11th HELLENIC ASTRONOMICAL CONFERENCE ATHENS, 8-12 SEPTEMBER 2013

Contents:

Outreach, Plenary, Highlight & Best PhD Talks

Κυριακή 8 Σεπτεμβρίου

Μαγνητικά πεδία και μελανές οπές στο Διάστημα

Ιωάννης Κοντόπουλος (RCAAM, Academy of Athens, Greece)

Η γη, ο ήλιος, το ηλιακό σύστημα, ο γαλαξίας μας, όλο το Διάστημα διαρρέονται από μαγνητικά πεδία. Ποιά είναι η προέλευσή τους; Ποιά η σχέση τους με τις χιλιάδες μελανές οπές που βρίσκονται διάσπαρτες στον γαλαξία; Ποιά η σημασία τους στην ενεργοποίηση των γιγάντιων μελανών οπών που κρύβονται στα κέντρα των κβάζαρς; Οι περισσότεροι από εμάς αγνοούμε τι είναι οι "μαύρες τρύπες", και όταν κάτι δεν το κατανοούμε αναρωτιόμαστε: "Μήπως πρόκειται για μαγνητικά πεδία;" Θα προσπαθήσουμε να απαντήσουμε σε όλα τα παραπάνω ερωτήματα και να εξηγήσουμε πώς ο συνδυασμός μαγνητικών πεδίων και περιστρεφόμενων μελανών οπών οδηγεί στην λειτουργία της πιο ισχυρής μηχανής στο Σύμπαν.

Monday 9th of September

Plenary Talk 1: 'Hurricane Season' in the Inner Heliosphere: Observations of Coronal Mass Ejections during Solar Maximum

Angelos Vourlidas (Naval Research Laboratory, USA)

The current solar cycle, albeit low in sunspot numbers, is not lacking in coronal explosive activity. The solar corona has produced several spectacular Coronal Mass Ejections (CMEs) directed at Earth and other planets. In addition, this is the first time in human history that we are able to image continuously the full 360 degree corona and the full inner heliosphere from the Sun to Earth, and beyond. In addition, a host of inner heliospheric spacecraft can directly probe the quiescent and transient solar wind at several locations around Mercury, Venus, Earth, and Mars. These unprecedented observational capabilities offer us a unique opportunity to study the solar maximum activity and in particular CMEs and their impact on Earth and the other planets. The new field of Interplanetary Space Weather is being born. In this talk, I review our progress (sometimes) and befuddlement (more often) towards understanding the evolution of CMEs in the inner heliosphere. I discuss how this knowledge is shaping Space Weather efforts around the world, including a comprehensive approach from a large group of Greek solar and space physicists under the THALIS aegis. I will also present ideas for future missions and instrumentation to improve our Space Weather predictive capabilities.

Tuesday, 10th of September

Plenary Talk 2: Supergiant Stars as Extragalactic Probes of Cosmic Abundances and Distances

R. Kudritzki (Institute for Astronomy, University of Hawaii, USA)

The determination of chemical composition and distances of galaxies is crucial for constraining the theory of galaxy formation and evolution in a dark energy and cold dark matter dominated universe. However, the standard technique using HII regions to determine the metallicity of star forming galaxies, nearby and at high redshift, is subject to large systematic uncertainties that are poorly understood and the determination of accurate distances using Cepheids suffers from uncertainties caused by the metallicity dependence of the period luminosity relationship and extinction and crowding corrections. Multi-object spectroscopy of blue and red supergiant stars - the brightest stars in the universe at visual and NIR wavelengths - provides an attractive alternative. I will present results accumulated over recent years for galaxies in the Local Group and beyond out to a distance of 8 Mpc and will discuss the potential of future work with TMT and E-ELT. Combining the photon collecting power of these next generation telescopes with Adaptive Optics we will be able to study individual supergiant stars in galaxies as distant as the Coma cluster. With spectroscopy of the integrated light of young very massive Star Super Clusters and simple population synthesis techniques we can reach out ten times further.

Tuesday, 10th of September

Plenary Talk 3: Building up a European astronomical community

T. Courvoisier (University of Geneva ISDC, Data Centre for Astrophysics, Switzerland)

Astronomy is arguably the science that brought most economical benefits throughout mankind history. Keeping time allowed for agriculture, navigation and most human activities. Intellectual pursuit came along the way. In the last century our activity has turned almost exclusively towards the physical study of our far environment. From local our pursuit turned global. Our research context has, however, not yet followed that route, most of the efforts are nationally funded. Looking at a world political map, one sees that Europe is in a rather poor position, being fractionated in very small national entities. The EAS works towards overcoming this by building a European astronomical community extending from the Azores to Russia.

2013 Best Phd thesis Prize: Statistical analysis of ALFALFA galaxies: insights in galaxy formation & near-field cosmology

E. Papastergis (Kapteyn Astronomical Institute, Netherlands)

We use the rich dataset of local universe galaxies detected by the ALFALFA 21cm survey to study the statistical properties of gas-bearing galaxies. In particular, we measure the number density of galaxies as a function of their baryonic mass ("baryonic mass function") and rotational velocity ("velocity width function"), and we characterize their clustering properties ("two-point correlation function"). These statistical distributions are determined by both the properties of dark matter on small scales, as well as by the complex baryonic processes through which galaxies form over cosmic time. We interpret the ALFALFA measurements with the aid of publicly available cosmological N-body simulations and we present some key results related to galaxy formation and small-scale cosmology.

Wednesday, 11th of September

Plenary Talk 4: Molecular gas in galaxies across the Hubble time

F. Combes (Observatoire de Paris, LERMA, France)

The cosmic star formation rate reveals a pronounced peak 10 Gyrs ago (or z=1-2) and then slows down, dropping by more than a factor 10 since z=1. This behaviour might be the result of combined physical processes, like hierarchical merging of galaxies, gas accretion, formation of molecular clouds and stars, metal enriched gas outfows that are driven by stellar winds, supernovae and AGN activity. I will review some recent results about the molecular content of galaxies and its dynamics, obtained from CO lines. The star formation efficiency increases with redshift, as shown by the Kennicutt-Schmidt law, and the derived depletion time. In massive galaxies, the gas fraction was higher in the past, and galaxy disks were more unstable and more turbulent. ALMA will allow the study of main sequence galaxies at high z with higher spatial resolution and sensitivity.

Highlight talk by a young astronomer: The Origin of Black Hole Spin in Galactic Low-mass X-ray binaries

A. Fragos (Harvard-Smithsonian CfA, USA)

Galactic field low-mass X-ray binaries (LMXBs), like the ones for which black hole (BH) spin measurements are available, are believed to form in situ via the evolution of isolated binaries. In the standard formation channel these systems survived a common envelope phase that resulted in a binary system with an unevolved low mass main sequence star orbiting around the core of the massive star in a tight orbit. The massive BH progenitor, before the onset of the common envelope phase, had expanded to of ~1000 solar radii. Up to that moment and at solar metallicity, the expansion of the star and the stellar wind mass loss most probably carried away any significant initial angular momentum that the primary star had. During the common envelope phase itself, while the orbit is shrinking significantly, the short timescale (common envelope is expected to last only up to ~1 thermal timescale) and the break of co-rotation of the binary will not allow any significant transfer of angular momentum from the orbit to the core of the primary star. Hence, the remaining helium core of the primary star is not expected to be highly spinning. In the detached orbital evolution that follows until the BH formation, the angular momentum losses due to the strong stellar stellar winds will dominate the evolution of the primary over the weaker, due to the low mass of the companion, tidal forces which tend to synchronize the spin of the BH progenitor with the orbit. As a consequence, the BHs formed in these systems are expected to have low birth spin.
However, the measured spins of BHs in LMXBs cover the whole range of spin parameters (a_*) from $a_* = 0$ to almost $a_* = 1$. If the assumptions above are even approximately valid, then this implies that the BH spin in LMXBs is determined by the matter that the BH has accreted during the long stable accretion phase of the system. In order to test the hypothesis that the origin of BH spin in Galactic LMXBs is the accretion of matter onto the BH during the XRB phase, we calculated extensive grids of evolutionary sequences for binaries in which a BH accretes matter from a close companion. For each evolutionary sequence, we examined whether, at any point in time, the calculated binary properties (orbital period, BH mass, donor mass, and effective temperature) are in agreement with their observationally inferred counterparts of observed Galactic LMXBs with BH spin measurements. Mass-transfer sequences that simultaneously satisfy all observational constraints represent possible progenitors of the considered LMXBs and thus give estimates of the total amount of matter that the BH has accreted from the onset of Roche-Lobe overflow until today. We found that in all Galactic LMXBs with measured or estimated BH spin, the origin of the spin can accounted by the accreted matter that was accreted onto the BH during the XRB phase. Furthermore, based on this hypothesis, we derived limits on the maximum spin that a BH can have depending on the orbital period of the binary it resides in. In a followup study, we combined extensive grids of detailed binary evolutionary sequences with simple Monte Carlo calculations in order to predict the combined 2-dimensional probability density function of orbital period and effective temperature of the secondary star, or orbital period and mass of the secondary star. These probability density functions were compared with the observationally derived properties of 17 Galactic BH LMXBs and were found to be in excellent agreement.

Thursday, 12th of September

Plenary Talk 5: Recent developments in Cosmology

E. Plionis (Aristotle University of Thessaloniki, Greece)

I will review the main relevant observations on which the currently favorable cosmological model (LCDM) is based (Hubble diagram of SNIa, CMB temperature fluctuations, Galaxy clustering, etc). Some emphasis will be given in the recent Planck satellite CMB results, which further supports the model but also open new issues. Then the work of our research group will be presented, regarding:
(a) the potential of a novel and alternative high-z tracer of the Hubble expansion to be used to constrain the Dark Energy equation of state parameter and our recent related results on the Hubble constant.
(b) The cosmological use of high-z X-ray AGN and current cosmological constraints from its use.
(c) The cluster number count expectations from future experiments (eROSITA and SPT) within a grid of Dark Energy models.
Finally, I will attempt to highlight the open issues and avenues for their possible solution.

S1: Sun, Planets and Interplanetary Medium - Oral Presentations

Monday, 9th of September

Energetic particles in geospace: Physics and space weather effects

Ioannis Daglis (University of Athens) **(Invited)**

Geospace is populated by charged particles covering a wide range of energies and densities. Influenced by electromagnetic fields and waves, a subset of these particles are accelerated and driven into the inner magnetosphere, creating the storm-time ring current and the radiation belts – the two dominant energetic particle populations in geospace. The acceleration processes are associated with a variety of space weather related phenomena, some of which are detrimental for space infrastructure and ground facilities alike. We present recent advances in our understanding of the complex interplay of particles, fields and waves in geospace, with an emphasis on the role of magnetic storms and wave-particle interactions.

An extraordinary ULF wave episode during the 2003 Halloween superstorm revealed by wavelet transforms of multipoint observations

Georgios Balasis (National Observatory of Athens), **Daglis Ioannis A.** (University of Athens), **Georgiou Marina** (National Observatory of Athens / University of Athens), **Papadimitriou Constantinos** (National Observatory of Athens/ University of Athens), **Zesta Eftyhia** (NASA/GSFC), **Mann Ian** (University of Alberta)

We investigate a rare concurrent observation of an ultra low frequency (ULF) wave event in the Earth's magnetosphere, topside ionosphere and surface employing a time-frequency analysis technique. We have examined the ULF wave activity in the Pc3 (22-100 mHz) and Pc4-5 (1-22 mHz) frequency bands within a short time interval during the Halloween 2003 magnetic storm, when the Cluster and CHAMP spacecraft were in good local time (LT) conjunction near the dayside noon-midnight meridian. A key finding of the wavelet spectral analysis of data collected from the Geotail, Cluster and CHAMP spacecraft, and the CARISMA and GIMA magnetometer networks was a remarkably clear transition of the waves' frequency into a higher regime within the Pc3 range. Our study offers insights into the energy transfer traced all the way from the solar wind through the magnetosphere and ionosphere to the ground. This work has received support from the European Community's Seventh Framework Programme under grant agreement no. 284520 for the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project.

A statistical study of ULF wave events observed by the CHAMP satellite

Constantinos Papadimitriou (National Observatory of Athens / University of Athens), **Balasis Georgios** (National Observatory of Athens), **Daglis Ioannis A.** (University of Athens), **Georgiou Marina** (National Observatory of Athens), **Giamini Sigiava A.** (National Observatory of Athens)

The CHAMP (CHAllenging Minisatellite Payload) satellite was a highly successful German Low Earth Orbit (LEO) mission that operated for more than ten years (2001 – 2010), providing high precision gravity and magnetic field measurements. Due to its almost circular and near-polar orbit it was able to achieve homogeneous and complete global coverage of the Earth's sphere, with orbit and magnetometer measurements, thus enabling many studies in a wide variety of fields. Starting from our wavelet-based spectral analysis methods, which we have applied extensively on CHAMP magnetic field data, we have developed an automated tool for the detection and classification of Pc3 and low frequency Pc2 wave events. The creation of a database of such events enabled us to derive valuable statistics for many important physical properties relating to the spatio-temporal location of these waves, the wave power and frequency, as well as other parameters and their correlation with solar wind conditions, magnetospheric indices, electron density data, ring current decay and radiation belt enhancements.

Reconstructing the Subsurface Three-dimensional Magnetic Structure of a Solar Active Region Using SDO/HMI Observations

Georgios Chintzoglou (George Mason University)

A solar active region (AR) is a three-dimensional (3D) magnetic structure formed in the convection zone, whose property is fundamentally important for determining the coronal structure and solar activity when emerged. However, our knowledge of the detailed 3D structure prior to its emergence is rather poor, largely limited by the low cadence and sensitivity of previous instruments. Here, using the

45 s high-cadence observations from the Helioseismic and Magnetic Imager on board the Solar Dynamics Observatory, we are able for the first time to reconstruct a 3D data cube and infer the detailed subsurface magnetic structure of NOAA AR 11158, and to characterize its magnetic connectivity and topology. This task is accomplished with the aid of the image-stacking method and advanced 3D visualization. We find that the AR consists of two major bipoles or four major polarities. Each polarity in 3D shows interesting tree-like structure, i.e., while the root of the polarity appears as a single tree-trunk-like tube, the top of the polarity has multiple branches consisting of smaller and thinner flux tubes which connect to the branches of the opposite polarity that is similarly fragmented. The roots of the four polarities align well along a straight line, while the top branches are slightly non-coplanar. Our observations suggest that an active region, even appearing highly complicated on the surface, may originate from a simple straight flux tube that undergoes both horizontal and vertical bifurcation processes during its rise through the convection zone.

Free Magnetic Energy and Helicity in Active and Quiet Solar Regions and their role in Solar Dynamics

Kostas Tziotziou (RCAAM, Academy of Athens), **Georgoulis M.K.** (RCAAM, Academy of Athens), **Tsiropoula G.** (National Observatory of Athens), **Moraitis K.** (RCAAM, Academy of Athens), **Kontogiannis I.** (National Observatory of Athens)

We present a novel nonlinear force-free method designed to calculate the instantaneous free magnetic energy and relative magnetic helicity budgets of a solar region from a single photospheric/chromospheric vector magnetogram of the region. Our objective is to study the role of these quantities in solar eruptions and quiet-Sun dynamics. We apply the method to (1) derive the energy/helicity diagram of solar active regions from a sample of 162 vector magnetograms corresponding to 42 different active regions (ARs), suggesting that there exist 4 10^{31} erg and 2 10^{42} Mx^2 thresholds in free energy and relative helicity, respectively, for ARs to enter eruptive territory, (2) study the dynamics of eruptive NOAA AR 11158 using a high-cadence 5-day time series of vector magnetograms, suggesting the formation of increasingly helical pre-eruption structures and a causal relation between flares and Coronal Mass Ejections (CMEs) and, (3) derive helicity and energy budgets in quiet Sun regions and construct the respective energy/helicity diagram. Our results highlight the importance of these two parameters in AR evolution and quiet-Sun dynamics and instigate further research including detailed analysis with synthetic, magnetohydrodynamical models. This work is supported by EU's Seventh Framework Programme via a Marie Curie Fellowship and by the Hellenic National Space Weather Research Network (HNSWRN) via the THALIS Programme.

Transmission and conversion of magneto-acoustic waves in the quiet solar chromosphere

Ioannis Kontogiannis (National Observatory of Athens / Eugenides Foundation), **Tsiropoula Georgia** (National Observatory of Athens), **Tziotziou Kostas** (Academy of Athens)

We investigate the interaction between acoustic oscillations and the fine-scale structures found at the chromospheric network boundaries that form the magnetic canopy. To this end, high precision photospheric magnetograms obtained by SOT/SP on-board the Hinode space mission and time series of high spatial-resolution filtergrams in five wavelengths along the Hα line profile taken by the Dutch Open Telescope are utilized. We extrapolate the photospheric magnetic field using the current-free assumption to calculate the vector of the magnetic field and reconstruct the magnetic configuration of the chromosphere. Assuming the VAL-C atmospheric model we calculate the height of the magnetic canopy. Through wavelet analysis on the Hα observations we obtain the 2-D distribution of the oscillatory power at different atmospheric heights. We then compare the obtained distribution of power with the one predicted by a 2-D theoretical model at various magnetic field inclination angles. Our results show that the magnetic shadow and power halo phenomena observed in network regions may be attributed to the conversion/transmission of magneto-acoustic waves in the magnetic canopy. The amount of transmission/conversion depends on the frequency of the waves and the "attack" angle, i.e. the angle between the wave vector and magnetic field direction. This mechanism allows transmitted waves to propagate to greater atmospheric heights.

On the possible importance of coherent resonant scattering in the solar transition region. A study of the C IV 154.8; 155.0 nm doublet.

Costis Gontikakis (RCAAM, Academy of Athens), **Vial Jean-Claude** (Institut d'Astrophysique Spatiale, France)

We study the importance of resonant, coherent scattering of photons, in the C IV 154.8 and 155.0 nm spectral lines formed in the solar transition region. We show that under the effect of coherent scattering, the two lines of the doublet can present different spectral shapes as found in some solar and stellar observations which have not yet been explained. In order to model the combination of

resonant scattering and opacity effects we simulate the spectral profiles of the C IV lines using Monte Carlo methods. Finally we present estimations of the importance of resonant scattering with respect to electron collisions inherent in the Differential Emission Measure function, a diagnostic tool much used for transition region plasma.

Tackling Some Issues in Planet Formation - from Mars's Size to a Fast Formation of Neptune

Hal Levison (Southwest Research Institute) **(Invited)**

The standard model of planet formation has difficulties explaining some of the features observed in our Solar System. Of particular note, it predicts that Mars should be as massive as the Earth. In addition, it has difficulty in building the cores of the giant planets before the gaseous nebula disappeared. Here, I will argue that current models of planet formation are missing two important processes - planetesimal-driven migration and collisional grinding. I will present new simulations that include these processes. Preliminary results suggest a heretofore unknown and radical mechanism for building the outer planets.

Dynamical formation of resonant planetary systems with high mutual inclination

Kleomenis Tsiganis (University of Thessaloniki), **K. Antoniadou** (University of Thessaloniki), **G. Voyatzis** (University of Thessaloniki)

We consider systems composed of two giant planets, which migrate radially due to their interaction with their host protoplanetary disc, in an effort to understand under which conditions '3-D' resonant systems can form. Planet migration can lead to permanent resonant capture and, in the planar case, it has been shown that the planets evolves along families of periodic orbits. In the full 3-D problem, resonant capture also takes place, while excitation of the orbital inclinations of the planets has been observed in numerical simulations. Here we show that, in the 3-D case, the planetary system also follows adiabatically the families of resonant periodic orbits. Inclination excitation occurs if there exist periodic orbits along the 2-D families that are vertically unstable. Thus, by computing the vertical stability index of 2-D periodic orbits for different mass ratios and by locating the vertically unstable periodic orbits in phase space, we can predict whether the planetary inclinations can be excited by any given resonance during migration. If the system passes through such a critical orbit, it subsequently follows the family of 3-D periodic orbits that bifurcates from it and can reach high values of mutual inclination (~40 deg), as long as the disc does not exert significant damping.

A Data-Driven, Integrated Flare Model Based on Self-Organized Criticality

Michaila Dimitropoulou (University of Athens), **Isliker Heinz** (University of Thessaloniki), **Vlahos Loukas** (University of Thessaloniki), **Georgoulis Manolis** (Research Center of Astronomy and Applied Mathematics, Academy of Athens)

We interpret solar flares as events originating in solar active regions having reached the self-organized critical state, by alternatively using two versions of an "integrated flare model" - one static and one dynamic. In both versions the initial conditions are derived from observations aiming to investigate whether well-known scaling laws observed in the distribution functions of characteristic flare parameters are reproduced after the self-organized critical state has been reached. In the static model, we first apply a nonlinear force-free extrapolation that reconstructs the three-dimensional magnetic fields from two-dimensional vector magnetograms. We then locate magnetic discontinuities exceeding a threshold in the Laplacian of the magnetic field. These discontinuities are relaxed in local diffusion events, implemented in the form of cellular-automaton evolution rules. Subsequent loading and relaxation steps lead the system to self-organized criticality, after which the statistical properties of the simulated events are examined. In the dynamic version we deploy an enhanced driving mechanism, which utilizes the observed evolution of active regions, making use of sequential vector magnetograms. We first apply the static cellular automaton model to consecutive solar vector magnetograms until the self-organized critical state is reached. We then evolve the magnetic field in-between these processed snapshots through spline interpolation, acting as a natural driver in the dynamic model.
The identification of magnetically unstable sites as well as their relaxation follow the same rules as in the static model after each interpolation step. Subsequent interpolation/driving and relaxation steps cover all transitions until the end of the sequence. Physical requirements, such as the divergence-free condition for the magnetic field vector, are approximately satisfied in both versions of the model. We obtain robust power laws in the distribution functions of the modelled flaring events with scaling indices in good agreement with observations. We therefore conclude that well-known statistical properties of flares are reproduced after active regions reach self-organized criticality. The significant enhancement in both the static and the dynamic integrated flare models is that they initiate the

simulation from observations, thus facilitating energy calculation in physical units. Especially in the dynamic version of the model, the driving of the system is based on observed, evolving vector magnetograms, allowing for the separation between MHD and kinetic timescales through the assignment of distinct MHD timestamps to each interpolation step.

Particle Acceleration in a Statistically Modeled Solar Active-Region Corona

Anna Toutountzi (University of Thessaloniki), **Vlahos Loukas** (University of Thessaloniki), **Isliker Heinz** (University of Thessaloniki), **Dimitropoulou Michaila** (University of Athens), **Anastasiadis Anastasios** (National Observatory of Athens), **Georgoulis Manolis** (RCAAM, Academy of Athens)

Elaborating a statistical approach to describe the spatiotemporally intermittent electric field structures formed inside a flaring solar active region, we investigate the efficiency of such structures in accelerating charged particles (electrons). The large-scale magnetic configuration in the solar atmosphere responds to the strong turbulent flows that convey perturbations across the active region by initiating avalanche-type processes. The resulting unstable structures correspond to small-scale dissipation regions hosting strong electric fields. Previous research on particle acceleration in strongly turbulent plasmas provides a general framework for addressing such a problem. This framework combines various electromagnetic field configurations obtained by magnetohydrodynamical (MHD) or cellular automata (CA) simulations, or by employing a statistical description of the field's strength and configuration with test particle simulations. Our objective is to complement previous work done on the subject. As in previous efforts, a set of three probability distribution functions describes our ad-hoc electromagnetic field configurations. In addition, we work on data-driven 3D magnetic field extrapolations. A collisional relativistic test-particle simulation traces each particle's guiding center within these configurations. We also find that an interplay between different electron populations (thermal/non-thermal, ambient/injected) in our simulations may also address, via a re-acceleration mechanism, the so called `number problem'. Using the simulated particle-energy distributions at different heights of the cylinder we test our results against observations, in the framework of the collisional thick target model (CTTM) of solar hard X-ray (HXR) emission. The above work is supported by the Hellenic National Space Weather Research Network (HNSWRN) via the THALIS Programme.

Solar Wind Complexity

Aggelos Iliopoulos, **Pavlos George**, **Karakatsanis Leonidas** (Democritus University of Thrace), **Xenakis Markos** (German Research School for Simulation Sciences, Aachen, Germany), **Pavlos Eugenios** (University of Thessaloniki)

In this study results concerning the nonlinear analysis of the ion flux solar wind time series of three shock phenomena, occurred during 24 October 2011, 09 September 2011 and 26 September 2011 correspondingly, as well as the non-extensive statistical theory of Tsallis are presented. In particular, the triplet of Tsallis, as well as the correlation dimension and the Lyapunov exponent spectrum were estimated for the solar wind time series. Also the multifractal scaling exponent spectrum , the generalized Renyi dimension spectrum and the spectrum of the structure function exponents were estimated experimentally and theoretically using the entropy principle included in Tsallis non-extensive statistical theory. Our analysis showed clearly the following: a) a phase transition process in the solar wind dynamics from high dimensional non-Gaussian self-organized critical (SOC) state to a low dimensional also non-Gaussian chaotic state, b) strong intermittent solar wind turbulence and anomalous (multifractal) diffusion solar wind process, c) faithful agreement of Tsallis non-equilibrium statistical theory with the experimental estimations, d) non-Gaussian probability distribution function , ii) and , iii) for the solar wind index and its underlying non-equilibrium solar dynamics.

Using the CME-index for short-term estimation of Ap geomagnetic index

Evangelos Paouris (University of Athens)

Using the CME-index for short-term estimation of Ap geomagnetic index E. Paouris, M. Gerontidou and H. Mavromichalaki Faculty of Physics, University of Athens It is known that the long-term cosmic ray modulation is very well anticorrelated with the coronal mass ejections emitted from the Sun. For this reason a CME-index has introduced to these studies and improved very well the reproduced cosmic ray intensity (Mavromichalaki and Paouris, 2013). In this work this index is examined from a new perspective applied to the short-term estimation of geomagnetic index Ap with daily or weekly duration. The characteristics of CMEs as the number per day, the angular width and the linear velocity through a new relation for this daily index show a good approximation to the geomagnetic conditions after extreme events associated with CMEs and energetic solar flares. This study will be useful for the estimation of the geomagnetic Ap index and it is a first effort for short prediction of the geomagnetic conditions based on CMEs.

SEPServer advances overview on Solar Energetic Particle events

Olga Malandraki (National Observatory of Athens) and the **SEPServer consortium** (FP7-EU)

SEPServer hosted activities related to the scientific analysis of SEP event observations, including data analysis using both data-driven and simulation-based methods. The scientific conclusions of this effort are drawn with the implementation and release to the SEP community of multiple SEP event catalogs based on different spacecrafts and instruments, covering a broad timescale from 1975 to 2013 as well as a variety of distances from 0.3 to ~5 AU in the heliosphere. SEP events from Helios A & B missions, going back to 1975, at distances 0.3-1 AU, together with their Electromagnetic (EM) counterpart from OSRA data are being released for the first time. A catalog covering solar cycle 23 based upon the Solar and Heliospheric Observatory (SOHO)/ Energetic and Relativistic Nuclei and Electron (ERNE) high-energy (~68 MeV) protons at 1 AU with parallel analysis of SOHO/ Electron Proton Helium Instrument (EPHIN) and Advanced Composition Explorer (ACE) / Electron, Proton and Alpha Monitor (EPAM) data, including the relevant EM associations has also been delivered. Furthermore, the first complete Solar TErrestrial RElations Observatory (STEREO) SEP catalog based on the Low Energy Telescope (LET) protons (610 MeV) and the Solar Electron Proton Telescope (SEPT) electrons (65-105 keV) covering the rising phase of solar cycle 24 has been implemented. Moreover, the Cosmic Ray and Solar Particle Investigation (COSPIN) Kiel Electron Telescope (KET) data of 38-125 MeV has been used to identify a new catalog of SEP events observed in and out of the ecliptic plane over solar cycle 23, with simultaneous analysis of electrons recorded by the Heliosphere Instrument for Spectra, Composition and Anisotropy at Low Energies (HISCALE). For selected cases simulation based analysis has been applied in order to identify the timing of the injection history and to provide a cross reference to the EM emissions, leading to a comprehensive treatment of these events and to the corresponding testing of the data-driven analysis methods. SEPServer brings together a wealth of SEP data, analysis methods and diverse but at the same time interconnected solar and heliospheric communities. It thus provides an open tool that will advance our understanding of SEP propagation and acceleration, under different conditions, an important element of Space Weather.

Solar Energetic Particles within the STEREO era: 2007-2012

Athanasios Papaioannou (University of Athens / National Observatory of Athens),**Malandraki O.E.** (IAASARS, National Observatory of Athens), **Heber B.** (Christian-Albrechts-Universitaet zu Kiel), **Dresing N.** (Christian-Albrechts-Universitaet zu Kiel), **Klein K.-L.** (Observatoire de Paris, Meudon, LESIA-CNRS), **Vainio R.** (Department of Physics, University of Helsinki), **Rodriguez-Gasen R.** (Observatoire de Paris, Meudon, LESIA-CNRS), **Klassen A.** (Christian-Albrechts-Universitaet zu Kiel), **Gomez-Herrero R.** (SRG, University of Alcalá), **Vilmer N.** (Observatoire de Paris, Meudon, LESIA-CNRS), **Mewaldt R.A.** (California Institute of Technology), **Tziotziou K.** (IAASARS, National Observatory of Athens), **Tsiropoula G.** (IAASARS, National Observatory of Athens)

STEREO (Solar TErrestrial RElations Observatory) recordings provide an unprecedented opportunity to identify the evolution of Solar Energetic Particles (SEPs) at different observing points in the heliosphere, which is expected to provide new insight on the physics of solar particle genesis, propagation and acceleration as well as on the properties of the interplanetary magnetic field that control these acceleration and propagation processes.

In this work, two instruments onboard STEREO have been used in order to identify all SEP events observed within the rising phase of solar cycle 24 from 2007 to 2011, namely: the Low Energy Telescope (LET) and the Solar Electron Proton Telescope (SEPT). A scan over STEREO/LET protons within the energy range 6-10 MeV has been performed for each of the two STEREO spacecraft. We have tracked all enhancements that have been observed above the background level of this particular channel and cross checked with available lists on STEREO/ICMEs, SIRs and shocks as well as with the reported events in literature. Furthermore, parallel scanning of the STEREO/SEPT electrons in order to pinpoint the presence (or not) of an electron event has been performed in the energy range of 55-85 keV, for all of the aforementioned proton events, included in our lists. We provide the onset of all events for both protons and electrons, time-shifting analysis for near relativistic electrons which lead to the inferred solar release time and the relevant solar associations from radio spectrographs (Nançay Decametric Array; STEREO/WAVES) to GOES Soft X-rays and coronal mass ejections spotted by both SOHO/LASCO and STEREO Coronographs

Sun-to-Earth Analysis of a Major Geoeffective Solar Eruption within the Framework of the Hellenic National Space Weather Research Network

Spiros Patsourakos (University of Ioannina), **Vlahos Loukas** (University of Thessaloniki), **Georgoulis Manolis** (RCAAM, Academy of Athens),**Tziotziou Kostas** (RCAAM, Academy of Athens), **Nindos Alexander** (University of Ioannina), **Podladchikova Olena** (University of Ioannina), **Vourlidas Angelos** (Space Science Division, Naval Research Laboratory), Anastasiadis **Anastasios** (National Observatory of Athens), **Sandberg Ingmar** (National Observatory of Athens), **Tsinganos Kanaris** (National Observatory of Athens/University of Athens), **Daglis Ioannis** (University of Athens), **Hillaris Alexander** (University of Athens), **Preka-Papadema Panagiota** (University of Athens), **Sarris Manolis** (Democritus University of Thrace), **Sarris Theodoros** (Democritus University of Thrace) **(Invited)**

Transient expulsions of gigantic clouds of solar coronal plasma into the interplanetary space in the form of Coronal Mass Ejections (CMEs) and sudden, intense flashes of electromagnetic radiation, solar flares, are well-established drivers of the variable Space Weather. Given the innate, intricate links and connections between the solar drivers and their geomagnetic effects, synergistic efforts assembling all pieces of the puzzle along the Sun-Earth line are required to advance our understanding of the physics of Space Weather. This is precisely the focal point of the Hellenic National Space Weather Research Network (HNSWRN) under the THALIS Programme. Within the HNSWRN framework, we present here the first results from a coordinated multi-instrument case study of a major solar eruption (X5.4 and X1.3 flares associated with two ultra-fast (>2000 km/s) CMEs) which were launched early on 7 March 2012 and triggered an intense geomagnetic storm (min Dst =-147 nT) approximately two days afterwards. Several elements of the associated phenomena, such as the flare and CME, EUV wave, WL shock, proton and electron event, interplanetary type II radio burst, ICME and magnetic cloud and their spatiotemporal relationships and connections are studied all way from Sun to Earth. To this end, we make use of satellite data from a flotilla of solar, heliospheric and magnetospheric missions and monitors (e.g., SDO, STEREO, WIND, ACE, Herschel, Planck and INTEGRAL). We also present our first steps toward formulating a cohesive physical scenario to explain the string of the observables and to assess the various physical mechanisms than enabled and gave rise to the significant geoeffectiveness of the eruption.

Flux emergence of a non twisted magnetic flux tube

Petros Syntelis (RCAAM, Academy of Athens), **Archontis Vasilis** (St. Andrews University), **Gontikakis Costis** (RCAAM, Academy of Athens), **Tsinganos Kanaris** (University of Athens)

We study the numerical simulation of a weakly twisted magnetic flux tube emergence in a non magnetized corona. We find that this flux tube creates a system of two expanding magnetic lobes, that exist over the photospheric bipolar magnetic region and are separated by the polarity inversion line. Those structures expand due to the magnetic pressure, creating a current sheet that leads to the reconnection of the magnetic field lines. This continuous interaction ejects chromospheric plasma to the upper atmosphere and heats plasma up to 2MK, creating a sequence of cool and hot coronal jets. Due to the reconnection, the initial emerging field creates hot and cool loops in the active region, and leads to the formation of a confined twisted flux rope inside the magnetic envelope. We created synthetic AIA and XRT images of the simulation to see whether those structures could be observed. We find that only some of the ejection can be identified in the synthetic images, and that some cool and dense structures could be misinterpreted as very warm in high temperature filters.

Slot Region Radiation Environment Models

Ingmar Sandberg (National Observatory of Athens), **Daglis Ioannis** (University of Athens), **Heynderickx Daniel** (DH Consultancy BVBA, Belgium), **Evans Hugh**, **Nieminen Petteri** (ESA/TEC-EES, The Netherlands)

The main characteristics and principles of the recently developed Slot Region Radiation Environment Models (SRREMs) are presented. The SRREMs are data-based statistical models that characterize the variability of trapped charged particle fluxes in the region between the inner and the outer electron radiation belts. The models are based on the analysis of a large volume of available data and on the construction of a virtual data base of slot region particle fluxes. The analysis that we have followed retains the long-term temporal, spatial and spectral variations in electron and proton fluxes as well as the short-term enhancement events at altitudes and inclinations relevant for satellites residing in the slot region. The output of the models provide mean and peak energetic particle fluxes for a user-defined mission orbit, space weather conditions and duration as determined by confidence level. Results and future developments of the models are presented and discussed.

Radiation Belt Electron Loss mechanisms: New results

Georgios Anagnostopoulos, **Barlas Georgios** (Democritus University of Thrace), **Sidiropoulos Nikolaos** (Institute for Language and Speech Processing/"Athena" R. C.), **Vassiliadis Vassilios** (Democritus University of Thrace)

The radiation belt electron precipitation (RBEP) into the topside ionosphere is a phenomenon which is known for several decades. However, the radiation belt source and loss mechanisms have not still well understood, including PBEP. Here we present the results of a systematic study of RBEP observations, as obtained from the satellite DEMETER and the series of POES satellites, in comparison with variation of seismic activity. We found that this type of RBEP bursts present special characteristics in the inner region of the inner radiation belt before large (M>7, or even M>5) earthquakes (EQs), as for instance characteristic (a) flux-time profiles, (b) energy spectrum, (c) electron flux temporal evolution, (d) spatial distributions and (e) they are associated with broad band VLF activity, some days before an EQ. The RBEP before EQs appears, not only as a burst, but as an increase of the normal electron background flux in large range of latitudes during magnetospheric storms. Recent results, in the presence of a magnetospheric storm and of strong seismic activity, seem to suggest an increase of the normal flux in the slot region as well. We found significant evidence that, among EQs-lightings-Earth based transmitters, seismic activity is that agent which probably make the main contribution to the RBEP at middle latitudes. Further research is in progress in order to further test the present results.

Exploring the Near Earth Object Population

William Bottke (Southwest Research Institute) **(Invited)**

This is a golden age for NEA research. We have discovered some 95% of the most threatening NEAs (those larger than 1 km, Mainzer et al. 2012), while ongoing surveys (e.g., Catalina Sky Survey) are finding many sub-km NEAs as well. NEA physical characterization studies by missions (e.g., NEAR-Shoemaker), space-based telescopes (e.g., WISE), and ground-based observatories (e.g., Arecibo, IRTF), are also revolutionizing our ideas about what NEAs are actually like. The OSIRIS-REx mission will return a sample from Bennu, a carbonaceous chondrite-like NEO in 2020, while President Obama announced on April 15, 2010 that NASA would send astronauts to an NEA by 2025. The Feb. 15 explosion of an NEA over Chelyabinsk, Russia, has further boosted interest in NEAs. In my talk, I will discuss several recent advances in our understanding of the NEO population (e.g, how they go from their source regions to their observed orbits; what we know about the size and nature of the population). I will give particular attention to candidates for robotic and human missions, namely those NEOs on near-Earth like orbits. Recent work has shown that a population of asteroids exists that have been temporarily captured in orbit around Earth ("minimoons"). They offer an innovative, but heretofore uninvestigated, population of targets for human exploration because of their proximity to the Earth and their low geocentric velocities. By better understanding them, we can test theories of the creation, internal structure, and transport of small asteroids. The largest minimoons in the steady state population are 1 to 2 meters in diameter, sizable enough to be both scientifically interesting and potentially suitable as destinations.

On the dynamics of a small body under the influence of a Maxwell ring-type N-body system with a spheroidal central body: Focal curves

Tilemahos Kalvouridis, **Fakis Demetrios** (National Technical University of Athens)

One of the most interesting aspects which characterize the dynamics of a small body under the influence of a regular polygon formation of N bodies with a spheroidal central primary, is related to the zero-velocity surfaces which, for a given set of the problem's parameters, separate the regions where particle planar motion is permitted from those where this motion is impossible. The non-sphericity of the central primary is here described by adding an inverse cube corrective term to Newton's law of gravitation, when applied both between the central primary and a peripheral one and between this primary and the small body. A similar expression of the potential including a corrective term was proposed by Manev in 1924 in his effort to describe some special physical properties of a body like radiation emission, or to explain some relativistic effects without using the theory of relativity. The version of the problem we deal with, is characterized by three parameters, namely, the number v=N-1 of the peripheral primaries, the mass parameter (ratio of the central mass m0 to the mass m of a peripheral body) and the oblateness parameter e, which appears in the non-Newtonian term of the force function related to the central primary. Parameter β takes only positive values, while parameter e can take small real values either positive (oblate body) or negative (prolate body). By using the existing Jacobian-type integral which characterizes the planar motion of the particle in the synodic coordinate system Oxyz located at the mass center O of the system, and by superposing the zero-velocity surfaces C=C(x,y, z=0; β, e) (where C is the Jacobian constant) drawn for a given configuration v, we observe that: (i) when e is kept constant and β varies, then the central parts of all

these surfaces ,which evolve around the central primary, intersect along one continuous curve while, (ii) when β is kept constant and e varies, then, depending on either positive or negative values of e, the central parts of all these surfaces intersect along either one or two common continuous curves respectively. We call these curves focal curves due to their aforementioned property. As it is expected, they display all the symmetry elements of the primaries arrangement in rotations around an axis perpendicular to the xy-plane through an angle 2π/ν. We shall prove that in case (i) the focal curve is independent of parameter e, while in case (ii) the focal curves (or curve) are independent of parameter β. It should be noted that, a similar property concerning the zero-velocity surfaces has been discovered by one of the present authors (Kalvouridis, 2004) during the investigation of the particle dynamics in the Newtonian field of a regular polygon formation of N spherical massive bodies. Another aspect dealt with in the present paper, is the mechanism of the parametric evolution of the focal curves and the effects of this property on the equilibrium locations and the periodic motions of the particle.

Complexity and Space Plasmas

George Pavlos, Iliopoulos Aggelos, **Karakatsanis Leonidas** (University of Thrace), **Xenakis Markos** (German Research School for Simulation Sciences, Aachen, Germany), **Pavlos Eugenios** (AUTH)

In this study the general theoretical framework of Complexity theory is presented, viewed through non-extensive statistical theory introduced by Constantino Tsallis in 1988. Nonlinear dynamics, fractional dynamics, thermodynamics and statistical physics constitute the basic elements of Complexity theory which can be applied to processes near, as well as, far from equilibrium. Moreover, the nonextensive statistics can be the fundamental linchpin of Complexity theory from microscopical to macroscopical level. Finally, a brief review of results concerning nonlinear analysis of space plasma time series corresponding to different complex systems is given.

Large-scale quantization in space plasmas

George Livadiotis (Southwest Research Institute), **McComas D. J.** (SwRI)

In plasmas, Debye screening structures correlations between particles. We identify a phase space minimum h* in non-equilibrium space plasmas that connects the energy of particles in a Debye sphere to an equivalent wave frequency. In particular, while there is no a priori reason to expect a single value of h* across plasmas, we find a very similar value of $h^* \sim 2\pi(1.2 \pm 2.4)\times 10^{-22}$ Js using four independent methods: (1) Ulysses solar wind measurements, (2) a variety of space plasmas spanning a broad range of physical properties, (3) the entropic limit emerging from statistical mechanics, (4) waiting-time distributions of explosive events in space plasmas. Finding a constant value for the phase space minimum in a variety of different plasmas, similar to the classical Planck constant but 12 orders of magnitude larger, reveals a new type of quantization in plasmas and correlated systems more generally.

S1: Sun, Planets and Interplanetary Medium – Poster Presentations

S1-1. Upstream ion events with a solar-type spectrum: what can we learn for space whether prediction?

Georgios Anagnostopoulos, **Maragkakis Mechael**, **Vassiliadis Efthymios** (Democritus University of Thrace)

Changes in plasma, magnetic field and energetic ion observations at Libration Point L1 (~220 Re) are important for space whether prediction research. However, short-lived (from some minutes to a few hours) ion intensity enhancements at L1 have been attributed to various sources and acceleration sites: interplanetary shock acceleration, acceleration at Earth's bow shock, leakage from Earth's magnetosphere etc. The scope of this study is to examine to which extent ion events originating from the Earth's magnetosphere environment might mimic ion events propagating up to L1 point after acceleration at distant interplanetary shock waves. For this reason we performed a statistical study and compared ion events observed almost simultaneously by the Geotail spacecraft near the Earth's bow shock and by ACE moving around the Libration point L1. Due to drastic changes of several parameters between the two sites, we found that at around the point L1, the ACE ion events show a strong spectrum with an average spectral index as low as γA = 2.1 (for a power law spectrum) at the level of 200 keV, whereas for the corresponding ion events observed by Geotail the average spectral index was found to be as high as γG = 5.4. We infer that a short duration ion event with a hard (i.e. γA ≈ 2) "solar" / "interplanetary" type energy spectrum can originate from the Earth's magnetosphere, and, that, therefore, these results should be seriously taken into account in space weather prediction research. More detailed information on the varying features of travelling ions and electrons from the bow shock to far distances are important as regards the problem of their origin and are also presented and discussed in the paper.

S1-2. Geospace variations measured by satellites before severe thunderstorms in Athens (June 27, 2010): An 'unexpected' sequence of evets

Georgios Anagnostopoulos (University of Thrace), **Ouzounov Dimitar** (Chapman University), **Pulinets Sergey** (Space Research Institute, Russian Academy of Sciences), **Kafatos Menas** (Chapman University), **Efthymiadis Dimitrios** (Centre for Climate Change, Department of Geography, University Rovira i Virgili, Tortosa, Spain)

Three physical parameters from space are consider for a significant time interval before severe thunderstorms occurred on June 27, 2010 in the greater region of Athens, and other places in Greece: radiation belt electron precipitation in ionosphere (CNES/DEMETER), electron concentration in atmosphere-ionosphere (GPS/TEC) / changes in plasma parameters and outgoing long-wavelength radiation (OLR) / (NOAA, NASA) on the top of the atmosphere. During May-July 2010, we performed first prospective tests for continuing analysis of the selected parameters over Greece. On June 25-26 we detected anomalous values in electron precipitation, ionospheric plasma and OLR over Crete Island, which occurred simultaneously with a large seismic swam (more 30 events, M>3) in Greece. On June 27, when the electron precipitation stopped, an extreme whether event occurred: severe thunderstorms in the greater region of Athens, and other places in Greece. Lighting activity was measured by the National Observatory of Athens ZEUS lightning detection system (Lagouvardos et al, 2009) and hundreds of lightning flashes (which exceeded the 20 per hour per 10 km2 rate) in the Greek capital were recorded. Two new phenomena are noted during the period June 25-27: (1) The radiation belt electron precipitation in ionosphere was recorded before the strong lighting activity above Crete / Greece, not during the lighting activity, as expected according to the relative scientific literature, and (2) The geospace measurements suggested that a great earthquake (M≈6) was possible to occur on June 25-27; instead, a large seismic swam did occur on June 25-26 near Crete. The possible physical relation between the observed variations in the radiation belts/ ionosphere, the seismic activity (June 24–26, 2010) and the following night of lighting (June 27) is discussed. Certainly, a high ionization of the atmosphere caused by the induced radiation belt electron precipitation and the seismic activity played most probably a great role in the appearance of thousand of lighting flashes in Greece the night of June 27/28. Further possible implications of this extreme event for the Radiation Belt-Ionosphere-Atmosphere-Lithosphere Coupling are also discussed (in particular, the possible agent of the radiation belt electron precipitation phenomenon).

S1-3. Acceleration and solar origin of solar energetic particles observed by SREM units

Anastasios Anastasiadis (National Observatory of Athens), **Georgoulis Manolis** (RCAAM, Academy of Athens), **Daglis Ioannis** (University of Athens), **Sandberg Ingmar** (National Observatory of Athens), **Nieminen Petteri** (ESTEC/ESA)

Within the previous solar cycle 23, SREM units onboard ESA's INTEGRAL and Rosetta spacecraft detected several tens of Solar Energetic Particle Events (SEPEs) and accurately pinpointed their onset, rise, and decay times. We have undertaken a detailed study to determine the solar sources and the subsequent interplanetary coronal mass ejections (ICMEs) that gave rise to these events, as well as the timing of SEPEs with regard to the onset of possible geomagnetic activity triggered by these ICMEs. We find that virtually all SREM SEPEs can be associated with CME-driven shocks. Moreover, for a number of wellstudied INTEGRAL/SREM SEPEs we see an association between the SEPE peak and the shock passage at L1, subject to the heliographic location of the source solar active region. Shortly after the SEPE peak (typically within a few hours), the ICMEdriven modulation of the magnetosphere kicks in, often associated with a dip of the Dst index, indicating storm conditions in geospace. In essence we find that SREM SEPEs can be seamlessly fit into a coherent and consistent heliophysical interpretation of solar eruptions all the way from Sun to Earth. Their contribution to space-weather forecasting may be significant and warrants additional investigation.

S1-4. On the dynamics of the three dimensional planetary systems

Kyriaki Antoniadou (University of Thessaloniki)

Over the last decades, there has been a tremendous increase in research on extrasolar planets. Many exosolar systems, which consist of a Star and two Planets, seem to be locked in 4/3, 3/2, 2/1, 5/2, 3/1 and 4/1 mean motion resonance (MMR). We herewith present the model used to simulate three dimensional planetary systems and provide planar families of periodic orbits (PO), which belong to all possible configurations that each MMR has, along with their linear horizontal and vertical stability. We focus on depicting stable spatial families (most of them up to mutual inclination of 60o) generated by PO of planar circular families, because the trapping in MMR could be a consequence of planetary migration process. We attempt to connect the linear stability of PO with long-term stability of a planetary system close to them. This can stimulate the search of real planetary systems in the vicinity of stable spatial PO-counterbalanced by the planets’ orbital elements, masses and MMR; all of which could constitute a suitable environment convenient to host them.

S1-5. 3D periodic orbits in the restricted four body problem

Agamemnon Baltagiannis (University of Patras), **Papadakis Konstantinos** (University of Patras, Department of Engineering Sciences, Division of Applied Mathematics and Mechanics)

One big body (Sun) of mass m1 and two other small bodies of masses m2 and m3 correspondingly, move in circular orbits keeping an equilateral triangle configuration, about the center of mass of the system fixed at the origin of the coordinate system. A massless particle is moving under the Newtonian gravitational attraction of the primaries and does not affect the motion of the three bodies. Using the vertical-critical orbits of planar families of symmetric periodic orbits as starting points, we determine and present in this paper, families of three-dimensional periodic solutions of the problem. Characteristic curves of the 3D-families which emanate from the plane are presented. The stability of every three-dimensional periodic orbit which numerically calculated is also studied.

S1-6. Metric Fiber Bursts Observed with the Artemis-IV Radio Spectrograph.

Costas Bouratzis (University of Athens)

The Intermediate Drift Bursts embedded in the type IV continuum have been an open research topic as regards the plasma radiation process of their origin and their diagnostic value in the estimation of magnetic field and plasma properties at their sources. We study the characteristics parameters of metric–decimetric Intermediate Drift Bursts such as frequency drift rate, instantaneous and total duration and spectral width. Furthermore their morphology on dynamic spectra regarding positioning of emission–absorption ridges is examined. A number of Intermediate Drift Bursts, isolated or in groups, were found within the fine–structures of type–IV bursts observed with the Artemis–IV solar radio-spectrograph in the 450–270 MHz range at high cadence (0.01 sec); these were grouped according to their form, on dynamic spectrum, and statistics on their characteristic parameters were calculated. Our results indicate six morphological groups of fibers based on the position of the emission and the absorption ridges: - Fibers exhibiting Emission Ridges only. - Fibers appearing as Absorption Ridges on the Type–IV continuum. -Fibers with Emission ridge and Absorption Ridge at the Lower

Frequency. - Fibers with Absorption ridge and Emission Ridge at the Lower Frequency. -Fibers with Emission ridge between Two Absorption Ridges at Lower and at the Upper Frequency. -Two Emission Ridges separated by an Absorption Ridge. Some complex groups, which were not easily classified were found within the data set used. Furthermore, certain borderline cases of fibers or ropes, of too high drift rate or bandwidth or too with narrow bandwidth were recorded representing outliers in their Intermediate Drift Bursts parameters statistics within this work.

S1-7. Space data routers: Space networking for enhancing data exploitation for space weather applications

Ioannis Daglis (University of Athens), **Anastasiadis Anastasios** (National Observatory of Athens), **Balasis George** (National Observatory of Athens), **Paronis Dimitrios** (National Observatory of Athens), **Diamantopoulos Sotiris** (University of Thrace)

Data sharing and access are major issues in space sciences, as they influence the degree of data exploitation. The project "Space-Data Routers" relies on space internetworking and in particular on Delay Tolerant Networking (DTN), which marks the new era in space communications, unifies space and earth communication infrastructures and delivers a set of tools and protocols for space-data exploitation. The main goal is to allow space agencies, academic institutes and research centers to share space-data generated by single or multiple missions, in an efficient, secure and automated manner. Here we are presenting the architecture and basic functionality of a DTN-based application specifically designed in the framework of the SDR project, for data query, retrieval and administration that will enable to address outstanding science questions related to space weather, by providing simultaneous real- time sampling of space plasmas from multiple points with cost-effective means and measuring of phenomena with higher resolution and better coverage. This work has received funding from the European Community's Seventh Framework Programme (FP7-SPACE-2010-1, SP1 Cooperation, Collaborative project) under grant agreement No 263330 (project title: Space-Data Routers for Exploiting Space Data). This presentation reflects only the authors' views and the Union is not liable for any use that may be made of the information contained therein.

S1-8. Variations of ULF wave power throughout the Halloween 2003 superstorm

Ioannis Daglis (University of Athens), **Balasis George** (National Observatory of Athens), **Papadimitriou Constantinos** (National Observatory of Athens), **Zesta Eftyhia** (NASA), **Georgiou Marina** (National Observatory of Athens / University of Athens), **Mann Ian** (University of Alberta)

Focused on the exceptional 2003 Halloween geospace magnetic storm, when Dst reached a minimum of -383 nT, we examine data from topside ionosphere and two magnetospheric missions (CHAMP, Cluster, and Geotail) for signatures of ULF waves. We present the overall ULF wave activity through the six-day interval from 27 October to 1 November 2003 as observed by the three spacecraft and by the Andenes ground magnetic station of the IMAGE magnetometerer array in terms of time variations of the ULF wave power. The ULF wave activity is divided upon Pc3 and Pc5 wave power. Thus, we provide different ULF wave activity indices according to the wave frequency (Pc3 and Pc5) and location of observation (Earth's magnetosphere, topside ionosphere and surface). We also look at three specific intervals during different phases of the storm when at least two of the satellites are in good local time (LT) conjunction and examine separately Pc3 and Pc4-5 ULF wave activity and its concurrence in the different regions of the magnetosphere and down to the topside ionosphere and on the ground. This work has received support from the European Community's Seventh Framework Programme under grant agreement no. 284520 for the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project.

S1-9. Monitoring, Analyzing and Assessing Radiation Belt Loss and Energization

Ioannis Daglis (University of Athens), **Balasis George** (National Observatory of Athens), **Bourdarie Sebastien** (ONERA), **Horne Richard** (British Antarctic Survey), **Khotyaintsev Yuri** (Swedish Institute of Space Physics), **Mann Ian** (University of Alberta), **Santolik Ondrej** (IAP), **Turner Drew** (UCLA), **Anastasiadis Anastasios** (National Observatory of Athens),**Georgiou Marina** (National Observatory of Athens / University of Athens), **Giannakis Omiros** (National Observatory of Athens),**Papadimitriou Constantinos** (National Observatory of Athens / University of Athens), **Ropokis George Sandberg Ingmar** (National Observatory of Athens), **Angelopoulos Vassilis** (UCLA), **Glauert Sarah** (British Antarctic Survey), **Grison Benjamin** (IAP), **Kersten Tobias** (British Antarctic Survey), **Kolmasova Ivana** (IAP), **Lazaro Didier** (ONERA), **Mella Meghan** (Swedish Institute of Space Physics), **Ozeke Louis** (University of Alberta), **Usanova Maria** (University of Alberta)

We present the concept, objectives and expected impact of the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Loss and Energization) project, which is being implemented by a consortium

of seven institutions (five European, one Canadian and one US) with support from the European Community's Seventh Framework Programme. The MAARBLE project employs multi-spacecraft monitoring of the geospace environment, complemented by ground-based monitoring, in order to analyze and assess the physical mechanisms leading to radiation belt particle energization and loss. Particular attention is paid to the role of ULF/VLF waves. A database containing properties of the waves is being created and will be made available to the scientific community. Based on the wave database, a statistical model of the wave activity dependent on the level of geomagnetic activity, solar wind forcing, and magnetospheric region will be developed. Multi-spacecraft particle measurements will be incorporated into data assimilation tools, leading to new understanding of the causal relationships between ULF/VLF waves and radiation belt dynamics. Data assimilation techniques have been proven as a valuable tool in the field of radiation belts, able to guide 'the best' estimate of the state of a complex system. The MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project has received funding from the European Union's Seventh Framework Programme (FP7-SPACE-2011-1) under grant agreement no. 284520.

S1-10. A statistical study of current-sheet formation above solar active regions based on self-organized criticality

Michaila Dimitropoulou (University of Athens), **Isliker Heinz**, **Vlahos Loukas** (University of Thessaloniki), **Georgoulis Manolis** (RCAAM Academy of Athens), **Anastasiadis Anastasios** (National Observatory of Athens), **Toutountzi Anna** (University of Thessaloniki)

We treat flaring solar active regions as physical systems having reached the self-organized critical state. Their evolving magnetic configurations in the low corona may satisfy an instability criterion, related to the excession of a specific threshold in the curl of the magnetic field. This imposed instability criterion implies an almost zero resistivity everywhere in the solar corona, except in regions where magnetic-field discontinuities and. hence, local currents, reach the critical value. In these areas, current-driven instabilities enhance the resistivity by many orders of magnitude forming structures which efficiently accelerate charged particles. Simulating the formation of such structures (thought of as current sheets) via a refined SOC cellular-automaton model provides interesting information regarding their statistical properties. It is shown that the current density in such unstable regions follows power-law scaling. Furthermore, the size distribution of the produced current sheets is best fitted by power laws, whereas their formation probability is investigated against the photospheric magnetic configuration (e.g. Polarity Inversion Lines, Plage). The average fractal dimension of the produced current sheets is deduced depending on the selected critical threshold. The above-mentioned statistical description of intermittent electric field structures can be used by collisional relativistic test-particle simulations, aiming to interpret particle acceleration in flaring active regions and in strongly turbulent media in astrophysical plasmas. The above work is supported by the Hellenic National Space Weather Research Network (HNSWRN) via the THALIS Programme.

S1-11. Energetic electron flux enhancements during geospace magnetic storms associated with earthward penetration of Pc 4-5 waves?

Marina Georgiou (University of Athens / National Observatory of Athens), **Ioannis A. Daglis** (University of Athens / National Observatory of Athens), **Eftyhia Zesta** (NASA Goddard Space Flight Center), **George Balasis** (National Observatory of Athens), **Kanaris Tsinganos** (University of Athens / National Observatory of Athens)

ULF waves with frequencies of a few millihertz (mHz) have been associated with changes in the flux levels among relativistic electrons comprising the outer zone of the radiation belts. In particular, the fluxes of electrons with energies > 1 MeV in the outer radiation belt increase and decrease during geospace magnetic storms. For all storms studied by Reeves et al. [2003], only about half of them led to increased electron fluxes, one quarter led to decreased the fluxes, and one quarter produced little or no change in the fluxes. We focus on the increase of relativistic electrons observed during a number of magnetic storms by GOES satellites at geosynchronous orbit. To minimise the effects caused by the Earth's magnetic field asymmetries, we apply a statistical reconstruction of the fluxes to a common local time, which is chosen to be noon, a technique proposed by O'Brien et al. [2001]. Next, we look into multipoint observations from ground-based magnetometer arrays and the characteristics of Pc 4-5 waves during the different phases of the magnetic storms with particular emphasis on the distribution of Pc 4-5 wave power over the L shells that correspond to the radiation belts. With these observations as a starting point, we investigate whether Pc 4-5 wave power penetrates to lower L shells during periods of enhanced relativistic electron fluxes. We discuss, lastly, the implications to wave-particle interaction. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7–SPACE–2011–1) under grant agreement n. 284520 for the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project.

S1-12. Genesis of Free Magnetic Energy and Helicity in Solar Active Regions and their Role in Solar Eruptions

Manolis Georgoulis (RCAAM, Academy of Athens)

Eruptive solar magnetic configurations are revisited in view of their magnetic energy and (relative) magnetic helicity budgets. We calculate these budgets via a novel self-consistent technique that requires neither photospheric flow velocity fields nor three-dimensional coronal magnetic field extrapolations of the observed photospheric structure. A single vector magnetogram of the structure is sufficient for the calculation of the instantaneous electric-current-induced (free) magnetic energy and helicity budgets. We apply the method to the intensely eruptive NOAA active region (AR) 11158 and report on the following findings: (1) significant budgets of free magnetic energy and helicity are developed in the AR, sufficient to power more than the observed eruptions; (2) eruption-related decreases of both budgets are noted, allowing estimation of the energy/helicity budgets of the eruptions themselves; (3) the AR complies with our previously and independently introduced energy/helicity diagram of solar active regions; and (4) a non-ideal transformation of mutual free energy and helicity terms into respective self terms results in increasingly helical pre-eruption structures. These findings suggest a new causal view of solar eruptions and the pre-eruption evolution of solar active regions. Parallel analysis with synthetic, magnetohydrodynamical models of active regions is underway, aiming to scrutinize our data analysis and subsequent interpretation. This work is supported by EU's Seventh Framework Programme via a Marie Curie Fellowship and by the Hellenic National Space Weather Research Network (HNSWRN) via the THALIS Programme.

S1-13. The global polytropic model for the solar and jovian systems revisited

Vassilis Geroyannis, **Valvi Florendia** (University of Patras), **Dallas Themis** (University of Thessaly)

The "global polytropic model" (Geroyannis) 1993 [P1]; Geroyannis and Valvi 1994 [P2]) is based on the assumption of hydrostatic equilibrium for the solar/jovian system, described by the Lane-Emden differential equation. A polytropic sphere of polytropic index n and radius R1 represents the central component S1 (Sun/Jupiter) of a polytropic configuration with further components the polytropic spherical shells S2, S3, ..., defined by the pairs of radii (R1,R2), (R2,R3), ..., respectively. R1, R2, R3, ..., are the roots of the real part Re(theta(R)) of the complex Lane-Emden function theta(R). Each polytropic shell is assumed to be an appropriate place for a planet/satellite to be "born" and "live". This scenario has been studied numerically for the case of the solar system (P1) and the jovian system (P2). In the present paper, the Lane-Emden differential equation is solved numerically in the complex plane by using the Fortran code dcrkf54.f95 (Geroyannis and Valvi 2012; modified Runge-Kutta-Fehlberg code of fourth and fifth order for solving initial value problems in the complex plane). We include in our numerical study some trans-Neptunian objects. We emphasize on computing distances and comparing with previous results. REFERENCES: V.S. Geroyannis 1993, Earth, Moon, and Planets, 61, 131-139. V.S. Geroyannis and F.N. Valvi 1994, Earth, Moon, and Planets, 64, 217-225. V.S. Geroyannis and F.N. Valvi 2012, International Journal of Modern Physics C, 23, No 5, 1250038:1-15.

S1-14. A study of the first solar proton event of current solar cycle recorded by satellites and ground based detectors

Maria Gerontidou, **Mavromichalaki Helen** (University of Athens), **Plainaki Christina** (INAF-Institute for Space Astrophysics and Planetology), **Belov Anatoly**, **Eroshenko Eugenia**, **Yanke Victor**(IZMIRAN, Russian Academy of Sciences), **Laurenza Monica**, **Storini Mariza** (INAF –Institute for Space Astrophysics and Planetology)

On 2012, May 17 the GOES satellites recorded a great and simultaneous increase on proton flux in different energy channels thereby producing a solar proton event (SPE). These protons had enough energy to be recorded by the ground based worldwide network of neutron monitors thereby producing the first ground level enhancement of solar cosmic rays (GLE71) of the current solar cycle. In this work a combined study of the this solar proton event, as it is recorded by GOES satellites as well as by the ground based network of Neutron monitors is presented. On 2012, May 17 at 02:10 UTC the GOES spacecraft recorded a fast rise in the flux of solar protons, followed by a slower decay, which was still ongoing on 18 May 2012. Several solar proton events stronger than that of 17 May 2012 were detected by GOES in January and March 2012. This event of 17 May extended to much higher energies than those earlier ones, but was weaker at lower energies. Through this research an attempt to understand the reason for these differences is performed. Additionally, a first attempt to derive the characteristics of this recent proton event, by applying an updated version of the NMBANGLE PPOLA model, already used for modeling past GLEs (e.g. GLE70) is presented. The special characteristics of this event with respect to the result of NMBANGLE POLLA model can provide useful information not only about the solar source that triggered this SPE, but also its special impact at interplanetary space.

S1-15. Particle acceleration and nanoflare heating in coronal loops

Costis Gontikakis (RCAAM, Academy of Athens), **Patsourakos Spiros** (University of Ioannina), **Efthymiopoulos Christos** (RCAAM, Academy of Athens), **Anastasiadis Anastasios** (National Observatory of Athens), **Georgoulis Manolis** (RCAAM, Academy of Athens)

We model nanoflare heating of extrapolated active-region coronal loops via the acceleration of electrons and protons in Harris-type current sheets. The kinetic energy of the accelerated particles is estimated using semi-analytical and test-particle-tracing approaches. Vector magnetograms and photospheric Doppler velocity maps of NOAA active region 09114, recorded by the Imaging Vector Magnetograph (IVM), were used for this analysis in order to compute a current-free field extrapolation of the active-region corona. The corresponding Poynting fluxes at the footpoints of 5000 extrapolated coronal loops were then calculated. Assuming that reconnecting current sheets develop along these loops, we utilized previous results to estimate the kinetic-energy gain of the accelerated particles and we related this energy to nanoflare heating and macroscopic loop characteristics. Kinetic energies of 0.1 to 8~keV (for electrons) and 0.3 to 470~keV (for protons) were found to cause heating rates ranging from 10^{-6} to 1 erg s^{-1} cm^{-3}. Hydrodynamic simulations show that such heating rates can sustain plasma in coronal conditions inside the loops and generate plasma thermal distributions which are consistent with active region observations. We concluded the analysis by computing the form of X-ray spectra generated by the accelerated electrons using the thick target approach that were found to be in agreement with observed X-ray spectra, thus supporting the plausibility of our nanoflare-heating scenario. This work is supported by EU's Seventh Framework Programme via a Marie Curie Fellowship and by the Hellenic National Space Weather Research Network (HNSWRN) via the THALIS Programme.

S1-16. The need of Professional-Amateur collaborations to the monitoring of the giant planets

Emmanuel Kardasis (Hellenic Amateur Astronomy Association), **Maravelias Grigoris** (University of Crete, Hellenic Amateur Astronomy Association), **Yanamandra-Fisher Padma** (Space Science Institute), **Orton Glenn** (Jet Propulsion Laboratory, California Institute of Technology), **Rogers John H.** (British Astronomical Association & JUPOS team), **Jacquesson Michel** (JUPOS team), **Christou Apostolos** (Armagh Observatory), **Delcroix Marc** (Societe Astronomique de France)

The observation of gaseous planets is of high scientific interest. Although they have been the targets of several space missions, still the need for continuous ground-based observations remains. As their atmospheres present a fast dynamic environment the time availability in professional telescopes is not enough to follow them. On the other hand, numerous amateurs with small telescopes (with typical diameters of 15-60cm) and sufficient modern hardware and software equipment can monitor these changes daily (within the 360-900nm wavelength range). Their observations provide a continuous record and it is not uncommon to trigger professional observations in cases of extremely rare and important events. Amateur observations are able to trace the structure and the evolution of atmospheric features, such as major planetary scale disturbances, vortices, and storms. Photometric monitoring of stellar occultation's by the planets can reveal spatial/temporal atmospheric variabilities. Moreover, the continuous amateur monitoring has led to the discovery of fireballs in Jupiter's atmosphere, which provide information not only on Jupiter's gravitational influence but also on the properties of the impactors. Thus, co-ordination and communication between professionals and amateurs is important. We present paradigms of such collaborations that: (i) engage systematic multi-wavelength observations and databases, (ii) examine the variability of Jovian cloud features (JUPOS-Database for Object Positions on Jupiter), (iii) provide, by ground-based professional and mainly amateur observations, the necessary spatial and temporal resolution of features that will be sampled by the space mission Juno, (iv) investigate video observations of Jupiter to recover impacts of small objects (Jovian Impacts Detection-JID and DeTeCtion of bolides in Jupiter atmosphere-DeTeCt software), (v) launch stellar occultation campaigns.

S1-17. Statistical analysis for extra galactic exoplanets

Konstantinos Karpouzas (University of Thessaloniki)

We present the first statistical analysis on extra galactic stars that could host an exoplanet. We analyze the photometric data of the Ursa Minor Dwarf Spheroidal galaxy, taken by the Isaac Newton Group of Telescopes (INT) and we calculate the probability to detect a planetary transit , based on the stellar characteristics of the statistical sample and the transit detection probability distribution. Our goal is to determine how many possible planets could be detected in the galaxy and therefore create the first catalogue of extra galactic exoplanet host star candidates for future space missions.

S1-18. New software for exoplanet trasnit light curve optimization

Konstantinos Karpouzas (University of Thessaloniki)

We present the first photometric software (Transit Light curve Optimization), designed to construct the best possible exoplanet transit light curve from a set of data. T.L.O loads the characteristics of a known exoplanet such as radius, inclination ,depth , duration and limb darkening coefficients and calculates the transit model light curve. Then , it uses the theoretical curve to choose the best target star's pixels and constructs the best experimental curve via minimizing rhe residuals between the theoretical and the experimental curves. Finally it creates a mossaic of the ideal pixels around the target star, discarding the pixels that add more noise than signal and constructs the best optimized lightcurve for the exoplanet transit event.

S1-19. The structure of Invariant tori around L4 in the case of the Sun-Jupiter system

Matthaios Katsanikas (RCAAM, Academy of Athens)

We study the structure of invariant tori around L4 of the 3D circular Restricted Three body problem in the case of the Sun-Jupiter System. For this reason we use the method of surfaces of section. In our case the space of section is 4D. In order to visualize this space we use the method of color and rotation (Patsis & Zachilas).

S1-20. Wavelet Analysis on Solar Wind Parameters and Geomagnetic Indices

Christos Katsavrias (University of Athens), **Preka-Papadema Panagiota** (University of Athens), **Moussas Xenophon** (University of Athens), **Hillaris Alexandros** (University of Athens)

The geomagnetic activity is the result of the solar wind–magnetosphere interaction. It varies following the basic 11-year solar cycle; yet shorter time-scale variations appear intermittently. An analysis of 14 time series covering four solar cycles (20, 21, 22, 23) corresponding to characteristics of the solar wind (speed, temperature, pressure, density), interplanetary magnetic field (Bx , By , Bz, β, Alfvén Mach number) and geomagnetic indices (DST, AE, Ap and Kp) is performed, in search of characteristic periodicities in each of the parameters using the Morlet wavelet expansion. Our results verify intermittent periodicities in our time-series data, which correspond to already known solar activity variations; some of these are shared between the solar wind parameters and geomagnetic indices.

S1-21. Shock formation characteristics in the low corona from type II radio bursts.

Athanasios Kouloumvakos (University of Ioannina), **Preka-Papadema P.** (University of Athens), **Vourlidas A.** (NRL), **Moussas X.**, **Hillaris A.** (University of Athens), **Tsitsipis P.**, **Kontogeorgos A.** (Technological Educational Institute of Lamia)

In this analysis we have identified the formation of coronal shock waves from 2007 to 2011, using as proxies the type II radio bursts from radio spectrograph ARTEMIS-IV and RSTN. For the 42 events we have identified, we combined data from STEREO, SOHO/LASCO και SDO with the characteristics of the composite radio spectra to investigate the properties of the type II formation with the associated flares and CMEs. From the timings between the flare, the CME onset, the HXR peak and the type II start, we grouped the type IIs into separate categories. We found that in most of the cases the type II radio burst starts at the flare maximum phase and particularly in 60% of the cases at the HXR maximum. All the characteristics of the type IIs obtained from their spectrum (duration, df, df/dt). We compared the computed velocities of the type IIs, using deferent density models, with the observed speeds of the CMEs from STEREO and SOHO/LASCO. Finally, from the composite radio spectra we associated the type II with the occurrence of other transient radio emissions such as, radio bursts type III or IV.

S1-22. Galactic cosmic ray spectrum and effective radiation doses on flights during Forbush decreases

Livada Maria, **Papaioannou Athanasios**, **Mavromichalaki Helen** (University of Athens)

In this work the spectral index during the Forbush decrease caused by a burst of solar activity in August 2010 is studied. We present analytical all mathematical arguments for the derivation of the spectrum during this strong series of Forbush decreases, using the coupling coefficient method that couples the secondary cosmic rays recorded at Earth to the primary cosmic ray flux at the edge of the magnetosphere, i.e. in free space. Our calculations provide a spectrum of the galactic cosmic rays free of the detectors local characteristics. Cosmic ray data from neutron monitor stations from the worldwide network are used. Moreover applying the models Magnetocosmics / Planetocosmics and Cari-6 during these events, the rate of the effective radiation dose that affects the crew and passengers during flights is calculated.

S1-23. Understanding kappa distributions in space physics

George Livadiotis (Southwest Research Institute), **McComas D. J.** (SwRI)

Space plasmas are non-equilibrium systems that typically deviate from the classical Boltzmann-Gibbs Statistical Mechanics, and are described by the kappa distribution of velocities, a straightforward replacement of the classical Maxwell distribution. In the past four decades, empirical kappa distributions have successfully applied to numerous space plasmas, from the solar wind and the planetary magnetospheres in the inner heliosphere, to the distant plasma in the inner heliosheath, the local interstellar medium, and beyond. Recently, we have shown that the kappa distribution is interwoven with the framework of non-extensive Statistical Mechanics. This connection was the starting point of further developments, some of whom are (i) the multi-particle kappa distribution, for the simultaneous description of the phase-space of many particles; (ii) the kappa distribution of the Hamiltonian function when a potential is considered, for the description of the whole phase-space rather than simply the velocity space; (iii) the concept of superposition on kappa distributions, that completes the description of non-equilibrium systems.

S1-24. : Magnetospheric cut-off rigidity changes during the magnetic storms of the years 2011 and 2012

Helen Mavromichalaki, **Laoutaris Aggelos**,**Kontiza Aikaterina**, **Millas Dimitris** , **Katsoulakos Grigorios** (University of Athens), **Eroshenko Eugenia**, **Belov Anatoly**, **Yanke Victor** (IZMIRAN Rusian Academy of Sciences)

Disturbances in the Earth's magnetic field during magnetic storms can cause essential changes in the charged particle trajectories in the magnetosphere. This has two main consequences for ground-level observations, changing the effective cut-off thresholds and the effective asymptotic directions of the particles. Both of these consequences are important for cosmic rays. During these events an increased amount of energy is transferring into the magnetosphere. The cosmic ray intensity variations during the recent magnetic storms of the years 2011 and 2012 covering the ascending phase of the solar cycle 24, were analyzed using data from about 30 neutron monitor stations of the worldwide network. The corresponding variations of the geomagnetic indices and the geomagnetic cut-off rigidity changes of each neutron monitor station were calculated by the global survey method. The latitudinal distribution of the stations shows that maximum changes of the geomagnetic cut-off rigidities occur in the middle latitude stations around the rigidity of 6.5-9.0 GV.

S1-25. Forbush decreases during the ascending phase of solar cycle 24

Helen Mavromichalaki (University of Athens), **Lingri Dimitra** (University of Athens), **Papailiou Maria-Christina** (University of Athens), **Belov Anatoly** (IZMIRAN Russian Academy of Sciences), **Eroshenko Eugenia** (University of Athens), **Yanke Victor** (IZMIRAN Russian Academy of Sciences)

A Forbush decrease is a sudden and rapid decrease in the intensity of the galactic cosmic ray component, which is due to some strong events, which take place on Sun (solar flares, CMEs). In this work the Forbush decreases which had taken place from January 2010 to April 2012, covering the ascending phase of the solar cycle 24, were studied. Using the IZMIRAN database of Forbush decreases extracting from the worldwide neutron monitor network, a statistical analysis of 280 selected events were performed, focusing on two most important of them. The first one occurred on February 18, 2011 presented a ~5% decrease at cosmic ray intensity and the second one happened on March 8, 2012 with an amplitude of ~11%. For these two events, a further study on the events that happened on the Sun, on the way that these affected the interplanetary space and finally provoked the decreases on the galactic cosmic rays on Earth was done. It is resulted that the way each neutron monitor records these decreases, depends on the cut-off rigidity of the station. The correlation between the amplitude of the decreases and the rigidity of each station gave interesting results.

S1-26. An overiew of the last ground level enhancement of cosmic rays on May 17, 2012

Helen Mavromichalaki, **Petris Sofianos**, **Chrysafeli Ersi**, **Papaioannou Athanasios**, **Gerontidou Maria** (University of Athens), **Belov Anatoly, Eroshenko Eugenia**, **Yanke Victor** (IZMIRAN Russian Academy of Sciences)

Ground level enhancement (GLE) events represent the GeV energy component of solar energetic particle (SEP) events, emanating from the solar activity. In this work, we particularly present a review and examine some aspects of the event of 2012 May 17, known as GLE71, which is the first of solar cycle 24. In order to study the variation of the cosmic ray flux at this time period, as a function of some parameters e.g. rigidity, we take into consideration data from up to 30 ground-level neutron monitor stations from Neutron Monitor Database (NMDB) from around the world. In addition, taking advantage of data for the X-ray, radio and proton flux from GOES just before the event, coupled with data for solar flares and coronal mass ejections (CMEs), we determine if the previously mentioned event can be attributed to any of these solar eruptive phenomena. GLE71 with its peculiarities, was recorded by only a few polar stations and it can be correlated with an M5.1 class solar flare situated at N11W76 of the active region AR11476, as it was indicated by intense X-ray flux. The solar flare was followed by a high speed halo CME occurred minutes before the start of the event, denoting the presence of a shock together with radio type ll burst, thus it is considered to be responsible for the acceleration of particles which caused ground-level measurements.

S1-27. Time-lag of cosmic ray intensity during solar cycles 19-24

Helen Mavromichalaki, **Paouris Evagelos**, **Mitrokotsa Stefania** (University of Athens)

It is known that the cosmic ray intensity is anticorrelated with the solar activity. In this work the correlation coefficient and the time lag of the cosmic ray intensity against the solar activity expressed by the sunspot number and the radio flux of 10.7 cm are studied. Using all the available cosmic ray data obtained from neutron monitor stations of the worldwide network from the beginning of their operation till now, results have been found for each solar cycle separately from the 19th up to the current one. The above analysis was also done for all solar cycles in total. It was concluded that the time lag of cosmic ray intensity present a different behavior in two consecutive solar cycles (odd and even solar cycles) due to the polarity reversal of the solar magnetic field, confirming once again the 22-years cycle of cosmic ray intensity.

S1-28. Implementing the European Neutron Monitor Service for the ESA SSA Program

Mavromichalaki H., **Papaioannou A.** (University of Athens), **Souvatzoglou G.** (ISNet), **Dimitroulakos J.** (ISNet), **Paschalis P.** (University of Athens), **Gerontidou M.** (University of Athens), **Sarlanis Ch.** (ISNet)

Ground level enhancements (GLEs) are observed as significant intensity increases at neutron monitor measurements, followed by an intense solar flare and/or a very energetic coronal mass ejection. Due to their space weather impact it is crucial to establish a real-time operational system that would be in place to issue reliable and timely GLE Alerts. Such a Neutron Monitor Service that will be made available via the Space Weather Portal operated by the European Space Agency (ESA), under the Space Situational Awareness (SSA) Program, is currently under development. The ESA Neutron Monitor Service will provide two products: a web interface providing data from multiple Neutron Monitor stations as well as an upgraded GLE Alert. Both services are now under testing and validation and will probably enter to an operational phase next year. The core of this Neutron Monitor Service is the GLE Alert software, and therefore, the main goal of this research effort is to upgrade the existing GLE Alert software and to minimize the probability of false alarms. The ESA Neutron Monitor Service is building upon the infrastructure made available with the implementation of the High-Resolution Neutron Monitor Database (NMDB). In this work the structure of the ESA Neutron Monitor Service, the core of the novel GLE Alert Service and its validation results will be presented and further discussed.

S1-29. Magnetic helicity and free energy in solar active regions

Kostas Moraitis (RCAAM, Academy of Athens), **Georgoulis Manolis** (RCAAM, Academy of Athens), **Tziotziou Kostas** (RCAAM, Academy of Athens), **Archontis Vasilis** (University of St Andrews)

We study the evolution of the non-potential free magnetic energy and relative magnetic helicity budgets in solar active regions (ARs). For this we use a time-series of a three-dimensional, synthetic AR produced by magnetohydrodynamical (MHD) simulations. As a first step, we calculate the potential magnetic field that has the same normal components with the MHD field along all boundaries of the AR, by solving Laplace's equation. The free magnetic energy of the AR is then easily derived. From the two fields, MHD and potential one, we calculate the corresponding vector potentials with a recently proposed integration method. The knowledge of both fields and their respective vector potentials throughout the AR, allows us to estimate the relative magnetic helicity budget of the AR. Following this procedure for each snapshot of the AR, we reconstruct the evolution of free energy and helicity in the AR. Our method reproduces, for a synthetic AR, the energy/helicity relations known to hold in real active regions.

S1-30. The spatial relationship between coronal mass ejections and solar flares

Eleni Nikou, **Nindos Alexander**, **Patsourakos Spiros** (Section of Astrogeophysics, Physics Department, University of Ioannina)

Using 19 well-observed eruptions that gave both coronal mass ejections (CMEs) and flares, we quantified the spatial relationship between pairs of CMEs and associated flares. The flare and CME source locations were identified using images obtained at 174 A by the SWAP instrument aboard PROBA 2 satellite. The SWAP data are suitable for this study because flare emission does not saturate much. To reduce saturation even more, our database did not contain any M-class or X-class flare events. We selected eruptions that occurred close to disk center, as viewed from Earth, whereas they appeared as limb events in images obtained by the EUV Imagers (EUVI) aboard the SECCHI/STEREO spacecraft. The centroids of the CME-associated EUV dimmings in the SWAP images were used as proxies for the CME source locations. For each event, we compared the location of the flare brightenings with the location of the dimmings' centroid at the time of CME initiation which was determined from the EUVI data. In six cases the CME location was cospatial with flare brightenings while in the remaining cases the distance between each pair of flare-CME locations varied from 4 to 191 arcsecs with a median value of 71 arcsecs. Furthermore, we investigated the CME source locations with respect to the underlying magnetic field structures.

S1-31. The Network of the families of symmetric periodic orbits of the photogravitational restricted four body problem

Ioannis Papadouris (University of Patras), **Papadakis Konstantinos** (University of Patras)

We consider three bodies of masses m1, m2 and m3 correspondingly, called primaries, which move in circular orbits around their center of mass under their mutual Newtonian gravitational attraction, keeping an equilateral triangle configuration, i.e. lie always at the apices of an equilateral triangle. A fourth massless particle moving in the same plane is acted upon the Newtonian gravitational attraction of the primary bodies. We study numerically the families of the simple symmetric periodic orbits of the problem when the first primary body, which is bigger (Sun) than the other two, is a source of radiation. The network of these families, for various values of the radiation pressure of the Sun, is illustrated. We found that the radiation pressure has a strong effect on the network of the families. Sample of simple symmetric periodic solutions of the problem are presented.

S1-32. Parametric study of drag force acting on interplanetary CME

Olena Podladchikova, **Patsourakos Spiros**, **Nindos Alexandros** (University of Ioannina)

The interaction of an interplanetary coronal mass ejection (ICME) with the solar wind leads to an equalisation of the ICME and solar wind velocities at 1 AU. The forces acting on ICMEs have been evaluated so far in terms of an empirical drag coefficient $C_D \sim 1$ that describes the aerodynamic drag experienced by a typical ICME due to its interaction with the ambient solar wind. The consideration of viscous drag coefficients due to proton-magnetic kink encounters is more realistic for solar wind turbulence. We compare aerodynamic and viscous drag description and their impact on ICME propagation in solar wind. We also consider the impact of ICME distortions to their kinematics as they propagate in the inner heliosphere.

S1-33. Dipolarization fronts in the near-Earth space and substorm dynamics

Ioannis Vogiatzis (University of Thrace), **Isavnin Alexey** (University of Helsinki), **Zong Qiugang** (Peking University), **Sarris Emmanuel** (Democritus University of Thrace), **Lu Shangwen** (Peking University), **Tian Anmin** (Shandong University)

During magnetospheric substorms and plasma transport in the Earth's magnetotail several magnetic structures can be detected. Two of the most important types observed are dipolarization fronts and flux ropes. Presently the research of these magnetoplasma structures absorbs a great deal of effort from magnetospheric scientists. However, they are treated as separate magnetotail features being independent of each other. Here we investigate a number of dipolarization fronts observed by THEMIS spacecraft by applying the magnetohydrostatic Grad-Shafranov reconstruction technique. Reconstruction results provide reasonable explanation that dipolarization fronts actually originate from highly dissipated flux ropes which are in the late stage of their evolution, subjected to a continuous magnetic deterioration due to anti-reconnection process. These results may have a great impact not only on Earth's magnetotail but also on magnetotails of other magnetized planets like Hermean, Jovian, Kronian, Uranian, and Neptunian, introducing a previously unrevealed perspective concerning magnetotail dynamics.

S2: Extragalactic Astronomy & Astrophysics - Oral Presentations

Wednesday, 11th of September

High Energy Photon and Neutrino Emission from Active Galactic Nuclei

Apostolos Mastichiadis (University of Athens) **(Invited)**

Observations of Active Galactic Nuclei with the Fermi gamma-ray telescope, as well as with ground based Cherenkov detectors, have proven that particles can be accelerated to very high energies in the jets of these objects. I will present some recent developments in our understanding of this field discussing a model where gamma-rays are produced as byproducts of interactions of ultrarelativistic protons with low energy jet radiation. By modeling the complicated radiation transfer equation in detail one can calculate not only the produced gamma-ray spectrum but also the expected neutrino emission. Applying the above to the well monitored BL LAc object Mrk 421, we show that it can explain not only the multiwavelenth spectrum and spectral variability of this source but it predicts, as well, a high energy neutrino flux compatible with the recent detection from the Ice-Cube detector located in the South Pole. If this picture is indeed correct, it will have some important consequences for the role of AGNs as sources of Ultra High Energy Cosmic Rays.

A mechanism for producing intrinsic broken power-law gamma-ray spectra in compact sources

Maria Petropoulou (University of Athens)

We study a mechanism for producing intrinsic broken power-law gamma-ray spectra in compact sources. This is based on the principles of automatic photon quenching, according to which, gamma-rays are being absorbed on spontaneously produced soft photons, whenever the injected luminosity in gamma-rays lies above a certain critical value. We derive an analytical expression for the critical gamma-ray compactness in the case of power-law injection. For the case where automatic photon quenching is relevant, we calculate analytically the emergent steady-state gamma-ray spectra. We show that a spontaneously quenched power-law gamma-ray spectrum obtains a photon index 3√/2, where √ is the photon index of the power-law at injection. Thus, large spectral breaks of the gamma-ray photon spectrum, e.g. ƒ√>1, can be obtained by this mechanism. We also discuss additional features of this mechanism that can be tested observationally. Finally, we fit the multiwavelength spectrum of a newly discovered blazar (PKS 0447-439) by using such parameters, as to explain the break in the gamma-ray spectrum by means of spontaneous photon quenching.

Probing Extragalactic Magnetic Fields and their Role in Cosmic Rays

Nectaria Gizani (Hellenic Open University)

VLA total intensity and polarization observations at L-, C and X-band have been taken to study the environment of powerful radio galaxies in terms of depolarization and external magnetic field. We have found a strong Laing-Garrington depolarization asymmetry between the two sides of the radio emission, which could be explained using the relativistic beaming model as a simple geometric effect. We have fitted a 'cooling flow model' to the X-ray surface brightness profile and a two-power law model to the Faraday dispersion ƒ-profile obtained from the radio data. We found that the extragalactic magnetic field is decreasing with radius with a central value of 3 <= B(ÏG) <= 9. We also probe their role in the acceleration of Cosmic Rays.

Exploring ultraluminous X-ray sources using the optical regime

Jeanette Gladstone (University of Alberta)

Ultraluminous X-ray sources (ULXs) are extragalactic objects located outside the nucleus of their host galaxy, with luminosities $>10^{39}$ erg/s. Such high luminosities are in excess of the Eddington limit for a black hole that is about 10 times the mass of our Sun (M_{Sun}). ULXs have long been touted as evidence of intermediate mass black holes ($M_{BH} = 10^2$-10^5 M_{Sun}), which are thought to be the building blacks of super-massive black holes. The alternative is that ULXs could be stellar mass (< 100 M_{Sun}) black holes accreting at extreme rates, which could explain the rapid growth of super-massive black holes in the early universe. Either option has important cosmological implications, and as a result, mass measurements of these black holes have been a topic of intense interest. Here we present optical analysis of these exotic sources, designed to identify and constrain the companion stars to these black holes. We discuss results from the imaging analysis of 33 nearby ULXs using data from Chandra and the Hubble Space Telescope. We will also present findings from spectroscopic analysis of both pilot and multi-epoch data from 3 of these sources using the Gemini Observatory. By combing this information, we will summarize the implications this work has on both the nature of black holes and companion stars in these systems.

Hidden accretion in supermassive black holes in the XMM CDFS survey

Ioannis Georgantopoulos (National Observatory of Athens)

The XMM-CDFS survey is the most sensitive observation of the X-ray sky (3Ms exposure) taken with ESA's XMM-Newton mission. The main aim of this survey is to find the most heavily obscured AGN. These play an important role in the history of accretion of super-massive black holes in the Universe as they cannot be detected at other wavelengths. Moreover, they represent the first stage of a birth of an AGN and therefore they have cital implications for AGN-galaxy co-evolution models. We compare the findings of the CDFS survey with our recently developed X-ray background synthesis models. Implications for future missions such as eROSITA are also discussed.

The XMM-Newton spectral-fit database

Amalia Corral (IAASARS-NOA)

The XMM-Newton serendipitous source catalogue is the largest catalogue of X-ray sources built to date. In its latest version, the 3XMM-Newton catalogue, it contains more than half a million sources, for which photometric data have been derived. For more than 100,000 of them, spectral products have also been extracted. I will present the XMM-Newton spectral-fit database, containing spectral fitting results for most of the X-ray sources within the 3XMM catalogue for which spectral data are available. The database has been constructed by making use of automated spectral fits. This automated process has been extensively tested and scientifically validated in order to derive the most relevant spectral information for every X-ray source. As a result, the XMM-Newton spectral database represents an unique tool for the astronomical community to construct large and representative samples of X-ray sources by selecting them according to their spectral properties.

The 2-10 keV luminosity function of AGNs from the XMM-Newton LSS and CDFS surveys

Piero Ranalli (National Observatory of Athens), **Georgantopoulos Ioannis** (National Observatory of Athens)

I will present the redshift-dependent luminosity functions (LF) of the X-ray detected AGNs in XMM-Newton LSS and CDFS surveys. The two surveys are complementary in terms of probed luminosity and redshift space, with the LSS covering the local universe over a large sky area, and the CDFS reaching the faintest objects observed by XMM-Newton. The LFs are built from a total of ~2000 objects detected in the 2-10 keV band and with a redshift, making it one of the largest samples available. For the LSS, different approaches to obtain completeness corrections, needed to account for objects without a redshift determinations, will be illustrated. The luminosity function will be compared to previous determinations and models.

AGN in the XMM-LSS clusters

Elias Koulouridis (National Observatory of Athens)

One of the most intriguing problems of extragalactic astrophysics is the understanding of AGN phenomenology and undoubtedly, the best way to detect active galaxies is through X-ray observations. The effect of the environment on the activity of the nucleus and vice versa is still undetermined, but nevertheless crucial in order to determine the possible triggering mechanism of the phenomenon. We will present an X-ray and optical analysis of 20 low redshift ($0.14<z<0.35$) and 14 high redshift ($0.43<z<1.05$) clusters in the XMM-LSS survey, which is the largest (11.1 deg2) contiguous x-ray survey to date and the first completed section of the XXL survey. Our aim is to expand our study on the effect of the dense and hot cluster environment on the triggering of the AGN phenomenon in the XXL survey (~50 deg2) when it is completed.

Clustering as a function of X-ray AGN properties

Lazaros Koutoulidis (NOA & Univ. of Patras)

It is now well established that there is an interplay between the evolution of galaxies and the accretion of supermassive black holes (SMBHs) that hosts, a connection that is suggested by the observed tight correlation between black hole and galaxy bulge masses. While the SMBH vs galaxy co-evolution is now an accepted scenario the physical details are not fully understood yet. For understanding the formation and evolution of galaxies one must study the active period of these systems. For that reason AGN provide us a lot of information especially at high redshifts. X ray surveys have allowed for detailed examination of the host galaxies and environments of X-ray AGN providing insight on the role of AGN. Measuring the clustering of AGN provide us important information about the AGN evolution models and put constraints in the relation between AGN activity and their dark matter halo hosts, the host galaxy type and the AGN lifetime. We present the spatial clustering properties of 1466 X-ray selected AGN compiled from the Chandra CDF-N, CDF-S, eCDF-S, COSMOS and AEGIS fields in the 0.5-8keV. The X-ray sources span the redshift interval 0<z<3. Furthermore we investigate if there is a dependence of the clustering strength on X-ray luminosity, on obscuration and optical color. We find indications for a positive dependence on clustering length on X-ray luminosity, in the sense that the more luminous sources have a larger clustering length and hence a higher dark matter halo mass. These findings appear to be consistent with a galaxy-formation model where the gas accreted onto the supermassive black hole in intermediate luminosity AGN comes mostly from the hot-halo atmosphere around the host galaxy.

Unsupervised spectral classification of synthetic galaxies using Principal Components Analysis

Antonios Karampelas (University of Athens)

We present an unsupervised spectral classification method, able to focus on the variances between the various spectra and identify spectral subtypes. A classification Decision Tree separates the spectra into several subtypes, based on Principal Components Analysis (PCA). The method was applied to synthetic galaxy spectra produced for ESA's cornerstone Gaia Mission, where the spectral type is known a priori. The results are very promising, since each defined subtype appears unique in terms of spectral shape and location on suitable PCA diagrams. This method could be used to classify galaxy and stellar spectra of all the major space and ground-based surveys.

AGN clustering using photometric redshifts

George Mountrichas (National Observatory of Athens)

The clustering properties of active galactic nuclei (AGN) are a powerful diagnostic of the mechanism that dominates the fuelling of supermassive black holes (SMBHs) across cosmic time. The problem is that current clustering analysis techniques depend heavily on spectroscopy for the AGN. I will present a new clustering method that does not require spectroscopy but uses photometric redshift probability distribution functions (PDFs) to determine the real-space correlation function of AGN. Results using this method will be shown for X-ray and IR selected sources and will be compared to the classical spectroscopic approach. This method will allow the optimal exploitation of the data of future and ongoing surveys (e.g. Pan-STARRS1, CANDELS, eROSITA).

Hand in hand: the co-evolution of AGN and their host galaxies

Marios Karouzos (CEOU, Seoul National University)

Supporting evidence for the co-evolution of central supermassive black holes and their host galaxies is ample. The exact role of nuclear activity, in the form of accretion onto these supermassive black holes, in this co-evolution remains however still unclear. We use a rich multi-wavelength dataset available for the North Ecliptic Pole field, most notably surveyed by the AKARI satellite infrared telescope to study the host galaxy properties of AGN. In particular we are interested in investigating star-formation in the host galaxies of radio-AGN and the putative radio feedback mechanism, potentially responsible for the eventual quenching of star-formation. Using broadband SED modeling, fitting simultaneously the passive host galaxy, the star-formation component, as well as the active nucleus. We study these as a function of the sources' radio luminosity and radio-loudness. We can also investigate the potential interplay between them. Here the close connection between AGN and star-formation in their host galaxies is shown, with a positive correlation between the two inferred. Tentative evidence that jets are inefficient star-formation quenchers, except in their most powerful state are offered. A maintenance mode for radio-AGN is supported, where jets effectively regulate rather than quench star-formation in their host galaxies.

Radio properties of galaxy groups in the Local Universe (<80 Mpc)

Konstantinos Kolokythas (University of Birmingham)

The most likely source of energy injection into the intergalactic medium of galaxy groups is AGN (Active Galactic Nuclei) feedback. Since >50% of galaxies in the local Universe reside in groups and many of them host radiative cooling gas halos, which can fuel a central SMBH, they are probably the key environment for the study of AGN/hot gas interactions. Using a complete, optically selected sample of groups -the Complete Local-Volume Groups Sample (CLoGS) project- observed in both radio and X-ray bands, I examine the radio properties of AGN in nearby galaxy groups. My work targets to the characterization of the AGN population in groups, and examination of their impact on the intra-group gas and member galaxies. By focusing on low-frequency radio emission (240 MHz and 610 MHz), past as well as current AGN activity can be identified with the combination of good spatial resolution at 610 MHz and the sensitivity to older electron populations at 235 MHz. The combination then of radio with optical and X-ray bands reveals the complex interactions with their environment and the physical processes that govern galaxy transformations. Results from our new GMRT observations at 235 and 610 MHz will be presented here for the first time for the systems of 4261, 5982, 1060 and 5903. These systems are good examples of the wide variety of radio properties: from groups dominated by a single powerful central source (4261), through weak AGN and star-formation dominated systems (1060, 5982) to diffuse, merger-related sources (5903). These are all important for the investigation of the IGM/AGN connection and the understanding of the physical mechanisms of the energy injection.

AGN feedback at high redshfit: the case of HS 1700+6416

Giorgio Lanzuisi (National Observatory of Athens)

We present a detailed analysis of the X-ray emission of HS 1700+6416, a high redshift (z = 2.7348) luminous quasar classified as a narrow absorption line (NAL) quasar. The source has been observed sever times by Chandra and XMM-Newton from 2000 to 2007. One broad absorption feature is clearly detected at 10.3 ± 0.7 keV (source frame) in the Chandra observation of 2000, while two similar features at 8.9 ± 0.4 and at 12.5 ± 0.7 keV are visible in the Chandra observations of 2007. We interpreted these features as absorption lines from a high-velocity, highly ionized (i.e. Fe XXV, FeXXVI) outflowing gas. In this scenario, the outflow velocities inferred are in the range v= 0.12 - 0.59c. To reproduce the observed features, the gas must have a high column density (NH > 3 x 10^{23} cm^{-2}), high ionization parameter (logÓ> 3.3 erg cm s^{-1}) and a wide range of velocities (‰V ~ 10^{4} km s^{-1}). A rough estimate of the kinetic energy carried by the wind of up to 18% Lbol, based on a biconical geometry of the wind, implies that the amount of energy injected into the outflow environment is large enough to produce effective mechanical feedback, and suppress the star formation in the host galaxy.

Analytical study of the structure of chaos near unstable points

George Contopoulos, **Efthymiopoulos C.**, **Katsanikas M.** (RCAAM, Academy of Athens) **(Invited)**

In a 2D conservative Hamiltonian system there is a formal integral \Phi besides the energy H. This is not convergent near a stable periodic orbit, but it is convergent near an unstable periodic orbit. We explain this difference and we find the convergence radius along the asymptotic curves. In simple mappings this radius is infinite. This allows the theoretical calculation of the asymptotic curves and their intersections at homoclinic points. However in more complex mappings and in Hamiltonian systems the radius of convergence is in general finite and does not allow the theoretical calculation of any homoclinic point. Then we develop a method of analytic continuation, applicable in systems expressed in action-angle variables, that allows the calculation of the asymptotic curves to an arbitrary length. In this way we can study analytically the chaotic regions near the unstable periodic orbit and near its homoclinic points.

The dynamical backbones of observed structures in barred-spiral models

Panos Patsis (RCAAM, Academy of Athens)

The flow in the arms of spiral galaxies is qualitatively different among different morphological types. The stars that reinforce the spiral arms can be either participating in an ordered or in a chaotic flow. Ordered flows are typically described by precessing ellipses corresponding to stable periodic orbits at successive energies (Jacobi constants). Contrarily, there are spiral arms in barred-spiral systems which may be supported by stars in chaotic motion "along" the arms. The trajectories of these stars are associated with the invariant manifolds of unstable periodic orbits at corotations region. We find that the spirals and the outer parts of the bars share the same orbital content. However, there also barred-spiral systems with spirals inside corotation, consisting mainly by chaotic orbits, or by ordered flows. The talk will present models where various dynamical mehanisms coexits and will compare them with structures that are possible the result of the concerted action of these mechanisms on the disks.

The diffusion of chaotic orbits in 3D barred spiral galaxies

Mirella Harsoula (RCAAM, Academy of Athens)

We study the way in which the 3D chaotic orbits, initially belonging to the bar of an N-body model simulating a barred spiral galaxy, are getting diffused outwards. An important percentage of these orbits stay trapped for very long time inside the corotation radius and behave as regular orbits. In the 4D phase space these orbits seem to be trapped close to rotational tori of stable periodic orbits, or close to simply unstable periodic orbits, supporting the shape of the bar. After they get diffused outwards, they get trapped along the asymptotic manifolds of the simply unstable periodic orbits of the region outside corotation and support the shape of the spiral structure for approximately 100 half mass crossing times of the system (Thmct), before escape from it. This phenomenon of diffusion through the 3rd dimension is known as "Arnold Diffusion".

Invariant manifolds and chaotic spiral structure

Christos Efthymiopoulos (RCAAM, Academy of Athens)

The talk will review the theory of chaotic spiral structure generated in disc galaxies by the unstable invariant manifolds of unstable periodic orbits in the corrotation domain. We will also discuss some applications of the manifold theory in particular galactic systems, as appeared recently in the literature.

The power-law dependence of the Lyapunov exponents on the central mass in galaxies

Nikos Delis (RCAAM, Academy of Athens and University of Athens)

We propose a theoretical interpretation for the observed (in numerical simulations) relation L~m^p , where L is the mean Lyapunov characteristic exponent of the chaotic orbits in galaxies hosting central black holes, and m is the ratio of the mass of the black hole over the mass of the galaxy. We construct a simple analytical model showing that in every close encounter with the central mass, a star's orbit exhibits a locally positive `stretching number', i.e. local Lyapunov exponent. Also, by the geometrical properties of the orbits, we estimate the frequency of visits of a chaotic orbit inside the black hole's sphere of influence, as well as the mean Lyapunov number as a function of the energy of an orbit. Combining these estimates, we find a theoretical value of the exponent p=2/3-q, with q~0.1-0.2. This value is verified by detailed numerical experiments. Finally, we show the applicability of the L~m^p law also in the case of rotating barred galaxies.

Thursday, 12th of September

Nearby galaxies as seen by the Herschel Space Observatory

Manolis Xilouris (National Observatory of Athens - IAASARS) **(Invited)**

I briefly discuss the capabilities of ESA's Herschel Space Observatory and present observations of nearby galaxies. In particular, I examine the gas and dust properties in local star-forming galaxies and Ultra Luminous Infrared Galaxies (ULIRGs), as well as galaxies in dense cluster environments.

Probing the interstellar medium of the NGC1569 super star cluster population with Herschel

Sophia Lianou (Western University), **Barmby Pauline** (Western University), **Madden Suzanne** (Laboratoire AIM, CEA), **Remy Aurelie** (Laboratoire AIM, CEA)

NGC1569 is one of the strongest nearby starburst dwarf galaxies as revealed by its super star cluster population. Its current distance estimate places it in the IC342 group of galaxies, thus tidal interactions with the IC342 group member galaxies may have triggered the starburst and the super star cluster formation. With the ultimate goal of understanding the impact of massive star formation on the interstellar medium, we derive properties of the interstellar medium surrounding the super star cluster population and of the galaxy globally. We use multiwavelength imaging, including new Herschel observations, to measure star formation rates, dust masses, and stellar masses. We find that the super star clusters have very little dust and contain only a tiny fraction of the total dust mass in NGC1569. Super star clusters are sometimes considered to be the young counterparts of the old Galactic globular clusters, which also have very little dust or gas. Thus, the starburst dwarf galaxy environment of NGC1569 may hold clues to the processes responsible for the missing intracluster medium in old Galactic globular clusters.

Modeling the dust emission in ULIRGs

Ioanna Leonidaki (National Observatory of Athens - IAASARS)

We present the most complete dust modeling of the Herschel Comprehensive (U)LIRG Emission Survey (HerCULES) key program. This, in conjunction with molecular line modeling, reveals extraordinary coupling between the thermal state of the dust and the gas in some merger starbursts. This indicates non-photon driven heating for the molecular gas, unlike the dust component. Moreover, our very well-sampled dust SEDs of local starbursts allows us to evaluate the uncertainty of the radio-to-submm spectral index as a redshift indicator of high redshift starbursts.

Optical Spectroscopy for the Star Formation Reference Survey (SFRS)

Alexandros Maragkoudakis, **Zezas Andreas** (University of Crete), **Ashby Matthew**, **Willner Steve** (Harvard-Smithsonian Center for Astrophysics)

The Star Formation Reference Survey (SFRS) is a multi-wavelength project, studying the processes of star formation in the local Universe and the possible feedback between star formation and AGN, using a representative sample of 369 nearby star-forming galaxies. We present the first results from our long-slit spectroscopic campaign and the activity classification of the sample galaxies, based on optical emission-line diagnostics. We find that the majority of the sample galaxies observed so far are star-forming with a small fraction of LINERs, and an even smaller number of Seyfert nuclei. From the observed metallic lines we also measure the metallicity of the sample galaxies. We find that all galaxies in the sample appear to have metallicities in the range of our own Galaxy close to solar. Furthermore, we examine the influence of aperture effects in the activity classification of galaxies based on long-slit as well as fiber spectrometers (e.g. SDSS). We find that there is a significant change in classification as we include larger fraction of the host galaxy light in the extraction aperture. Most importantly we find that current methods for star-light subtraction cannot always remove the effect of the star-light contamination.

Properties of the Molecular Gas in Outflows vs. in the Ambient Medium: A Case Study on the Radio-loud Galaxy 4C12.50

Kalliopi Dasyra (Observatoire de Paris)

Theoretical studies indicate that the feedback of active galactic nuclei (AGN) is capable of affecting the evolution of galaxies, and observational data confirm that this could be the case in at least a handful of nearby objects with massive molecular outflows expelling hundreds to thousands of solar masses of gas per year. We will discuss follow-up Herschel and IRAM PdB CO observations of a local radio-loud and ultraluminous-infrared galaxy in which a massive molecular gas outflow was detected in purely rotational H_2 lines with Spitzer. Main findings from the comparison of the multi-wavelength data are (i) that the mass ratio of warm (~400K) to cold (~10K) molecular gas is considerably higher in the outflow than that in the ambient interstellar medium, and (ii) that the amount of cold gas in the outflow is at most twice as high as the amount of warm gas. These results constitute direct evidence of a scenario claiming that the outflowing gas is inefficient in forming stars due to turbulent heating. They also indicate that both millimeter and IR data could be needed for reliable measurements of outflow masses.

The physical properties of luminous infrared galaxies: unveiling the dust

Vassilis Charmandaris (University of Crete & FORTH) **(Invited)**

A major result of the IRAS survey, the first unbiased survey of the sky at mid and far-infrared wavelengths, was the discovery of a large population of luminous infrared galaxies (LIRGs), which emit a significant fraction of their bolometric luminosity in the far-infrared, log[L(8-1000 Ïm)] > 11 Lsun. LIRGs cover the full range of morphologies from single isolated disk galaxies, to interacting systems and advanced mergers, exhibiting enhanced star-formation rates and a higher fraction of Active Galactic Nuclei (AGN) compared to less luminous galaxies. Although rare in the local universe LIRGs are 1000 times more abundant at z~1-2, dominating the total energy density production. Furthermore, recent studies have revealed that the even most extreme of these distant systems, the Ultra LIRGS log[L(8-1000 Ïm)] > 12 Lsun (the so called ULIRGs), do not resemble their local ULIRG analogues, but the instead the lower luminosity local LIRGs. I will present a summary of our current understanding on the physical properties of LIRGs based on the study of the Great Observatories All-Sky LIRG Survey (GOALS, Armus et al. 2009), a complete infrared selected flux-limited sample of galaxies. I will rely on recent mid- and far-infrared spectroscopy of the sample using the Spitzer and Herschel Space Telescopes, which provides a nearly extinction free view of the nuclear regions of these systems. Using a variety of diagnostics I will discuss the excitation conditions of the atomic and molecular gas, the spatial extend of the circumnuclear starbursts as well as the contribution of optically obscured AGN to their total luminosity.

Herschel observations of Hickson compact groups of galaxies: Unveiling the properties of cold dust

Theodoros Bitsakis (University of Crete)

We present results of a Herschel far-IR and sub-mm study of a sample of 120 galaxies in 28 Hickson Compact Groups. Using the theoretical model of da Cunha et al. (2008), we have estimated the dust masses, luminosities and temperatures of the individual galaxies. Based on our results, we find that about half of the late-type galaxies in dynamically "old" groups, which were found to display redder UV-optical colors, have significantly lower dust-to-stellar mass ratios compared to those of actively star-forming galaxies of the same mass found both in HCGs and the field. Examining their dust-to-gas ratios we conclude that it is much easier for the dynamical interactions to strip the HI rather than the interstellar dust and H2 out of the galaxies. About 40% of the early-type galaxies (mostly lenticulars), of the dynamically "old" groups, where found to display similar dust properties with the "red" late-type galaxies. We detect the presence of diffuse cold dust in 4 HCGs and we estimate its mass. In addition, we quantify the fraction of the 250Ïm emission, which is located out of the main bodies of the "red" late-type galaxies to be 20% of their total emission at this band. Our findings suggest that the "red" late-type, as well as these lenticular galaxies should consist the transition populations between the star-forming and the quiescent galaxies sequences. On the other hand, the complete absence of any correlation between the dust and stellar masses of the elliptical galaxies (about 30% of the far-IR detected early-type galaxies), implies the external origin of their dust content.

The Radio Continuum Properties of Luminous Infrared Galaxies

Eleni Vardoulaki (University of Crete), **Charmandaris Vassilis** (University of Crete), **Armus Lee** (Caltech), **Murphy Eric J** (Garnegie Observatories), **Diaz-Santos Tanio** (Caltech), **Evans Aaron** (University of Virginia)

Luminous Infrared Galaxies (LIRGs) are systems enshrouded in dust, which absorbs most of their optical/UV emission reradiating it in the mid- and far-infrared. Radio observations are completely unaffected by dust obscuration enabling us to study the central regions of LIRGs in an unbiased manner. Here we present our first results on the radio continuum properties of the Great Observatories All-sky LIRG Survey (GOALS), which consists of 202 low-redshift ($z < 0.088$) systems. Our radio sample of objects observed both at 1.49 & 8.44 GHz (A array configuration), includes 35 systems or 42 individual galaxies. The main goal of this project is to examine how the radio properties of local LIRGs relate to their infrared spectral characteristics. We identify the presence of an active nucleus using the radio structure, deviations from the radio/infrared correlation and spatially resolved spectral index maps. We correlate this to the usual mid-infrared AGN diagnostics, which show that only 10% of local LIRGs host an AGN, and in particular the [NeV]/[NeII] line ratios and the EQW of the 6.2-micron PAH feature. We find that ~20% of the LIRGs in our final sample are confirmed AGN based on our method of radio classification. We furthermore find that ~5% of the objects are confirmed AGN, although they were not identified as such by the mid-IR AGN diagnostics. Additionally, we calculate the size of the area where the radio spectral index is flat ($\alpha < 0.5$; $S \sim \nu^{\alpha}$), which corresponds to compactness based on the study of Murphy et al. This gives us a measure of the size of the emitting area in the radio. Finally, since there is a tight correlation between radio and infrared luminosities, we compare the size of the mid-IR area from Diaz-Santos et al. with the radio sizes calculated from the radio maps, to investigate a possible connection between the emitting areas.

Tracing the Evolving Interstellar Medium of star forming galaxies since z=2

Georgios Magdis (University of Oxford)

The Herschel Space Observatory has opened a new window into galaxy evolution, allowing for the first time a detailed and unbiased view of the galaxies responsible for the bulk of the star formation activity in the last 10 billion years. By combining results from the GOODS-Herschel program, that provide the deepest far-IR view of distant star forming galaxies (z=1-2), with a unique far-IR spectroscopic survey of intermediate redshift galaxies (z=0.2-0.6), that has recently be completed, I will trace the evolution of the interstellar medium in star forming galaxies through cosmic time and present: - a new technique to measure the gas content of distant galaxies based on robust M_dust estimates that are now feasible with Herschel and ground based mm observations - evidence that variations in the star formation activity of the galaxies echo variations in their fraction of molecular gas - evidence that the contrasting nature of local and high-z ULIRGs, appears to be already at place at z~0.3

S2: Extragalactic Astronomy & Astrophysics - Poster Presentations

S2-1. Automatic quenching of power law gamma ray spectra from compact sources

Dafni Arfani (University of Athens)

We study a non linear mechanism for producing intrinsic broken power law spectra in the GeV-TeV energy range in AGN SEDs, based on the principles of automatic photon quenching according to which, γ-rays are being absorbed on spontaneously produced soft photons whenever the injected luminosity in γ-rays lies above a certain critical value. More specifically, we derive an analytical expression for the critical γ-ray compactness in the monoenergetic case of γ-ray injection and we generalize in the case of injection in two and finally in N discrete energies in γ-rays. Passing on to the continuous case, we discuss our results which are currently leading to some interesting suggestions about the observational features of the mechanism (see Petropoulou M., Arfani D. and Mastichiadis A., accepted in A&A)

S2-2. Photohadronic Instability Model for GRB Prompt Emission

Stavros Dimitrakoudis (University of Athens)

The mechanisms behind gamma-ray bursts (GRBs) are not yet well understood. Here we investigate a model where a spectral energy distribution (SED) that looks surprisingly like a typical GRB prompt emission is generated starting with merely high energy protons and a magnetic field. Using a self-consistent, time-dependent code we show that when the density of such protons exceeds a certain threshold their energy is converted explosively to lower energy photons through a series of positive feedback loops. At even higher densities, Compton scattering of cold electrons shapes the low energy part of the SED into the familiar Band function, a distinctive peak between 1-10 keV (in the comoving frame) in GRB observations. This approach, although similar to the photospheric GRB model, also allows us to investigate the neutrino emission, which can be compared with recent ICECUBE limits.

S2-3. Continuous optical monitoring of the highly active blazar Mrk421

Kosmas Gazeas (University of Athens), **Petropoulou Maria** (University of Athens), **Mastichiadis Apostolos** (University of Athens)

We present the recent photometric monitoring of blazar Mrk421, obtained from the Gerostathopouleio Observatoty at University of Athens. Follow-up observations have been performed on this source after a highly energetic flare which occurred on 13 April, 2013. The flare was observed in X- rays by Nustar & Swift and in GeV - TeV gamma-rays by the Fermi satellite and MAGIC/VERITAS telescopes respectively. Continuous photometric monitoring in the optical BVRI bands during 3 months after the flaring activity reveals a quasi-periodic light variation. This is one of the few times that Mrk 421 was observed for such a long period without large observational gaps. We perform Fourier analysis of the almost uninterrupted 3-months-long dataset in order to get insight on the characteristic timescales of the system. We discuss also possible origins of the optical variability by performing cross-correlation analysis of the optical and of the simultaneous X-ray emission detected with XRT onboard the SWIFT orbital satellite.

S2-4. Solving the wind equation for relativistic magnetized jets

Konstantinos Karampelas (University of Athens), **Millas Dimitrios** (University of Athens), **Katsoulakos Grigorios** (University of Athens), **Lingri Dimitra** (University of Athens), **Vlahakis Nektarios** (University of Athens)

We approach the problem of bulk acceleration in relativistic, cold, magnetized outflows, by solving the momentum equation along the flow, a.k.a. the wind equation, under the assumptions of steady-state and axisymmetry. The bulk Lorentz factor of the flow depends on the geometry of the field/streamlines and by extension, on the form of the "bunching function" $S=r^2\ B_p/\ A$, where r is the cylindrical distance, B_p the poloidal magnetic field, and A the magnetic flux function. We investigate the general characteristics of the S function and how its choice affects the terminal Lorentz factor gamma_f and the acceleration efficiency gamma_f/mu, where mu is the total energy to mass flux ratio (which equals the maximum possible Lorentz factor of the outflow). Various fast-rise, slow-decay examples are selected for S, each one with a corresponding field/streamlines geometry, with a global maximum near the fast magnetosonic critical point, as required from the regularity condition. As it is proved, proper choices of S can lead to efficiencies greater than 50%. Last, we apply our results to the momentum equation across the flow, in an effort to estimate their validity, as well as identifying the factors that lead to an accurate full-problem solution. The results of this work, depending on the choices of the flow integral mu, can be applied to relativistic GRB or AGN jets.

S2-5. Study of the C IV (1548.187 - 1550.772), Si IV (1393.755 - 1402.770) and O IV (401.156) regions of the QSO J021327.25-001446.93

Christos Katsavrias (University of Athens), **Danezis Emannouil** (University of Athens), **Antoniou Antonis**

Boad Absorption Line Regions - BALR are composed of a number of successive independent absorbing density layers. Using the GR model, we analyze the UV Si IV (1393.755 - 1402.770), O IV (1401.156) and C IV (1548.187 - 1550.772) resonance lines in the spectra of a certain QSO and discuss the results concerning its kinematic properties (rotational, radial and random velocities).

S2-6. Stellar and gas spiral arm dynamics in barred-spiral systems

Spyridon Kitsionas (HAEF, Psychico College)

We study the formation of spiral arms in barred-spiral systems in response models for which different distributions of jacobi constants are assumed for the initial conditions.

S2-7. Highly obscured AGN in deep surveys

Giorgio Lanzuisi (National Observatory of Athens)

Highly obscured, Compton-thick (N_H>1.5 x 10^{24} cm^{-2}) AGN are common in the local universe, and at high z are thought to be responsible for the peak of the cosmic X-ray background at about 30 keV. They may also represent an important early phase in the AGN/Galaxy co-evolution. Nevertheless they are elusive, and very difficult to identify at high z with current facilities. We present first results on a systematic search for CT AGN in COSMOS and Lockman Hole deep X-ray surveys.

S2-8. Imagecube: an astropy affiliated package

Sophia Lianou (Western University), **Barmby Pauline** (Western University), **Taylor Jeff** (Western University)

Astropy is a community python library for astronomy. Imagecube has been developed as an astropy affiliated package for processing multiwavelength (spectro)-imaging. This module automates tedious steps of image processing and analysis and delivers a science-ready image datacube. The included steps involve converting to common flux units, image registration to a common WCS, and convolution to a common resolution. Individual steps can be performed separately. We test the module using the dwarf galaxy NGC1569 by producing its observed spectral energy distribution on a pixel-by-pixel basis.

S2-9. Studying the profile of C IV, S IV and O IV in the QSO J031828.9-001523.1

Stefania Mitrokotsa (University of Athens)

In this paper, using the GR model, we analyze the UV CIV and SiIV resonance lines and the absorption line of OIV in the spectrum of quasar J031828.9-001523,1. We study the presence and behavior of absorption and emission clouds analyzing their characteristics. From this analysis we can calculate the values of a group of physical parameters, such as the apparent rotational and radial velocities, the random velocities of the thermal motions of the ions, the Full Width at Half Maximum (FWHM), the optical depth, as well as the absorbed energy and the column density of the independent regions of matter which produce the main and the satellites clouds of the studied spectral lines.

S2-10 Are counter-rotating jets possible?

Nektarios Vlahakis (University of Athens), **Sauty Christophe**, **Cayatte Veronique** (Observatoire de Paris, France), **Matsakos Titos** (CEA, France), **Tsinganos Kanaris** (University of Athens and National Observatory of Athens), **Lima Joao** (Universidade do Porto, Portugal)

Young stellar object observations suggest that some jets rotate in the opposite direction with respect to their disk. In a recent study, we have shown that this can be well in agreement with the magnetocentrifugal mechanism that is believed to launch such outflows. Here, we extend this analytical derivation to relativistic jets demonstrating that under rather general conditions counter-rotation can indeed take place. We also illustrate the involved mechanism by performing relativistic magnetohydrodynamic jet simulations.

S2-11 Investigating the influence of dark matter on the nature of motion in axially symmetric galaxies

Euaggelos Zotos (Aristotle University of Thessaloniki)

An axially symmetric galactic gravitational model composed of a dense, massive, spherical nucleus and a dark matter halo component is used in order to reveal the regular or chaotic character of orbits of stars moving in the meridional plane. Two different cases are under investigation: (i) the case where we have a disk galaxy model (ii) the case where our model represents an elliptical galaxy. Of particular interest, is the influence of the portion of the dark matter on the nature of orbits. As a tool for distinguishing between ordered and chaotic motion, we use the Fast Lyapunov Indicator (FLI) method to extensive samples of orbits obtained by integrating numerically the equations of motion as well as the variational equations. In each case, we compute not only the percentage of chaotic orbits, but also the percentages of orbits composing the main regular resonant families. The classification of regular orbits into different families is made using a method which is based on the field of spectral dynamics. This method calculates the Fourier transform of the coordinates of an orbit, identifies its peaks, extracts the corresponding frequencies and then searches for the fundamental frequencies and their possible resonances.

S3: Cosmology and Relativistic Astrophysics - Oral Presentations

Wednesday, 11th of September

Torsional modified gravity and cosmology

Emmanuel Saridakis (Baylor University)**(Invited)**

Torsion has been proved to be crucial in gauging gravity, which is in turn a necessary step towards its quantization. On the other hand, almost all the efforts in modifying gravity has been performed in the usual curvature-based framework. We investigate the case where one modifies gravity based on its torsional-teleparallel formulation, namely the f(T) gravity paradigm, and its cosmological applications. In particular, we analyze the perturbations of the theory examining the growth history, we construct a cosmological bounce, and we use solar system observations in order to impose constraints on the f(T) forms. Additionally, we study the case where T is nonminimally coupled to a scalar field, that is the scenario of teleparallel dark energy. Finally we analyze the charged black hole solutions of the theory, performing a comparison between f(R) and f(T) modifications.

Testing General Relativity on Cosmological scales

Athina Pouri (University of Athens/RCAAM, Academy of Athens)

In order to test the validity of General Relativity (GR) on cosmological scales, it has been proposed that measuring the so called growth index, γ, could provide an efficient way to discriminate between scalar field dark energy models which admit to general relativity and modified gravity models. Using the clustering properties of the X-ray selected AGNs and galaxy clusters we attempt to place tight constraints on the growth index γ and thus testing possible departures from GR.

Chern-Simons Modified Gravity

Panagiotis Efstratiou (University of Thessaloniki)

This presentation will be based on my, undergraduate, thesis at Aristotle University of Thessoliniki with the same subject, supervised by Professor Demetrios Papadopoulos. I will first present the general mathematical formulation of the Chern-Simons (CS) modified gravity, which is split in a dynamical and a non-dynamical context, and the different physical theories which suggest this modification. Then proceed by examing the possibility that the CS theory shares solutions with General Relativity in both contexts. In the non-dynamical context I will present a new, undocumented solution as well as all the other possible solutions found to date. I will conclude by arguing that General Relativity and CS Theory share any solutions in the dynamical context.

The Euclid space mission

C Sofia Carvalho (CAAUL/RCAAM Portugal, RCAAM Academy of Athens)

I will present the Euclid space mission. Euclid is an ESA medium class mission selected for launch in 2019. The main goal of Euclid is to understand the origin of the accelerating expansion of the Universe attributed to dark energy. Since dark energy imprints effects on galaxies, which are a tracer of the large-scale structure, the strategy will be to map out the large-scale structure of the Universe with unprecedented accuracy. Euclid will explore the expansion history of the Universe, as well as the growth and distribution of cosmic structure over a very large fraction of the sky. To achieve this, Euclid will be equipped with a 1.2 m telescope and three imaging and spectroscopic instruments working in the visible and near-infrared wavelength domains. Finally I will present the expected results for cosmology.

Supermassive black hole accretion modes to z~1.

Antonis Georgakakis (Max-Planck-Institut fur Extraterrestrische Physik, and NOA)

I will present observational constraints on (i) the large scale clustering of X-ray AGN as a function of accretion luminosity and redshift to z~1 (ii) their Eddington ratio distribution as a function of the level of star-formation and morphology of their host galaxies. The results will be discussed in the context of semi-analytic models for the formation of AGN and galaxies to show that they are consistent with two modes for the fuelling of SMBHs to z~1. The first dominates the accretion density and is associated with high specific star-formation galaxies, while the second is sub-dominant and takes place in quiescent systems.

Properties of the radio jet emission of four gamma-ray Narrow Line Seyfert 1 galaxies

Emmanouil Angelakis, **Fuhrmann Lars & Myserlis Ioannis** (MPIfR)

The detection of γ-rays from a small number of Narrow Line Seyfert 1 galaxies by the LAT instrument onboard Fermi seriously challenged our understanding of AGN physics. Among the most important findings associated with their discovery has been the realisation that smaller-mass black holes seem to be hosted by these systems. Immediately after their discovery a radio multifrequency monitoring campaign was initiated to understand their jet radio emission. Here the first results of the campaign are presented. The light curves and some first variability analyses are discussed, showing that the brightness temperatures and Doppler factors are moderate. The phenomenologies are typically blazar-like. The frequency domain on the other hand indicates intense spectral evolution and the variability patterns indicate mechanisms similar to those acting in the jets of BL Lacs and FSRQs. Finally, the linear polarisation also reveals the presence of a quiescent, optically thin jet in certain cases.

Adventures in the microlensing cloud: eResearch tools for zooming into the heart of quasars

Georgios Vernardos (Swinburne University of Technology Melbourne)

Gravitational cosmological microlensing is an established technique for exploring the structure of the inner parts of a quasar, especially the accretion disc and the central supermassive black hole.Results from studies on ~20 of the ~90 known lensed systems, indicate the presence of a thin Shakura-Sunyaev disc (Eigenbrod et al. 2008, Blackburne et al. 2011, Mediavilla et al. 2011), although this is not always the case (Floyd et al. 2009, Morgan et al. 2010). Upcoming all-sky synoptic surveys are expected to discover, and monitor regularly, thousands of new microlensed systems. The GPU-Enabled, High-Resolution cosmological MicroLensing parameter survey (GERLUMPH) can be thought of as a theoretical counterpart of an all-sky survey, which explores the microlensing parameter space in preparation for these new discoveries. GERLUMPH's high resolution magnification maps, the basic tool for quasar microlensing, allow for statistical studies of accretion disc models and comparisons to observations. As the volume of astronomical data sets continues to increase, there is a growing need to move more analysis tasks to a remote service model on cloud-like architectures. I will describe how the GERLUMPH data form a computationally demanding part of the microlensing eResearch cloud, and what are the interactions between its various constituents.

Thursday, 12th of September

A Newtonian problem as a guide of relativistic astrophysics

Theocharis Apostolatos (University of Athens) **(Invited)**

A 250 year old problem, that of Euler's two fixed gravitational centers, proves strikingly analogous to that of a Kerr black hole. We will exhibit the extend of the corresponding analogy, and use it to draw quantitative conclusions for the relativistic problem, that are difficult to obtain otherwise.

Accreting magnetars: spectral formation in the accretion shock

Nikolaos Kylafis (University of Crete)

It is well known that accretion onto magnetic neutron stars, with magnetic fields in the range of 10^{12} ,Äì 10^{13} G, results in the formation of a radiative shock in the accretion column. For luminosities of Anomalous X-ray Pulsars (AXPs) and Soft Gamma-ray Repeaters (SGRs), which are in the range 10^{34}-10^{36} erg/s, the transverse optical depth of the accretion column at the shock is relatively small compared to that of normal X-ray pulsars like Her X-1. Assuming that AXPs and SGRs have normal (10^{12} - 10^{13} G) dipole fields and accrete from a fall-back disk, we have studied by Monte Carlo the upscattering of soft X-ray photons by allowing them to crisscross the radiative shock as many times as the optical depth dictates. We have found that the resulting X-ray spectrum reproduces the persistent and transient X-ray spectra, both soft and hard, observed from AXPs and SGRs. In particular, one can obtain a high-energy power-law spectrum, with photon number spectral index $\Gamma \sim 1$ and a cutoff around 100 keV, with a transverse Thomson optical depth of ~ 5. In our model, the outbursts with super-Eddington luminosities are produced in localized super-strong (10^{14} - 10^{15} G) multipole fields.

Black hole jets

Ioannis Contopoulos (RCAAM, Academy of Athens)

We revisit the Blandford & Znajek (1977) process and solve the fundamental equation that governs the structure of the steady-state force-free magnetosphere around a Kerr black hole. The solution depends on the distributions of the magnetic field angular velocity and the poloidal electric current I. These are not arbitrary. They are determined self-consistently by requiring that magnetic field lines cross smoothly the two singular surfaces of the problem, the inner `light surface' located inside the ergosphere, and the outer `light surface' which is the generalization of the pulsar light cylinder. We obtain the rate of electromagnetic extraction of energy and confirm the results of Blanford & Znajek. Unless the black hole is surrounded by a thick disk and/or extended disk outflows, the asymptotic solution is very similar to the asymptotic pulsar magnetosphere which has no collimation and no significant plasma acceleration. We discuss the role of the surrounding disk and of pair production in the generation of black hole jets.

Searching for chaos around black hole candidates

Georgios Loukes-Gerakopoulos (University of Jena)

We expect that a compact object with a mass greater than three solar masses is a Kerr black hole. The Hamiltonian function describing the geodesic motion of a non-spinning test particle in the Kerr spacetime background corresponds to an integrable system. If we perturb this system either by deforming the compact object or by adding spin to the test particle, we can make the system non-integrable. In this talk we are going to discuss the dynamical consequences of such non-integrable systems and their possible observational imprints on gravitational and/or electromagnetic wave signals.

RoboPol: blazar astrophysics from Skinakas with a unique optical

Vasiliki Pavlidou (FORTH / University of Crete)

Blazars are the most active galaxies known. They are powered by relativistic jets of matter speeding towards us almost head-on at the speed of light, radiating exclusively through extreme, non-thermal particle interactions, energized by accretion onto supermassive black holes. Despite intensive observational and theoretical efforts over the last four decades, the details of blazar astrophysics remain elusive. The launch of NASA's Fermi Gamma-ray Space Telescope in 2008 has provided an unprecedented opportunity for the systematic study of blazar jets and has prompted large-scale blazar monitoring efforts across wavelengths. In such a multi-wavelength campaign, a novel effect was discovered: fast changes in the optical polarization during gamma-ray flares. Such events probe the magnetic field structure in the jet and the evolution of disturbances responsible for blazar flares. Their systematic study can answer long-standing questions in our theoretical understanding of jets; however, until recently, optical polarimetry programs in operation were not adequate to find and follow similar events with the efficiency and time-resolution needed. RoboPol is a massive program of optical polarimetric monitoring of over 100 blazars, using an innovative, specially-designed and built polarimeter mounted on the 1.3 m telescope at Skinakas Observatory, a dynamical observing schedule, and a large amount of dedicated telescope time. The program is a collaboration between the University of Crete and the Foundation for Research and Technology - Hellas in Greece, the Max-Planck Institute for Radioastronomy in Germany, Caltech in the US, the Nicolaus Copernicus University in Poland, and the Inter-University Centre for Astronomy and Astrophysics in India. The instrument was successfully commissioned in March of 2013 and has been taking data since. In this talk we will review the RoboPol program, its potential for discovery in blazar astrophysics, and we will present results from its first three months of operation.

Blazar physics through multi-band linear and circular polarization monitoring

Ioannis Myserlis (MPIfR)

Blazars comprise the class of Active Galactic Nuclei (AGN) that emit a remarkably broad Spectral Energy Distribution (SED) from long cm wavelengths to GeV and TeV energies. They exhibit rapid flux density variations, practically over the entire electromagnetic spectrum, high superluminal motions and significant optical polarization. The observed emission is attributed to incoherent synchrotron radiation from the magnetized plasma that forms a relativistic jet, powered by an accreting supermassive black hole (SMBH) and directed at small angles to the line-of-sight. Multi-band linear and circular polarimetry is an invaluable tool in the investigation of the wealth of their physical properties, such as the topology and magnitude of their magnetic fields, the composition of their jets and structural characteristics of their galactic environments.

High cadence monitoring programs furthermore, allow the exploration of the dynamics of such parameters on the one hand, while they provide a unique probe of the models developed to explain the variability-producing mechanisms and the spectral evolution of outbursts. The F-GAMMA monitoring program by utilizing the Effelsberg 100m, the IRAM 30m and the APEX 12m telescopes, provides monthly sampled light curves for some 60 selected Fermi blazars at 12 radio frequencies ranging from 2.6 GHz to 345 GHz since 2007. The dataset includes polarization information for at least 5 of the observed frequencies which are currently being extracted and analyzed. In parallel, the F-GAMMA team has co-initiated the construction of an optical polarimeter, which is mounted on the 1.3m Skinakas telescope (University of Crete) aiming at measuring and parametrizing the optical polarization behaviour of AGNs especially during gamma-ray outbursts (RoboPol monitoring program). The RoboPol program is designed to observe a large number of γ-ray bright blazars (~100) at high cadence and in a dynamic manner by increasing the sampling rate while the sources show rapid polarization variability. I will start the talk with a general discussion of the great potential that high cadence polarization monitoring holds for probing the physical conditions of blazars. Subsequently, a description of the F-GAMMA and RoboPol monitoring programs will follow, including: (a) the sample selection, (b) the system description and (c) important observational facts. Then, the focus will be put on the radio polarization measurements and the method followed for the necessary determination and correction of the instrumental polarization. Such measurements can be very challenging, especially for circular polarization, since most AGN exhibit low levels of radio polarization (~5% linear and <1% circular) due to incoherent emission, beam depolarization and so on. Nevertheless, preliminary analysis of the radio monitoring data has revealed sources which show significant Stokes V measurements persistently (3C84, 3C454.3). These findings are very promising because circular polarization measurements can give us a direct insight into the magnetic field ordering, the composition and other features of the jet. Finally, some first results from the radio and optical polarimetric data analysis in progress will be discussed. Such results can also be combined to investigate the correlation between the two regions of the jet which are probed by optical and radio emission.

Rarefaction in magnetized, relativistic, astrophysical outflows

Kostas Sapountzis (University of Athens)

We study the implications of the rarefaction phenomenon in magnetohydrodynamic (MHD) outflows, focusing on gamma-ray burst jets in the framework of the collapsar scenario. The rarefaction wave appears when the jet crosses the envelope of the progenitor star and the pressure of its environment drops from finite values inside the star to nearly zero. By assuming steady-state, axisymmetry, and a cold flow, we solve the MHD equations using the method of characteristics. The procedure we followed and the obtained results will be presented, including a comparison with previous works where the rarefaction was modeled using r self-similar semi-analytical solutions and planar symmetric outflows. The main difference, caused by the axisymmetry, is the reflection of the wave on the rotation axis and the formation of a standing shock.

Accuracy of the IWM-CFC approximation in differentially rotating relativistic stars

Panagiotis Iosif and **Nikos Stergioulas** (University of Thessaloniki)

Many astrophysically relevant systems are being studied via the spatial conformal flatness (IWM-CFC) approximation. We determine the accuracy of IWM-CFC for the case of single, but strongly differentially rotating stars. We find that for the fastest rotating models, the deviation from full general relativity is still below 2% for most integrated quantities and reaches up to 6% for sensitive quantities, such as the angular velocity at the equator. We construct a simple error indicator and demonstrate that it correlates well with the largest errors observed in physical quantities characterizing the model. In addition, we study the deviation of the IWM-CFC approximation from full general relativity by evaluating a different error indicator that is constructed from a tensor that identically vanishes in IWM-CFC.

S3: Cosmology and Relativistic Astrophysics - Poster Presentations

S3-1. Computing general-relativistic differentially rotating polytropic models and comparing results

Vassilis Geroyannis and **Katelouzos Anastasios** (University of Patras)

We compute general-relativistic polytropic models of differentially rotating neutron stars. Uniform rotation is treated in the framework of Hartle's perturbation method. Corrections to mass and radius, owing to spherical and quadrupole deformations, are calculated. A perturbation approach in terms of third order in the angular velocity is implemented. Assuming that the models obey a particular differential rotation law, specifically the so-called Clement's A-parameter model, we compute the change in mass, angular momentum, gravitational potential energy, rotational kinetic energy, and in certain other significant physical quantities, owing to differential rotation. The motivation for this study is a systematic comparison of our numerical results with corresponding results of other methods.

S3-2. Critical rotation of general-relativistic polytropic models revisited

Vassilis Geroyannis and **Vassilis Karageorgopoulos** (University of Patras)

We develop a perturbation method for computing the critical rotational parameter as a function of the equatorial radius of a rigidly rotating polytropic model in the "post-Newtonia approximation" (PNA). We treat our models as "initial value problems" (IVP) of ordinary differential equations in the complex plane. The computations are carried out by the code dcrkf54.f95 (Geroyannis and Valvi 2012 [P1]; modified Runge-Kutta-Fehlberg code of fourth and fifth order for solving initial value problems in the complex plane). Such a complex-plane treatment removes the syndromes appearing in this particular family of IVPs (see e.g. P1, Sec. 3) and allows continuation of the numerical integrations beyond the surface of the star. Thus all the required values of the Lane-Emden function(s) in the post-Newtonian approximation are calculated by interpolation (so avoiding any extrapolation). An interesting point is that, in our computations, we take into account the complete correction due to the gravitational term, and this issue is a remarkable difference compared to the classical PNA. We solve the generalized density as a function of the equatorial radius and find the critical rotational parameter. Our computations are extended to certain other physical characteristics (like mass, angular momentum, rotational kinetic energy, etc). We find that our method yields results comparable with those of other reliable methods. REFERENCE: V.S. Geroyannis and F.N. Valvi 2012, International Journal of Modern Physics C, 23, No 5, 1250038:1-15.

S3-3. A Simple Almost-Flat Variable c Cosmology

Themis G. Dallas (University of Thessaly)

We revisit the cosmological scenarios of Zatrikean pregeometry, focusing on the results of a decreasing maximum attainable speed c, based on the machian idea of c being equal to the expansion rate of the universe.

S3-4. On the production of high energy neutrinos in gamma-ray bursts

Matias Reynoso (University of Athens)

We present preliminary results of a model with two zones in order to study the production of high energy neutrinos in internal shocks at the prompt phase of gamma-ray bursts (GRB). We consider an acceleration zone, where protons and electrons are injected and accelerated, being subject to synchrotron, proton-proton, and proton-gamma cooling. We also assume that they can escape from this zone at a certain rate. The produced pions and the decaying muons are also subject to energy loss and gain processes within the acceleration zone, and the escaping ones are re-injected in a second zone where acceleration no longer operates. In a steady state approximation, we compute the neutrino output expected from both of these zones using typical GRB parameters, and integrate in the redshift to obtain a diffuse neutrino flux which can be different from the expected within one-zone models.

S4: Stars, Our Galaxy and the Local Group - Oral Presentations

Monday, 9th of September

Star Formation through the Chemical Lens

Konstantinos Tassis (University of Crete) **(Invited)**

Star formation is the process that connects the physical and the observable universe, that lights up the stars and creates planets. Yet to this day our understanding of it remains highly uncertain: the mechanism that is responsible for the fragmentation of star-forming clouds and that regulates the contraction of interstellar gas to form pre-stellar objects and protostars remains the subject of intense debate. At the heart of the problem lies the difficulty in observing star-forming sites and obtaining directly the initial conditions of star formation: molecular hydrogen, the raw material of star formation and the dominant constituent of interstellar clouds that act as stellar nurseries, does not have any transitions that are excitable and thus observable at the chillingly low temperatures of molecular clouds. For this reason, observations of star-forming sites rely heavily on the use of molecular tracers, chemical compounds present in molecular clouds. However, the abundance of these tracers is not constant: it is a result of a complex network of chemical reactions, and it depends on the age, density, and dynamical history of the star-forming site. In this talk, I will discuss how the coupling between chemistry and dynamics can help us probe the initial conditions of star formation and the origin of protostars. To this end, we have studied a variety of dynamical models describing the evolution of pre-stellar molecular cloud cores that cover the entire spectrum of proposed mechanisms, including pure hydrodynamical collapse and magnetically mediated collapse at various levels of importance of the magnetic field in the cloud dynamics. These models have been coupled to a network of chemical reactions that follow the relative abundances for ~100 molecular species, by solving the non-equilibrium chemical reactions for the first time simultaneously with the dynamical equations. I will present highlights from the results of this work, including newly proposed observables with maximal potential for discrimination between different models of cloud evolution and star formation. These results are especially timely as current and future facilities, such as ALMA and SKA, will be able to measure these quantities and contribute to the resolution of long-standing questions in star formation.

Two Mass Distributions in the L1641 Molecular Clouds: The Herschel connection of Dense Cores and Filaments in Orion A

Danai Polychroni (University of Athens)

We present the Herschel Gould Belt survey maps of the L 1641 molecular clouds in Orion A. We extracted both the filaments and dense cores in the region. We identified which of dense sources are proto- or pre-stellar, and studied their association with the identified filaments. We find that although most (71%) of the pre-stellar sources are located on filaments there is still a significant fraction of sources not associated with such structures. We find that these two populations (on and off the identified filaments) have distinctly different mass distributions. The mass distribution of the sources on the filaments is found to peak at 4 solar masses and drives the shape of the core mass function (CMF) at higher masses, which we fit with a power slope of 1.4+/-0.4. The mass distribution of the sources off the filaments, on the other hand, peaks at 0.8 solar masses and leads to a flattening of the CMF at masses lower than 4 solar masses. We postulate that this difference between the mass distributions is due to the higher proportion of gas that is available in the filaments, rather than in the diffuse cloud.

YSO jet simulations: from theory to synthetic observations

Kanaris Tsinganos (University of Athens & NOA/IAASARS), **Matsakos Titos** (CEA, FR), **Tesileanu Ovidiu** (National Institute of Physics, Romania), **Vlahakis Nektarios** (University of Athens), **Massaglia Silvano** (Universita degli Studi di Torino), **Mignone Andrea** (Universita degli Studi di Torino), **Trussoni Edoardo** (Osservatorio Astronomico di Torino), **Sauty Christophe**, **Cayatte Veronique**, **Stehle Chantal** (Observatoire de Paris), **Chieze Jean-Pierre** (CEA)

A plethora of analytical studies have addressed the physical mechanisms of jet launching and propagation in young stellar objects. However, their link to observations is still missing due to the complexity of the emission processes involved. In this work we address this issue, by presenting MHD simulations of two-component YSO jet models that are based on analytical disk and stellar outflow solutions. We include ionization and optically thin radiation losses during the temporal evolution of the flow and we post process the output files to generate synthetic emission maps. Our results are confronted to observational data and we find that our models predict the correct range of values for the density, temperature and velocity of YSO jets. Moreover, the synthetic emission maps of the doublets [OI], [N II] and [S II] outline a well collimated and knot-structured jet, which is surrounded by a less dense and slower wind, not observable in these lines. The jet is found to have a small opening angle and a radius that is also comparable to observations.

Multiple Stellar Populations in Star Clusters

Giampaolo Piotto (Dipartimento di Astronomia, Universita di Padova)

For half a century it had been astronomical dogma that a globular cluster (GC) consists of stars born at the same time out of the same material, and this doctrine has borne rich fruits. In recent years, high resolution spectroscopy and high precision photometry (from space and ground-based observations) have shattered this paradigm, and the study of GC populations has acquired a new life that is now moving it in new directions. Evidence of multiple stellar populations have been identified in the color-magnitude diagrams of several Galactic and Magellanic Cloud GCs where they had never been imagined before.

Age metallicity relation in the MCs clusters

Evdokia Livanou (University of Athens)

We investigate a possible dependence between age and metallicity for 15 LMC and 8 SMC clusters, scattered all over the area of these galaxies, to cover a wide spatial distribution and metallicity range, using Stroemgren photometry. Our goal is to trace evidence of an age metallicity relation (AMR) and correlate it with the mutual interactions of the two MCs. Our aim is also to correlate the AMR with the spatial distribution of the clusters. LMC, the majority of the selected clusters are young (up to 1 Gyr) and our aim is to search for an AMR at this epoch which has not been much studied. Data: The selected LMC clusters were observed with the 1.54m Danish Telescope in Chile, using the Danish Faint Object Spectrograph and Camera (DFOSC), whereas the SMC clusters were observed with the ESO 3.6m Telescope also in Chile with the ESO Faint Object Spectrograph and Camera (EFOSC). We used Stroemgren filters in order to achieve reliable metallicities from photometry. Isochrone fitting was used in order to determine the ages and metallicities. The AMR for the LMC displays a metallicity gradient, with higher metallicities for the younger ages. The AMR for LMC-SMC star clusters shows a possible jump in metallicity and a considerable increase at about 6x108yr. It is possible that this is connected to the latest LMC-SMC interaction. The AMR for the LMC also displays a metallicity gradient with distance from the centre. The metallicities in SMC are lower, as expected for a metal poor host galaxy.

The DWARF project

Panagiota-Eleftheria Christopoulou (University of Patras)

In the era of staggering Kepler data and sophisticated approach of the automatic analysis, how obsolete are the traditional object-by-object multiwavelength photometric observations? Can we apply the new tools of classification, light curve modeling and timing analysis to study the newly detected or/and most interesting Eclipsing Binaries or to detect circumbinary bodies? In this talk, I will discuss developments in this area in the light of the recent DWARF project that promises additional useful science of binary stars within an extensive network of relatively small to medium-size telescopes with apertures of ~20-200 cm.

Tracing non-conservative mass transfer eras in close binaries from observed period variations

Nikolaos Nanouris (University of Athens), **Kalimeris Anastasios** (Technological and Educational Institute of the Ionian Islands), **Antonopoulou Evgenia** (University of Athens), **Rovithis-Livaniou Helen** (University of Athens)

The pure information directly taken from the observed orbital evolution of eclipsing binary stars (centuries at most) is valuable for the study of many important physical mechanisms related to the stellar structure. Especially in the case of eclipsing binary systems, this may happen by monitoring their eclipse timing variations, i.e. by means of an O-C diagram analysis. As long as a binary system attains a semi-detached configuration, material begins to flow from the component that fills its Roche lobe toward its mate through the first Lagrangian (L1) point. Here, we examine two non conservative mass transfer (MT) paths. The MT process is then accompanied by mass and angular momentum loss from the system. In the first path, angular momentum is removed through a hot spot which re-emits part of the incoming material, and in the second, angular momentum is carried away via an outer Lagrangian point (L2/L3) due to the small accumulating efficiency of the accretion disk surrounding the gainer. Dealing with the less massive component as the donor in the latter path, it is shown that there is always a critical mass ratio over which the period is expected to decrease, contrary to what the fully conservative MT predicts. Consistent with our expectations, the critical values become progressively smaller as the degree of liberalism is gradually widened. The O-C diagram of several semi-detached systems, expecting to experience a liberal era, is individually examined aiming to estimate both the mass transfer and the mass loss rate.

Variability of Massive Stars with Known Spectral Types in the Small Magellanic Cloud Using 8 Years of OGLE-III Data

Michalis Kourniotis (National Observatory of Athens / IAASARS & University of Athens**)**

We present a variability study of 4650 massive stars in the Small Magellanic Cloud (SMC) with known spectral types from the catalog of Bonanos et al. (2010) using the OGLE-III database. The goal is to systematically study the photometric properties of a large number of massive stars and to derive statistics for variability related to their spectral types. Given the precision of OGLE-III photometry, we find that 1897 stars exhibit significant variability, among which 108 are newly discovered eclipsing binaries, mainly with O and B spectral types. We find that at least 50% of O and early-B type stars are photometrically variable and that at least 60% of spectroscopically confirmed Be stars exhibit stochastic variability. We therefore propose photometric variability as a powerful tool for identifying Be stars and in general, for studying the evolution of massive stars. This is the largest study of variability in massive stars as a function of their spectral type, by a factor of 7.

KOI-676: An active star with two transiting planets and a third possible candidate detected with TTV

Panagiotis Ioannidis (Hamburg Observatory), **Schmitt Jurgen** (Hamburg Observatory), **Avdellidou Chrysa** (Centre for Astrophysics and Planetary Science, School of Physical Sciences, SEPnet, The University of Kent), **von Essen Carolina** (Hamburg Observatory), **Agol Eric** (Dept. of Astronomy, University of Washington)

We report the detection and characterization of two short period, Neptune sized planets, around the active star KOI-676. The orbital elements of both planets are not the expected ones, as they lead to miscalculation of the stellar parameters. We discuss various scenarios which could cause that discrepancy and we suggest that the reason is most probably the high eccentricities of the orbits. We use the Transit Timing Variations, detected in both planets' O-C diagrams to support our theory, while due to the lack of autocorrelation in their pattern we suggest the existence of a third, more massive, mutual inclined, outer perturber. To clarify our suggestions we use n-body simulations to model the TTVs and check the stability of the system.

Tuesday, 10th of September

Life after stellar death: Planetary Nebulae and Supernova Remnants

Panayotis Boumis (National Observatory of Athens / IAASARS)**(Invited)**

Planetary nebulae (PNe) are powerful tracers of our Galaxy's star formation history. Their study can provide insight to the late stages of stellar evolution, the nucleosynthesis in low and intermediate mass stars (1-8Mo) and the chemical evolution of galaxies. Supernova explosions belong to the most spectacular events in the Universe. Supernova remnants (SNRs), which are the consequent results of these events and come from the late stages of massive stars (>8Mo), are among the strongest radio sources observed. They have a major influence on both the properties of the interstellar medium (ISM) and the evolution of galaxies as a whole. They enrich the ISM with heavy elements, release about 10^{51} ergs of energy, heat the ISM, compress the magnetic field, and efficiently accelerate, by their shock waves, energetic cosmic rays observed throughout the Galaxy. I will present results of our work on PNe and SNRs, which aims to (a) discover optical SNRs in the Galaxy, (b) study their morphology and kinematics, (c) characterize their properties (such as density, shock velocity etc.) and (d) provide information on their interaction with the ISM, using the "Aristarchos" among other telescopes.

THEoretical Modelling and multi-wavelength Observations of evolved Stars (THEMOS)

Lucero Uscanga and Boumis Panayiotis (National Observatory of Athens / IAASARS)

Planetary Nebulae (PNe) are one of the last phases in the evolution of low/intermediate mass stars (<8Msun), characterized by extended diffuse ionized and neutral gas surrounding the dying hot cores of highly evolved stars. Their immediate precursors are stars in the asymptotic giant branch (AGB), characterized by a strong mass-loss, followed by a short (100-10000 yr) transitional post-AGB phase. While the morphology of the mass-loss processes in the AGB phase is usually spherically symmetric, PNe show complex bipolar or multipolar structures. Diverse structural components of these evolved stars can be observed at different wavelengths, i.e., 1) ionised bipolar/multipolar structures in PNe, observed from optical to cm-wavelengths; 2) maser emission tracing outflows/discs in post-AGBs/extremely young Pne, observed at cm-wavelengths; 3) circumstellar molecular gas presumably tracing dense toroidal structures towards the centre of PNe, observed at mm/submm-wavelengths. These multi wavelength studies together with theoretical modelling (3D hydrodynamical simulations, kinematical models, and radiative transfer studies) are important to derive a complete picture of the

evolution of low/intermediate mass stars. The aim of THEMOS project is to determine the genesis of the asymmetry in these evolved stars by studying their physical conditions, morphology, and kinematics of ionized and neutral gas. These studies will cover a wide range of spatial scales from hundreds of AU for optical studies, down to a few AU, using radio interferometric techniques. We will present our first results from our radio interferometric observations in PNe, as well as the hydrodynamical modeling of the morphology and kinematics of the PN NGC 6302.

Magnetospheric moment of inertia variations as a source of timing noise in magnetars

Konstantinos Gourgouliatos (McGill University)

We find that the timing noise of strong magnetic field pulsars and magnetars, scales with the intensity of their inferred dipole magnetic field. A model that assumes a random walk in spin frequency, thus implying moment of inertia variations, shows stronger lower bound correlation with the magnetic field intensity, as opposed to models assuming random walks in phase or spin frequency derivative. Calculating the contribution of the magnetic field to the total moment of inertia and assuming magnetic activity with rates similar to those of moding and nulling of pulsars we find that this component of timing noise can be due to variation of the magnetospheric moment of inertia while implying rapid global magnetospheric variability.

A New Technique for Identifying Massive Stars in the Local Group

Nikolay Britavskiy (National Observatory of Athens / IAASARS)

We present a novel method for identifying massive stars in nearby galaxies using mid-IR photometry. Using the fact that these stars are bright in infrared colors due to dust, we provide a technique for selecting and identifying dusty evolved stars based on the results of Bonanos et al. (2009, 2010) and available Spitzer/IRAC photometry. We demonstrate the technique in the Local Group dwarf irregular galaxies Sextans A and IC 1613, by obtaining low-resolution spectra and discovering several new K and M-type supergiants. Therefore, we show that our approach is successful and has the potential to optimize the selection and identification of massive stars in the Local Group.

The Deep Chandra Survey of the SMC

Andreas Zezas (University of Crete) and the **SMC XVP Collaboration**

We present the first results from a Deep Chandra survey of the Small Magellanic Clouds. This is one of Chandra's X-ray Visionary Projects with a total time allocation of 1.1Msec. The goal of this program is to probe the faint (~10^{32} erg/s) X-ray source populations (accreting binaries and stars), and Supernova Remnants in 13 regions of the SMC with well characterized stellar populations of ages between ~10Myr - ~100Myr, in order to address their connection with their parent stellar populations. We will describe the selection of the observed fields, the observing strategy, and the results from the first half of the survey. In particular we will focus on the overall discrete source populations, and the population of Supernova Remnants and their central compact sources encompassed in the youngest fields.

Insights into the High-Mass X-ray Binary Population of the Magellanic Clouds

Vallia Antoniou (Harvard-Smithsonian CfA, USA), **Zezas** Andreas (University of Crete, FORTH/IESL, Harvard-Smithsonian CfA,), **D. Hatzidimitriou** (University of Athens), **V. Kalogera** (Northwestern University)

In contrast to the Small Magellanic Cloud (SMC), the Large Magellanic Cloud (LMC), our nearest star-forming galaxy with metallicity between the Galaxy and the SMC, has received little attention in X-rays so far. With the aim to compare the accreting X-ray binary (XRB) populations in two of our nearest star-forming galaxies, we recently compiled the most complete census of high-mass X-ray binaries (HMXBs) in the LMC. We found 43 members of which 13 are XRB pulsars, while we also identified their most likely optical counterpart (previously, half of these sources lacked an identification). Using this census, we investigated the link between the young accreting XRBs and their parent stellar populations. It was known that HMXBs can be used as star-formation (SF) rate indicators, but these first studies have been focused only on bright systems (Galaxy: >10^{38} erg s^{-1}; Magellanic Clouds: >10^{36} erg s^{-1}) and SF values for the whole galaxy. By including Magellanic Cloud sources with X-ray luminosities at least two order of magnitudes fainter than the above limits and by utilizing the detailed, spatially resolved, SF history maps of these galaxies, we were able to provide observational constraints on ill-understood parameters related to their formation and evolution (such as the kick velocities imparted into the neutron star during the supernova explosion) and to derive their formation efficiency. This work was mainly supported by the National Aeronautics and Space Administration under Grant No. NNX10AH47G issued through the Astrophysics Data Analysis Program.

The XMM-Newton surveys of the Magellanic Clouds

Georgios Vasilopoulos, **Haberl Frank**, **Sturm Richard**, **and Maggi Pierre** (MPE)

Nearby galaxies are well suited for investigating X-ray source populations in different environments than in our own Galaxy. Moreover, sources in these galaxies have well determined distances and are less absorbed than sources in the galactic plane. The Large (LMC) and the Small (SMC) Magellanic Clouds (MC) are the nearest gas-rich star-forming galaxies and their gravitational interactions are believed to have tidally triggered recent bursts of star formation. The XMM-Newton large program for the SMC, together with archival observations covers an area of 5.5 square degrees and has already produced significant results. The XMM-Newton large program for the LMC has just been completed and has covered an even bigger area of about 10 square degrees. Both surveys reach a limiting luminosity of 10^{32} erg/s and provide a unique data set for X-ray source population studies. The two surveys have allowed us to derive hardness ratios for the point sources and conduct spectral classification. For the brightest sources, we performed spectral and timing analysis. By complementing these results with surveys at other wavelengths we have managed to extend our understanding of the nature of individual sources as well as providing complete data-sets of X-ray source populations (X-ray Binaries, supersoft sources, supernova remnants, background active galactic nuclei and foreground galactic sources). From the classification of the sources we have constructed luminosity functions which will allow as to compare X-ray populations in the different environments that the MCs provide. Here, we present an overview of these two surveys together with the highlights of the most interesting sources that they have produced so far (e.g. Be/X-ray binaries).

Accretion in supergiant High Mass X-ray Binaries

Antonios Manousakis (N. Copernicus Astronomical Center), **Blondin J.** (NCSU, USA), **Walter R.** (UniGE, CH)

Supergiant High Mass X-ray Binary systems (sgHMXBs) consist of a massive, late type, star and a neutron star. The massive stars exhibit strong, radiatively driven, stellar winds. Wind accretion onto compact object triggers X-ray emission, which alters the stellar wind significantly. Hydrodynamic simulation has been used to study the neutron star - stellar wind interaction it two sgHMXBs: i) A heavily obscured sgHMXB (IGR J17252-3616) discovered by INTEGRAL. To account for observable quantities (i.e., absorbing column density) we have to assume a very slow wind terminal velocity of about 500 km/s and a rather massive neutron star. If confirmed in other obscured systems, this could provide a completely new stellar wind diagnostics. ii) A classical sgHMXB (Vela X-1) has been studied in depth to understand the origin of the off-states observed in this system. Among many models used to account for this observed behavior (clumpy wind, gating mechanism) we propose that self-organized criticality of the accretion stream is the likely reason for the observed behavior. In conclusion, the neutron star, in these two examples, acts very efficiently as a probe to study stellar winds.

Looking for High-Mass X-ray Binaries in the Small Magellanic Cloud

Grigoris Maravelias (University of Crete), **Zezas Andreas** (University of Crete and FORTH, Harvard-Smithsonian CfA), **Antoniou Vallia** (Harvard-Smithsonian CfA), **Hatzidimitriou Despoina** (University of Athens), **Haberl Frank** (MPE)

The Small Magellanic Cloud (SMC) is host to approximately 100 High-Mass X-ray Binaries (HMXBs), predominantly Be X-ray Binaries (BeXRBs), a number which is surprisingly high when compared to the Milky Way. As these galaxies present different metallicities it is reasonable to ask if their populations of HMXBs are different. In order to address this we investigated their properties such as their spectral types and orbital parameters (periods and eccentricities). We find no apparent differences, implying that the nature of these systems is similar which sets at the same time strong constraints on the magnitude of supernova kicks in low metallicities. In order to extend the sample of BeXRBs we performed a systematic photometric survey of selected active regions of the SMC. Since the optical counterparts of the BeXRBs display Halpha excess they can be identified through Halpha imaging. Observations in 5 regions with the Wide Field Imager at the 2.2m MPG/ESO telescope yield approximately 24000 Halpha emitting stars. By cross-correlating these sources with those identified in the Chandra and XMM-Newton shallow surveys of the SMC and the census of HMXBs of Liu et al. (2005), we find 34 Halpha emitting X-ray sources. These are most likely BeXRBs, which we will confirm with follow-up spectroscopic runs.

S4: Stars, Our Galaxy and the Local Group - Poster Presentations

S4-1. Habitable exoplanets statistics in the Milky Way

Theodoros Anagnos (Aristotle University of Thessaloniki)

We present an exoplanet statistical analysis into the Milky Way. We use the Becanson galactic synthetic model to simulate the Milky Way and the galactic and stellar habitable zones to calculate habitable planets. To assess habitability on the Galactic scale, we model supernova rates and planet formation. Our study, models the SNII and SNIa sterilizations by selecting them from within this pre-existing stellar population. Furthermore, we consider habitability on tidally locked and non-tidally locked planets separately, and study habitability as a function of height above and below the Galactic mid-plane. The number of total habitable planets makes Milky Way practically empty of habitable planets. Our results, from these simulations, agree very well with Kepler's discoveries. Finally, we apply our results to the PLATO future space mission.

S4-2. Light Curve Solutions of Detached Binaries in the ASAS-ROSAT Catalogue

Panagiota-Eleftheria Christopoulou, **Papageorgiou Athanasios**, **& Chrysopoulos Ioakeim** (University of Patras)

We present the preliminary results of modeling of the optical counterparts of the ROSAT X-ray sources identified by ASAS survey data for detached systems (Szczygiel et al. 2008, ASAS.ROSAT.cat) in the framework of the optical variability campaign for strong X-ray sources among eclipsing binaries that was launched in summer 2012, with the 14" telescope at the University of Patras "Mythodeia" Observatory. By using the V-I colors and empirical relation for the mass ratio, the photometric elements of these systems are derived from their V curve using the software PHOEBE (Prsa & Zwitter 2005). The derived parameters are used for statistical analysis.

S4-3. Transient high frequency optical oscillations on red dwarfs

Michael E. Contadakis (Aristotle University of Thessaloniki)

In this paper we present a brief review of the contribution of the scientific teem of the Stephanion Observatory, University of Thessaloniki to the research of high frequency optical oscillations on red dwarfs, firstly, participating in international programs for multiwavelength observations of strong flares of selected flare stars, and in addition analysing one colour (B, or U) observations of the Stefanion Observatory of different red dwarfs (EV Lac, AD Leo, YZ Cmin, V 360 Ophi, UV Cet) at any stage of their activity (quiescence, weak flares, strong flares). Our results indicate that: (1) Transient high frequency oscillations occur during the flare event and during the quiet-star phase as well; (2) The Observed frequencies range between 0.0083Hz (period 2min) and 0.3 Hz (period 3s) not rigorously bounded; (3) The phenomenon is most pronounced during the flare state; (4) The presence of high frequency optical oscillations is a general characteristic of all the stars of the program.

S4-4. Computing polytropic models obeying specific metrics

T.G. Dallas (University of Thessaly) **and Geroyannis V.S.** (University of Patras)

We apply zatrikean pregeometry to polytropic stars, finding the corresponding zatrikean Lane-Emden equations, solving them numerically and presenting the results on the boundary conditions and the interior structure of the zatrikean polytropes.

S4-5. Combined photometric and spectroscopic modelling of the contact binary system EL Aqr

Kosmas Gazeas (University of Athens) and **Kourkoulou Ioanna** (Princeton University)

Our recent ground-based BVRI CCD observations of the eclipsing binary system EL Aqr provide the most accurate photometric light variation obtained so far for this system. In addition to the photometric observations, a revision of all existing spectroscopic data is carried out and a new mass ratio is derived. The combined photometric and spectroscopic data are analyzed using the Wilson-Devinney light curve synthesis code and new geometric and photometric elements are calculated. EL Aqr is found to be in contact configuration, showing partial eclipses, and one of the smallest mass ratios ever found on contact binaries.

S4-6. Discovering new variable stars from the University of Athens Observatory

Kosmas Gazeas (University of Athens)

New variable stars were discovered at the University of Athens Observatory, during data reduction in the frame of BVRI CCD observations of the eclipsing variable stars between August 2012 and June 2013. The photometric data were used in order to classify the new variables and calculate their principle photometric properties, such as their orbital period and amplitude of variation. All new discoveries are classified as contact eclipsing binaries of W UMa-type. New times of minimum light are determined and the astronomical ephemeris is calculated for each individual system.

S4-7. Eclipse mapping of accretion disc of V447 Lyr.

Alexandros Halevin (Astronomical Observatory, Odessa University)

Using Kepler observations of U Gem type eclipsing dwarf nova V447 Lyr, we reconstructed the brightness distribution across an accretion disc when the system was in the outburst state, when the disc eclipses becomes more prominent. Our investigations show evolution of accretion disc shape during different outburst phases.

S4-8. Search for TeV gamma-ray emission from AE Aqr coincident with high optical and X-ray states with the MAGIC telescopes

Zach Ioannou (Sultan Qaboos University, Oman)

We report on observations of the nova-like cataclysmic variable AE Aqr performed by MAGIC. The observations were part of a quasi-simultaneous multi-wavelength campaign carried out between 2012 May and June covering the optical, UV, X-ray and gamma-ray ranges. MAGIC conducted the campaign and observed the source during 12 hours. The other instruments involved were KVA, Skinakas, and Vidojevica in the optical and Swift in the X-ray. We also used optical data from the AAVSO. The goals were to: monitor the variability of the source at different wavelengths, perform gamma-ray studies coincident with the highest states of the source at the other wavelengths, and confirm or rule out previous claims of detection of very-high-energy emission from this object. We report on a search for steady TeV emission during the whole observation, for variable TeV emission coincident with the highest optical and X-ray states and periodic TeV emission at the 33.08 s rotation period (30.23 mHz rotation frequency) of the white dwarf and its first harmonic (60.46 mHz rotation frequency). These are the first observations under good weather conditions performed by the present generation of IACTs for this object.

S4-9. A mathematical formula to calculate the distances of exoplanets' orbits from their stars

Polychronis Karagkiozidis

For distances of exoplanets from their stars, we can use a mathematical formula derived with an appropriate generalization and modification of the Titius-Bode law. Specifically it is applicable to seven planetary systems, in each one of which at east three planets have been discovered. The planetary systems in which the formula applies must meet the following conditions: (a) to be coplanar (b) the planets do not have great concentricity and (c) to not be located near the star of a planet with a very high mass compared with the mass of the star. An adaptation of the well-known Titius-Bode law to the system HR 8799 is: Take the geometrical series 7.3, 14.6, 29.2, 58.4, 116.8, in which each term is double the previous one. With the addition of 0 as the first term, we have the series 0, 7.3, 14.6, 29.2, 58.4, 116.8. Adding 9.4 to each term produces a third series: 9.4, 16.7, 24, 38.6, 67.8, 126.2. So we arrive at the distances of the planets from the star as expressed in astronomical units. The distances of the discovered planets are 24, 38 and 68 AU.

S4-10. Updated analysis for the system V1464 Aql

Alexios Liakos (National Observatory of Athens / IAASARS)

New BVRI light curves of the system V1464 Aql (ellipsoidal variable with a delta Scuti component) were obtained. Using these observations and taking into account previous studies of the system, its light curve model was reproduced and the pulsation frequencies of the delta Scuti component were recalculated. Moreover, the derived parameters were used to estimate the evolutionary status of both components.

S4-11. Modeling and statistical analysis of Detached Binary Systems in the SMC

Alexis Matthaiou, **Christopoulou P.- E.**, and **Papageorgiou Athanasios** (University of Patras)

Using BVI data from OGLE II survey, we analyze light curves for detached binary systems with nearly circular orbits in the Small Magellanic Cloud (SMC). We make use of orbital periods, classification, empirical relations as well as the distance to the SMC to present light curve solutions with the software PHOBE. The assumptions made for the procedure of light curve solution are thoroughly discussed and compared with previously determined global stellar parameters of other detached binaries in SMC from spectroscopic and photometric data.

S4-12. A near infrared study of intermediate age galactic open clusters

Dimitrios Mavrikis and **Hatzidimitriou Despina** (University of Athens)

We use JHK photometry from the 2MASS catalog to construct color-magnitude diagrams and density profiles of intermediate age open clusters in the Galaxy, that appear to contain carbon stars within their radius. The clusters in the sample have not been extensively studied in the past, as they are often very low density as well as extended and therefore difficult to observe. We have used the most recent Padova isochrones (Bressan et al. 2013) to estimate the ages of the clusters.

S4-13. Thorough analysis and deep insight into the low amplitude W UMa type system FI Boo

Athanasios Papageorgiou (University of Patras)

We present results of the modeling of new multicolor light curves of the low amplitude W UMa type binary system FI Boo obtained at the University of Patras Observatory "Mythodea", in spring 2012, in view of the presence of a detected third body that may play an important role in the formation and evolution. The absolute properties of the components have been derived from spectroscopic data with the PHOBE software and are tested extensively by heuristic scanning and parameter kicking in order to check the solution uniqueness. The classification as A or W subtype, the formation and the evolutionary status of the binary are also investigated in detail.

S4-14. The First Photometric Study of the Algol-Type System ASAS 194531+2821.4

Athanasios Papageorgiou, **Christopoulou Panagiota-Eleftheria**, **Derlopa Sofia**, and **Galanakis Nikolaos** (University of Patras)

We present the first extensive photometric results of ASAS 194531+2821.4 from our BVRcIc CCD photometry made on 8 nights from 2012 August with the 14" telescope at the University of Patras "Mythodeia" Observatory and the SBIG 10XME CCD camera. ASAS 194531+2821.4 (V=10.808 mag) is reported to be an Algol semidetached or detached system with amplitude of variation 0.311 mag and light curve elements MinI=2452756.4+0.708 E. Our preliminary photometric parameters are derived for the first time using the software PHOEBE (Prsa & Zwitter 2005) and are used for statistical analysis.

S4-15. An automated search of O'Connell effect for Large Numbers of Eclipsing Binaries

Athanasios Papageorgiou, **Kleftogiannis Georgios**, **and Christopoulou Panagiota Eleftheria** (University of Patras)

The O'Connell effect in eclipsing binary systems (unequally high maxima) has stood for many decades as one of the most perplexing challenges in binary studies. So far, this simple asymmetry has not been convincingly explained, but most theories attribute the effect to dynamic phenomena such as migrating star-spots or swirling circumstellar gas and dust. Nevertheless there has been no clear demonstration of a correlation between the assumptions of any one theory and the morphology of physical parameters of binary systems that exhibit O'Connell effect. We have developed an automated program that characterizes the morphology of light curves by depth of both minima, height of both maxima and curvature outside the eclipses. In terms of programming it is being developed in FORTRAN and PYTHON. This project results from realization of two needs, both related to recent discoveries of large number of contact binaries. Thus the first need is of a simple method to obtain essential parameters for these systems, without the necessity of full light-curve synthesis solution. The second is a statistical one: we would like to extract information from light curves with the use of coefficients that describe the asymmetry in the light curve maxima and the overall shape in the growing observational data of eclipsing binaries (OGLE, ASAS, KEPLER, GAIA). Before applying the automated program several complications must be addressed, as eccentricity, quality of data with many outlying points, limitations to the classification method already applied.

S4-16. Study of Star Clusters in the Small Magellanic Cloud using the 6.5m Magellan Telescope

Achilleas Strantzalis (University of Athens), **Hatzidimitriou Despoina** (University of Athens), **Antoniou Vallia** (Harvard-Smithsonian CfA), **Zezas Andreas** (University of Crete/FORTH, Harvard-Smithsonian CfA)

We present radial profiles and color magnitude diagrams for 18 star clusters in the central region of the neighboring irregular galaxy Small Magellanic Cloud (SMC), using BVR photometric data obtained with the Inamori Magellan Areal Camera and Spectrograph (IMACS) mounted on the 6.5m Magellan Telescope at the Las Campanas Observatory in Chile. The star clusters studied (Œí79, NGC330, H86-135, H86-129, H86-127, H86-138, NGC306, H86-146, SOGLE220, B69 ŒÆ SOGLE89, H86-136, H86-145, BS259, H86-149, H86-142, H86-119, BS257, B73 or SOGLE96) are distributed over a 0.44o field centered at RA: 00h 53m 28.2s, DEC:-72o26,Äô34.5,Äô,Äô (2000) in
the central bar and have been previously catalogued by Bonnato & Bica (2010), Glatt et al. (2010) and Chiosi et al. (2006). The observations obtained with IMACS have very high spatial resolution (of about 0.2 arcsec) and they are thus very well suited for studies of crowded fields. Some of the objects that had been previously classified as clusters in the aforementioned catalogues, have not been confirmed as such, by the new high resolution data. It is also noteworthy that only one of the 18 star clusters has been observed with the Hubble Space Telescope ,Äì and thus with high spatial resolution. For all of the confirmed star clusters in the sample, we have constructed radial density profiles, color magnitude and color-color diagrams. Ages were estimated using the Padova isochrones of Bressan et al. (2012), while the interstellar reddening of each cluster was estimated both from the location of the zero-age main sequence and from the color-color diagrams.

S4-17. Modeling of Detached Binary Systems in LMC from OGLE III

Anna Theodosiou, **Christopoulou Eleutheria-Panagiota and Papageorgiou Athanasios** (University of Patras)

Using BVI data from OGLE II and OGLE III survey, we analyze light curves for detached binary systems with nearly circular orbits in the Large Magellanic Cloud (LMC). We make use of orbital periods, classification, empirical relations as well as the distance to the LMC to present light curve solutions with the software PHOEBE. The assumptions made for the procedure of light curve solution are thoroughly discussed and compared with previously determined global stellar parameters of other detached binaries in LMC from spectroscopic and photometric data.

S4-18. Classification of Stellar Variability with Kepler Data

Aggelos Tsiaras (Aristotle University of Thessaloniki)

We aim to classify the different kinds of stellar variability as they appear in Kepler data. For that we use the PDC light-curves after a low degree polynomial normalization. The variability factor, which we call relative rms (relrms) and represents the stellar activity, is the standard deviation of the light-curve divided by its median error in order to limit the affect of magnitude on standard deviation. Our first calculations are the distributions of a) relrms and b) standard deviation of relrms in range of 1, 7 and 30 days. According to them we divide stars into categories of low or high activity level and low of high activity variation and try to find the relation between them. The final step is to correlate these categories with stellar physical characteristics such as spectral type, radius and periodicity. We summarize the results in tree basic categories: I) stars with high activity level but low activity variation; II) stars with high activity level and high activity variation; III) stars with activity variation proportional to their activity level. Each category includes stars of different spectral types, giants or dwarfs, periodic or not in a way that helps us add in special subcategories.

S4-19. New Be/X-ray binary pulsars in the in the Large Magellanic Cloud

Georgios Vasilopoulos (MPE)

We observed a newly discovered X-ray source int X-rays and in the optical to confirm its nature as a high mass X-ray binary. We analysed XMM-Newton and Swift X-ray data, along with optical observations with the ESO Faint Object Spectrograph, to investigate the spectral and temporal characteristics of the source. The XMM-Newton data show coherent X-ray pulsations while the spectra can be modelled with a combination of a power law plus a black body component. We performed optical spectroscopy from which we classify the companion star as a B0-1.5Ve star. The X-ray pulsations, the long-term x-ray variability and the properties of the optical counterpart confirms the the x-ray source as a new Be/X-ray binary pulsar in the LMC.

S4-20. The Massive Stellar Content of M83 as Revealed by Spitzer

Stephen Williams and Bonanos Alceste (National Observatory of Athens / IAASARS)

We report on the preliminary findings and methods used in investigating rare, luminous, dusty massive stars in the galaxy M83. How mass loss affects the evolution of massive stars (M>8Mo) remains an open question in stellar evolution theory. To begin to answer this question, we have selected a number of candidate luminous infrared sources from archival Spitzer Space Telescope images of M83. These data have been supplemented with near infrared and optical data in order to construct spectral energy distributions and determine more about their underlying properties. In this way, we may choose the best candidates for follow up spectroscopy, form a census of these rare stars in the nearby universe, and determine statistics for these objects across a range of host galaxy metallicities via future studies.

Authors index