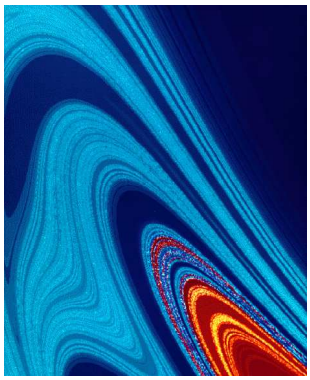
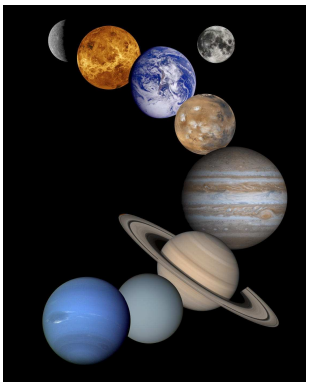
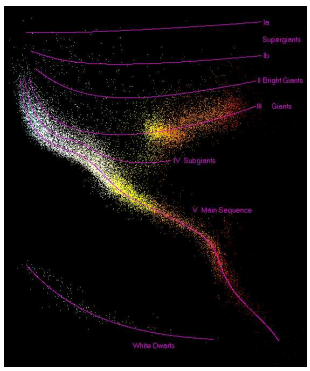
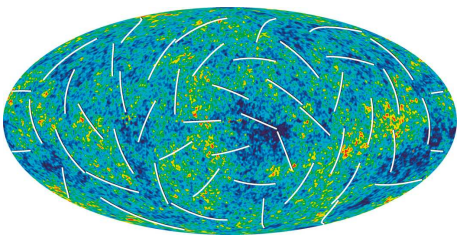
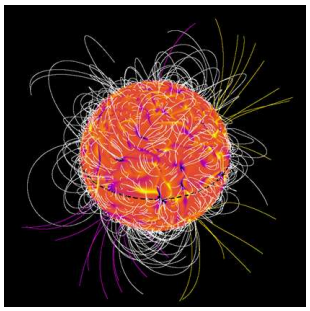
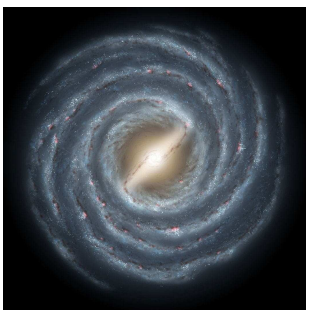
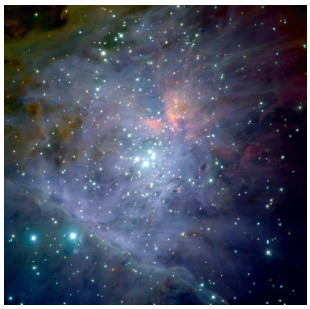
Elbereth Conference 2008

Abstract Programme

8 - 10 December, 2008
Institut d'Astrophysique de Paris

Contents

8th December 2008

1 High Angular Resolution and High Dynamic Range Imaging

10h00 Anthony Boccaletti: Review

10h20 Fabrice Vidal (LESIA): Optique adaptative pour les futurs ELT's

En Astronomie la résolution spatiale des plus grands télescopes est limitée à cause des perturbations introduites par l'atmosphère sur la lumière provenant de l'objet observé (galaxie, planète...). L'Optique Adaptative (OA) est une technique apparue à la fin des années 1980 dont le rôle est de corriger en temps réel ces perturbations afin de redonner au télescope le pouvoir de résolution théorique. Son succès durant les années 90 en font aujourd'hui une technique incontournable pour l'observation sur les plus grands télescopes d'aujourd'hui (VLT, Gemini, Keck ...). La prochaine génération de télescopes, nommés ELT's (Extremely Large Telescopes), en seront bien sûr équipés. Je présenterai les problèmes posés par les contextes scientifiques nécessitant la construction de ces ELT's ainsi que les solutions techniques apportées par les futurs instruments intégrant des systèmes d'OA de plus en plus spécialisés.

10h40 Anne Costille (ONERA): Optimisation des performances en OAMC : résultats expérimentaux sur le banc d'OAMC de l'ONERA

L'optique adaptative (OA) permet d'améliorer la résolution angulaire des systèmes d'imagerie notamment en astronomie. Elle connaît cependant une forte limitation de son champ de correction liée au phénomène d'anisoplanétisme, qui dégrade les performances lorsqu'on observe un objet éloigné de la source d'analyse. L'OA multi-conjuguée (OAMC) permet de palier cette limitation et d'accroître le champ de correction. Ce concept réalise une analyse du front d'onde dans plusieurs directions, permettant un sondage du volume turbulent, et plusieurs miroirs déformables (MD) conjugués à différentes altitudes permettent la correction. Actuellement, de tels systèmes sont à l'étude pour rendre ce concept d'OAMC opérationnel et améliorer les performances des télescopes dans les années à venir. Plusieurs approches de reconstruction du front d'onde en OAMC et de commande de tel système ont été proposées. Des résultats théoriques ont montré l'intérêt d'utiliser une commande de type Linéaire, Quadratique, Gaussienne (LQG), comparée à des commandes plus standard comme la commande intégrateur. Cette commande optimale est basée sur l'utilisation d'un filtre de Kalman qui permet l'estimation et la prédiction de la turbulence. Une démonstration expérimentale de cette approche est en cours de validation sur HOMER, le banc d'OAMC développé à l'ONERA et consacré à l'étude en laboratoire des OA tomographiques. Ce banc comprend deux MDs et un analyseur de surface d'onde grand champ de type Shack-Hartmann. Nous présentons les résultats expérimentaux obtenus sur HOMER en OA classique, en GLAO, en (L)TAO et en OAMC

obtenus d'une part avec une commande classique et d'autre part avec la commande LQG suivant les configurations. Nous aborderons aussi la stratégie de calibration mise en place sur le banc et nécessaire à l'implantation de tout système d'OAMC.

Coffee Break

11h20 Nicolas Muller (ONERA): Analyse de front d'onde sur étoile laser pour les ELT

En l'absence de couverture de ciel par des étoiles suffisamment brillantes, la future génération de télescopes géants sera équipée d'OA et d'étoiles laser. L'objectif de la thèse est de proposer un concept de mesure de front d'onde sur étoile laser permettant de réduire l'erreur d'anisoplanétisme et éventuellement d'estimer le basculement.

11h40 Enguerran Delavaquerie (ONERA): Cophasage en plan focal de miroir segmenté

Le futur « European - Extremely Large Telescope » (E-ELT) sera le prochain grand outil de l'astronomie Européenne. Grâce à son miroir primaire segmenté de 42m, des résultats sans précédents pourront être obtenus. Cependant, l'obtention de la résolution théorique ultime du télescope sera indexée au cophasage d'un peut plus de 900 segments. Cela implique des contraintes sur le capteur de front d'onde qui obligent à revoir les concepts habituels utilisés en Optique Adaptative (discontinuités, étoiles guides hors axe et peu lumineuses) Contrairement aux approches traditionnelles, une analyse du front d'onde en plan focal telle que la diversité de phase, permet de faire une mesure interférométrique entre les segments. Cette technique a déjà été validée pour d'autres instruments multipupilles. La présentation montrera des simulations de la méthode sur une configuration de type ELT et la comparera avec des méthodes plan pupilles plus classiques.

12h00 Rami Gasmi (GEPI): Étude du comportement dynamique du grand miroir déformable

La première fréquence de résonance d'un miroir déformable doit être suffisamment élevée par rapport à la fréquence d'échantillonnage pour introduire un retard de phase tolérable dans la boucle de contrôle. En effet, la déformation mécanique doit être quasistatique et les déformations doivent être assez faibles pour avoir une déformation linéaire de la plaque optique. Aujourd'hui, la nouvelle génération de grands télescopes conduit à des optiques adaptatives avec des dimensions inédites des miroirs déformables. Dans le cas particulier de l'E-ELT (European Extremely LargeTelescope), le design proposé par l'industriel Cilas correspond à une structure de 2.5 m de diamètre, composée d'environ 7000 actionneurs et dont la masse sera inférieure à 5 t. Ces caractéristiques conduisent à un faible rapport raideur/masse et à des fréquences de résonances probablement dans la plage de fonctionnement du miroir. Dans ce travail nous présenterons nos résultats relatifs au comportement dynamique du prototype du concept de miroir déformable proposé par Cilas pour l'E-ELT. Ce prototype a été dimensionné afin de reproduire le comportement

dynamique du miroir de 2.5 m. Dans un premier temps, nous présenterons un modèle éléments finis 3D de ce prototype. Ce modèle nous permettra d'accéder aux quatre premiers modes propres ainsi qu'à sa réponse fréquentielle à une excitation tilt suivant l'axe x entre 0 et 100 Hz. Dans un second temps, nous présenterons un modèle d'état bidimensionnel simplifié de la plaque optique, basé sur l'analyse modale précédente, et qui a pour objectifs de diminuer les temps de calcul et de simplifier la modélisation. Enfin, une comparaison entre ces deux modèles nous permettra de valider l'approche bidimensionnelle pour la modélisation du comportement dynamique de telles structures.

12h20 Alberto Cornia (ONERA): Maximum-Likelihood based method for spectral and angular differential imaging

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

12h40 Raphaël Galicher(LESIA): Wavefront error correction and Earth-like planet detection by a self-coherent camera

In the context of exoplanet detection, the performance of coronagraphs is limited by wavefront errors. To remove efficiently the effects of these aberrations using a deformable mirror, the aberrations themselves must be measured in the science image to extremely high accuracy. The self-coherent camera which is based on the principle of light incoherence between star and its environment can estimate these wavefront errors. This estimation is derived directly from the encoded speckles in the science image, avoiding differential errors due to beam separation and non common optics. Earth-like planet detection is modeled by numerical simulations with realistic assumptions for a space telescope.The self-coherent camera is an attractive technique for future space telescopes. It is also one of the techniques under investigation for the E-ELT planet finder the so-called EPICS.

Lunch Break

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2 The Galaxy and galaxies

14h40 Simona Mei: Review

15h00 Michaël Thibon (LESIA): Dynamique autour du trou noir central de la Galaxie

The center of the Milky Way is occupied by a supermassive black hole (SMBH), what has been defintively proved recently. Studying the Galaxiy's black hole is a mean to understand what is happening within the other galaxies and in particular in the active galaxy nuclei (AGN). Among those numerous questions on this black hole, 3 of them represent my thesis: 1- why are there young stars distributed on 2 disks orbiting very close (<1l-y) around the central black hole? 2- the "northern arm", gas complex very close of the black hole: what is its dynamics? (shocks, gravity, ...) 3- what is the influence of the molecular gas disk (∼10l-y from the black hole)? (origin for the northern arm?, future stars to appear?)

15h20 Natalia Vale Asari (LUTH): The SEAGAL Project (Semi-Empirical Analysis of Galaxies)

The classification of galaxies as star forming or active is generally done in the (oiii Hb, nii Ha) plane. The Sloan Digital Sky Survey (SDSS) has revealed that, in this plane, the distribution of galaxies looks like the two wings of a seagull. Galaxies in the right wing are referred to as Seyfert/LINERs, leading to the idea that non-stellar activity in galaxies is a very common phenomenon. In this work, we argue that a large fraction of the systems in the right wing could actually be galaxies which stopped forming stars. The ionization in these "retired" galaxies would be produced by hot post-AGB stars and white dwarfs. Our argumentation is based on a stellar population analysis of the galaxies via our STARLIGHT code and on photoionization models using the Lyman continuum radiation predicted for this population. The proportion of LINER galaxies that can be explained in such a way is however uncertain. We further show how observational selection effects account for the shape of the right wing. Our study suggests that nuclear activity may not be as common as thought. If retired galaxies do explain part of the seagull's right wing, some of the work concerning nuclear activity in galaxies, as inferred from SDSS data, will have to be revised.

15h40 Myriam Rodrigues (GEPI): M-Z relation

Intermediate mass galaxies (>1010 M$\odot$) at z∼0.6 are the likeliest progenitors of the present-day, numerous population of spirals. There is growing evidence that they have evolved rapidly since the last 6 to 8 Gyr ago, and likely have formed a significant fraction of their stellar mass, often showing perturbed morphologies and kinematics. We have gathered a representative sample of 88 such galaxies and have provided robust estimates of their gas phase metallicity. For doing so, we have used moderate spectral resolution spectroscopy at VLT/FORS2 with unprecedented high S/N allowing to remove biases coming from interstellar absorption lines and extinction. We definitively confirm that the predominant population of z∼0.6 starbursts and lumi- nous IR galaxies (LIRGs) are on

average, two times less metal rich than the local galaxies at a given stellar mass. We do find that the metal abundance of the gaseous phase of galaxies is evolving linearly with time, from z=1 to z=0 and after comparing with other studies, from z=3 to z=0. Combining our results with the reported evolution of the Tully Fisher relation, we do find that such an evolution requires that ∼30 % of the stellar mass of local galaxies have been formed through an external supply of gas, thus excluding the close box model. Distant starbursts & LIRGs have properties (metal abundance, star formation efficiency & morphologies) similar to those of local LIRGs. Their underlying physics is likely dominated by gas infall probably through merging or interactions.

Coffee Break

16h20 Rodney Delgado (GEPI): Morpho-dynamic evolution of galaxies from z=0.8 to z=0

Nearly half of the stellar mass of present-day spirals have been formed since z=1, and galaxy kinematics is the best tool to identify the underlying mechanisms responsible for the galaxy mass assembly since that epoch. Kinematics of distant galaxies require 3D spectroscopy and morphological studies require better classification methodes as well as good image qualities. In that way, a combined analysis of the morphological and dynamical properties of galaxies is needed to determine a morpho-kinematic evolution of galaxies. We aim at evaluate robustly the morpho-kinematic evolution of galaxies since z 0.6, as well as to test the different schemes for classifying galaxies morphologically. We use all the information provided by multi-band images, color maps and 2 dimensional light fitting to assign to each object a morphological class.

16h40 Loïc Le Tiran (GEPI): The physics of high redshift galaxies revealed by integral field spectroscopy

We use integral field spectroscopy of a large collection of galaxies at high redshift (Z 2) to highlight the different physical processes they undergo during their growth. The analysis of our sample, containing a wide range of galaxy types, shows very different dynamical and spectral properties that we use to distinguish the roles of gas accretion, mergers, star formation and feedback in galaxy evolution during the youth of the Universe.

17h00 Benjamin Bertincourt (IAS): Ultradeep Infrared Spectroscopy of Distant Galaxies with Spitzer

Mid-IR spectroscopy is a powerful tool to disentangle the energy source of distant galaxies: active galactic nuclei (AGN) versus star formation (starburst). Surveys dedicated to such studies have mostly relied on photometric and/or color selection prior. As such, bright targets have always been preferred for both efficiency in observation time and scientific returns. We present here an unbiased spectroscopic survey using the infrared spectrograph (IRS) on board Spitzer targeting a 8 square arcminute region in the GOODS-North field. IRS was used in spectral mapping mode with 5 hours of effective integration time per pixel offering both an unprecedented view and detection level

of distant galaxies. We extracted spectra for 45 sources in the field. We used a new cross-correlation technique to measure redshifts and estimate spectral types from IRS data alone; this was successful for about 60% of the spectra. Aromatic emission (PAHs), signature of star-formation activity, is detected in about half of the spectra (22 / 45 sources) and prominent in a third of the sample (14 / 45 sources). Silicate absorption at 9.8 microns, often linked with the presence of an AGN, is also detected in a smaller subset (4 / 45 sources). The IRS redshifts of this sample range from z = 0.2 to z = 2, with a median of 1. We reach much higher sensitivity than previous IRS spectroscopic surveys and detect sources with median estimated IR luminosities up to 10 times fainter (2. 10^{11} and 7. 10^{11} solar luminosities at z = 1 and z = 2 respectively). This sample has fewer AGN than previous faint samples observed with IRS, which we attribute to the fainter luminosities reached here.

17h20 Anand Raichoor (GEPI): Assemblage de la masse stellaire dans les galaxies

Cadre général : voir l influence de l environnement (amas, champ) sur l evolution de la masse des galaxies. Description de la methode pour obtenir la masse des galaxies de l amas du Lynx a partir de photometrie infrarouge et optique.

End of the day

9th December 2008

3 Planetary Sciences

9h00 Thierry Fouchet: Review

9h20 Emilie Royer (Service Aéronomie): Emissions d'Oxyde Nitrique (NO) vues par SPICAV en Occultattion Stellaire, à bord de Venus Express

Les émissions de NO dans l'UV ont été détectées sur Vénus, du côté nuit de la planète, la première fois par Barth & al., en 1968, depuis Mariner 5, puis identifiées comme étant des émissions d'oxyde nitrique, par Feldmann & al., et par Stewart et Barth en 1979, avec Pioneer. SPICAV (Spectroscopy for the Investigation of the Atmosphere of Venus), un spectromètre actuellement en vol sur la sonde Venus Express, les voit aussi. Je décris ici un modèle directe qui simule le chemin d'un rayon lumineux, émis par une couche atmosphériue de NO, à travers le spectromètre et reproduit le spectre d'une émission de NO. C'est une première approche vers une meilleure compréhension des phénomènes dynamiques de la thermosphère vénusienne. Ces émissions sont dues à un processus de recombinaison radiative. Du côté jour de la planète, nous avons des atomes d'azote et d'oxygène, créés par dissociation UV de N_2, CO_2 et O_2. Ces atomes sont transportés du côté nuit, où ils se recombinent et émettent un rayonnement UV. Les émissions de NO sont donc des traceurs de la circulation solaire / anti-solaire dans le moyenne/haute atmosphère de Vénus.

9h40 Emmanuel Arzoumanian (LISA): Preliminary studies for the development of SETUP: Experimental and Theoretical Simulations Useful for Planetology

This talk presents studies performed in the frame of the SETUP program (a French acronym for Experimental and Theoretical Simulations Useful for Planetology). The final goal of this project is to perform representative simulations of Titan's atmosphere and to be able to determine the physico-chemical processes involved in its atmosphere. The simulation experiments will be performed in a reactor where an initial gas mixture will be exposed, for the first time, to both major energy sources (electrons and photons) that are responsible for the chemical evolution of Titan's atmosphere. Thus, the complex chemistry between N atoms and CH_3, CH_2, CH fragments, issued from electron dissociation of N_2 and photodissociation of CH_4 respectively, will be initiated. For these simulation experiments, we are planning to use a pulsed excimer KrF laser delivering photons at 248 nm to dissociate methane via a multiphotonic process because the Lyman- ; radiation, mainly responsible for the dissociation of this compound in the upper atmosphere, cannot be easily reproduced in the laboratory. A first attempt to check for the energetic equivalence of the two processes 2 photons at 248 nm vs. one single photon at Lyman- ; has already been performed and a more extensive re-examination of the methane photolysis at both wavelengths has been undertaken. The available literature indeed provides

contradictory results for the methane's primary photolytic scheme at Lyman-α and no studies at all have been performed yet to establish the different photolytic decomposition pathways at 248 nm. One has to note that the available literature provides contradictory results for methane's primary photolytic scheme at Lyman-α; and no studies at all have been performed yet to establish the different photolytic decomposition pathways at 248 nm. Thus, a re-examination of the methane photolysis at both wavelengths has been undertaken. Photolysis of methane has been carried out using a photochemical classic continuous lamp filled with H_2/He or a KrF pulsed laser delivering radiation at 121.6 nm or 248 nm respectively In parallel of the experimental studies, a zero dimension photochemical model has been developed. It has been adapted for both studies of methane photolysis at Lyman ; and 248 nm. The chemical scheme has been taken from Hebrard et al. The theoretical results have been compared to experimental ones. From this work some information about chemical mechanisms following both types of photolysis have been retrieved showing that primary products obtained at these two wavelengths are different. These results and their implication on the development of the experimental program will be presented.

10h00 Sandrine Guerlet (LESIA): Temperature and composition of Saturn's stratosphere from Cassini data

The Cassini spacecraft, in orbit around Saturn since 2004, provides a unique opportunity to study in detail the planet, its rings and satellites. In particular, we have analyzed Saturn's infrared emission collected by the CIRS instrument. Using a radiative transfer model coupled to an inversion algorithm, we determined the temperature and chemical composition of the planet at several latitudes, from 80°S to 70°N. In addition, by using data acquired in limb geometry, we retrieved information on a large vertical extent, from the lower to the upper stratosphere. The meridional variations of the temperature and of the molecular abundances (C_2H_6, C_2H_2, C_3H_8 and CO_2), at different altitudes, can be analyzed in terms of seasonal variations, chemistry as well as atmospheric dynamics. In a few word, I will review the general methods, our main results so far and their analysis.

10h20 Magda Evgenia Gkini (LESIA): Temperature & Density of the Electrons Localized In the Inner Magnetosphere of Saturn:Cassini Results

On July 2004, the Cassini spacecraft performed its Saturn orbit insertion (SOI). Since then and for 6 years Cassini will orbit the planet more than 134 times with various periapsis (so called perikrones) and inclinations. This work is interested in the closest approaches of Saturn by Cassini, i.e. the trajectory part located around the perikrones, typically between 3.5Rs and 9Rs. Around each of these perikrones, the radio-HF receiver of RPWS, observed a peak at the upper-hybrid frequency and weakly banded emissions having well-defined minima at the gyroharmonics. We have studied these spectra by using the technique of the Quasi-Thermal Noise spectroscopy (QTN) in magnetized plasmas and from that we deduced the electron density, the core and the halo temperatures in the inner magnetosphere of Saturn. We present the results for 19 perikrones, which have been accomplished during the period 02/2005-02/2008. We show the dependence of those parameters on the distance from the planet and on the inclination related to

the ring plane. From the latter we will be able to have a clear view of the large scale structure of the plasma torus in this region of Saturn's magnetosphere (embedded in the dusty ring E), which is not well known, especially because it is rather cold (typically a few eV for the core electrons) and thus hardly accessible to particle analyzers.

10h40 Jean-Baptiste Madeleine (LMD): Modeling and observing the Mars water cycle

The Mariner 9 mission launched by NASA in the late 1970s revealed an active climate on Mars, and evidence for an intense past water cycle. In the same time period, Global Climate Models (GCM) appeared, allowing the modelling of the Earth and other planetary atmospheres. The terrestrial GCM of the Laboratoire de Météorologie Dynamique (LMD) has been adapted to Mars in 1989 by changing the radiative transfer and adding the CO_2 cycle. Since then, many physical processes, including the dust and water cycles, are being implemented in the GCM with an increasingly high level of accuracy, based on recent spacecraft observations. This presentation will particularly focus on the water cycle. The evolution of water vapor and clouds in space and time will be described, and the main questions will be introduced. We will particularly focus on the way cloud scattering in the GCM can change the radiative budget of the planet, and explore near-infrared observations of clouds made by the OMEGA imaging spectrometer onboard Mars Express. Finally, we will see that the same GCM can be used to simulate past climate regimes, and can give crucial insights, as on Earth, into past climate changes.

Coffee Break

11h20 John Carter (IAS): Hydrated minerals on mars : probing the aqueous past of the planet

Coupling imaging and spectroscopy data from various instruments orbiting around Mars has led to a better understanding of the planet as it may have been billions of years ago, and in particular has given us a new insight into its aqueous past. Since the arrival of the Mars Express/OMEGA instrument in 2003 and the later arrival of the Mars Reconnaissance Orbiter/CRISM instrument, several classes of hydrated minerals - minerals that can only be formed on earth in the presence of liquid water - have been unambiguously detected, mapped and at times quantified. It is hypothesized that the widespread alteration of the Martian crust by a great amount of liquid water has led to the formation of a particular class of hydrated minerals - phyllosilicates, including clays - early in its history. My work focuses on the detection and mapping of small areas of clay deposits throughout the ancient southern hemisphere of Mars, so as to acquire a global perspective on the extent and state of water which was present at the time of alteration. Menu : -An overview of the datasets, mapping and analysis tools -A digest of recent results -The diversity of phyllosilicates as observed over the ancient terrains of Mars -Future work

11h40 Yannick Boissel (LESIA): Exploring the Kuiper belt through stellar occultations

The Kuiper belt was originally thought to extend from 30 AU to 50 AU. Hundreds of Trans-Neptunian Objects (TNO) have been discovered since then, with sizes ranging from several hundred meters to two thousand meters of diameter, also at higher distances. Direct imaging give only a few information about the bigger TNOs, namely astrometry and surface composition. According to the faintness of the smaller objects - a 1km-sized TNO at 40 AU has a magnitude of 35 - there is no way of observing them through direct imaging. A solution is to study stellar occultations. Two different approaches, thought for the two ends of the size distribution of the TNOs will be presented : Predicted events for big TNOs, that leads to the study of pressure and extension of their atmospheres, and serendipitous occultations for small TNOs, that leads to setting constraints on the size distibution of objects in the Kuiper belt. The search presented here has been focussed on Pluto hypothetic satellites and serendipitous occultation data from ULTRACAM.

12h00 Aurélie Guilbert (LESIA): Chariklo's surface

10199 Chariklo (1997 CU26) is the largest Centaur observed so far. Spectroscopic studies performed since its discovery have shown the presence of water ice on its surface, with possible variations of its amount (Brown et al., 1998, Brown & Koresko, 1998, Dotto et al., 2003). However, recent observations performed in the framework of a new ESO-Large Program on Trans-Neptunian objects and Centaurs have provided high quality data, showing a varying composition (Guilbert et al., submitted). We also detect a feature in the visible spectrum that could be attributed to the presence of aqueously alterated minerals on Chariklo's surface, linked to the presence of liquid water on this object (Alvarez-Candal et al., 2008, Guilbet et al., in prep.). The new observations will be presented and compared to previsous studies to explore the possibility for Chariklo's surface to be heterogeneous. Some explanation for the presence of hydrated minerals will also be looked for.

Lunch Break

13h40 Davide Perna (LESIA): Light curves and densities of Centaurs and trans-Neptunian objects

The analysis of the rotational properties of the small bodies in the outer Solar System is a useful tool for retrieving information on the internal structure of the observed objects and for having hints on the collisional evolution state of the whole population. Unfortunately the presently available sample of known rotational rates is still rather limited, including few tens of Trans-Neptunian Objects (TNOs) and Centaurs. In order to increase the available data, in the framework of the ESO Large Program 178.C-0036 (P.I.: M. A. Barucci), we carried out at ESO-NTT (La Silla, Chile) photometric observations of 2 Centaurs and 10 TNOs. Applying the method based on the Fourier analysis of the light curves, developed by Harris et al. 1989 (Icarus, 77, 171), rotational synodic periods

were computed. We determined the spin rate for seven objects and we confirmed previously published periods of other two bodies. The computed rotational periods and the obtained light curve amplitudes allowed us to estimate the axis ratio a/b, and hence the density of these nine objects. Putting together our results and already published ones, we investigated density statistics of the small bodies of the outer Solar System. The obtained results will be presented and discussed.

14h00 Benoît Carry (LESIA): Adaptive Optics and Small Bodies

Since a decade, large telescopes on ground and Hubble Space Telescope in space provide us the angular resolution needed to spatially resolve the apparent disk of the largest asteroids. I will present the interests and scientific outputs of high angular-resolution imaging of Solar System Small Bodies.

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4 Stellar Evolution

14h20 Marc-Antoine Dupret: Review

14h40 Quang Nguyen Luong (CEA): Global Collapse in high mass star formation

High-mass stars (O- or B-type stars with 10 to 100 Msun), though few in number, play a major role in the energy budget of galaxies. Surprisingly, there is still a controversy on how these stars form: is it through a powerful accretion of matter? or by the coalescence of multiple stellar embryos? In both cases, the process of high-mass star formation seems very dynamic, surely more dynamic than the one forming low-mass stars like our Sun. One should study the « earliest phases » of high-mass star formation to make progress and identify its main physical process. These phases correspond to massive protostars and pre-stellar cores which are mainly constituted of cold dense gas. In this talk, I will present the preliminary results of the observations of the assive complex W43 in the massive clouds in Cygnus X which show evidences of highly dymamic processes.

15h00 Thierry Semaan (GEPI): Be stars

I present the current research on Be stars. Be stars are defined as non-supergiant B stars whose spectrum has or had at sometimes one or more Balmer lines in emission. This emission is due to the presence of a circumstellar disk formed from matter ejected from the star. Our goal is to understand why Be stars exhibit these ejections and disk. To progress on this matter, I will investigate in a statistical way the correlation between the stellar parameters of Be stars and their pulsation properties. The determination of the stellar parameters will be obtained from the fitting of ground-based ESO/FLAMES observations with synthetic spectra adapted for Be stars. The pulsation properties will be obtained through the analysis of their CoRoT light curves.

15h20 Alberto Marocchino (LERMA): Numerical Studies for Episodic Magnetically Driven Plasma Jets

Recent experiments performed at Imperial College on the pulsed-power MAGPIE facility have successfully shown the formation of magnetically driven radiatively cooled plasmas jets formed from radial wire arrays, which are relevant to study the launching mechanism of astrophysical jet. The experiments have been now extended to study the episodic ejection (∼25 ns) and the interaction of jets and magnetic bubbles with an ambient gas. The dynamics of the interaction is investigated through three-dimensional resistive magneto-hydrodynamic simulations using the code GORGON. Comparison with experiments is offered to validate the results. The ablation process as well as current reconnection due to radiative cathode ablation is described. The complex three-dimensional structure and the confinement/collimation effect offered by the magnetic field are investigated. The periodic emissions trap the magnetic field in between bubbles increasing the collimation of the jet on axis. The scenario is modified introducing a background gas (Ar, 6.7E-3 kg.m-3). The background gas modifies the ablation velocity and the bubble shape: the bubble is smaller, the magnetic field density is thus higher, and the jet results to be more collimated. The background gas also generates a new emission region where the expanding jet interacts with the background gas. Dimensionless numbers are offered in order to scale laboratory experiments to astrophysical objects.

Coffee Break

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5 Interstellar Medium

16h00 Marc-Antoine Miville-Deschênes: Review

16h20 Manuel Gonzalez (LUTH): Water in PDRs.

Transfer in lines controls the gas cooling of photon dominated regions (PDR) provides many of the observational constraints that are available for their modelling. The interpretation of infrared and radio observations by the new generation of instruments, such as Herschel, requires sophisticated line radiative-transfer methods. The effect of dust emission on the excitation of molecular species in molecular regions is investigated in detail to explicitly show the origin of various approximations used in the literature. Applications to H_2O is emphasised. The standard 1D radiative transfer equation is written as a function of the space variable (as opposed to the usual optical depth). This permits to simultaneuosly consider all pumping contributions to a multi-level species in a non-uniform slab of dust and gas. This treatment is included in the Meudon PDR Code (available at http://aristote.obspm.fr/MIS/). Infrared emission from hot grains at the edge of the PDR may penetrate deep inside the cloud, providing an efficient radiation source to excite some species at a location where cold grains no longer emit. This leads to non-negligible differences with classical escape probability methods for some lines, e.g.

water. Cooling efficiency does not follow directly from line emissivities. The infrared pumping contribution leads to a higher excitation that enhances collisional de-excitation and reduces cooling efficiency.

16h40 Yannick Libert (LERMA): HI and CO in circumstellar environments

Circumstellar shells around red giants are built over long periods of time that may reach several 10^6 years. They may therefore be extended over large sizes ($\sim$ 1 pc, possibly more) and different complementary tracers are needed to describe their global properties. We are engaged in a programme designed to gauge the properties of matter in the external parts of circumstellar shells around AGB stars and to relate them to those of the central sources. We will present 21-cm HI and CO rotational line data obtained on 3 sources.

17h00 Séverine Raimond (Service d'Aéronomie): The local interstellar Medium

It is necessary to know and to understand the Local Interstellar Medium (LISM) because it contaminates the background emissions by its absorbent effects. Besides it is often an essential tool in order to localize the studied objects and to define their environment. At last it is useful for modelling the structure of the different phases of the interstellar medium in general. A first 3D mapping of the LISM, although imprecise, has already been realised. However new spectroscopic data are being added in order to refine and complete it.

17h20 Anaelle Maury (CEA): Probing the role of protostellar feedback in clustered star formation.

I will present the last results on the NGC2264-C protocluster. Based on a comparison between millimetric observations and SPH simulations, Peretto et al. (2007) showed that another source of support should be added to the simulations to explain the global dynamics of the region. Moreover, Li & Nakamura (2006) argued that protostellar outflow-driven turbulence can quickly replace the initial interstellar turbulence in protoclusters, and therefore keep the region close to a virial equilibrium for a longer time. New spectroscopic data have been taken using the 30-m telescope of IRAM. Analysis of these data show evidences of numerous outflows emanating from the prestellar and protostellar objects of NGC2264-C. From a quantitative study we lead, we can deduce the global momentum flux injected in this region by protostellar feedback. We discuss the relative support induced by these flows with regard to the stability of the protocluster.

17h40 Timea Csengeri (CEA): Origin of high-mass stars and clusters in DR21(OH)

We study the DR21 filament located in the Cygnus-X star forming region - one of the closest site hosting high-mass star formation, where significant amount of the gas is concentrated at very high density. With single-dish (IRAM 30m) data we study the large scale (1 pc) structures of the filament focusing on global collapse and infall signatures. While with interferometric data (PdBI) we study the level of fragmentation on smaller scales (0.01 pc), where we see a population of continuum-condensations. With studying the distribution and the kinematic properties of these cores we hope to understand the origin of high-mass collapsing objects.

18h00 Pierre Guillard (IAS): H_2-luminousgalaxies: What do they teach us about galaxy formation?

Spitzer space telescope observations led to the surprising detection of a diverse set of extragalactic sources whose infrared spectra are dominated by line emission of molecular hydrogen. The absence or relative weakness of typical signs of star formation suggest the presence of large quantities of molecular gas with no (or very little) associated star formation. These observations set a new light on the contribution of H_2 to the cooling of the interstellar medium, on the relation between molecular gas and star formation, and on the energetics of galaxy formation. I will present the observations, show how they can be interpreted, and discuss the relevance of H_2 formation for the energetics of key processes that participate in galaxy formation: galaxy interactions, gas accretion, and AGN feedback.

End of the day

10th December 2008

6 Plasmas in Astrophysics

9h00 : Review

9h20 Céline Boutry (IAS): Turbulence dans la couronne solaire

La température très élevée de la couronne solaire demeure un dilemme depuis plus de 60 ans. On estime que la couronne est chauffée par l'énergie de la convection photosphérique (proche de la surface). Le défi est donc de déterminer comment est transférée cette énergie. La turbulence qui permet de disloquer des mouvements de grandes échelles vers de petites apparait comme un bon candidat.

9h40 Joël Stienlet (CETP): Simulation PIC2D d'une onde de choc sans collisions

Nous utilisons un code PIC 2D vectorisé et parallélisé avec OpenMP pour simuler l'onde de choc magnétosphérique terrestre. Nous nous intéressons en particulier à la dynamique des particules accélérées, ainsi qu'aux ondes émises par le choc.

10h00 Gaétan Le Chat (LESIA): Study of stellar wind energy flux: from the Sun to Beltegeuse

This study examines the solar wind energy flux, from 17 years of Ulysses measurements at different heliolatitudes, completed by multi-instrument observations. The solar wind energy flux is almost constant, nearly independant on wind speed and solar activity. We then compare the energy flux of the Sun to the stellar wind fluxes, in addition to the luminosity fluxes, from young stars to supergiants. A share processus of origin and acceleration of the main-sequence stars and cool giants' winds is suggested. T-Tauri stars'winds show a possible result of an accretion powered wind.

10h20 Nicolas Aunai (CETP): Asymmetric Magnetic Reconnection

As one of the main phenomena allowing energy entry in the magnetosphere, magnetic reconnection has been heavily studied via in-situ observations and theoritical investigations, numerical simulations playing an important role. For many years now, Harris' kinetic equilibrium (1962) has been extensively used to initiate curent sheets simulations. If it can be considered as an approximation at the magnetotail, it can no longer be valid for magnetopause reconnection, where asymmetries due to magnetosheath and magnetospheric plasma populations can not be ignored. So far, kinetic simulations performed in such an asymmetric configuration have been initiated with fluid equilibrium conditions where the plasma is locally Maxwellian. A certain amount of time is therefore required for the distribution function to thermalize, involving pressure waves emission and slight modifications of the first moments, during which magnetic reconnection is triggered via tearing mode instability, magnetic perturbation or anomalous resistivity spot. In this

work we propose a study of magnetic reconnection within a magnetopause-like topology with hybrid kinetic equilibrium loading allowing density and temperature gradients. The Vlasov equilibrium is found via considerations on the constants of motion for the ion species for an antiparallel magnetic tangential discontinuity.

Coffee Break

7 Celestial Mechanics

11h00 Jacques Laskar: Review

11h20 Gwenaël Boué (IMCCE): Spin axis evolution of interacting bodies

I will present the study of a three body problem with one solid body. This is typically a Sun-planet-satellite problem. The solution of this problem should be useful for the understanding of the long time evolution of planetary and satellites spin axis, and thus for the search of dynamical constraints on the evolution of the Solar System.

11h40 Julien Frouard (IMCCE): Dynamique et stabilité des satellites lointains de Jupiter

Les satellites orbitant à des distances éloignées de leurs planètes, à la limite de stabilité, possèdent une dynamique bien différente de celle des satellites proches à cause des perturbations solaires élevées qu'ils subissent. On peut trouver en particulier dans cette région la résonance d'évection, qui fait intervenir une commensurabilité 1:1 entre la fréquence du péricentre du satellite et le moyen mouvement du Soleil. On présentera les régions dynamiquement stables et chaotiques dans des problèmes simplifiés, la dynamique induite par la résonance d'évection, ainsi que les difficultés rencontrés lors de l'application des techniques analytiques classiques dans cette région orbitale particulière.

12h00 François Farago (IMCCE): Averaging on the motion of a fast revolving body. Application to the stability study of a planetary system

Exploring the global dynamics of a planetary system involves computing integrations for an entire subset of its parameter space. This becomes rime-consuming in presence of a planet close to the central star, and in practice this planet will be very often omitted. We derive for this problem an averaged Hamiltonian and the associated equations of motion that allow us to include the average interaction of the fast planet. We demonstrate the application of these equations in the case of the μ Arae system where the ratio of the two fastest periods exceeds 30. In this case, the effect of the central planet is limited because the planet's mass is one order of magnitude below the other planetary masses. When the inner planet is massive, considering its averaged interaction with the rest of the system becomes even more crucial.

12h20 Pierre Inizan (IMCCE): Fractional Hamiltonian dynamics

As a model problem for the study of chaotic Hamiltonian systems, we look for the effects of a long-tail distribution of recurrence times on a fixed Hamiltonian dynamics. We follow Stanislavsky's approach of Hamiltonian formalism for fractional systems, based on a subordinated time clock. We prove that his formalism can be retrieved from the fractional embedding theory, developped by Cresson. We deduce that the fractional Hamiltonian systems of Stanislavsky stem from a particular least action principle, said causal.

Lunch Break

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8 Cosmology and Gravitation

14h40 Karim Benabed: Review

15h00 Nicolas Clerc (CEA): Galaxy clusters and evolution of the Universe with the XMM-LSS survey

The standard model of hierarchical structure formations predicts that the local overdensities collapsed by merging with the surrounding overdensities, thus forming bigger and bigger structures all along the history of the Universe. Galaxy clusters are the most massive and virialized structures known to date, and thus represent valued probes for the determination of the growth rate of density perturbations. Consequently, they provide tight cosmological constraints, which appear to be independent and orthogonal to those inferred from the supernovae and Cosmological Microwave Background observations. The detection of galaxy clusters can be achieved through the characteristic X-ray emission of their internal gas. The XMM-LSS survey aims to fully exploit the capabilities of the most sensitive X-ray satellite ever built, XMM-Newton, in order to map a wide area on the sky (up to 64 deg2). This allows the gathering of large and weakly contaminated samples : several hundreds of clusters up to z=1 and a few tens of thousands of Active Galactic Nuclei. In this talk, I will present the previous work achieved during the past ten years, with particular emphasis on the well-defined selection methods which constitute a strong feature of the XMM-LSS survey. Then, I will explain my PhD project, from the study of the XMM archive and its consequences on cluster physics, to the extension and cosmological analysis of the XMM-LSS data. I will finally present the near-future and future prospects of the project and their cosmological implications.

15h20 Hao Wang (IAS): Reconstruction of the history of reionization

By modeling the distribution of galaxies, QSOs, massive stars, etc. at different redshift, and considering the quantity of ionizing photons each object emit, we reconstruct an evolution picture of ionizing photons, and hence an ionization history. Different ionization histories would produce different signal on Cosmic Microwave Background, this

allow us to set constraints on the cosmological parameters that are included in the model we choose, e.g., hubble parameter h in the model of galaxy distribution.

15h40 Florian Boudol (APC): CMB Lensing with Planck

The therory of the cosmic microwave background (CMB) will be quickly reviewed. I will present the nature of CMB lensing and its probable detection with the Planck satellite. I will focus mainly on the consequences of a detection at few tens sigma level on large and intermediate spatial scales. Such an accurate measurement of CMB lensing could improve constraints on several cosmological parameters like cosmic matter density or neutrino mass.

Coffee Break

16h20 Nicolas Taburet (IAS): Biases on the cosmological parameters estimation induced by the Sunyaev Zel'dovich effect

With the WMAP mission, and to a higher extent, with the forthcoming Planck mission, the cosmology has entered a precision era : Cosmic Microwave Background analyses with the Planck instrument will allow us to constrain the cosmological parameters with a relative precision of the order of one percent. It is thus essential to be able to quantify the biases induced on these parameters when the presence of a secondary signal, that adds to the primary CMB one, is not taken into account in the analyses. I will present an exact analytical method I developed to calculate the biases on parameters when any additive signal is neglected in the analyses. I will then present an application of this formalism in the context of the forthcoming Planck experiment to estimate the impact, on cosmological parameters estimation, of the Sunyaev Zel'dovich signal that remains after cluster extraction.

16h40 Alexis Lavabre (In2p3): Gravitational lensing of the CMB with Planck

The Big Bang theory explains that if we go sufficiently back in time, the Universe was so hot and dense that it was only constituted of photons in thermal equilibrium in an electron-proton plasma. Photons strongly interact with charged particles and were thus constantly emitted and absorbed on very short distances. As it expands, the Universe gets cooler. When the temperature got sufficiently low, the electrons and protons combined to form the first atoms, making the universe transparent to radiation. Photons emitted at that epoch constitute the Cosmic Microwave Background (CMB). During their travel through the universe, from the last scattering surface to the detector, photons of the CMB are slightly deviated by large scale structures. This has a non negligible effect on the statistics of the CMB. Therefore gravitational lensing of the CMB can serves as a probe of the large scale structure.The Planck satellite will be launch next year. It will provide hight resolution, full sky CMB maps in 9 frequency bands, ranging from 30Ghz to 857Ghz. Using these data, we will be able for the first time to directly detect the effect of CMB lensing. This will also enable us to estimate the power spectrum of the underlying large scale structure responsible for lensing.

17h00 Aurélien Benoit-Lévy (CEA): A symmetric Milne Universe: a second concordant cosmology?

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

17h20 Quentin Bodart (SYRTE): Cold atoms gravimeter for earth gravity measurement and fundamentals physics tests with spatial inertials sensors

In the frame of the watt balance project led by Laboratoire National de Métrologie et d'Essais (LNE) and aiming at a new definition of the mass unit (the kilogram), SYRTE develops an absolute gravimeter. It will enable to obtain an extremely precise measurement of the gravity acceleration g. The principle of operation of this apparatus is based on techniques of atomic interferometry using cooled atoms. In a first step, about hundred millions atoms are captured in a magneto-optical trap. The atoms are cooled down to a temperature close to 10 micro-Kelvin, before being released. During their free fall, they are submitted to a sequence of three laser pulses which split and recombine the atomic wave packets. Finally, the phase shift between the two arms of the interferometer, proportional to g, is deduced from the atomic state measurement at the output of the interferometer. The instrument sensitivity is limited by stray vibrations. It is currently $2\ 10^{-8}$g for a 1s measurement time, at the same level as the current State of the Art in classical absolute gravimeters. The evaluation of systematic effects is in progress and should enable to reach a relative accuracy of 10^{-9}. Tests of G variations for Cosmology, verification of equivalence principle, dark matter search or new kind of interstellar guidance, notably in SAGAS mission are now planned.

17h40 Jingfang Hao (CEA): Detector Simulation and Data Analysis of Gamma Ray Bursts

Gamma Ray Bursts(GRBs) are one of the most high energetic astrophysic objects in the Universe. The ongoing and next generation detections of GRBs will bring us not only more knowledge about extreme explosions and compact bursts, but also more precise measurements of cosmological theories. SVOM is a French-Chinese collaborating space project for broad band GRB detections. Monte-Carlo simulations, well designed on the base of Geant4, are now carried out for the SVOM GRM detector, simulating varies kinds of incident photon events and providing profound knowledge in the instrument design. We also performed the analysis of the satellite SWIFT by NASA, another GRB space telescope, in comparison for theoretical studies. The satellite SVOM is expected to bring us a step beyond towards the understanding of the universe.

18h00 Alexandre Le Tiec (IAP): Comparison of third post-Newtonian and self-force calculations for extreme mass ratio black hole binaries on circular orbits

Binary black holes are among the most promising sources of gravitational waves. The detection and analysis of this gravitational radiation by the VIRGO and LIGO observatories requires very accurate templates. There are two main approximation schemes to perform such calculations : (i) the post-Newtonian approximation, which is well suited to describe arbitrary mass ratio compact binaries in the slow motion regime, and (ii) the black hole perturbation theory, which gives a very accurate description of extreme mass ratio binaries. In order to be able to rely on both formalisms with certainty, it is crucial to compare them in their common domain of validity : the slow motion regime of an extreme mass ratio binary. We perform the first comparison of third post-Newtonian and self-force calculations for extreme mass ratio black hole binaries on circular orbits. This work in still in progress.

End of the day

Social Event

Participants belong to the following laboratories:

APC:	Astroparticules et Cosmologie
CEA:	Commissariat à l'Energie Atomique
CETP:	Centre d'étude des Environnements Terrestre et Planétaires
GEPI:	Galaxies, Etoiles, Physique, Instrumentation
IAP:	Institut d'Astrophysique de Paris
IAS:	Institut d'Astrophysique Spatiale
IMCCE:	Institut de Mécanique Céleste et de Calcul des Ephémérides
IN2P3:	Institut National de Physique Nucléaire et de Physique des Particules
LERMA:	Laboratoire d'Etude du Rayonnement et de la Matière en Astrophysique
LESIA:	Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique
LISA:	Laboratoire Inter-universitaire des Systèmes Atmosphériques
LMD:	Laboratoire de Météorologie Dynamique
LUTH:	Laboratoire Univers et THéories
ONERA:	Office National d'Etudes et de Recherches Aérospatiales
SA:	Service d'Aéronomie
SYRTE:	Système de Référence Temps-Espace