily results.

Clumps being off the right path? The complicated nature of X-ray winds in Seyfert galaxies
R. W. Goosmann
(Observatoire astronomique de Strasbourg)

Outflows are a fundamental constituent of active galactic nuclei (AGN) and have important implications for black hole evolution and AGN feedback. The outflow velocities are measured by X-ray spectroscopy, but to constrain the total mass ejection rate it is necessary to also infer the column density and the overall geometry of the wind. We compare recent radiative transfer modeling to results derived from the 900 ksec Chandra observation of the Seyfert-1 galaxy NGC 3783. We estimate the ionic column densities of the X-ray wind and the ionization parameter on its irradiated side while assuming that the medium is in pressure equilibrium. For the Seyfert-2 galaxy NGC 1068, we present coherent modeling of the X-ray reprocessing by the various inner AGN components. The modeling includes polarization results and shows that future observations with X-ray polarimetry can test if the polar outflows in NGC 1068 are (mis-)aligned with respect to the symmetry axis of the obscuring dusty torus.

Les vestiges de supernova dans les domaines de haute et très haute énergie
M. Renaud
(LUPM UMR 5299-CNRS Université Montpellier 2)

La présentation portera sur les récentes observations à haute et très haute énergie des vestiges de supernova avec l'expérience Cherenkov HESS (100 GeV - 100 TeV) et l'instrument LAT à bord du satellite Fermi (100 MeV - 100 GeV). Je discuterais des implications apportées par ces observations concernant la capacité à ces vestiges de supernova à accélérer des particules à très haute énergie, avec en toile de fond la question des sources à l'orgine des rayons cosmiques galactiques.

Le second catalogue Fermi

Jean Ballet pour la collaboration Fermi-LAT
(AIM, CEA Saclay)

Je décrirai la construction du second catalogue de sources gamma (100 MeV - 100 GeV) établi par Fermi sur la base de deux ans de données (2FGL) et son contenu. J'indiquerai les améliorations par rapport au précédent catalogue (1FGL).

CTA et la variabilité des noyaux actifs de galaxie

Jonathan Biteau - Berrie Giebels
(LLR)

La génération actuelle de télescopes Cherenkov, représentée par les collaborations H.E.S.S, MAGIC et VERITAS, fournit de précieuses informations sur la variabilité des noyaux actifs de galaxie (NAG). Le flux de ces sources astrophysiques peut varier sur échelle de temps aussi courtes que la minute, comme l'a démontré H.E.S.S. lors de l'exceptionnel sursaut de PKS 2155-304. Cette variabilité de haute fréquence impose de fortes contraintes sur les propriétés de la zone d'émission et sur les mécanismes d'accélération.

Nous étudierons lors de cette présentation les apports de la nouvelle génération d'observatoire de très hautes énergies à l'analyse temporelle des NAG. La simulation de sursauts ultra rapides de PKS 2155-304 vus avec la sensibilité du Cherenkov Telescope Array (CTA) nous permettra de souligner les questions que de telles observations déclencheront.

Off-Axis Energy Generation in Active Galactic Nuclei: Explaining Broad-Line Profiles, Spectropolarimetric Observations, and Velocity-Resolved Reverberation Mapping

C. Martin Gaskell
(Universidad de Valparaíso, Chile)

It is argued that the highly-variable thermal energy generation in AGNs originates off axis in regions that cannot be axially symmetric. This off-axis model readily explains the varying degrees of temporal correlation found in multi-wavelength variability studies: the strong, variable asymmetry of BLR line profiles, the varying time delays in the response of the BLR to different continuum events, how narrow velocity ranges of line profiles will often appear to respond differently or not at all to continuum variability, complex changes in the Balmer decrement with velocity, inconsistent and variable inflow/outflow signatures found in velocity-resolved reverberation mapping, the diversity of velocity-dependent polarizations observed, and polarization variability.

Accurate AGN Black Hole Mass Measurements and the Origin of the Correlations Between Black Hole Mass and Bulge Properties

C. Martin Gaskell
(Universidad de Valparaíso, Chile)

The origins of the correlations between the masses of supermassive black holes on the one hand and the luminosities and velocity dispersions of the bulges on the other (the so-called "M-L" and "M-sigma" relationships) have been receiving considerable attention. I show how more accurate black hole masses can be obtained for AGNs. These show that the dispersion in the M-L and M-sigma relationships decreases strongly with increasing mass. I demonstrate that these changes in dispersion in the relationships can be readily explained by the increasing number of mergers that have taken place in more massive galaxies. Feedback between the growth of a bulge and the growth of a supermassive black hole is neither necessary nor desirable.

Status of HImalayan Gamma-Ray Observatory (HIGRO) and observations with HAGAR at Very High Energies.

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

High Altitude GAmma Ray (HAGAR) telescope array, which is the first stage of Himalayan Gamma Ray Observatory (HiGRO), has been successfully installed at Hanle in Himalayas and has been collecting science data since September, 2008. In last two and half years, we have observed several sources including Galactic objects like Crab nebula, Geminga, LSI+61 303 and some of the Fermi detected pulsars as well as extragalactic objects including Mkn 421, Mkn 501, 1ES2344+514, 3C454.3 etc. Analysis of data on all these sources is underway. Preliminary results include detection of Crab nebula and Mkn 421 during its flare in February, 2010. Details on our analysis procedures and these results will be presented. In the second phase of HiGRO, Major Atmospheric Cherenkov Experiment (MACE), a 21 m imaging telescope, will be installed at Hanle, next to HAGAR. Update on our activities at Hanle will be given.

Relativistic MHD : a general approach for stationary and axisymmetric configurations

E. Gourgoulhon, C. Markakis, K. Uryu & Y. Eriguchi
(LUTH, Observatoire de Paris)

We have developed a new approach to General Relativistic MHD in stationary and axisymmetric spacetimes. This approach is more general than that for Kerr-type spacetimes usually considered in GRMHD, thereby allowing to deal with neutron star interiors or self-gravitating tori around black holes. We have generalized previously obtained results in various directions. In particular, we present the first explicit versions of the relativistic Soloviev and Grad-Shafranov equations in generic spacetimes.

This talk is based on the article E. Gourgoulhon, C. Markakis, K. Uryu & Y. Eriguchi, Phys. Rev. D 83, 104007 (2011)

Search for Lorentz Invariance Violation with AGNs: a prospect for the Cherenkov Telescope Array

J. Bolmont, A. Jacholkowska, J.-P. Tavernet
(LPNHE)

In the recent years, many results have been published about a possible violation of Lorentz Invariance in the frame of Quantum Gravity (QG) models using gamma-ray photons. All major high-energy gamma-ray detec-

tors (HESS, MAGIC, VERITAS) have obtained limits on the QG energy scale by studying distant and variable sources such as active galaxies. However, no deviation has been discovered so far either for linear or quadratic corrections of the speed of light in vacuum. The Cherenkov Telescope Array (CTA) will be able to probe deeper into this area. A quantitative study will be presented where the impacts of several parameters (increased sensitivity, broader energy range, higher number of potential sources) are studied through simulations. Predictions for linear and quadratic limits will be given and discussed.

Impact of the observation of a two solar mass star on the equation ofstate of dense matter
Micaela Oertel
(LUTH (CNRS/Observatoire de Paris/Université Paris 7))

Recently[1] a neutron star with a mass of almost two solar masses has been observed. The authors claim that "The implied pulsar mass of 1.97 +/- 0.04 M_*odot* is by far the highest yet measured with such certainty, and effectively rules out the presence of hyperons, bosons, or free quarks at densities comparable to the nuclear saturation density." I will critically discuss this assertion, since even if it turns out that we do not yet have reached such a breakthrough in our understanding of dense matter, this observation imposes strong constraints on the equation of state and thus has important consequences for the description of dense matter.

[1] Demorest et al., Nature 467, 1081 (2010)

Sources d'ondes gravitationnelles
Philippe Grandclément
(LUTH, Observatoire de Paris)

Je passerai en revue les différentes sources d'ondes gravitationnelles, aussi bien du point de vue des signaux attendus que de l'information astrophysique qu'une détection apporterait.

L'accent sera mis à la fois sur les sources attendues pour les détecteur terrestres et sur celles que l'on pourrait observer par une instrument spatial. Dans ce dernier cas, une bonne connaissance des sources est particulièrement cruciale dans cette période où l'ancienne mission LISA est en phase de redéfinition, après l'abandon de la participation avec la NASA.

Do Fermi-LAT observations really imply very large Lorentz factors in GRB outflows ?
R. Hascoët, F. Daigne & R. Mochkovitch
(Institut d'Astrophysique de Paris, UMR 7095 CNRS-UPMC)

Detections of GeV photons in a few GRBs by Fermi-LAT have led to strong constraints on the bulk Lorentz factor in GRB outflows. To avoid a large gamma-gamma optical depth, minimum Lorentz factors have been estimated to be as high as 1000 in some bursts. We present a detailed calculation of the gamma-gamma attenuation taking into account both the geometry and the dynamics of the jet. We compute the resulting spectrum and lightcurves and we show how the minimum Lorentz factor can be significantly lowered compared to previous estimates. The constraint is even further lowered if the MeV and GeV components are not radiated at the same location. We study several other consequences of gamma-gamma annihilation in GRBs: the shape of the expected spectral cutoff is closer to a power-law than an exponential decay; the temporal evolution of the opacity favors a delay between the MeV and GeV lightcurves; in complex GRB lightcurves, the shortest time-scale features can be suppressed at high energy.

Self-consistent spectra from GRMHD simulations with radiative cooling: A link to reality for Sgr A*
S. Drappeau, S. Dibi, S. Markoff, C. Fragile
(Sterrenkundig Instituut)

Cosmos++ (Anninos et al. 2005) is one of the first fully general relativistic magneto-hydrodynamical (MHD) codes that can self-consistently account for radiative cooling, in the optically thin regime. As the code combines a total energy conservation formulation with a radiative cooling function, we have now the possibility to produce spectral energy density from these simulations and compare them to data. The Galactic Center is the perfect candidate to test these simulations, since we have extremely good observational constraints on its physical parameters and radiative mechanisms because it is our closest supermassive black hole.

In this talk we present preliminary results of spectra calculated using the same cooling functions as 2D Cosmos++ simulations of the accretion flow around Sgr A* (S. Dibi et al, in prep.). The simulation parameters were designed to roughly reproduce its very low ($\sim 10^{\{} - 9\}$ M_{sun}/yr) accretion rate, but only via spectra can we test that this has been achieved

Thermal evolution of neutron stars and constraints on their internal properties
M. Fortin, J.-L. Zdunik, J. Margueron, P. Haensel
(CAMK Varsovie/ LUTh Meudon)

Modeling the thermal evolution of both isolated and accreting neutron stars enables to put constraints on the poorly known composition and properties of their interior. The theoretical modeling of the thermal evolution of an isolated neutron star shows that the cooling depends on the properties of crust, in particular the superfluidity -Lattimer et al., ApJ (1994), Gnedin et al., MNRAS (2001)-. I will present new calculations of the specific heat of superfluid neutrons in the crust taking into account the presence of the nuclei and cooling curves in the fast cooling scenario, with enhanced neutrino emission -Fortin et al., PRC (2010). Recently the first direct observation of the cooling of a young and isolated neutron in Cassiopeia A supernova remnant has been reported -Heinke and Ho, ApJL (2010). So far, only the temperatures at one point in time of neutron stars with different ages and different masses were known. Modeling the thermal evolution of CasA neutron star, two groups -Shternin et al., MNRAS (2011); Page et al., PRL (2011)- conclude that the protons in the core are superfluid and superconducting. They also put constraints on the superfluid properties of the neutrons in the core and the associated neutrino emissivity. Future

monitoring of the source offers exciting perspectives. A subclass of accreting neutron stars, the so-called quasi-persistent X-ray transients, also constrains the properties of the matter in neutron stars. These transients accreted matter from a low-mass companion during years to decades before accretion stops. In the deep-crustal heating scenario, the accreted matter undergoes a series of nuclear reactions while it sinks deeper into the crust under the weight of the newly-accreted material. The reactions produce heat that also propagates in quiescence and is radiated away. The modeling of the thermal relaxation after accretion stops depends on the accretion rate, the composition and mass of the neutron star and the microphysical input. Shternin et al., MNRAS (2007) show that the thermal relaxation of one of these four sources, KS 1731-260 exclude fast cooling due to enhanced neutrino emission in the core and is consistent with a crystalline crust with superfluid neutrons. Brown and Cumming, ApJ (2009) conclude the thermal relaxation of KS 1731-260 and MXB 1659-29 implies that the impurity parameter which describes the distribution of nuclide charge numbers is of the order of 1. I will present some new results of the modeling of the thermal evolution of all the four quasi-persistent X-ray transients based on an up-to-date description of the microphysics in the outer layers of neutron stars.

Fermi Large Area Telescope observations of gamma-ray pulsars
L. Guillemot, on behalf of the Fermi LAT Collaboration
(Max-Planck-Institut fuer Radioastronomie)

Since Fermi was launched in June 2008, its main instrument, the Large Area Telescope (LAT), has observed the gamma-ray sky with unprecedented sensitivity, establishing pulsars as the largest gamma-ray source class in the Galaxy and enabling a considerable advance in our understanding of their high-energy emission properties. The number of known gamma-ray pulsars is approaching a hundred, including pulsars discovered in blind searches of the Fermi LAT data, and a population of gamma-ray millisecond pulsars.

Nevertheless, supporting radio observations have been key to the success of pulsar studies with Fermi. As an example, searches for radio pulsars in Fermi sources with no known counterparts yielded a burst of discoveries of new millisecond pulsars, with more than thirty detections of these particularly interesting objects so far. I will review Fermi LAT observations of gamma-ray pulsars and the multi-wavelength follow-up of pulsars discovered in Fermi unidentified sources.

Détection des ondes gravitationnelle, résultats et perspectives
Matteo Barsuglia
(APC-CNRS)

Nous ferons d'abord une revue des résultats des expériences LIGO-Virgo. Ensuite nous décrirons les expériences futures pour la détection des ondes gravitationnelles sur terre et dans l'espace et leur intérêt scientifique.

Neutrino transport in gravitationnal supernovae simulations : a simplified treatment via a leakage scheme
Bruno Peres
(Luth observatoire de Paris Meudon)

Neutrinos in gravitationnal supernovae play a major role in the dynamics of the explosion. One way to implement a simplified neutrino treatment in supernovae simulations is via a leakage scheme, which considers neutrinos either fully at equilibrium with the fluid or free streaming. This approach can be useful e.g. when a parameter study is done, where a CPU time consuming scheme cannot be used. I will present this scheme and its implementation, with some results and comparaisons with full neutrino transport (Boltzmann solver).

Optical follow-up of high energy neutrinos detected by the ANTARES telescope
Manuela Vecchi on behalf of the ANTARES Collaboration
(CPPM)

The ANTARES Collaboration has developed a Target of Opportunity strategy to enhance the detection prospects to transient sources of high energy neutrinos, searching for an optical counterpart associated either to a single neutrino of high energy, either to a doublet of events in space and time coincidence. The ANTARES alert system can trigger the observation with a network of optical telescopes within a few minutes, making the system suitable for the observation of transient phenomena, such as Gamma Ray Bursts or Core Collapse SuperNovae. The system is operational since 2009, and since then more than 30 alerts have been sent to the TAROT and ROTSE telescopes: preliminary results on the analysis of optical images will be presented as well as the system performance.

The Galactic Center region viewed by H.E.S.S..
Aion Viana
(IRFU CEA-Saclay)

The Galactic center region is the most active region in our Galaxy harboring a wealth of photon sources at all wavelengths. H.E.S.S. observations of the Galactic Center (GC) region revealed for the first time in very high energy (VHE, E> 100 GeV) gamma-rays a detailed view of the innermost 100 pc of the Milky Way and provided a valuable probe for the acceleration processes and propagation of energetic particles near the GC. H.E.S.S. has taken more than 180 hours of good-quality observations toward the GC region since the experience started in 2003. A strong and steady gamma-ray source has been detected coincident in position with the supermassive black hole Sgr A*. Besides the central pointlike source, a diffuse emission extended along the Galactic Plane has been detected within about $1^{\{circ\}}$ around the GC. An accurate analysis of the Galactic Centre region suggests that the diffuse emission may dominate highest energy end of the GC source spectrum. I will review the current VHE view by H.E.S.S. of the GC region and briefly discuss the theoretical models which explain VHE gamma-ray emissions of the central

source and the diffuse emission.

The W49 region as seen by H.E.S.S.
François Brun, Mathieu de Naurois, Werner Hofmann, Svenja Carrigan, Arache Djannati-Ataï, Yvonne Becherini, Stefan Ohm for the H.E.S.S. Collaboration
(LLR, Ecole Polytechnique)

The W49 region hosts a star forming region (W49A) and a supernova remnant interacting with molecular clouds (W49B). The $10^6, M\_\{sun\}$ Giant Molecular Cloud W49A is one of the most luminous giant radio HII region in our Galaxy and hosts several active, high-mass star formation sites. The mixed-morphology supernova remnant W49B has one of the highest radio surface brightness of all the SNRs of this class in our Galaxy. Infrared observations evidenced that W49B is interacting with molecular clouds and Fermi recently reported the detection of a coincident bright, high-energy gamma-ray source. Observations by the H.E.S.S. telescope array resulted in the significant detection of VHE gamma-ray emission from the W49 region, compatible with gamma-ray emission from the SNR W49B. The results, the morphology and the origin of the VHE gamma-ray emission will be presented in the multi-wavelength context and the implications on the origin of the signal will be discussed.

Suivi électromagnétique d'événements gravitationnels
Eric CHASSANDE-MOTTIN pour la LVC
(CNRS AstroParticule et Cosmologie)

La dernière campagne de prises de données scientifiques achevée en octobre dernier par les détecteurs d'ondes gravitationnelles Virgo et LIGO a donné lieu pour la première fois à un programme de suivi optique. Une chaine d'analyse en ligne a assuré la production rapide d'alertes qui ont été ensuite communiqué à un ensemble de télescopes partenaires, permettant ainsi la recherche d'éventuelles contre-parties électromagnétiques dans la direction reconstruite de la source. Nous présenterons un premier bilan de cette opération.

Transport de particules autour d'une onde de choc relativiste.
I. Plotnikov, G. Pelletier, M. Lemoine
(Institut de Planétologie et Astrophysique de Grenoble)

Dans la vision actuelle des chocs relativistes une intense turbulence magnétique à courte échelle de cohérence peut être excitée par les instabilités dans le précurseur du choc. L'étude analytique et numérique du transport de particules chargées dans une telle structure magnétique sera présentée. En présence du champ magnétique externe la diffusion paralléle et transverse exhibent des propriétés essentiellement différentes, malgré l'intensité du champ turbulent. Les coefficients de diffusion spatiale suivent des lois simples en fonction de la rigidité de la particule et du degré de turbulence du champ. On voit notamment que la diffusion transverse sature à la valeur imposée par le degré de turbulence. Les performances d'accélération et processus de chauffage électronique seront discutés aussi.

Poster contributions

Data analysis method for the search of point sources of gamma rays with the HAGAR telescope array
Richard J. Britto (on behalf of HAGAR collaboration)
(Tata Institute of Fundamental Research)

The High Altitude GAmma-Ray (HAGAR) experiment is the highest altitude atmospheric Cherenkov sampling array, set up at ∼4300 m amsl in the Himalayas (Northern India). It constitutes 7 telescopes, each one with seven 90 cm-diameter mirrors, a field of view of 3 degrees, and was designed to reach a relatively low threshold (currently around 200 GeV) with quite a low mirror area (31 m^2). In order to remove the strong isotropic background of charged cosmic rays, data are collected by tracking separately On-source followed by Off-source regions, or vice-versa. Typical observations period is about 30-40 min. On-Off data pairs are then selected according to quality parameters such as stability of the trigger rate and the comparisons of trigger rate means between On and Off-source data sets. Signal extraction from point sources is done by performing analysis cuts on the count rate excess, rejecting off-axis events. Validation of method and systematics of Off-Off pairs are evaluated through the analysis of fake sources located at similar declination as the observed point sources. Spurious signal, if any, would show up in this study.

Self-consistent spectra from GRMHD simulations with radiative cooling: A link to reality for Sgr A*
S. Drappeau, S. Dibi, S. Markoff, C. Fragile
(Sterrenkundig Instituut)

Cosmos++ (Anninos et al. 2005) is one of the first fully general relativistic magneto-hydrodynamical (MHD) codes that can self-consistently account for radiative cooling, in the optically thin regime. As the code combines a total energy conservation formulation with a radiative cooling function, we have now the possibility to produce spectral energy density from these simulations and compare them to data. The Galactic Center is the perfect candidate to test these simulations, since we have extremely good observational constraints on its physical parameters and radiative mechanisms because it is our closest supermassive black hole.

In this talk we present preliminary results of spectra calculated using the same cooling functions as 2D Cosmos++ simulations of the accretion flow around Sgr A* (S. Dibi et al, in prep.). The simulation parameters were designed to roughly reproduce its very low ($\sim 10^{\{} - 9\}$ M_$\{sun\}$/yr) accretion rate, but only via spectra can we test that this has been achieved.

Importance of the radiative losses and other key physical parameters in the dynamical evolution of Sgr A*
Salomé Dibi, Samia Drappeau, Sera Markoff, Chris Fragile
(Astronomical Institute "Anton Pannekoek", University of Am)

We present general relativistic magneto- hydrodynamic (GRMHD) numerical simulations of the accretion disk

around the Galactic Centre black hole Sgr A*. The simulations include the radiative cooling processes (Synchrotron, Bremsstrahlung, and Compton) self consistently in the dynamics allowing us to overcome the common simplification consisting of ignoring the cooling processes in the modelling of Sgr A*. Using a new version of the code COSMOS++, we made a parameter study of an axi-symmetric two dimensional torus of gas accreting around the 4.4 x 10^6 M super-massive black hole of the Galactic Centre.

We show that the initial magnetic field configuration in the torus influences strongly the nature of the accretion disk and outflow: the simpler this configuration, the more powerful the resulting jet and the emission from the disk. With a more sophisticated configuration, it is difficult to generate high Lorentz Factors, even with very high spins. Nevertheless, the value and the sign of the spin make a significant contribution to the physics and the dynamics of the system as well.

We further show that the accretion rate is a key parameter, influencing the dynamics and the resulting spectrum. This accretion rate sets the regime where the cooling losses can be neglected or not. We can confirm that for SgrA*, neglecting the cooling losses is not a bad approximation because the limit at which the radiative losses should be taken into account is about the upper limit of the accretion rate detected in Sgr A* ($10^{\{} - 7\}$ M/year). But, for higher accretion rate, we see significant differences in the dynamics and in the resulting spectra between the cooling versus non cooling runs, showing the limitation of over- simplification of numerical simulations. Moreover most nearby low-luminosity active galactic nucleus are in this regime where cooling should not be neglected.

13 A13 - Tutoriels AS-OV

Invited talks

tutoriels OV

(Observatoire Astronomique de Strasbourg)

Oral contributions

Efficient distribution and exploration of numerical simulations using VO tools
P. Ocvirk, D. Aubert, L. Michel, P. Fernique
(Observatoire astronomique de Strasbourg)

This presentation is aimed at theoreticians who would like to make their numerical simulations available to the community but can not afford to spend days or weeks to do so. We show how to quickly create and deploy a database of numerical simulations results using SAADA ((Système Automatique d'Archivage de Données Astronomiques). We then show how to easily query and explore the snapshots using Aladin and TOPCAT.

14 A15 - Gravitation, Références, Astronomie, Métrologie

Oral contributions

Measuring the unbiased non-gravitational acceleration of a spacecraft with an electrostatic accelerometer
Benjamin LENOIR, Bruno CHRISTOPHE, Serge REYNAUD
(Onera - The French Aerospace Lab)

Radio tracking of interplanetary probes is an important tool for navigation purposes as well as for testing the laws of physics or exploring planetary environments. The addition of an accelerometer on board a spacecraft provides orbit determination specialists and physicists with an additional observable: it measures the value of the non-gravitational acceleration acting on the spacecraft, i.e. the departure of the probe from geodesic motion.

This technology is used for geodesy missions in Earth orbits with electrostatic accelerometers. This presentation will focus on an evolution which consists in adding a subsystem to remove the bias of an electrostatic accelerometer. It aims at enhancing the scientific return of interplanetary missions in the Solar System, for fundamental physics as well as Solar System physics.

The instrument and the measurement principle will be described. An emphasis will be made on the signal processing techniques developed for this instrument and the expected performances. A performance better than 10 pm/s2 will be demonstrated, which is the precision recommended by ESA in its Roadmap for Fundamental Physics in Space (2010).

Simulating observations to test general relativity in its strongest regime at the Galactic Center
F. H. Vincent, T. Paumard, E. Gourgoulhon, G. Perrin
(LESIA/LUTH)

Probing gravity in the immediate vicinity of a supermassive black hole would be a powerful test of general relativity (GR). The Galactic Center is an ideal laboratory to do so. The accretion structure that may surround the central black hole (BH), Sgr A*, can be used to constrain the BH properties. Moreover, radiation flares are regularly observed there, which could be due to a hot spot orbiting around the BH : a perfect probe of strong gravity. In order to determine at what level future observations will be able to constrain GR, a full GR ray-tracing code has been developed: GYOTO. The aim of this talk is to present recent results from this code. I will present simulations of the emitted spectrum of a torus-like accretion structure around Sgr A*, which can be used as a tool to constrain the black hole's properties. The precise observation of Sgr A*'s flares will be possible in the near future thanks to the second generation VLTI beam combiner GRAVITY. I will show recent results on the simulation of a hot spot orbiting around the central black hole. These results are in turn used as inputs to a code simulating the GRAVITY instrument. The final goal is to de-

termine to what extent GRAVITY will allow to probe spacetime in the immediate vicinity of Sgr A*.

Development of Techniques to Study the Dynamic of Highly Eccentric Elliptical Orbits
Guillaume Lion, Gilles Metris, Florent Deleflie
(GeoAzur - Observatoire de la Côte d'Azur)

Many spacecrafts are or will be placed in highly eccentric orbits around telluric planets of the Solar system. Such eccentricities allow to cover a wide range of altitudes, mainly for planetology purposes. There are also orbits with very high eccentricity around the Earth, especially the GTO (Geostationary Transfer Orbit) and orbits of some space debris. In this case, the motion is strongly perturbed by the luni-solar attraction. For various reasons which will be recalled, the traditional tools of celestial mechanics are not well adapted to the particular dynamic of highly eccentric orbits. Therefore, it is necessary to develop specific techniques for this configuration. This concerns numerical as well as analytical tools. We will show how to construct the expression of the disturbing function due to the presence of an external body, well-suited for highly eccentric orbits. Expansion of the elliptic motion in closed-form by using Fourier series in multiple of the eccentric anomaly will be presented. On the other hand, classical methods of numerical integration have often a poor efficiency. We will show the interest of geometric integrators and in particular of variational integrators.

In-flight calibration of the MICROSCOPE space mission instrument: development of the simulator
E. Hardy, A. Levy, M. Rodrigues, P. Touboul (ONERA), G. M'etris (OCA), A. Robert (CNES)
(Onera)

The space mission MICROSCOPE aims at testing the Equivalence Principle (EP) with an accuracy of $10^{\{} - 15\}$. The test is based on the precise measurement delivered by a differential electrostatic accelerometer onboard a drag-free microsatellite which includes two cylindrical test masses submitted to the same gravitational field and made of different materials. The accuracy of the measurement exploited for the EP test is limited by our knowledge of the instrument's physical parameters. The on-ground evaluation of these parameters is not precise enough. An in-orbit calibration is therefore needed to finely characterize them in order to correct the measurements. The calibration procedures have been determined and their analytical performances have been evaluated. In addition, a software simulator including models of the instrument and the satellite drag-free system has been developed. After an overall presentation of the MICROSCOPE mission, the presentation will focus on the description of the simulator used to validate the specific procedures which are planned to determine in-orbit the exact values of the instrument's driving parameters.

Evolution of mass determination in Pluto's system
Beauvalet, L., Lainey, V., Arlot, J.-E., Binzel, R.P.
(IMCCE-Observatoire de Paris)

Pluto's system is the multiple system which has been observed for the longest time. It will also be observed in situ by New Horizons mission in 2015. We have developped a numerical model which allows a global solution of Pluto's and its satellites'orbit through fitting both the heliocentric motion of an object and the motion of its satellites. We present here the results we obtained on the expected evolution of the masses uncertainty before and after the arrival of New Horizons in Pluto's system. We find the data collected by the probe will enable us to constrain clearly the masses of the smallest satellites, Nix and Hydra. GAIA's observations have also been simulated to know the mission's impact on our knowledge of Pluto's system. We also present the results of fitting our model to currently published observations.

Testing gravitation in the Solar System with radio science observations
A. Hees, B. Lamine, P. Wolf, S. Reynaud, M.T. Jaekel, C. Le Poncin-Lafitte, V. Lainey, V. Dehant
(Royal Observatory of Belgium and LNE-SYRTE Observatoire de P)

There is still a great interest to test General Relativity (theoretical motivations such as quantification of gravity, unification with other interactions...). Within the solar system, the gravitational observations are always related to radio science measurements (Range and Doppler) or to angular measurements of light (position of body in the sky, VLBI). In this communication, we will briefly review the current tests of gravitation performed in the Solar system.

In order to have an idea of the signature and of the order of magnitude that an hypothetical theory of gravitation can have on radio science observations, we developed a new software that simulates range/Doppler signals. We will present this new tool that simulates radio science observations directly from the space-time metric (which means that we can simulate signals in GR and in alternative theories of gravity).

We will present range/Doppler simulations of Cassini spacecraft in an alternative theory of gravity going beyond standard Post-Newtonian formalism and we will show how it is possible to derive constraint on this alternative gravitation theory.

IERS conventions and impact on operational products provided by GRGS ILRS AC
F. Deleflie, J.-M. Lemoine, F. Reinquin, D. Coulot
(IMCCE-GRGS)

We will show the impact on some of the new recommandations of the new IERS 2010 conventions on the operational products provided by the GRGS Analysis Center. In particular, we will show the impact of the choice of a new mean pole.

Absolute calibration of the MOBLAS laser station at Tahiti for the T2L2 experience
C. Courde (OCA-Grasse), P. Exertier (OCA-Grasse), F. Pierron (OCA-Grasse), E. Samain (OCA-Grasse), P. Guillemot (CNES-Toulouse)

(OCA-GéoAzur)

The comparison of clocks on earth or embedded on satellite, need that the link used gives the accuracy and the stability adapted to the performances of these local time references. The Time Transfer by Laser Link (T2L2) has the advantage to be almost 100 times better than currently radio-frequency techniques.

T2L2 consists of using laser pulses issued by ground stations. Pulses are sent on a satellite equiped with a datation system, a retroreflector and a clock. A comparison of the departure date, the arrival date on the satellite and the arrival date at the ground station after light reflexion, allow to measure eventual time shifts. With these comparisons we are able to construct an universal time scale.

After a description of this instrument embedded on the satellite Jason2, we will present the exploit results since its sends in 2008. We will explain the works on the absolute calibration carried on the MOBLAS laser station and the FTLRS laser station, installed close since the end of april 2011 at Tahiti.

A relativistic and autonomous navigation satellite system

Pacôme Delva
(SYRTE/Observatoire de Paris/UPMC)

A relativistic positioning system has been proposed by Bartolome Coll in 2002. Since then, several group developed this topic with different approaches. I will present a work done in collaboration with Ljubljana University and the ESA Advanced Concepts Team. We developed a concept, Autonomous Basis of Coordinates (ABC), in order to take advantage of the full autonomy of a satellite constellation for navigation and positioning, by means of satellite inter-links. I will present the advantages of this new paradigm and a number of potential application for reference systems, geophysics and relativistic gravitation.

Updated orbit of Apophis with recent observations

Bancelin D., Thuillot W., Colas F., Hestroffer D., Assafin M.
(IMCCE, Observatoire de Paris, CNRS, UPMC)

Since its discovery in 2004, asteroid (99942) Apophis previously designed 2004 MN4 became a study case. It was the first asteroid who reached level 4 on Torino Scale for a possible collision with the Earth in 2029. The last observations for Apophis were made in 2008 and the last results conclude on a collision probability of 1/250000 for the 2036-threat. Recent observations were made at Pic du Midi Observatory (France) and at Magdalena Ridge Observatory (New Mexico). We propose here an update of Apophis's orbit and the new predictions of encounters with Earth.

Poster contributions

The detection of the secular aberration drift by the VLBI

S. Lambert
(Observatoire de Paris/SYRTE)

While analyzing decades of very long baseline interferometry (VLBI) data, we detected the secular aberration drift of the extragalatic radio source proper motions caused by the rotation of the Solar System barycenter around the Galactic center. Our results agree with the predicted estimate to be 4–6 micro arcseconds per year (muas/yr) towards $alpha = 266$ deg and $delta = -29$ deg. The analysis method consisted of three steps. First, we analyzed geodetic and astrometric VLBI data to produce radio source coordinate time series. Second, we fitted proper motions of 555 sources with long observational histories over the period 1990–2010 to their respective coordinate time series. Finally, we fitted vector spherical harmonic components of degrees 1 and 2 to the proper motion field. Within the error bars, the magnitude and the direction of the dipole component agree with predictions. The dipole vector has an amplitude of 6.4 pm 1.5 muas/yr and is directed towards equatorial coordinates $alpha = 263$ deg and $delta = -20$ deg.

Relativistic astrometry and Time Transfer Functions.

Stefano Bertone , Christophe Le Poncin-Lafitte
(SyRTE - Observatoire de Paris)

Almost all of the studies devoted to relativistic astrometry are based on the integration of the null geodesic differential equations. However, the gravitational deflection of light rays can be calculated by a different method, based on the determination of the Time Transfer Function between two arbitrary points-events. We give a brief review of the preliminary results obtained by this method.

Analytical expression of the potential generated by a massiveinhomogeneous straight segment

Nour-Eddine. Najid and El haj. El ourabi
(Faculté des Sciences Aïn Chock Casablanca)

Abstract. Potential calculation is an important task to study dynamical behavior of test particles around celestial bodies. Gravitational potential of irregular bodies is of great importance since the discoveries of binary asteroids, this opened a new field of research. A simple model to describe the motion of a test particle, in that case, is to consider a finite homogeneous straight segment. In our work, we take this model by adding an inhomogeneous distribution of mass. To be consistent with the geometrical shape of the asteroid, we explore a parabolic profile of the density.We establish the closet analytical form of the potential generated by this inhomogeneousmassive straight segment. The study of the dynamical behavior is fulfilled by the use of Lagrangian formulation, which allowed us to give some two and three dimensional orbits. Keywords : Potential-Inhomogeneous distribution-Asteroids

Lasers stabilisés sur l'iode

O. Acef et. al.
(SYRTE UMR-8630 / Observatoire de Paris)

Nous développons un programme de R&D visant à sta-

biliser divers lasers IR (@ 1030 nm, 1064 nm et 1545) nm sur des transitions de l'iode moléculaire au voisinage de 515 nm -532 nm. Les différents développements sont susceptibles de servir dans des projets terrestres et/ou spatiaux.

A general solution of the Poisson and Laplace equations for homogeneous phi-invariant celestial bodies from a line, kernel-regularized integral

TROVA A. , HURE J.M. , HERSANT.F
(Université Bordeaux 1- Laboratoire d'Astrophysique de Bordea)

The numerical determination of the gravitational potential of celestial bodies (rotating stars, planets, asteroids, etc.) is a common challenge in Astrophysics. For axisymmetrical objects, the potential is classically found from a two-dimensional integral with singular kernel. Without a special treatment, there is no way to achieve high accuracy. The usual expansion of the Green kernel into Legendre polynomials suffers from inaccuracy due to truncations. Here, we improve the theory by Ansorg et al. (2003) where the two dimensional Poisson integral is converted into a line integral along the body's physical boundary. We first make the kernel regular by straight analytical integration of the singularity and then apply Green's theorem. The resulting line integral is regular and has satisfactory mathematical properties.

A new dynamical solution of (45)Eugenia's satellites

Beauvalet, L., Marchis, F., Lainey, V.
(IMCCE-Observatoire de Paris)

(45)Eugenia and its satellites Petit-Prince and S/2004(45) are one of the few triple asteroid system observed. Eugenia's shape is far from spherical, hence a theoretical J2 of 0.17. We adapted the numerical model we developped for Pluto's system to Eugenia's case, adding the second harmonics of Eugenia's gravity field. Previous study by Marchis et al. (2010) found a lesser value of the coefficient. We present here our results of fitting the satellites observations to our model using new observations of the system made in 2010 . We confirm the fact that the value of J2 is about three times lower than its theoretical value as well as the pole direction and the orbital elements of Petit-Prince.

Statistical Analysis on the Uncertainty of Asteroid Ephemerides

J. Desmars (1,2), D. Bancelin (2), D. Hestroffer (2), W. Thuillot (2) (1) SHAO, Chinese Academy of Sciences, Shanghai, China (2) IMCCE, Observatoire de Paris, UMPC, CNRS France
(IMCCE/Observatoire de Paris)

The large number of asteroids allows a statistical analysis especially for their orbital uncertainty. It presents a particular interest for Near-Earth asteroids in order to estimate their close approach from Earth and eventually their risk of collision. Using ASTORB and MPCORB databases, we analyse the different uncertainty parameters (CEU, U) and highlight relations between the uncertainty parameter and the characteristics of the asteroid (orbital arc, absolute magnitude, ...). A review of the different measurements are also compiled and the impact of these measures on the accuracy of the orbit is also estimated.

proposal models for next generations of LISA

Habibollah MinooAmanda Shamiryan
(K.N.Toosi university of technology)

This paper proposes models for next generations of LISA in order to increase its capacities and performance in detecting gravitational waves (GW), which are: 1) developement of LISA by replicating the triagular LISA in a hexagonal pattern in order to increase the detectable frequency band by using 5 or 6 spacecrafts (SC) instead of 3 and doubling the arm lengths in the first step, and continuing the same formation pattern with more SCs in next steps. By using this formation, a 10 Gm system can be achieved, while still having the current 5 Gm system is available . 2) expanding LISA in a 3D cubical network which will be able to observe GWs in two different directions simultaniously while keeping the hexagonal pattern formation. It is anticipated that these mentioned models can be implemented with almost the same science and technology used in original LISA arrangement without additional major difficulties.

ACES : Microwave link data processing

F. Meynadier, P. Delva, C. Le Poncin-Lafitte, P. Laurent, P. Wolf (SYRTE – Observatoire de Paris)
(SYRTE – Observatoire de Paris)

The Atomic Clocks Ensemble in Space (PHARAO-ACES mission), which will be installed on board the international space station, uses a dedicated two-way microwave link in order to compare the timescale generated on board with those provided by many ground stations disseminated on the Earth. Phase accuracy and stability of this long range link will have a key role in the success of the PHARAO-ACES experiment.

The SYRTE is heavily involved in the design and the development of the data processing software : from theoretical modelling and numerical simulations to the development of a software prototype. Our team is working on a wide range of problems that need to be solved in order to achieve high accuracy in (almost) real time.

In this poster we present some key aspects of the measurement, as well as the current status of the software's development.

proposal models for next generations of LISA

Habibollah Minoo,Amanda Shamirian
(K.N.Toosi university of technology Tehran Iran)

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On the possible use of Phobos Grunt's radio-science data after landing on Phobos
V. Lainey, C. Le Poncin-Lafitte, P. Rosenblatt
(SyRTE-Obs. de Paris)

Phobos-Grunt spacecraft is expected to stay one year at the surface of Phobos. Thanks to 2-way Doppler data, this will be an opportunity to track Phobos satellite with an unprecedented accuracy. Here we focus on the benefit of such data to improve our knowledge of the Mars system and fundamental physics. Such experiment will provide a preview of what a space mission dedicated to Mars' geodesy, like the GETEMME mission, will bring.

GETEMME - A Mission to Explore the Martian Satellites and the Fundamentals of Solar System Physics
C. Le Poncin-Lafitte, J. Oberst, V. Lainey, V. Dehant, P. Rosenblatt, S. Ulamec, J. Biele, H. Hoffmann, K. Willner, U. Schreiber, N. Rambaux, P. Laurent, A. Zakharov, B. Foulon, L. Gurvits, S. Murchie, C. Reed, S. Turyshev, B. Noyelles, J. Gil, M. Grazian
(SyRTE-Obs. de Paris)

GETEMME (Gravity, Einstein's Theory, and Exploration of the Martian Moons' Environment) shall be launched for Mars on a Soyuz Fregat in 2020 or 2022. The spacecraft will initially rendezvous with Phobos and Deimos in order to carry out a comprehensive mapping and characterization of the two satellites and to deploy passive Laser retro-reflectors on their surfaces. In the second stage of the mission, the spacecraft will be transferred into a lower 1500-km Mars orbit, to carry out routine Laser range measurements to the Phobos and Deimos reflectors. Also, asynchronous two-way Laser ranging measurements between the spacecraft and stations of the ILRS (International Laser Ranging Service) on Earth are foreseen. An onboard accelerometer will ensure a high accuracy for the spacecraft orbit determination. The inversion of all range and accelerometer data will allow us to determine or improve dramatically on a host of dynamic parameters of the Martian satellite system. From the complex motion and rotation of Phobos and Deimos we will obtain clues on internal structures and the origins of the satellites. Also, crucial data on the time-varying gravity field of Mars related to climate variation and internal structure will be obtained. Ranging measurements will also be essential to improve on several parameters in fundamental physics, such as the Post-Newtonian parameter as well as time-rate changes of the gravitational constant and the Lense-Thirring effect. Measurements by GETEMME will firmly embed Mars and its satellites into the Solar System reference frame.

Study of the Yarkovsky diurnal effect on planetary satellites: Application to the satellites of Mars
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The Yarkovsky effect is a result of a force acting on a rotating body in space caused by the anisotropic emission of thermal photons (basically re-emitted from the Sun) , which carries momentum. It is usually considered in relation to meteoroids or small asteroids (about 10 cm to 10 km in diameter), as well as artificial satellites of the Earth, since its influence is most significant for objects in this size range and not too far from the Sun. The induced force affects the orbital motion of these bodies. To our knowledge the effect on small planetary satellites has never been studied. Here we study the perturbation caused by the Yarkovsky diurnal effect on the long term evolution of Phobos' and Deimos' orbits. In particular, the past evolution of the Mars satellites is still not completely understood. While tidal effects may have played the most important role in the past evolution of their orbits, it is still important to verify that all relevant perturbations required to compute accurately the moon orbits have been considered. We consider the Mars system composed of a main central body (the Sun), Mars and one of its satellites. We develop a general analytical formulation describing the effect of the Yarkovsky diurnal perturbation on the variations of the semi-major axis, eccentricity. We conclude, that the Yarkovsky diurnal effect has provided only a very limited effect on the past evolution of the Mars moons. Our formulation can be easily applied to any other planetary or asteroid system.

15 A16 - Discussions EJSM JGO après le Decadal Survey US: vers un nouveau scénario de mission ?

Invited talks

Les atmosphères des satellites Galiléens
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Les atmosphères des satellites Galiléens sont essentiellement le produit direct de l'érosion des surfaces de ces objets. Comprendre leur formation, mesurer leur composition et leur structure spatiale permet donc de sonder les processus qui modifient en permanence la structure de la couche supérieure de ces surfaces observée par spectrométrie. Par ailleurs, caractériser l'échappement atmosphérique et sa composition permet de contraindre la composition interne de ces objets, tout comme une des sources du plasma de la magnétosphère de Jupiter. De plus, ces atmosphères étant en partie produites par l'interaction du plasma

magnétosphérique Jovien avec la surface, leur exploration permet également de comprendre les mécanismes d'interaction entre ces objets et la magnétosphère jovienne. Enfin, mieux comprendre ces atmosphères permettra de mieux cerner les processus physiques qui régissent ces milieux faiblement denses, de savoir par exemple comment le criblage d'une surface éjecte de la matière depuis une surface, comment ces atmosphères interagissent avec la surface, leur dépendance en fonction de la composition de la surface, en fonction du plasma incident, des conditions de surface (température, porosité, éclairement…). Dans cette présentation, nous illustrerons ces différentes questions dans le cas de Europa et Ganymède et soulignerons les mesures à faire, selon nous, pour mieux y répondre.

The ESA-led Jupiter Ganymede Orbiter: present status
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Laplace was selected as a Large-class candidate mission in the Cosmic Vision 2015-25 programme and underwent an assessment study (phase 0/A, 2008-2010) under the assumption of an international cooperation including ESA and NASA. ESA would provide the Jupiter Ganymede Orbiter (JGO) and NASA would provide the Jupiter Europa Orbiter (JEO). Following the recent announcement of the US Planetary Science Decadal Survey, and the evolution of the NASA budget, the NASA Europa Orbiter will not be executed as conceived. Consequently, the science team investigates different options to recover parts of the original science goals of the Laplace mission. The status of this study will be described.

Conditions d'habitabilité dans le système de Jupiter par la mission EJSM-Laplace
Athena Coustenis et le EJSM-Laplace Science Definition Team
(LESIA, Observatoire de Paris-Meudon)

EJSM-Laplace (TGO) is aimed at a thorough investigation of the Jupiter system in all its complexity with emphasis on Ganymede and its potential habitability. The overarching theme for EJSM-Laplace is: The emergence of habitable worlds around gas giants. Habitability is commonly understood as "the potential of an environment (past or present) to support life of any kind". The concept does not relate to whether life actually exists or has existed. It refers instead to whether environmental conditions are available that could support life. The mission focus is also to characterize the conditions that may have led to the emergence of habitable environments among the Jovian icy satellites, with special emphasis on the internally active ocean-bearing worlds, Ganymede and Europa. Investigating their habitability includes confirming the existence and determining the characteristics of a liquid-water ocean below the icy surfaces, understanding the possible sources and cycling of chemical and thermal energy, investigating the evolution and chemical composition of the surfaces and of the sub-surface oceans, and evaluating the processes that have affected the satellites through time.

Observations de l'atmosphère de Jupiter dans le cadre de la mission EJSM-Laplace
Pierre Drossart
(LESIA, Observatoire de Paris)

La mission ESA/EJSM-Laplace (Cosmic Vision -L) à l'étude permettra des études renouvelées du système de Jupiter et de ses satellites. Les objectifs scientifiques concernant l'atmosphère de Jupiter seront revus, dans le contexte de notre connaissance de Jupiter qui suivra les missions d'exploration précédentes : Pioneer, Voyager, Galileo et Juno. Une instrumentation adaptée doit permettre d'appréhender de nouvelles mesures dans l'atmosphère, et d'étudier les aspects de couplages entre les différentes couches (troposphère-stratosphère-mésosphère) encore peu connus.

Etude détaillée de la magnétosphère de Jupiter et de ses interactions avec les satellites Galiléens et exploration de la mini-magnétosphère de Ganymède avec EJSM-Laplace
Nicolas André
(IRAP)

La mission EJSM-Laplace à l'étude à l'ESA se propose d'explorer de manière approfondie non pas une mais deux magnétosphères d'échelles spatiales et temporelles très différentes : la magnétosphère gigantesque de Jupiter, en rotation rapide, et la mini-magnétosphère de Ganymède, seule lune connue du Système solaire à posséder un champ magnétique intrinsèque. La mission EJSM-Laplace permettra également d'étudier les interactions entre la magnétosphère de Jupiter et les autres satellites Galiléens (Callisto et Europe principalement). Les propriétés des différents environnements ionisés des objets du système de Jupiter et leur couplage seront revus dans le contexte de la préparation de la mission, de même que les instruments magnétosphère et plasma nécessaire à leur exploration.

Oral contributions

Probing Jupiter's moons' interiors with tidal deformation and magnetic fields
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The magnetic data returned by the Galileo spacecraft have suggested that deep salted water oceans are present within Europa, Ganymede and Callisto. As these three moons are subjected to significant tidal deformation, the presence of an internal ocean on these three icy moons is predicted to result in both a significant deflection of their surface and internal mass redistribution. Altimetric or/and gravi- metric measurements to be performed by the EJSM spacecrafts should be able to confirm the presence of the internal oceans by monitoring the periodic surface deflection and gravity change. However, these measurements alone will not be able to constrain the thickness of the ice shell, as the tidal deformation significantly depends on the unconstrained shear modulus of the ice shell and the physical properties of the subsurface ocean. Here we

investigate whether the ice shell thickness and ocean properties can be better constrained by combining the static gravity field, periodic altimetric and gravimetric fluctuations and magnetic signals. We test the sensitivity of the tidal response and electric conductivity to the ice shell and ocean properties (thickness, shear and bulk modulus, electrolyte content, degree of stratification, temperature profile etc.). By solving the equations of motion for a compressible viscoelastic layered interior subjected to time-varying potential (Tobie et al. Icarus 2005), we predict that the tidal response of Europa is primarily sensitive to the ice shell thickness and to the density of the water ocean (almost insensitive to ice density, iron core and mantle size and state). In the absence of additional constraints on the ocean composition, the uncertainty on the ice shell thickness from altimetric and gravimetric measurements will be larger than 15-20 km. Only a joint inversion of the entire geophysical dataset, including low-degree static gravity field and topography, tidal fluctuation (k2 and h2), magnetic induction, would permit us to reduce the uncertainty on the ice shell thickness.

Quantifying the measurement requirements needed to understand the origin of the Galilean satellite system

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One of the primary science objectives of the EJSM mission is to characterize the origin and evolution of the Galilean satellites. Three different sets of formation conditions can be considered regarding the Galilean satellite system: 1) unaltered building blocks from the protosolar nebula [1, 2], 2) slightly altered materials where a significant fraction of the volatile components have outgassed before the formation process [3], and 3) building blocks that were vaporized in the subnebula of Jupiter before coalescing in the formation process, i.e. the Jupiter mini-solar system formation scenario [1, 4]. Cassini has shown that the Saturn system seems to fall largely into category 2 [5, 6] but the size of Jupiter and its relative distance from the Sun may favor process 3 for the Galilean satellites. Here we discuss the observational tests that could shed light on the formation circumstances of the Galilean satellite system. INMS measurement of the ratios of the noble gases in the satellite environments, particularly Ne, Ar, Kr, would allow comparison with bodies that likely formed in the solar nebula, such as comets, and thereby constrain whether the material from which the icy satellites formed was primarily circumsolar or circum-Jovian. The deuterium-to-hydrogen ratio in water, compared to that of the well-determined primordial value and that in terrestrial ocean water, gives an indication of the extent to which water in planetesimals experienced elevated temperatures for durations sufficient for re-equilibration with the surrounding hydrogen-rich gas [2, 7]. Measurement of the ratios of noble gases to CH4 and the 12C/13C and D/H ratios provides constraints on the origin of any methane that might be present either primordially or as a product of hydrothermal reactions in the interiors of Europa and Ganymede [8, 9]. The origin of methane as primordial or a later product of internal processing would provide a supplementary constraint on the temperature history of the disk. [1] Mousis, O., Gautier, D. 2004. Constraints on the presence of volatiles in Ganymede and Callisto from an evolutionary turbulent model of the Jovian subnebula. Planetary and Space Science 52, 361-370. [2] Horner, J., Mousis, O., Alibert, Y., Lunine, J. I., Blanc, M. 2008. Constraints from deuterium on the formation of icy bodies in the Jovian system and beyond. Planetary and Space Science 56, 1585-1595. [3] Mousis, O., and 10 colleagues 2009. Clathration of Volatiles in the Solar Nebula and Implications for the Origin of Titan's Atmosphere. The Astrophysical Journal 691, 1780-1786. [4] Prinn, R. G., Fegley, B., Jr. 1981. Kinetic inhibition of CO and N2 reduction in circumplanetary nebulae - Implications for satellite composition. The Astrophysical Journal 249, 308-317 [5] Waite, J. H., Jr., and 15 colleagues 2009. Liquid water on Enceladus from observations of ammonia and 40Ar in the plume. Nature 460, 487-490. [6] Mousis, O., Lunine, J. I., Waite, J. H., Magee, B., Lewis, W. S., Mandt, K. E., Marquer, D., Cordier, D. 2009. Formation Conditions of Enceladus and Origin of Its Methane Reservoir. The Astrophysical Journal 701, L39-L42. [7] Koch, F. E., Horner, J., Hansen, B. M. S., Mousis O., and Bailey J. 2011. Constraining the formation of irregular satellites – an important goal for JWST., MNRAS Letter, submitted. [8] Jehin, E., Manfroid, J., Hutsemékers, D., Arpigny, C., Zucconi, J.-M. 2009. Isotopic Ratios in Comets: Status and Perspectives. Earth Moon and Planets 105, 167-180. [9] Mousis, O., Lunine, J. I., Pasek, M., Cordier, D., Hunter Waite, J., Mandt, K. E., Lewis, W. S., Nguyen, M.-J. 2009. A primordial origin for the atmospheric methane of Saturn's moon Titan. Icarus 204, 749-751.

Observations de Jupiter de l'intérieur profond à la troposphère avec JGO

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Jupiter, par sa masse, a modelé la formation du système solaire. Les mécanismes de cette formation peuvent être contraints par la mesure de la structure interne de Jupiter, notamment la taille et la composition du coeur. Les méthodes sismolologiques, utilisées sur le Soleil, peuvent également s'appliquer à Jupiter, où la présence de modes propres acoustiques vient d'être démontrée. La mission de l'ESA vers le système de Jupiter est une opportunité unique d'appliquer ces techniques et de mesurer les variations, périodiques ou non, du champ de vitesse à la surface de Jupiter. Ceci nous donnera accès à la structure et la dynamique interne de Jupiter, permettant de comprendre la physique sous fortes pressions, et de comparer l'évolution de Jupiter avec les planètes géantes extra-solaires. Ces mesures donnent

également accès à la dynamique au niveau de la troposphère où des ondes de gravité se forment et peuvent se propager vers les couches les plus hautes, participant à la circulation générale de l'atmosphère et aux couplages entre l'intérieur et les couches externes de l'atmosphère.

Poster contributions

Emissions UV-visible des ionosphères-thermosphères de Jupiter et Ganymède.
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Institut De Planétologie Et D'astrophysique De Grenoble}{Nous avons entrepris, à l'aide de modèles ionosphériques basés sur le code Trans*, de calculer les émissions des ionosphères-thermosphères de Jupiter et Ganymède, de manière à comprendre quelles informations pourraient être tirées de mesures UV-vis de ces émissions et quelles seraient les meilleures conditions d'observation.

De la même manière, sur Jupiter, des méthodes d'extraction des énergies des électrons précipitant dans les zones aurorales sont en cours d'étude à partir des émissions de H et H2 dans l'UV lointain. Un des aspects critiques est, dans ce cas, la résolution spectrale.

Nous ferons un bilan de ces modèles et de ce que peuvent apporter ces mesures dans le cadre d'EJSM après la mission JUNO, en tenant compte des spécifications prévues pour les spectromètres UV-vis.

Photometry of Ganymede's surface: a review of previous data in the context of a new mission
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The surface of Ganymede is generally divided into two terrain types that show differences in albedo, crater density, and topography (Prockter et al., 2010 Space Sci. Rev. vol.153, p63–111). Covering approximately a third of the surface is a lower albedo or dark terrain that is heavily cratered. The other two thirds of the surface are covered by vast globe-encircling swaths of a higher relative albedo or light terrain that have a crater density significantly lower than dark material. We propose a review of the photometric data of the surface of Ganymede obtained by previous works. The previous data are mainly radar measurements (Giese et al. 1998 Icarus vol.135, p303–316), spectral data (Spencer et al. 1995 JGR vol.100, p19045-19056), rotational light curves and solar phase curves at various wavelengths (Hendrix et al., 2005, Icarus vol.173, p29-49), thermal cooling (Spencer, 1987 PhD thesis) and linear degree of polarization (Rosenbush et al. 1997, Icarus vol.179, p490–496). Unified models are necessary to process simultaneously all the photometric data and then constrain the nature of Ganymede's soil. The topographic database for Ganymede is very limited and radar data are scarce. The solar phase curves (unpolarized and polarized) are the most incomplete data, in both leading and trailing sides, and especially within the moderate to high phase angle range (50°-180°), besides a good coverage of the opposition effect (phase angles less than 30°, see Déau et al. 2009 Plan. and Space Sci. vol.57, p.1282-1301). Since the high solar phase angles are impossible to reach from Earth due to the small angular separation between the Earth and the Sun as seen by Jupiter, only an in-situ mission can provide the missing phase angles. We also examine the main issues implied by the Ganymede's photometry in the context of the comparative planetology.