The 13th Hellenic Astronomical Conference

Heraklion 2-6 July 2017

Conference book

- Program
- Book of abstracts
- List of participants

Organizing Committee

SOC: A. Mastichiadis (Chair), M. Georgoulis, P. Patsis, V. Pavlidou, P. Reig, N. Stergioulas, E. Xilouris, S. Basilakos, A. Zezas, O. Malandraki, and G. Tsiropoula

LOC: N. Kylafis (Chair), P. Reig, I. Papadakis, V. Pavlidou, I. Liodakis, K. Anastasopoulou, and K. Kouroumpatzakis

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PROGRAM

Session 1: Heliophysics and the Solar System

Session 2: Extragalactic Astronomy and Astrophysics

Session 3: Cosmology and Relativistic Astrophysics

Session 4: Stars, Planets and the Interstellar Medium

	Monday, 3 July	
	SESSION 1	**SESSION 2**
9:00-9:15	Opening address	
Chair	**L. Vlahos**	**A. Mastichiadis**
9:15-9:45	**D. Jess (Invited):** Current overarching science questions in solar physics and challenges from the future ground-based telescopes	**N.Vlahakis (Invited)**: Astrophysical jet dynamics
9:45-10:05	**Al. Nindos:** Center-to-limb Observations of the Sun with ALMA: Implications for Solar Atmospheric Models	**K. Gourgouliatos**: 3-D Simulations of FR-I Jets
10:05-10:25	**G. Tsiropoula:** Analysis of multi-wavelength observations of persistent and spatially-extended quiet Sun vortex	**D. Blinov**: Connection between optical polarization plane rotations and gamma-ray flares in blazars
10:25-10:45	**M. Georgoulis:** Linking Solar Eruptions with Fundamental Physical Parameters at the Solar Atmospheric Base	**E. Kalafountzou** : A benchmark study of AGN: Feedback, orientation and AGN activity at a single epoch
10:45-11:05	**G. Chintzoglou:** Elucidating the Role of Magnetic Cancellation in Triggering Energetic Solar Eruption	**D. Giannios**: Star-disk interactions in the Galactic center
11:05-11:30	**COFFEE BREAK**	
11:30-12:15	**PLENARY TALK 1** **V. Bothmer:** Heliophysics and Space Weather – Challenges and Perspective	
Chair	**G. Tsiropoula**	**I. Papadakis**
12:30-12:50	**L. Vlahos:** Particle acceleration and heating in turbulent reconnecting astrophysical plasmas	**A. Mastichiadis**: On the flaring gamma-ray activity of quasar 3c279
12:50-13:10	**I. Kontogiannis:** Non-neutralized currents and flaring activity in solar active regions	**M. Charisi**: Quasars with periodic variability as milliparsec supermassive black hole binary candidates
13:10-13:30	**V. Archontis:** Solar bombs in the cool solar atmosphere	
13:30-15:00	**LUNCH BREAK**	
15:00-15:30	**BEST PhD** **I. Liodakis:** Scale invariant jets: from blazars to microquasars	
Chair	**V. Archontis**	**P. Patsis**
15:30-16:00	**S. Patsourakos (Invited):** Observations of Coronal Mass Ejections: Recent Results and Upcoming Developments	**T. Naab (Invited)**: Theoretical challenges in galaxy formation

16:00-16:20	**K. Moraitis:** Calculating relative magnetic helicity in spherical wedge volumes	**G. L. Granato**: Hydrodynamical simulations of galaxy clusters including the evolution of dust
16:20-16:40	**COFFEE BREAK**	
Chair	**A. Nindos**	
16:40:17:00	**P. Syntelis:** The process of magnetic flux emergence as a major driver for solar jets and eruptions.	**A. Maragkoudakis**: The sub-galactic and nuclear main sequences for local star-forming galaxies
17:00-17:20	**K. Florios:** Forecasting solar flares using magnetogram-based predictors and machine learning	**K. Kolokythas**: Radio properties and feedback implications of brightest group galaxies in the Local Universe
17:20-17:40	**An. Anastasiadis:** Foretelling Flares and Solar Energetic Particle Events: the FORSPEF tool	**M. Kopsacheili**: Detection of extragalactic Supernova Remnants

Special talk

17:45-18:30 **P. Rojo**: Chilean Astronomy

	Tuesday, 4 July	
	SESSION 1	**SESSION 2**
Chair	**M. Georgoulis**	**V. Pavlidou**
9:00-9:30	**<u>P. Zucca (Invited)</u>:** Energetic particles from the Sun: HESPERIA studies on gamma-ray events, particle forecasting and recent observations of shock signatures with the Low Frequency ARray (LOFAR)	**<u>A. Mesinger (invited)</u>**: Illuminating the Cosmic Dawn
9:30-9:50	**O. Malandraki:** Solar Particle Radiation Storms Forecasting and Analysis: The HESPERIA HORIZON 2020 project and beyond	**A. Zezas**: The hard X-ray view of galaxies
9:50-10:10	**K. Dialynas:** Voyager and Cassini measurements suggest a bubble-like shape for the global heliosphere	**K. Kouroumpatzakis**: The Star Formation Reference Survey Ha emission line campaign: Description and first results.
10:10-10:30	**G. Balasis:** Statistics of Pc3 waves and plasma instabilities observed by Swarm satellites in low-Earth orbit	**K. Anastasopoulou**: Studying the ULX population of the X-ray starburst galaxies NGC 3310 and NGC 2276
10:30-10:50	**G. Anagnostopoulos:** New space application to the earthquake prediction research	**K. Dasyra**: Consequences of the detection of optically thin and highly excited CO in the wind of the radio galaxy IC5063
10:50-11:30	**COFFEE BREAK**	
11:30-12:15	**PLENARY TALK 2** **A. Burkert:** The dynamics of high-redshift star-forming galaxies, driven by disk instabilities	
Chair	**K. Tsiganis**	**A. Zezas**
12:30-12:50	**M. Xilouris:** The NEO Lunar Impact Monitoring Project NELIOTA	**P. Patsis**: Gaseous flows and star-forming dynamical mechanisms in the spiral arms of barred-spirals
12:50-13:10	**Al. Liakos:** First lunar impact flash results from NELIOTA	**A. Katsianis**: The evolution of the star formation rates of z ~ 0-8 galaxies

13:10-13:30	**M.A. Barucci:** Ice spots on the nucleus of comet 67P/Churyumov-Gerasimenko as observed by Rosetta mission	**P. Bonfini**: Studying galaxy stellar cores to constrain the co-evolution of early-type galaxies and their host super-massive black holes
13:30-15:00	**LUNCH BREAK**	
	SESSION 1	**SESSION 4**
Chair	**O. Malandraki**	**A. Zezas**
15:00-15:30	**A. Coustenis (Invited):** The icy moons of the gas giants as possible habitat	**E. Ntormousi (Invited)**: The formation and evolution of interstellar filaments
15:30-15:50	**K. Tsiganis:** New models of asteroid belt formation	**K. Tassis**: PASIPHAE: Clearing the path to inflationary B-modes through optopolarimetric magnetic tomography
15:50-16:10	**A.Toliou:** Constraining the magnitude and timing of the giant planet instability from the perspective of the asteroid belt	**A. Tritsis**: The Musca molecular cloud: An interstellar symphony
16:10-16:40	**COFFEE BREAK**	
Chair	**A. Anastasiadis**	
16:40:17:00	**G. Tsirvoulis:** Reconstructing the size distribution of the primordial Main Belt	**G. Panopoulou**: Molecular cloud filaments: do they really have a characteristic width?
17:00-17:20	**D. Skoulidou:** Dynamical study of the near-Earth space environment for passive debris removal	**I. Leonidaki**: Towards a complete optical atlas of Galactic Supernova Remnants
17:20-17:40	**A.Rosengren:** Killing satellites with resonances: the dynamics of passive debris removal	**M. Zapartas**: The impact of stellar binarity on core-collapse supernovae

18:00-19:00 General Assembly

	Wednesday, 5 July	
	SESSION 4	**SESSION 3**
Chair	**P. Reig**	
9:00-9:30	**V. Antoniou (Invited):** The fast and the furious: the young accreting binary population of the Small Magellanic Cloud	**M. Plionis (Invited):** Using HII galaxies as a tracer of the high-z Hubble expansion
9:30-9:50	**A. Strantzalis**: Main Sequence Luminosity Functions in the central 1.5 degrees of the main body of the SMC	**V. Pavlidou:** Where the world stands still: cosmology at turnaround scales
9:50-10:10	**G. Maravelias**: Investigating the circumstellar structures of B[e] Supergiants	**M. Chira:** Environmental Dependence of the Abundance function of Dark Matter Halos
10:10-10:30	**M. Koutoulaki**: VLTI/AMBER NIR interferometric observations of the Bracket gamma and high-n pfund emitting regions of the Herbig B[e] star HD50138	**K. Tanidis:** Indications for Anisotropy of the Hubble flow
10:30-10:50	**A. Manousakis**: Stellar Winds in Massive X-ray Binaries	**D. Tseneklidou:** Relativistic magnetised cosmological perturbations in the post-recombination era
10:50-11:30	**COFFEE BREAK**	

11:30-12:15	**PLENARY TALK 3** **J. Solá:** Is the 100 years old cosmological constant in Einstein's equations really constant? Maybe not!	
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Chair	**V. Antoniou**	**M. Xilouris**
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12:50-13:10	**D. Hatzidimitriou**: The Hubble Catalog of Variables	**G. Leloudas**: The nature of the extremely bright nuclear transient ASASSN-15lh
13:10-13:30	**Z. Spetsieri**: Variability of massive stars in the Virgo Cluster galaxy NGC 4535 with the Hubble Space Telescope	**P. Sell**: The Classification and Analysis of Distinct X-ray Binary Populations in M81
13:30-15:00	**LUNCH BREAK**	
15:00-15:30	**BEST PhD** **A. Nathanail:** The magnetic field structure in the vicinity of a black hole	
	SESSION 4	**SESSION 2**
Chair	**D. Hatzidimitriou**	**D. Giannios**
15:40-16:00	**P. Kalas**: Detecting dusty debris disks, exoplanets, and exoplanetary rings using the Gemini Planet Imager, HST and Antarctic observatories	**I. Georgantopoulos**: The most obscure AGN at low and high redshift
16:00-16:20	**N. Georgakarakos**: Long term evolution of planetary systems with a terrestrial planet and a giant planet	**E. Pouliasis**: Active Galactic Nuclei selected by optical variability in the GOODS South field
16:20-16:40	**COFFEE BREAK**	
Chair		**G. Magdis**
16:40:17:00	**A. Tsiaras**: A population study of hot Jupiter atmospheres	**V. Charmandaris**: The physical properties of galaxies with Spitzer/IRS spectra: SED modeling
17:00-17:20	**K. Karpouzas**: A survey for non-transiting planets with Kepler	**M. Xilouris**: DustPedia: A Definitive Study of Cosmic Dust in the Local Universe
17:20-17:40	**A. Kokori**: Developing a user-friendly photometric software for exoplanets to increase participation in Citizen Science	**S. Lianou**: Hierarchical Bayesian modelling of 900 DustPEDIA Galaxies: Insights into their global dust and star formation properties
17:40-18:00		**A. Psychogyios**: Multi-wavelength structure analysis of galaxies in the WINGs

	Thursday, 6 July	
	SESSION 4	**SESSION 2**
Chair	**P. Kalas**	**V. Charmandaris**
9:10-9:30	**O. Dionatos**: Links between protostellar accretion and ejection observed with ALMA	**G. Magdis**: Exploring scaling relations between gas and dust across cosmic time
9:30-9:50	**E. Christopoulou**: V912 Per: A new twin low-mass binary with a third component	**T. Bitsakis**: Star cluster formation history in the Large Magellanic Cloud
9:50-10:10	**A. Liakos**: The new catalogue of delta Sct pulsators in binary systems	**V. A. Masoura**: Using Machine Learning Techiques to estimate photometric redshifts for X-ray sources
10:10-10:30	**G. Loukaidou**: Evolution of low mass contact binaries close to the orbital period cut-off	**E. Paraskeva**: High-cadence photometry of bright Type Ia Supernovae with the 2.3m Aristarchos telescope
10:30-10:50	**G. Kleftogiannis**: The O' Connell effect: one of the most celebrated problems in contact binaries. The cases of NSVS 13943900, NSVS 10384295 and NSVS 4316778	**D. Kantzas**: Temporal evolution of high energy radiation in Type IIn Supernovae
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Chair		**K. Gazeas**
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12:40-13:00	**A. Manusakis:** Relativistic hydrodynamical tori: QPO & PPI	**K. Kovlakas**: Ultra-Luminous X-ray sources in Chandra Source Catalog 2.0 and a master catalog of nearby galaxies
13:00-13:20	**A. Tsouros:** The energy distribution of electrons in radio jets	**P. Bonfini**: Mass characterization of star-forming galaxies in the local Universe

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Plenary Talks

Public Outreach Talk

Αστροφυσικοί πίδακες: Εκροή ύλης από μαύρες τρύπες

Καθ. Νικόλαος Κυλάφης

Πανεπιστήμιο Κρήτης

Στην αρχή θα εξηγηθεί με απλό τρόπο τι είναι οι μαύρες τρύπες, διότι ούτε ¨μαύρες' είναι ούτε ¨τρύπες¨. Πρόκειται για πολύ συμπαγή αντικείμενα, που όπως θα εξηγηθεί απορροφούν τα πάντα και δεν εκπέμπουν τίποτε. Φυσικά, ένα εύλογο ερώτημα γεννάται: Αφού οι μαύρες τρύπες δεν εκπέμπουν τίποτε, πώς είναι δυνατόν να έχομε εκροή ύλης από αυτές· Η απάντηση είναι ότι η εκροή ύλης, υπό μορφή πίδακα, γίνεται στο περιβάλλον της μαύρης τρύπας, πριν αυτή η ύλη πέσει μέσα στη μαύρη τρύπα. Θα εξηγηθεί με ένα απλό πείραμα Φυσικής πώς μπορεί να συμβεί αυτό. Τέλος, θα εξηγηθεί με πειστικό τρόπο ότι οι μαύρες τρύπες δεν είναι μυθοπλασίες, αλλά πραγματικά αντικείμενα. Εκατό χρόνια μετά τη θεωρητική πρόβλεψή τους από τον Αϊνστάϊν, ανιχνεύθηκε πέρυσι για πρώτη φορά το αποτέλεσμα της σύγκρουσης δυο μαύρων τρυπών. Τα κύματα που ανιχνεύθηκαν λέγονται βαρυτικά και θα εξηγηθεί τι είναι αυτά. Πρόκειται για τη μεγαλύτερη επιστημονική ανακάλυψη του αιώνα μας.

Talk 1

Heliophysics and Space Weather – Challenges and Perspectives

Dr. Volker Bothmer
University Goettingen

The current feet of solar, heliospheric, geospace, and planetary spacecraft, such as SOHO, ACE, STEREO, SDO or MMS amongst others, have provided unprecedented new data over the past decades on the scientific processes governing the physics of our solar system. The simultaneous operations are today referred to as the 'Heliophysics System Observatory', with new missions such as Solar Probe Plus and Solar Orbiter being just around the corner. It appears thus timely to review the major breakthroughs in our understanding of the physics of the dynamic solar corona, heliosphere and space weather. Moreover, what are the challenges and perspectives for the next years, i.e., how do we interface space and ground based data best, what are our current major knowledge gaps, how do we place space weather into operations, what insights will the new missions offer, and finally of course, what are the steps to new knowledge?

Talk 2

The dynamics of high-redshift star-forming galaxies, driven by disk instabilities

Prof. Andreas Burkert
University of Munich

The redshift two Universe ist one of the most interesting epochs of galaxy evolution. It is the era with the peak of the cosmic star formation rate. Between redshift 3 and 1 the total stellar mass density in galaxies increased from 15% to 70%. It is also the time of rapid galaxy assembly and the epoch where galaxy morphology was determined. I will summarize recent observations of the SINS survey, a Spectroscopic Imaging survey of z=2 galaxies in the near infrared with the ESO SINFONI spectrograph. This survey has opened a fascinating window into early galaxy evolution. The SINS data show a diversity of galactic systems at redshift 2 with physical properties that are unparalleled in the z=0 Universe. Gas-rich, extended, fast rotating and highly turbulent disks have been found with star formation rates that are a factor of 10 to 100 larger than in present-day Milky-Way type galaxies. Kpc-sized, massive gas clumps dominate the appearance of these galaxies. These giant clumps are considered to represent the progenitors of present-day globular clusters. They could provide the seeds for supermassive black holes and they might lead to the formation of young bulges in the centers of their galaxies. These fascinating and puzzling observations will be confronted with theoretical ideas and numerical simulations of gas-rich galactic disk evolution. I will argue that the high-redshift galaxies like present-day disks, are in a self-organized equilibrium state with their observed extreme properties emerging naturally from self-regulated galactic evolution, controlled by gas inflow from the cosmic web and regulated by gravitational disk instability and stellar feedback.

Talk 3

Is the 100 years old cosmological constant in Einstein's equations really constant? Maybe not!

Prof. Joan Solà
Univ. de Barcelona

In this talk I will assess the possibility that a rigid cosmological constant, Λ, and hence the traditional concordance ΛCDM model of cosmology, might not be the best phenomenological description of the current cosmological data. In a series of recent works we find that a large class of dynamical vacuum models (DVMs), whose vacuum energy density consists of a nonvanishing constant term and a series of powers of the Hubble rate, provides a substantially better phenomenological account of the overall SNIa+BAO+H(z)+LSS+CMB cosmological observations. The main models within the class of DVMs appear significantly much more favored than the ΛCDM, at an unprecedented confidence level of roughly 4σ. If the results presented here would be reconfirmed in the light of future investigations, the hundred years hitherto rigid status of the "cosmological constant" , in its traditionally accepted role for the optimal description of the cosmological data, would be seriously disputable.

Talk 4

Supernova 1987A at 30

Dr. Iason Spyromilio
ESO

Supernova 1987A exploded 30 years ago this year. Observations of this remarkable object have revolutionised the astronomy of supernovae but also have had profound implications in many other fields. A brief overview of some important results from the past shall be made as well as an update on the most exciting results from ALMA, VLT and HST.

Special talk

Chilean Astronomy

Patricio Rojo
Departamento de Astronomia Universidad de Chile

This talk presents an overview of the current status of the Chilean Astronomical community. The extremely dry conditions of the Atacama Desert in northern Chile has made it, arguably, the best place on Earth for ground-based Astronomical facilities. Over 70% of the optical-to-mm photons collected for ground-based astronomy will be received by telescopes in Chile once the new generation of telescopes finishes their construction during the next decade. The XXI century is thus witnessing an unprecedented growth of the Chilean astronomical community creating clear opportunities as well as unique challenges. The observatories in the Atacama desert, the Chilean institutions, and their main research areas will be briefly discussed, attempting to highlight collaboration opportunities.

“Best PhD” Talks

Scale invariant jets: from blazars to microquasars

Dr. Ioannis Liodakis
University of Crete

Blazars are some of the most active and mysterious of galaxies with their intrinsic properties shrouded by relativistic effects due to the alignment of their jet close to our line of sight. These relativistic effects can be quantified by the Doppler factor: one of the most important and hard to estimate parameters in the blazar paradigm. To this respect, a breakthrough was achieved when population models showed that the variability Doppler factor method can adequately describe the blazar populations. Based on this result, we used multiwavelength radio light curves from the F-GAMMA program and novel algorithms to identify, track and characterize flares seen in multiple radio frequencies. Our novel approach allowed us to estimate the most accurate Doppler factors to date with an average of 16% uncertainty. Using these Doppler factors we uncovered a strong correlation between the intrinsic broad-band radio luminosity and the black hole mass which extends nine orders of magnitude down to microquasars. Our results show that jets are scale invariant, while the scaling derived in this work is the first ever relation to connect the intrinsic radio luminosity of the jet with the mass of the black hole in beamed sources.

The magnetic field structure in the vicinity of a black hole

Mr. Antonios Nathanail
Goethe University of Frankfurt

According to Blandford & Znajek, the spin energy of a rotating black hole can be extracted electromagnetically, should the hole be endowed with a magnetic field supported by electric currents in a surrounding disc. We solve the fundamental equation that describes the magnetic field structure in the vicinity of a black hole. In all solutions the magnetic field taps the rotational energy of the black hole and generates powerful outflows of electromagnetic (Poynting) energy. We derive analytically the energy loss rate of a spinning black hole through this mechanism. We associate this black hole electromagnetic spin down with the X-ray afterglow of a gamma-ray burst. We argue that the duration of a burst of this kind depends on the magnetic field of the progenitor star. Finally, in order to put forward the long standing riddle of the origin of astrophysical magnetic fields, we study the growth rate of the magnetic flux in the vicinity of a black hole through the Cosmic Battery model.

Invited Session Speakers

Session 1: Heliophysics and the Solar System

Current overarching science questions in solar physics and challenges from the future ground-based telescopes

Dr. Dave Jess
University of Belfast

Within the last decade, solar physics has moved into a golden era of discovery. A diverse assortment of ground- and space-based facilities has helped make rapid progress in the detection, identification, characterisation and understanding of dynamic motions near and above the solar surface, ranging from the photosphere through to the outermost extremities of the solar corona. Combined modelling efforts have resulted in a number of outstanding science questions that can only be addressed with more advanced, larger aperture telescopes. Here I will outline some of the recent landmark discoveries that have developed into overarching science questions in solar physics, before highlighting how new and upcoming ground-based facilities, such as DKIST, EST and ALMA, will shine light on these challenging problems.

Observations of Coronal Mass Ejections: Recent Results and Upcoming Developments

Dr. Spiros Patsourakos
University of Ioannina

Coronal Mass Ejections (CMEs) is a fascinating phenomenon initiated in the Sun, and possibly other stars as well. They represent transient expulsions of large amounts of magnetized plasmas into the interplanetary space. CMEs hold a central role in shaping space-weather conditions throughout the solar system via their dynamic pressure, magnetic felds as well as by the shocks driven by them and the resulting Solar Energetic Particles. Major steps in our understanding of CME physics resulted from recent space missions (Hinode, STEREO, SDO), which Largely increased our knowledge in all important domains (spatial/temporal/wavelength coverage) and supplied for the frst time multi-viewpoint imaging and Sun-to-Earth tracking of these transients. We hereby supply a review of recent key observations of CMEs obtained from these space missions focusing on the nature and nurture of the CME magnetic confgurations and their propagation and evolution throughout the inner heliosphere. We also briefly discuss how our current understanding of CME initiation and propagation may be exploited in the study of CMEs occurring in other stars and their potential impact on exoplanets orbiting them. We will conclude with an overview of the exciting new opportunities in CME science that will be soon become available from upcoming solar and heliospheric missions (PROBA III, Solar Orbiter, Solar Probe Plus).

Energetic particles from the Sun: HESPERIA studies on gamma-ray events, particle forecasting and recent observations of shock signatures with the Low frequency ARray (LOFAR).

Dr. Pietro Zucca
ASTRON - LOFAR

P. Zucca[1,8], K.-L. Klein[1], O. Malandraki[3], M. Nunez[7], A. Rouillard[5], R. Fallows[8] G. Share[2], N. Vilmer[1], B. Heber[4], R. Vainio[6]

(1) LESIA-Observatorie de Paris, (2) University of Maryland, (3) Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, (4) Institut fur Experimentelle und Angewandte Physik, (5) Institut de Recherche en Astrophysique et Planetologie, (6) University of Turku, (7) Universidad de Màlaga, (8) ASTRON - The Netherlands Institute for Radio Astronomy

Energy built-up in the coronal magnetic field is released in solar eruptions in form of thermal and kinetic energy of particles. Particles can be accelerated to high energies (GeV) and they propagate in the interplanetary medium to Earth's orbit and beyond. Solar energetic particles (SEPs) can also be accelerated by shock waves driven by the propagating CMEs. In this talk, we present a recent test tool for now-casting energetic protons using radio observations as a proxy and we introduce recent studies on gamma-ray events using the FERMI/LAT experiment. A surprisingly large number of solar events with gamma-ray emission above photon energies of 100 MeV were observed. The emission is likely due to pion-decay photons, implying that the acceleration of protons in the solar corona to energies above 300 MeV is much more frequent than previously thought. In some cases, the emission persists over several hours. We compared the durations of the gamma-ray emission with the durations of hard X-ray, metric, decametric and microwave signatures, to identify the mechanism responsible for the acceleration of the primary particles resulting in gamma rays. Flares, shocks, trapped particles and continuous reconnection in the current sheet, have been explored as accelerators; with our sample of events we cannot exclude any of these possibilities, thus we present here the pro and contra of each phenomenon. In this talk, we will also present recent observations with the Low Frequency Array (LOFAR) of a radio shock signature for which we identify for the first time the location (from 80 to 50 MHz) at the flank of the expanding CME. Performing a 3D reconstruction of the CME and studying the properties of the coronal medium we identify the location of the radio signature to be in a region with a Mach number of 1.3 and in a quasi-perpendicular geometry.

The icy moons of the gas giants as possible habitats

Dr. Athena Coustenis
Paris Observatory

Solomonidou Anezina (Jet Propulsion Laboratory, California Institute of Technology), Encrenaz Therese (LESIA, Observatoire de Paris, PSL-Research Univ., CNRS, Univ. Paris 6, Sorbonne Univ., Univ. Paris-Diderot)

The study of the habitable conditions in our solar system tends to extend the limits of the traditional habitable zone towards the outer parts. Several of the icy moons around gas giants show promising conditions for the development and/or maintenance of life. Jupiter's Europa, Callisto and Ganymede as well as Saturn's Titan and Enceladus, seem to have some of the requirements for habitability, like organic-rich atmospheres and underground liquid water oceans for which we find evidence in the data acquired by the Galileo and the Cassini-Huygens missions. The liquid water oceans hidden under icy crusts, may even be (in the case of Europa) in direct contact with a silicate mantle foor and kept warm through time by tidally generated heat. furthermore, the strong gravitational pull caused by the giant planets may produce enough energy to sufficiently heat the cores of orbiting icy moons. Similarly, waterworlds can exist as exoplanets which are currently investigated thoroughly by large ground-based telescopes and earth observatories. In the solar system, such potential habitats can be investigated with designated space missions, like ESA's JUpiter ICy moon Explorer to Jupiter's system (launch in 2022) or the Europa mission studied by NASA. Titan could be explored in the future via mission concepts proposed to the space agencies in recent years. We will discuss these environments and their potential for habitability.

Session 2: Extragalactic Astrophysics and Astrophysics

Theoretical challenges in galaxy formation

Dr. Thorsten Naab
MPA - Garching

Galactic outflows regulate galaxy formation on cosmic timescales. A better physical understanding of the physical driving mechanisms of outflows is one of the major theoretical challenges of galaxy formation. Recent high resolution simulations can capture the most relevant physical feedback processes like stellar winds, ionizing radiation and supernova blast waves. Their impact on the structure of the interstellar medium and the driving of outflows will be discussed.

Astrophysical jet dynamics

Prof. Nektarios Vlahakis
University of Athens

Collimated plasma outflows are connected to some of the most energetic phenomena in the Universe, such as blazars, gamma-ray bursts and microquasars. Recent progress in various topics related to their dynamics will be discussed: Our current understanding on the bulk acceleration mechanisms, how these are connected to the magnetic field, and to the jet-environment. The stability of these structures and possible connections to the observed changes in their morphology and the topology of the magnetic field.

Illuminating the Cosmic Dawn

Dr. Andrei Mesinger
Scuola Normale Superiore, Pisa, Italy

The birth of the first stars, black holes and galaxies heralded the end of the cosmic Dark Ages and the beginning of the Cosmic Dawn. The light from these objects heated and ionized almost every atom in existence, culminating in the Epoch of Reionization: the final major phase change of the Universe. This final frontier of astrophysical cosmology is undergoing a transition from an observationally-starved epoch to a "Big Data" field. This process will culminate with interferometric observations of the redshifted 21-cm line, eventually providing a 3D map of the first billion years of our Universe. I will discuss the recent clues to reionization, obtained from the CMB, high-redshift galaxies, and quasars. Finally, I will showcase the physical bounty of the upcoming 21-cm observations. I will discuss the innovative modeling techniques we are developing to tap into this bounty, allowing us to constrain astrophysical parameters in a fully Bayesian framework.

Session 3: Cosmology and Relativistic Astrophysics

Using HII galaxies as a tracer of the high-z Hubble expansion

Prof. Manolis Plionis
National Observatory of Athens & University of Thessaloniki

We will present cosmological results based on the use of an alternative to SNIa high-z cosmic expansion tracer. The correlation between the Hβ emission-line luminosity and the stellar velocity dispersion provides a new distance indicator that extends to redshifts up to ~3-4. Using this new tracer we present results on the Hubble constant and on the Dark Energy equation of state parameters.

Session 4: Stars, Planets and the Interstellar Medium

The formation and evolution of interstellar filaments

Dr. Evangelia Ntormousi
FORTH/ University of Crete

The filamentary structure of interstellar matter and its potential link to star formation have been brought into focus by recent high resolution observational surveys. The densest of these filaments host pre-stellar and star forming cores, so explaining their properties is tightly correlated to revealing the initial conditions for star formation. I will present high-resolution, 3D MHD simulations performed with the AMR code RAMSES, and aimed at investigating two filament formation mechanisms: turbulence and sheet fragmentation. The first series of simulations has as a particular aim to address the origin of the characteristic filament thickness found in observations. Our numerical experiments consist of (driven or decaying) ideal and non-ideal MHD turbulence, at a resolution that greatly exceeds the reported 0.1 pc thickness. In this picture dense filaments are the diffusive end of the turbulent cascade, an interpretation with important implications for our understanding of the dynamical behavior of the ISM. A second series of simulations investigates filament formation by the fragmentation of supershells. We find a striking difference between hydrodynamical and MHD runs as in the first case the sheets fragment into almost spherical clumps, while in the latter they produce large filaments. In this scenario filaments are prominent features in the ISM, and their fate is determined by the Galactic magnetic field.

The fast and the furious: the young accreting binary population of the Small Magellanic Cloud

Dr. Vallia Antoniou
Harvard-Smithsonian CfA

Nearby star-forming and starburst galaxies offer a unique environment to study the populations of young (<100 Myr) X-ray binaries, which consist of a compact object - either a neutron star or a black hole - powered by accretion from a companion star. These systems are tracers of past populations of massive stars that heavily affect their immediate environment and parent galaxies. The Small Magellanic Cloud is the ideal environment for population studies of young X-ray binaries by providing us with what the Milky Way cannot: A complete sample of X-ray sources within a galaxy. With the advent of Chandra and XMM-Newton, it became feasible to investigate the neutron star binary population in this low-metallicity, nearby, star-forming galaxy by reaching quiescent X-ray luminosity levels ($\sim$ few times 10^{32} erg/s) that we have been able to observe only in our own Galaxy, but without the Galactic limitations of distance uncertainties, and obscuration. In this talk, I will review our current understanding of young accreting binaries, describing how neutron star binaries form and evolve. In addition, I will review their multi-wavelength properties and present their formation efficiency as a function of age. I will present the deepest luminosity function ever recorded for a galaxy, and discuss the X-ray properties of the largest sample of extragalactic accreting pulsars as well. finally, I will conclude on how we can build on our success by observing the high-energy processes related to the star-forming activity in our nearest low-metallicity galaxy, the Large Magellanic Cloud.

Session 1: Heliophysics and the Solar System

Oral presentations

Calculating relative magnetic helicity in spherical wedge volumes

Dr. Kostas Moraitis
Observatoire de Paris
Pariat Etienne (Observatoire de Paris) Savcheva Antonia (Harvard-Smithsonian Center for Astrophysics)

Magnetic helicity, a key quantity in magneto-hydrodynamics because of its conservation properties, quantifies the level of entanglement and torsion of field lines in a magnetic domain. Many methods have been developed recently to compute relative magnetic helicity, the appropriate helicity for solar applications, however, these are either limited to the Cartesian domain, while the natural geometry for the Sun is the spherical one, or, they do not comply with all the assumptions of relative helicity usage. We present here the first method to compute properly and consistently relative magnetic helicity in spherical coordinates. The volume considered is of spherical wedge shape and the three-dimensional magnetic field is considered known in the whole volume. The relative magnetic helicity calculation relies on the computation of a potential field, which is done by solving the three-dimensional Laplace's equation using a multigrid technique. The vector potentials of the two magnetic fields are derived with a recent, fast and robust method which employs the direct integration of the magnetic field, and optionally, the solution of a two-dimensional Laplace's equation. The method is first tested with the help of semi-analytic force-free solutions of the magnetic field. Then, it is applied to a set of nonlinear force-free reconstructions of the magnetic field of observed solar active regions. The obtained helicity values are compared with the respective ones that are derived using a simplified approach and their comparison enables us to estimate the applicability of the simplified method. Our method is paving the way for the complete and proper diagnostic of the helicity content in both numerical simulations and magnetic feld reconstructions using spherical coordinates.

Foretelling flares and Solar Energetic Particle Events: the FORSPEF tool

Dr. Anastasios Anastasiadis
IAASARS, National Observatory of Athens

Papaioannou Athanasios (IAASARS, National Observatory of Athens), Sandberg Ingmar (IAASARS, National Observatory of Athens), Georgoulis Manolis (RCAAM, Academy of Athens), Kouloumvakos Athanasios (Department of Physics, University of Ioannina), Tziotziou Kostas (IAASARS, National Observatory of Athens), Jiggens Piers (ESTEC/ESA)

A novel integrated prediction system, for both solar flares (SFs) and solar energetic particle (SEP) events is being presented. The forecasting Solar Particle Events and flares (FORSPEF) provides forecasting of solar eruptive events, such as Sfs with a projection to coronal mass ejections (CMEs) (occurrence and velocity) and the likelihood of occurrence of a SEP event. In addition, FORSPEF, also provides nowcasting of SEP events based on actual SF and CME near real-time data, as well as the complete SEP profile (peak flux, fluence, rise time, duration) per parent solar event. The prediction of SFs relies on a morphological method: the effective connected magnetic field strength (Beff); it is based on an assessment of potentially flaring active-region (AR) magnetic configurations and it utilizes sophisticated analysis of a large number of AR magnetograms. for the prediction of SEP events new methods have been developed for both the likelihood of SEP occurrence and the expected SEP characteristics. In particular, using the location of the flare (longitude) and the flare size (maximum soft X-ray intensity), a reductive statistical method has been implemented. Moreover, employing CME parameters (velocity and width), proper functions per width (i.e. halo, partial halo, non-halo) and integral energy (E>30, 60, 100 MeV) have been identified. In our technique warnings are issued for all > C1.0 soft X-ray flares. The prediction time in the forecasting scheme extends to 24 hours with a refresh rate of 3 hours while the respective prediction time for the nowcasting scheme depends on the availability of the near real-time data and falls between 15-20 minutes for solar flares and 6 hours for CMEs. We present the modules of the FORSPEF system, their interconnection and the operational set up. The dual approach in the development of FORPSEF (i.e. forecasting and nowcasting scheme) permits the refinement of predictions upon the availability of new data that characterize changes on the Sun and the interplanetary space, while the combined usage of Sf and SEP forecasting methods upgrades FORSPEF to an integrated forecasting solution. This work has been funded through the "FORSPEF: FORecasting Solar Particle Events and flares", ESA Contract No. 4000109641/13/NL/AK and the "SPECS: Solar Particle Events foreCasting Studies" project of the National Observatory of Athens.

Statistics of Pc3 waves and plasma instabilities observed by Swarm satellites in low-Earth orbit

Dr. Georgios Balasis
National Observatory of Athens

Constantinos Papadimitriou (1), ,Ioannis A. Daglis (2,1), Omiros Giannakis (1)
(1) Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens (2) Section of Astrophysics, Astronomy and Mechanics, Department of Physics, National and Kapodistrian University of Athens

The ongoing Swarm satellite mission provides an opportunity to a better knowledge of the near-Earth electromagnetic environment. Herein, we study the occurrence of ultra low frequency (ULF) wave events observed by the Swarm satellite

mission for a period spanning two years after constellation's fnal confguration. for this purpose, we use a new methodological approach for detection and classification of wave events based on the utilisation of Swarm Level 2 products (i.e., the field Aligned Currents - FAC and Ionospheric Bubble Index - IBI). We present maps of the dependence of ULf wave power with magnetic latitude and magnetic local time (MLT) as well as geographic latitude and longitude from the three satellites at their different locations in the topside ionosphere. We derive daily and monthly variations of the Pc3 wave power (20-100 mHz) and show distributions for various wave properties of the detected events. Moreover, we include Swarm power maps of plasma instabilities in the topside ionosphere revealing a globally symmetric mirrored structure along the magnetic equator for these instabilities, which is attributed to equatorial spread-f (ESF) signatures. We also fnd an enhancement of ESF power in the region of South Atlantic Anomaly (SAA) in agreement with the recently discovered by Swarm enhancement of compressional Pc3 wave energy in SAA.

Center-to-limb Observations of the Sun with ALMA: Implications for Solar Atmospheric Models

Prof. Alexander Nindos
University of Ioannina

Alissandrakis Costas (University of Ioannina), Patsourakos Spiros (University of Ioannina), Bastian Tim (National Radio Astronomy Observatory)

We derive information on the temperature structure of the solar chromosphere and compare it with existing models using ALMA full-disk images observed at 100 and 230 GHz. We measured the center-to-limb variation of the brightness temperature, Tb, from the ALMA full-disk images at both frequencies and inverted the solution of the transfer equation to obtain the electron temperature, Te, as a function of optical depth, τ. The ALMA images are very similar to AIA images at 1600 A. The brightness temperature at the center of the disk is 6180 and 7250 K at 239 and 100 GHz respectively, with dispersions of 100 and 170 K. Plage regions stand out clearly in the 239/100 GHz intensity ratio, while faculae and filament lanes do not. The solar disk radius, reduced to 1 AU, is 961.1±2.5" and 964.1±4.5" at 239 and 100 GHz respectively. A slight but statistically significant limb brightening is observed at both frequencies. The inversion of the center-to-limb curves shows that Te varies linearly with the logarithm of optical depth for $0.34 < \tau_{100GHz} < 12$.

Analysis of multi-wavelength observations of persistent and spatially-extended quiet Sun vortex flows

Dr. Georgia Tsiropoula
IAASARS, NOA

Tziotziou K. (IAASARS, NOA), Kontogiannis I. (RCAAM, Ac. of Athens), Scullion E. (Northubria Univ.), Doyle J.G. (Armagh Observatory)

We investigate the morphological characteristics and temporal evolution of exceptional, both in size and duration, vortex flows that are observed in a quiet-Sun region. for our analysis, we use high spatial and temporal resolution ground-based observations of narrowband images of both Hα 6563 A and Ca II 8542 A lines, obtained with the CRiSP Imaging SpectroPolarimeter (CRISP) instrument mounted at the Swedish 1-m Solar Telescope (SST) in La Palma, as well as imaging of the solar atmosphere in several UV and EUV wavelengths obtained with the space-based AIA instrument on-board SDO. This is the first time that such a persistent (lasting for at least two-hours) and spatially-extended system of vortex flows is reported in literature. We study its intricate morphology in the different wavelengths and its interaction with nearby quiet-Sun features and compare it to the already published state-of-the-art numerical vortex-flow simulations. furthermore, using a space-time analysis within the system of the vortex structures, we explore the characteristics and dynamics of the swirling motions using information from the time series of both the intensities at the different wavelengths and the Doppler shifts obtained from the Hα line profile. Understanding of vortexes is important as these events may provide an efficient way for transferring energy and possibly matter from the lower into the higher solar atmospheric layers by the continuous driving of high-speed upflows.

Particle acceleration and heating in turbulent reconnecting astrophysical plasmas

Prof. Loukas Vlahos
University of Thessaloniki

H. Isliker (University of Thessaloniki), Th. Pisokas (University of Thessaloniki), and A. Anastasiadis (Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens)

We analyze statistically the energization of particles in a large scale environment of turbulent reconnection that is fragmented into a number of randomly distributed Unstable Current Sheets (UCS). We consider two important cases of energization mechanisms when the particles interact with the UCS: (a) electric field acceleration, and (b) refection by contracting islands. Electrons and ions are accelerated very efficiently, reaching a power law energy distribution with a very steep index 1-2 that depend on the acceleration mechanism. Based on test-particle simulations, we estimate the transport coefficients in energy space for the use in the classical fokker-Planck (FP) equation, and we show that the latter fails to reproduce the simulation results. The reason is that transport in energy space is highly anomalous (strange), the particles perform Levy flights, and the energy distributions show extended power-law tails, Given this fact ,we derive and use a specific form of a fractional transport equation (FTE). We determine its parameters and the order of the fractional derivatives from the simulation data, and we show that the FTE is able to reproduce the simulation data very well. The procedure for determining the FTE parameters also reveals that the analysis of the simulation data indicates whether a classical FP or a FTE is appropriate.

Forecasting solar flares using magnetogram-based predictors and machine learning

Dr. Kostas Florios
RCAAM, Academy of Athens

Kontogiannis Ioannis (RCAAM, Academy of Athens), Park Sung-Hong (School of Physics, Trinity College Dublin), Guerra Jordan A. (School of Physics, Trinity College Dublin), Benvenuto federico (Department of Mathematics, University of Genova), Georgoulis Manolis K. (RCAAM, Academy of Athens)

In this paper we propose a forecasting approach for solar flares occurrence based on recently available information by the NASA Solar Dynamics Observatory (SDO) mission. Our approach utilizes predictors calculated for every Active Region (AR) of the Sun, using available magnetograms, taken by the Helioseismic and Magnetic Imager (HMI) instrument of SDO. More specifically, we use the Space-weather HMI Active Region Patches (SHARPs) product (see Bobra et al., 2014) which facilitates cut-out magnetograms of AR in the Sun in real-time. The predictors we have used are the decay index, the B effective, the Non-neutralized Current etc. These predictors are not included in the header of the SHARP datasets. Their computation for a representative sample of the SHARP data during the period 2012-2016 is thus non-trivial. Using a set of magnetogram-based predictors, we exploit several classic and modern Machine Learning (ML) techniques in order to build predictive models of Solar flares Occurence. We are interested in predicting >M1 class flares and C-class flares in the following 24 hours after the SHARP dataset has been issued. The methods used are Multi-Layer Perceptrons, Support Vector Machines and Random forests. Comparison to published results and also to traditional statistical approaches is undertaken. It seems that the Random forests are the prediction technique of choice, while the second best method are the Multi-Layer Perceptrons with the entropy objective function and additional tuning of their hyperparameters. A Monte Carlo simulation showed that the best performing method is Random Forest with ACC=0.98±0.00, TSS=0.66±0.05 and HSS=0.51±0.04 (>M1 class flares prediction with threshold 20%) and ACC=0.91±0.00, TSS=0.71±0.02 and HSS=0.60±0.01 (C-class flares prediction with threshold 25%) using ffteen Blos and Br based magnetogram predictors.

Elucidating the Role of Magnetic Cancellation in Triggering Energetic Solar Eruptions

Dr. Georgios Chintzoglou
Lockheed Martin Solar & Astrophysics Lab

NOAA Active Region 12017 was a source of rich flare activity, which culminated with an eruptive X1.0 flare on 29-Mar-2014. AR12017 was observed simultaneously by the Atmospheric Imaging Assembly (AIA) and the Helioseismic and Magnetic Imager (HMI) instruments onboard the Solar Dynamics Observatory (SDO) and also by the Interface Region Imaging Spectrograph (IRIS). The obtained high temporal and spatial resolution observations of this evolving AR covered the entire solar atmosphere, from the surface to the chromosphere and transition region (TR) all the way to the corona. As a result, and thanks to the favorable pointing of the IRIS spectrograph's slit at the core of this AR, this event comprises the best-observed X1.0 flare to date. An hour before the X1.0 flare, a persistent brightening (reminiscent of an Ellerman Bomb) appears in the 2832 Mg II continuum slit-jaw images from IRIS. This bright feature is seen at the core of the AR, right where the opposite polarities of two small emerging bipoles collide and cancel. In addition, Differential Emission Measure (DEM) analysis links this feature to the west end of a convex-up bright structure seen in the corona with SDO/AIA and in the Transition Region in Si IV 1400 slit-jaw images by IRIS. Over time, the DEM maps reveal a weakly twisted structure with the convex-up feature being part of it, signifying the formation of a coronal magnetic flux rope in the core of AR12017. Our unique observations show that cancellation driven by the collision of two emerging bipoles led to the formation of a magnetic flux rope that erupted as a CME and produced the X1.0 flare.

Reconstructing the size distribution of the primordial Main Belt

Mr. Georgios Tsirvoulis
University of Belgrade

One of the reasons for which asteroids are subject of many studies is that they represent what is left over of the original population of planetesimals in the inner Solar System. Among the many properties of asteroids, their size-frequency distribution (SfD) may be diagnostic of the process by which planetesimals formed. In this work we aim to constrain the slope of the size distribution of main-belt asteroids, at its primordial state. To do so we turn out attention to the part of the main asteroid belt between 2.82 and 2.96 AU, the so-called "pristine zone", which has a low number density of asteroids and few, well separated asteroid families. Exploiting these unique characteristics, and using a modifed version of the hierarchical clustering method we are able to remove the majority of asteroid family members from the region. The remaining, background asteroids should be of primordial origin, as the strong 5/2 and 7/3 mean-motion resonances with Jupiter inhibit the transfer of asteroids to and from the neighboring regions. The size-frequency distribution of asteroids in the size range 17

Constraining the magnitude and timing of the giant planet instability from the perspective of the asteroid belt

Ms. Athanasia Toliou
University of Thessaloniki

The evolution of the early Solar System has been a very active topic of research over the past decades. It is generally accepted that the orbits of the giant planets have undergone an instability phase, however, the timimg (early or late with

respect to the dispersal of the gas disk) and the magnitude (in terms of orbital variation) of the instability is still an open debate. The terrestrial planets and the main asteroid belt can help constrain these parameters. The orbits of the terrestrial planets must have avoided being destabilized or overexcited and the fnal orbital distribution of the main belt asteroids must be able to reproduce the currently observed one. In this study we focus on the asteroid belt; we chose an initial orbital distribution in accordance to the Grand Tack-end-state and simulated a small jump in the Jupiter-Saturn period ratio. We find that, irrespective of the timing of the instability, if the jump is too short, the 6 secular resonance, which affects the eccentricities of the asteroids, crosses the asteroid belt and, as the giant planets migrate smoothly, it sweeps through the inner belt strongly affecting bodies at low inclinations. As a consequence, the final ratio between the number of asteroids above and below the 6 resonance is much larger than the observed ratio. We conclude that even though a short jump is a higher probability solution for the giant planet instability, it does not reproduce the asteroid belt under any assumption for their initial distribution.

Ice spots on the nucleus of comet 67p/churyumov-gerasimenko as observed by rosetta mission

Prof. Maria Antonietta Barucci
LESIA-Paris Observatory
Fulchignoni Marcello (LESIA-Paris Observatory)

During more than two years of observations on board of Rosetta spacecraft orbiting close to the comet 67P/Churyumov-Gerasimenko, the OSIRIS (Optical, Spectroscopic, and Infrared Remote Imaging System) camera acquired a huge quantity of resolved images of the comet, producing the most detailed maps at the highest spatial resolution ever made of a cometary nucleus surface. Comet 67P shows a body with a dark, dehydrated surface, rich in hetereogeneous geological structures. The morphologically complex surface shows color and albedo variations with local time and perihelion distance. Numerous bright spots of different size with high visible albedo and fat visible slope have been identifed by OSIRIS high resolution images. The detected bright spots are mostly situated on consolidated dust free areas distributed on the two lobes of 67P in locations which stay longer in shadow. Some of them have been observed also by VIRTIS (Visible InfraRed Thermal Imaging Spectrometer) which has detected the diagnostic absorption bands of ice in at 1.5 and 2.05 μm Comparing the image data with near-infrared spectra and modeling the spectra as a mixture of H2O ice and the ubiquitious "Dark Material" associated to complex organic material present on the nucleus' surface, we were able to study at the same time the morphological, thermal and compositional properties of these areas. With this complementary study we are able to confrm the presence of H2O ice on many brighter areas distributed on the two lobes of 67P. We enlarge the study on all the surface of the comet. Depending on the morphologies and potential formation scenarios of the analysed features, we divide them into 5 categories as follows: 1. isolated patches on smooth terrain, 2. isolated patches close to irregular structures, 3. patches resting on boulders, 4. cluster of features and 5. frost. Generally, these bright features are preferably located in equatorial regions of the cometary nucleus. The majority of them can be restricted to the -30° to +30° of latitudes. The majority of the detected H2O ice spots are located in the vicinity of previously detected cometary outbursts source areas. We investigated all the available observations to evaluate the lifetime of the ice spots. Some spots are stable for several months and others show temporal changes connected to diurnal and seasonal variations. The morphological variation of the comet surface as well the temporal evolution of the ice spots will be presented and discussed as well as their stability.

Linking Solar Eruptions with fundamental Physical Parameters at the Solar Atmospheric Base

Dr. Manolis Georgoulis
RCAAM, Academy of Athens

The solar photospheric interface separates the highly magnetized solar atmosphere from the fluid-dominated interior of the star. Above it, plasma succumbs to the powerful magnetic field but manages to manifest itself as electric current, that pushes the magnetic field above its minimum-energy state. Electric currents hence imply magnetic energy available for release and the powering of solar eruptions, namely flares and coronal mass ejections (CMEs). Some of these currents in particularly stressed magnetic configurations are "non-neutralized", meaning that they are "net" currents deposited in the solar corona. In addition, this "free for release" energy implies magnetic helicity, a quantity approximately conserved in solar atmospheric conditions. We link measured non-neutralized electric currents and magnetic helicity in the solar atmosphere with observed eruptions and their impact at Earth and geospace, some 1 AU away. Results are encouraging and boost physical understanding, at the same time exposing our limitations toward a practical, operational prediction of solar magnetic eruptions. This research has been partly supported by the EU Horizon 2020 Research and Innovation Action FLARECAST Project (Grant Agreement no. 640216).

Non-neutralized currents and flaring activity in solar active regions

Dr. Ioannis Kontogiannis
RCAAM, Academy of Athens

Georgoulis Manolis (RCAAM, Academy of Athens), Park Sung Hong (Trinity College Dublin), Guerra Jordan A. (Trinity College Dublin)

Solar flares are sudden emissions of huge amounts of energy throughout the entire electromagnetic spectrum, with an immediate effect on geospace. Therefore, new and efficient prediction methods of increased sophistication are required to mitigate their impact. It has been known that the free magnetic energy necessary for solar flares is associated with electric currents. Prone to flaring active regions contain significant amounts of non-neutralized (net) currents, which are injected into the photosphere via magnetic flux emergence and are exclusively associated with the formation of strongly sheared magnetic polarity inversion lines. We use a detailed analysis to measure the non-neutralized currents in active regions and investigate their predictive potential using data from the Helioseismic Magnetic Imager (HMI) instrument onboard the Solar Dynamics Observatory (SDO). Utilizing a representative sample of active regions of the current solar cycle we show, for the first time, that non-neutralized currents facilitate the distinction between flaring and non-flaring active regions and that larger flares are associated with larger values of non-neutralized currents. We finally discuss their efficiency and integrability in the operational framework of the FLARECAST project. This study has received partial support by the EU Horizon 2020 FLARECAST Project (Grant Agreement No. 640216)

The NEO Lunar Impact Monitoring Project NELIOTA

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We present the motivation for and current status of NELIOTA, an ESA activity launched at the National Observatory of Athens in 2015 aiming to determine the size-frequency distribution of small near-earth objects (NEOs) via lunar monitoring for NEO impact flashes. The NELIOTA project has upgraded the 1.2m Kryoneri telescope of the National Observatory of Athens, commissioned a prime focus Lunar Imager consisting of two fast-frame sCMOS cameras and deployed a hardware system for recording and processing images. We have also developed a software system, which controls both the telescope and the cameras, processes the images and automatically detects candidate NEO lunar impact flashes. The impact events are verifed, characterized and made available to the scientific community and the general public via the NELIOTA website(neliota.astro.noa.gr) within 24 hours of discovery. NELIOTA completed its commissioning phase in early 2017 and began a 22 month observing campaign in March 2017 in search of NEO impact flashes on the Moon. The 1.2m Kryoneri telescope is capable of detecting fashes much fainter than current, small-aperture, lunar monitoring telescopes. NELIOTA is therefore expected to characterize the size-frequency distribution of NEOs weighing as little as a few grams.

Voyager and Cassini measurements suggest a bubble-like shape for the global heliosphere.

Dr. Konstantinos Dialynas
Academy of Athens

The Low Energy Charged Particle (LECP) in situ measurements from Voyager 1 and Voyager 2 (V1, V2) have revealed the reservoir of ions and electrons that constitute the heliosheath after crossing the termination shock 35deg north and 32deg south of the ecliptic plane at ~94 and ~84 astronomical units (1 AU=1.5x1$\hat{8}$ km), respectively. In August 2012, at 121.6 AU, V1 crossed the heliopause to enter the interstellar space, while V2 remains in the heliosheath since 2007. The advent of Energetic Neutral Atom (ENA, produced through charge exchange between ions and neutral particles flowing through the heliosphere) imaging, has revealed the global nature of the heliosheath at both high (5.2-55 keV, Cassini/Ion and Neutral Camera-INCA, from 10 AU) and low (<6 keV, Interstellar Boundary Explorer-IBEX, from 1 AU) energies. The presence of the two Voyagers measuring ions locally in the heliosheath contemporaneously with INCA global imaging through ENA in overlapping energy bands provides a powerful tool for examining the spatial, temporal, and spectral evolution of the source hot plasma ions. Here we report 5.2-55 keV ENA global images of the heliosphere from Cassini/INCA and compare them with V1,2/LECP 28-53 keV ions measured within the heliosheath over an 11-year period (2003-2014). The similarity between the time profles of ENA and ions establish that the heliosheath ions are the source of ENA. These measurements also demonstrate that the heliosphere responds promptly, within ~2-3 years, to outward propagating solar wind changes (manifested in solar sunspot numbers and solar wind energy input) in both the upstream (nose) and downstream (tail) hemispheres. These results, taken together with the V1 measurement of a ~0.5 nT interstellar magnetic feld and the enhanced ratio between particle pressure and magnetic pressure in the heliosheath, constrain the shape of the global heliosphere: by contrast to the magnetosphere-like heliotail (that past modeling broadly assumed for more than 55 years), a more symmetric, diamagnetic bubble-like heliosphere, with few substantial tail-like features is revealed.

The process of magnetic flux emergence as a major driver for solar jets and eruptions.

Dr. Petros Syntelis
University of St Andrews

We report on 3D MHD simulations of magnetic flux emergence in the Sun. We demonstrate how this key physical process drives the ejection of multi-scale jets and eruptions, such as blow-out jets and Coronal Mass Ejections. We show that the magnetic energy of the emerging fields is a crucial parameter that affects the dynamics, energetics and physical properties of the eruptive events. We also show the mechanism, which triggers the eruptions in emerging flux regions.

First lunar impact fash results from NELIOTA

Dr. Alexios Liakos
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We present the first lunar impact fashes observed with the upgraded 1.2m Kryoneri telescope at Kryoneri Observatory in the framework of the NELIOTA project and the first scientific results regarding the characteristics of these flashes. Simultaneous observations in the R and I bands allow the calculation of the flash temperature and, in addition, their cooling as a function of time for the long, multi-frame flashes. The magnitude of the flashes, their temperatures, location on the lunar surface, and the resulting physical parameters (mass, radius) of the impacting near-Earth objects (NEOs) are discussed, along with the assumptions made in these estimations. finally, the current statistics of the flashes for the first five months of the 22-month campaign period are presented.

Solar Particle Radiation Storms forecasting and Analysis: The HESPERIA HORIZON 2020 project and beyond

Dr. Olga Malandraki
National Observatory of Athens/IAASARS

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We describe the two real-time prediction tools, HESPERIA UMASEP-500 and HESPERIA REleASE that have been developed in the framework of the HESPERIA project based upon the proven concepts UMASEP and REleASE. A major impact on human and robotic space exploration activities is the sudden and prompt occurrence of solar energetic ion events. The fact that near-relativistic electrons (1 MeV electrons have 95% of the speed of light) travel faster than ions (30 MeV protons have 25% of the speed of light) and are always present in Solar Energetic Particle (SEP) events can be used to forecast the arrival of protons from SEP events with real-time measurements of near relativistic electrons. The faster electrons arrive at L1 30 to 90 minutes before the slower protons. The Relativistic Electron Alert System for Exploration (REleASE) forecasting scheme (Posner, 2007) uses this effect to predict the proton flux by utilizing the actual electron flux and the increase of the electron flux in the last 60 minutes. In the framework of the HESPERIA project, a clone of the REleASE system was built in the open source programming language PYTHON. The same forecasting principle with use of the same forecasting matrices were in addition adapted to real-time electron flux measurements from the Electron, Proton & Alpha Monitor (EPAM) onboard the Advanced Composition Explorer (ACE). It is shown, that the REleASE forecasting scheme can be adapted to work with any near relativistic electron flux measurements. SEPs are sometimes energetic enough and the flux is high enough to cause air showers in the stratosphere and in the troposphere, which are an important ionization source in the atmosphere. >500 MeV solar protons are so energetic that they usually have effects on the ground, producing what is called a Ground Level Enhancement (GLE) event. Within the HESPERIA project a predictor of >500 SEP proton events at the near-earth (e.g. at geostationary orbit) has been developed. In order to predict these events, the UMASEP scheme (Núñez, 2011, 2015) has been used. UMASEP makes a lag-correlation of solar electromagnetic (EM) flux with the particle flux at near-earth. If the correlation is high, the model infers that there is a magnetic connection through which particles are arriving. If, additionally, the intensity of the flux of the associated solar event is also high, then the UMASEP scheme issues a SEP prediction. In the case of the prediction of >500 MeV SEP events, the implemented system, called HESPERIA UMASEP-500, correlates X-ray flux with each of the differential proton fluxes measured by the GOES satellite network. When the correlation estimation surpasses a threshold, and the associated flare is greater than a specific X-ray peak flux, a >500 MeV SEP forecast is issued. Both forecasting tools are operational under the HESPERIA server maintained at the National Observatory of Athens (https://www.hesperia.astro.noa.gr/). furthermore, results of the data analysis of the SEP event compositional signatures observed during solar cycle 23 which provide diagnostics for the particle acceleration processes during large SEP events will be presented, obtained within the HESPERIA project. Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 637324 (HESPERIA project).

Solar bombs in the cool solar atmosphere.

Dr. Vasilis Archontis
University of St Andrews

A spectacular manifestation of solar activity is the appearance of transient brightenings in the far wings of the Hα line, known as Ellerman bombs (EBs). Recent observations obtained by the Interface Region Imaging Spectrograph have revealed another type of plasma "bombs" (UV bursts) with high temperatures of perhaps up to 8×10^4 K within the cooler lower solar atmosphere. Realistic numerical modeling showing such events is needed to explain their nature. We present results from 3D radiative magnetohydrodynamic simulations of magnetic flux emergence in the solar atmosphere. We find that ubiquitous reconnection between emerging bipolar magnetic fields can trigger EBs in the photosphere, UV bursts in the mid/low chromosphere and small (nano-/micro-) flares (10^6) K in the upper chromosphere. These results provide new insights into the emergence and build up of the coronal magnetic field and the dynamics and heating of the solar surface and lower atmosphere.

Dynamical study of the near-earth space enviroment for passive debris removal

Ms. Despoina Skoulidou
University of Thessaloniki

Rosengren Aaron J. (University of Arizona, University of Thessaloniki) Tsiganis Kleomenis (University of Thessaloniki) Voyatzis George (University of Thessaloniki)

Only during the past decade has the precarious state of the Earth's orbiting environment, permeated by clouds of space debris, been fully appreciated and understood. Both active and passive debris mitigation and removal techniques are designed to curtail the growth of the debris environment by limiting the amount of mass in preferential space regions that may lead to future collisions. The solution to the debris proliferation problem, however, can only be found by coupling these mitigation and remediation methods with a deep understanding of the dynamical environments occupied by artificial satellites and space debris. An attempt at this heuristic approach is presented herein. This work uses tools and practices that are common in celestial mechanics and dynamical systems theory, which have been applied successfully in studies on the long-term dynamics in the Solar System and on the design of satellite orbits, but have only just started to be applied to the dynamics of space debris in recent years, as did the need for extending our knowledge of these artificial celestial bodies on intervals longer than mission timescales. Though a cartography of stability maps, obtained using a suitably modifed version of the SWIfT symplectic integration package (Levison & Duncan, 1994), we characterize the whole circumterrestrial space from LEO to GEO for the purposes of passive debris removal using resonances. The overlap of the predominant lunisolar secular and semi-secular resonances furnish a number of interesting disposal hatches at moderate and low eccentricity orbits. We show, furthermore, that increasing the satellite's area-to-mass ratio using a solar sail helps promote the deorbiting process, through coupled gravitational and radiation pressure perturbations.

Killing satellites with resonances: the dynamics of passive debris removal

Dr. Aaron Jay Rosengren
University of Arizona

One of the main goals of the space debris community is to determine how to prevent debris from becoming so populous that it adversely affects operational satellites. Recent efforts have explored more passive means to curtail the growth rate of the debris population, by seeking to cleverly exploit the dynamical instabilities brought on by resonant perturbations to deliver retired Earth-orbiting satellites into the regions where atmospheric drag can start their decay. With a modest delta-v budget, satellites can be steered into a short-lived resonance, or passive systems can be deployed at the end of life like solar sail devices to enhance solar radiation pressure to bring satellites down earlier than would otherwise be the case. Having previously characterized the dynamical architecture of the circumterrestrial environment, from very low-altitude orbits up to the geostationary region and beyond, this talk will link these cartographic stability maps to the appropriate disposal strategy or deorbiting device for any operational orbit. We will highlight in particular how our previous dynamical assessments can have a profound and tangible infuence on space debris mitigation though the passive debris removal ideology.

New models of asteroid belt formation

Prof. Kleomenis Tsiganis
University of Thessaloniki

Toliou Athanasia (Aristotle University of Thessaloniki)

The origin of the orbital structure in the asteroid main belt has been a puzzling problem for decades, as an initially 'flat' disc of nearly circular and co-planar orbits cannot evolve into the currently observed distribution in 4 Gy, if the giant planets always followed the same secular evolution. Recent work suggests that the mass depletion and dynamical excitation of the asteroid belt has to be examined within the context of terrestrial planets formation and points to additional constraints that have to be met (most notably, the small final mass of Mars). Here we investigate a model that assumes an initially multi-resonant configuration for the giant planets, as suggested by recent formation models, which introduces a small degree of chaos in their orbits. We perform a series of simulations of the whole system (giant planets in resonance, asteroids and planetary embryos) under the gravitational effects of a dispersing gaseous disc, assuming various values for the relevant parameters. Our results are suggestive of the physical conditions under which the observed structure of the main belt can be reproduced.

New space application to the earthquake prediction reserch

Prof. Georgios Anagnostopoulos
Demokritos U. of Thrace

Alexandros Rigas (Demokritos U. of Thrace)

Earthquakes (EQs) is one of the most catastrophic physical phenomena in the world and the most catastrophic one in Greece and in south-east Mediterranean in general. After the 2010, January 12 M7.0 Haiti earthquake, at least 300000 deaths were reported, while for the well known 2011, March 11 Japan EQ, the World Bank estimated an economic cost of ~US$235 billion. During the last few decades several electromagnetic (EM) phenomena on Earth and its environment were reported as EQ precursory signals. Most importantly, the French satellite DEMETER (Detection of Electro-Magnetic Emissions Transmitted

from Earthquake Regions), which was dedicated to investigate EQ rlated EM phenomena, highly advanced the interest of researchers around the word, and confirmed that the space measurements is a very significant component of EQ prediction research. For this reason China, a country with serious problems from EQs and an increasing space research interest, has prepared a second special satellite sponsored by China Space Administration and China Earthquakes Administration, which is scheduled to be launched in some months in order to further improve EQ prediction attempts. In this paper we present EQ precursory signals related with six different EM phenomena. The first triplet of signals concerns charged particle variations in the inner Radiation Belt (RB), the Ionosphere and the Total Electron Content (TEC) of the Earth's Atmosphere. The second triplet concerns EM emissions in Infrared (IR), Very Low Frequency (VLF) and Ultra Low Frequency bands, each one related with a different EM phenomenon in the Earth's environment. To this end, we present results from both a case study (Methoni, 14.2.2008 M6.7 EQ) and statistical results for the six signals. Particular emphasis is given to the RB electron precipitation, since this phenomenon, beside to be a precursory signal, it is an important RB electron loss mechanism. Finally, we briefly discuss the social and epistemological dimension of the EQ prediction research, since 6 scientists and one goverment officer were considered guilty and were sentenced to six months prison for the death of people after the L' Aquila (Italy) EQ in April 6, 2009.

Poster presentations

Intermittent criticality revealed in the ENIGMA magnetometer array time series prior to the strongest magnetic storms of the present solar cycle

Dr. Georgios Balasis

National Observatory of Athens

Ioannis A. Daglis (2,1), Yiannis Contoyiannis (3), Stelios M. Potirakis (3), Constantinos Papadimitriou (1), Nikolaos S. Melis (4), Omiros Giannakis (1), Athanassios Papaioannou (1), Anastasios Anastasiadis (1), and Charalampos Kontoes (1)

(1) Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece, (2) Section of Astrophysics, Astronomy and Mechanics, Department of Physics, National and Kapodistrian University of Athens, Greece, (3) Department of Electronics Engineering, Piraeus University of Applied Sciences (TEI of Piraeus), Greece, (4) Institute of Geodynamics, National Observatory of Athens, Greece

The geomagnetic field observations of the ENIGMA magnetometer array associated with the most intense magnetic storms of solar cycle 24 are studied in terms of the theory of critical phenomena and phase transitions. The application of the critical fluctuations analysis method on the unprocessed Earth2019s magnetic field variations provides evidence of the existence of criticality from 8 up to 45 hours before the occurrence of these intense magnetic storms. The identified dynamics are analogous to those of thermal systems undergoing phase transition of the second-order. Detrended fluctuation analysis results are consistent to the findings of the method of critical fluctuations implying that the underlying nonlinear processes are anti-persistent, as expected for criticality caused by intermittent dynamics.

Short- and long- term periodicities of cosmic ray intensity time series

Ms. Maria Tsichla

University of Athens

Gerontidou Maria (National and Kapodistrian University of Athens) Mavromichalaki Helen (National and Kapodistrian University of Athens)

Galactic cosmic rays are energetic charged particles coming from outside the solar system, originating mostly from Supernova remnants. The aim of studying cosmic rays is the monitoring of the space weather conditions, so as to protect spacecraft and ground electronic systems and more importantly humans in space and in high latitude/altitude fights. Cosmic rays are detected by the ground based neutron monitor network in all over the world. In this work we examine short, mid and long term periodicities of cosmic ray intensity, sunspot numbers and geomagnetic Ap index for the time period 1976-2017 using fast fourier Transform and Wavelet Analysis. The periodicities that are present in these two approaches regarding cosmic ray intensity are the well-known 11-year, which is caused by the anti-correlation with the solar activity and the 27-day and its harmonics due to the rotation of the Sun. The 5-year and the 1.7-year periodicity are also found with a significant level 95%. The last one belongs to quasi-biennial oscillations which are considered as one of the basic variations of solar activity indices on the scale of shorter than 11 years and probably they are intrinsic properties of the Sun related to the solar dynamo mechanism. The 5-year periodicity may be related to the 11-year as its first harmonic and belongs to quasi-periodic oscillations. Regarding sunspot numbers, except of the mentioned periodicities found in the cosmic ray intensity, the 2.3-year and the 5-month, known as Rieger period, were determined. The same results were applicable to the Ap index time series where the 6-month and the 1.3-year periodicity were found. Short scale variations such as the 5-6 months, are caused by transient effects in interplanetary space.

Magnetic Helicity and free Energy Injection in Emerging Active Regions

Ms. Evangelia Liokati

University of Ioannina

Nindos Alexandros (Section of Astrogeophysics, Department of Physics, University of Ioannina, Ioannina) Liu Yang (W. W. Hansen Experimental Physics Laboratory, Stanford University, Stanford)

Using vector magnetic field data from the Helioseismic and Magnetic Imager instrument aboard the Solar Dynamics Observatory, we calculate the magnetic helicity and magnetic free energy injection into the corona in several emerging active regions. for each active region these quantities are monitored from its emergence until it reaches a heliographic longitude of 45-50 degrees or until the occurrence of the first coronal mass ejection (CME) associated with it, whichever happens first. We interpret the CME and flare productivity of the emerging active regions in terms of their magnetic helicity and free energy budgets.

A new way to calculate solar flare precursors using time series of the Differential Emission Measure averaged over flaring active regions. An explorative FLARECAST analysis.

Dr. Costis Gontikakis
RCAAM, Academy of Athens

Guennou Chloé (LESIA Observatoire de Meudon), Kontogiannis John (RCAAM Academy of Athens), Georgoulis Manolis (RCAAM Academy of Athens), Syntelis Petros (School of Mathematics and Statistics, University of St. Andrews)

Understanding the Active Region evolution helps to predict the solar flare occurrences, it is part of space-weather forecasting and is important for the protection of space technology. We selected the Differential Emission Measure (DEM) of 15 active regions, from solar disk maps computed using the EUV fltergrams of the SDO/AIA instrument. We found that the maximum value of the DEM distribution, averaged over each of the active regions, rises as a function of time up to a few hours before flares of M and X-class. We computed the conditional probability for a flare when the maximum DEM time series increases as a function of time. This research is held in the frame of the FLARECAST project. The DEM disk maps were provided by the MEDOC GAIA-DEM database located at the Institut d'Astrophysique Spatiale.

Families of multi multiplicity periodic orbits in the Sun-Jupiter-Asteroid-Spacecraft system

Prof. Konstantinos Papadakis
University of Patras
Baltagiannis Agamemnon (University of Patras)

The circular restricted equilateral four body problem consists of three primary bodies m_1, m_2 and m_3 lying in a Lagrangian configuration i.e. the three bodies remain fixed at the apices of an equilateral triangle and moving in circular periodic orbits around their center of mass fixed at the origin of a rotating coordinate system. The fourth massless body m_4 is moving under the Newtonian gravitational attractions of the primaries and does not affect the motion of the three bodies. In this paper we consider as m_1 the Sun, as m_2 the Jupiter, as m_3 an Asteroid (say the 2797 Teucer of the Trojan asteroids) and as m_4 a spacecraft. We study numerically the network of the families of non-symmetric periodic orbits which have more than two intersections with the $x-$axis per period. We found a large number of families that were computed in detail covering their natural termination, the morphology, and stability of their member solutions. The vast majority of the families have stable periodic solutions. Characteristic curves of the families as well as non-symmetric periodic orbits of the problem are also presented.

Solar activity and forbush decreases in June 2015

Ms. Evangelia Samara
University of Athens

Smponias Athanasios (University of Athens), Lytrosyngounis Ioannis (University of Athens), Lingri Dimitra (University of Athens), Helen Mavromichalaki (University of Athens)

Although the descending phase of the current solar cycle 24 is characterized by low solar activity, a number of intense CMEs and SEPs were recorded in June 2015 leading to two complicated forbush decreases (fDs) of the cosmic ray intensity. These decreases were clearly recorded by the ground based neutron monitors of the world wide network. The first one started on June 22 with an amplitude of 8.4% and during its recovery, on June 24, a second one followed with an amplitude of 5.2% for cosmic rays of 10GV obtained by the GSM method. One of the main goals of the present work is to examine the connection between the observable fDs on Earth and the activity on the Sun in the same period. This process requires an analysis of the characteristics of the CMEs such as their size, their proximity to Earth and their magnetic feld. The cosmic ray anisotropy variation at the ecliptic plane was also calculated and it was found to be very complicated justifying the above mentioned event. furthermore, hourly cosmic ray intensity data recorded from polar and middle latitude neutron monitor stations around the Earth and obtained from the High Resolution Neutron Monitor Database (NMDB) were used to investigate the rigidity dependence of these events. Interesting results regarding the solar and interplanetary parameters are discussed.

Forbush decreases of cosmic ray intensity without a shock wave

Ms. Dimitra Lingri
University of Athens

Mavromichalaki Helen (National and Kapodistrian University of Athens), Belov Anatoly (Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS (IZMIRAN)), Abunina Maria (Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS (IZMIRAN))

Forbush decreases of the cosmic ray intensity are produced either from a sudden solar eruption, as a CME, or from a high speed solar wind stream that comes from the Sun as a result for example of a coronal hole. The first events, in the most cases,

are connected with a sudden storm commencement that reaches the Earth and creates a Forbush decrease at the cosmic ray intensity. The second ones can also create Forbush decreases of smaller amplitude but without the appearance of a sudden storm commencement. In this study the Forbush decreases that do not orientate by a sudden storm commencement will be studied for the total time period that cosmic ray intensity data recorded by the neutron monitors are available (1957-2017). An analysis of these ground recorded events with solar and interplanetary associated parameters will be performed. Finally the possibility of observing precursory signals before the beginning of these cosmic ray decreases without a shock wave will be examined.

Geomagnetic storms of the solar cycle 24

Mr. Panagiotis Alexakis
University of Athens

Paouris Evangelos (University of Athens), Mavromichalaki Helen (University of Athens), Gerontidou Maria (University of Athens)

Solar cycle 24 has been characterized by a low solar activity and it is the smallest sunspot cycle in over a century. Despite of this fact a number of geomagnetic storms from G1 to G4 scale according to NOAA classification was noticed. In this work the characteristics of these geomagnetic storms like the scale level, the origin of the storm (CME or CIR) and the duration during the period 2009 to 2016 have been presented. It is noteworthy that the year 2015 was characterized by long geomagnetic quiet periods with a lot of geomagnetically active breaks, although it is on the declining phase of the current solar cycle. A comparison with the geoeffectivness of the previous cycle 23 was carried out. furthermore, a statistical analysis of these events and a comparative study of the forecasting and the actual geomagnetic conditions are performed using data from the NOAA space weather forecasting center and from the Athens Space Weather forecasting Center as well. These forecasting centers estimate and provide every day the geomagnetic conditions for the upcoming days giving the values of the geomagnetic index Ap.

Morphological flaring activity predictors: Testing and improving

Dr. Ioannis Kontogiannis
RCAAM, Academy of Athens

Park Sung Hong (Trinity College Dublin), Guerra Jordan A. (Trinity College Dublin), Georgoulis Manolis (RCAAM, Academy of Athens)

Efficient prediction of solar flares depends on quantities that parameterize the eruptive capability of flare hotspots, solar active regions. Several such quantities have been proposed in the literature, based mostly on magnetograms and/or white light observations. Two of them are the Ising energy and the sum of the total horizontal magnetic gradient. The former has been developed from line-of-sight magnetograms while the latter further utilizes sunspot detections and characteristics, derived from continuum images. Aiming to include these parameters in an automated prediction scheme, we test their applicability on regular photospheric magnetic field observations provided by the Helioseismic Magnetic Imager (HMI) instrument onboard the Solar Dynamics Observatory (SDO). We test their efficiency as predictors of flaring activity on a representative sample of active regions and investigate possible modifications. We fnd that both quantities are efficient flare predictors and their efficiency may improve with appropriate modifications. This study has received partial support by the EU Horizon 2020 FLARECAST Project (Grant Agreement No. 640216)

Contribution of Athens Neutron Monitor Services to Space Weather Research

Ms. Dimitra Lingri
University of Athens

Mavromichalaki Helen (National and Kapodistrian University of Athens), Gerontidou Maria (National and Kapodistrian University of Athens), Paschalis Pavlos (National and Kapodistrian University of Athens), Paouris Evangelos (National and Kapodistrian University of Athens), Tezari Anastasia (National and Kapodistrian University of Athens)

The ground-based measurements of the neutron monitors network provide apart from others important information relevant to space weather monitoring and forecasting. In the frame of the extension of the use of neutron monitor data beyond their real time provision in the implementation of several space weather applications Athens Neutron Monitor Station (A.Ne.Mo.S) has developed several research applications. Specifically, applications such as a) an optimized automated Ground Level Enhancement Alert (GLE Alert Plus) b) a web interface, providing data from multiple Neutron Monitor stations (Multi-Station tool), which are currently federated products in European Space Agency (ESA) available via the Space Weather Portal operated by ESA (http://swe.ssa.esa.int). Additionally, a model of forecasting an upcoming Forbush decrease by observing the precursory signals is being developed, while a simulation model, named DYnamic Atmospheric Shower Tracking Interactive Model Application (DYASTIMA), which allows the study of the cosmic ray showers resulted when primary cosmic ray particles enters the atmosphere, has already been done and its extended application named DYASTIMA-R is under development. DYASTIMA-R will provide calculations of the radiation dose received by aircrews and passengers within the Earth's atmosphere. Furthermore, a Space Weather Forecasting Center which provides a three day geomagnetic activity report on a daily basis has been set up. Finally, all above developed services are in essential importance for the fundamental research as well as for practical applications concerning Space Weather.

Session 2: Extragalactic Astrophysics and Astrophysics

Oral presentations

The evolution of the galaxy star formation rate-stellar mass relation

Dr. Antonios Katsianis
Universitad de Chile

In this talk I present the evolution of the cosmic star formation rate density, star formation rate function and star formation rate-stellar mass relation at redshifts z 0 - 7 using cosmological hydrodynamic simulations and a compilation of UV, Ha and IR observations. The relation between the Star formation Rate (SfR) and stellar mass (M) of galaxies represents a fundamental constraint on galaxy formation, and has been studied extensively both in observations and cosmological hydrodynamic simulations. However, the observed amplitude has not been successfully reproduced by models, indicating either that the halo accretion history and baryonic physics are poorly understood or that observations contain biases. I present the evolution of the SFR-M relation and display the inconsistency between observed relations that are obtained using different techniques. Some of them are actually in agreement with simulations and others are not. On the other hand, I present the remarkable agreement between the numerical results from various groups (e.g. EAGLE, ANGUS, Illustris) who have employed different cosmological codes and run simulations with different resolutions. The above can be interesting since they point to the direction that A) The tension between observations and models in the literature is not absolute B) it is possible that models can produce realistic populations of galaxies within representative cosmological volumes even at relatively modest resolutions. C) It is likely that current numerical codes that rely on similar subgrid multiphase Inter-Stellar Medium (ISM) models and are tuned to reproduce statistical properties of galaxies, produce similar results for the SFR-M relation artificially and by construction, regardless of resolution, box size and, to some extent, the adopted feedback prescriptions.

ULX spectra revisited: Are accreting, highly magnetized neutron stars the engines of ultraluminous X-ray sources?

Dr. Filippos Koliopanos
IRAP/CNRS

Vasilopoulos Georgios (MPE), Godet Olivier (IRAP/CNRS), Bachetti Matteo (INAF), Webb Natalie (IRAP/CNRS), Barret Didier (IRAP/CNRS)

In light of recent discoveries of pulsating ultra luminous X-ray sources (ULXs) and recently introduced models placing neutron stars as the central engines of ULXs, we revisit the spectra of seventeen ULXs, in search of indications that favor or reject this hypothesis. We find that the notable (>6keV) spectral curvature observed in most ULXs, is commensurate with the Wien tail of a hot (T>1keV) multicolor black body component. More importantly, we find that a double thermal model (comprised of a "cool" and "hot" thermal component) – often associated with emission from neutron star X-ray binaries – describes all ULX spectra in our list. We offer a new physical interpretation for the dual thermal spectrum where it is the result of accretion onto highly magnetized NSs, as predicted in recent theoretical models (Mushtukov et al. 2017). We find that the magnetic field strength strongly correlates with the source luminosity and the temperature of the hot component. Within this new framework, the ultraluminous state classification put forward by Sutton et al. (2013) is rendered obsolete. The apparent different accretion states are the result of different temperatures and relative flux contribution of the two thermal components which, in turn, correspond to different values of the magnetic field strength and the mass accretion rate. Our findings offer an additional and compelling argument in favor of neutron stars as prime candidates for powering ULXs, as has been recently suggested (King & Lasota 2016; King et al. 2017). In my talk I will briefly review the observational history of ULXs and present the most widely accepted theoretical considerations for their spectral shape. I will then present our novel physical interpretation along with its implications, merits and shortcomings.

Hydrodynamical simulations of galaxy clusters including the evolution of dust

Dr. Gian Luigi Granato
INAF-OATS

In order to correctly investigate basic properties of galaxies, such as the star formation rate and the masses of the various baryonic components, it is usually essential to account for dust reprocessing. A combination of simulations and post-processing radiative transfer computations are in principle capable of preducing mock data, for a direct comparison with observation. Until now, however, dust properties have been only included by means of rough post-processing assumptions, leaving room for uncertainties particularly severe at wavelengths shorter than 100 micron. In order to reduce these uncertainties, we implemented in our simulation code GADGET-3 a state of the art treatment of the production and evolution of dust grains. This model traces the creation, evolution, and destruction of dust by mean of various processes. It accounts for the size of dust particles with a two-grain-size approximation. We will present the first result applied to zoom-in simulations of massive galaxy clusters, focusing in particular to the early stages of assembly of the cluster at high redshift, where the SF activity is at its maximum and the proto- cluster regions are rich of cold, dust polluted gas.

Star cluster formation history in the Large Magellanic Cloud

Dr. Theodoros Bitsakis
Instituto de Radioastronomia y Astrofisica, UNAM

We present our new, fully-automated method to detect and measure the ages of star clusters in nearby galaxies, which we apply on the large Magellanic Cloud (LMC). It decontaminates the cluster color-magnitude diagrams and, using a Bayesian isochrone fitting code, it estimates the ages of the clusters. It is arguably the first method purely relying on statistical analysis and Monte-Carlo simulations – from the definition of stellar overdensities in the data throughout the determination of the cluster ages. Our analysis yielded the most complete LMC cluster catalogue to date, including 4850 objects in the 7 deg2 we surveyed (3451 of which have not been reported before). Our findings suggest multiple epochs of star cluster formation, with the most probable occurring ~10, 310, and 400 Myr ago. Several of these events are consistent with the epochs of the interactions among the Large and Small Magellanic Clouds and the Galaxy, as predicted by N-body numerical simulations. finally, the spatially resolved star cluster formation history suggests an inside-out formation scenario for the LMC, for the past 1 Gyr.

Mass characterization of star-forming galaxies in the local universe

Dr. Paolo Bonfini
Instituto de Radioastronomia y Astrofisica, UNAM

We introduce the Star Formation Reference Survey (SFRS): a multi-wavelength study which aims at defining global estimators that can systematically account for the different conditions under which star-formation occurs. The 369 galaxies composing the sample are chosen to be representative of star formation rate (SFR), dust temperature, and specific star-formation rate (sSFR) in the Local Universe. We describe our 2D bulge/disk decomposition of the 2MASS/K-band images of the sample, which we use to derive the masses of the galaxies (and of their bulge/disk sub-components) and, ultimately, the specific SFR. We present the global stellar mass function, which covers the whole range of galaxy masses from dwarf galaxies to large spirals, along with the separate mass functions for the bulge and disk sub-components. Additionally, we present the sSFR and the bivariate (mass VS. sSFR) volume-weighted functions, the latter being a more accurate representation of the star-forming main sequence. Our functions are representative of the global star-formation activity in the Local Universe, and allow us to investigate the significance of morphological quenching (i.e. whether the assembly of a bulge suppresses star-formation). Moreover, our results constitute the ideal reference benchmarks for simulations investigating star-formation in different environments.

Studying galaxy stellar cores to constrain the co-evolution of early-type galaxies and their host super-massive black holes

Dr. Paolo Bonfini
Instituto de Radioastronomia y Astrofisica, UNAM

Massive Early Type Galaxies (ETGs; $M_B < -20.5$ mag) are characterized by depleted stellar cores, i.e. marked flattenings of their inner light distribution. The structural characteristics of such cores are clearly dictated by the formation history of the host ETG, but they have also been shown to correlate with the mass of the central SuperMassive Black Hole (SMBH). This addresses to a direct link between the formation of the ETG, the SMBH, and the core. It has been suggested that Black Hole binaries, established during the dry (i.e. gas-poor) mergers which shape the ETGs, kick stars out of the galaxy center via three-body interactions (hence creating the core) before coalescing into the central SMBH. However, the recent discoveries of extremely large cores (> 1 kpc), have started casting doubts over this "binary SMBH scouring" as the sole mechanism for the formation of depleted cores. In this talk, this scenario is probed at its extremes by investigating the two galaxies reported to have the Largest partiallydepleted cores found to date: 2MASX J09194427+5622012 and 2MASX J17222717+3207571 (the brightest galaxy in Abell 2261). In particular, for the latter galaxy, we explored and find support for the "stalled in-falling perturber" core-formation mechanism, in which this galaxy's core could have been excavated by the action of a captured massive object. We discuss how identifying the boundaries of the various core-formation scenarios not only will pose upper limits to the build-up of ETGs through [dry] mergers, but will also help in constraining the cosmological SMBH mass and spin evolution.

DustPedia: A Definitive Study of Cosmic Dust in the Local Universe

Dr. Manolis Xilouris
National Observatory of Athens

DustPedia is a project funded by the European Union for exploitation of space science and exploration data. It is a collaboration of six European institutes with a primary goal of exploiting existing data in the Herschel Space Observatory and Planck Telescope databases. This dataset is combined with other available data from both ground based and space based telescopes to make the most extensive and intensive study of galaxies in the nearby Universe. I will review the DustPedia objectives and present the science issues addressed so far.

Exploring scaling relations between gas and dust across cosmic time

Prof. Georgios Magdis
Niels Bohr Institute

Recent studies have tried to establish a link between the warm dust emission in the mid-IR, as traced by the polycyclic aromatic hydrocarbons (PAH), and the cold gas as traced by CO observations, showing that sources with PAH deficiency are characterised by high star formation efficiencies (SFE) and compact star forming regions. However, these studies are limited to local galaxies and a small number of of high-z (z>1) ULIRGs. To bridge this gap we have carried out CO(1-0) observations of a representative sample of star forming galaxies at 0.07

A benchmark study of AGN: Feedback, orientation and AGN activity at a single epoch

Dr. Eleni Kalfountzou
European Space Agency

Stevens Jason (Univeristy of Hertfordshire, UK), Jarvis Matt (Oxford University, UK), Hardcastle Martin (Univeristy of Hertfordshire, UK)

In recent years the study of active galactic nuclei (AGN) has undergone a renaissance. This is due to the fact that AGN activity is now widely believed to be an important phase in the evolution of every massive galaxy in the Universe. However, the picture is still not clear, with investigations at different wavelengths producing many differences of opinion as to the amount of radiation that is absorbed and reprocessed by dust, how this is related to the host galaxy and whether the triggering mechanism behind the AGN activity is also responsible for massive star-formation activity. Moreover, it is also unclear how these processes depend on luminosity, radio-loudness and orientation. A drawback of all previous surveys is that they are fundamentally limited by the degeneracy between redshift and luminosity in flux-density limited samples. We have constructed well-defined samples of radio-quiet and radio-loud quasars, along with radio galaxies. These samples are defined to span a factor of >100 in both optical and radio luminosity, with each subsample composed of objects with matched luminosity distributions, at a single cosmic epoch ($0.9 < z < 1.1$). Combining multi-wavelength observations and surveys (e.g. XMM-Newton, UKIRT, Spitzer, Herschel, SDSS, VLA), we aim to create a detailed picture of how the full SEDs of AGN change as a function of luminosity, orientation, radio-loudness and redshift which is crucial for improving our understanding of virtually all aspects of the AGN phenomenon. At the same time, it will also provide a benchmark sample from which other AGN surveys will benefit, in particular when computing bolometric luminosities and accretion rates. Our results, extracted from the full SEDs, optical spectra and wide-field photometric observations, will be discussed in terms of the fundamental questions such as: Do AGN feedback quench the star formation in their hosts, or do black holes and stellar bulges form in parallel? Is star formation different in the host galaxies of radio-loud and radio-quiet AGN and whether all radio-loud AGN are the same in this respect? Which are the dust properties of AGN over the epoch of activity and the Unification picture? What is the evolutionary status of the clusters forming around the $z \sim 1$ AGN and whether this depends on the central mass of the AGN host galaxy/black hole, the radio-loudness, or on the fraction of massive galaxies in the cluster?

The nature of the extremely bright nuclear transient ASASSN-15lh

Dr. Giorgos Leloudas
University of Copenhagen

ASASSN-15lh was proposed to be the most luminous supernova ever discovered, challenging the total energy budget of supernova models. I will present a different view according to which ASASSN-15lh was not a superluminous supernova but a tidal disruption of a star around a supermassive black hole. Arguments in favour of this interpretation include: the light curve and temperature evolution, the spectroscopic properties of the event and the surrounding medium, and its location at the nucleus of a passive and massive galaxy. The supermassive black hole needs to be spinning rapidly for the tidal disruption to happen outside the event horizon.

The Classification and Analysis of Distinct X-ray Binary Populations in M81

Dr. Paul Sell
University of Crete

We present a detailed analysis of the X-ray point source population of M81. By identifying HST counterparts to Chandra sources, taking into account the chance coincidence probability, we classify a large fraction of the X-ray point source population with unique counterparts: high-mass X-ray binaries and low-mass X-ray binaries in globular clusters. We then compare the shapes of the uncontaminated X-ray luminosity functions and the X-ray properties of sources of different classes to models and other existing work. We also calculate scaling relations with the star formation rate and stellar mass between the different classes of sources in global and sub-galactic scales. One initial, primary result is that the more massive and dense globular clusters are more likely to be associated with X-ray binaries.

Star-disk interactions in the Galactic center

Prof. Dimitrios Giannios
Purdue University

The compact radio source Sgr A* marks the location of the supermassive black hole in our Galactic Center (GC). It is an ideal target to study low-luminosity accreting systems. The inner most pc of the GC has the highest stellar densities in the Galaxy and is known to harbor massive young stars (the S-Cluster) as well as a proposed, yet elusive, pulsar population. For members of both the S-Cluster and pulsar population, strong interactions between the stellar winds and accretion disk gas lead to the formation of a termination shock in the winds. For both cases, an X-ray flare is produced via either thermal bremsstrahlung emission for S-Cluster members or synchrotron radiation for pulsars. Here, I will discuss the detectability of these transient events and their different observational signatures. Ultimately, the detection of such events can allow constraints to be placed on both stellar properties (i.e. wind mass-loss rate and terminal wind velocity) as well as properties of the accretion flow (i.e. gas density, velocity, temperature) around Sgr A*.

Hierarchical Bayesian modelling of 900 DustPEDIA Galaxies: Insights into their global dust and star formation properties

Dr. Sophia Lianou

SAP, CEA-Saclay

Galliano Fred (SAP, CEA-Saclay), Madden Suzanne (SAP, CEA-Saclay), Clark Chris (Cardiff, UK), DustPEDIA Collaboration (EU)

As part of the DustPEDIA project, we investigate the physical properties of the dust versus star formation for ~900 galaxies in the local universe. We use Herschel and ancillary multi-wavelength observations, ranging from the ultraviolet to the far-infrared and sub-millimeter wavelength regime, in order to construct the spectral energy distribution (SED) of these ~900 galaxies, as well as to derive their global star formation rates and stellar masses. We model their dust SED with a sophisticated statistical (Hierarchical Bayesian) model developed by Galliano et al, which has a realistic dust model (THEMIS; Jones et al. 2017) implemented. We derive their global physical properties, i.e. dust masses and temperatures, PAH mass fraction, radiation field intensities, and their correlations. This large galaxy sample is used to place statistical constraints on the underlying physical processes of the dust versus their star formation and stellar mass, and as a function of different types of galaxies. These results will allow us to better understand the variations of the dust properties across different physical environments and their impact on galaxy evolution.

3-D Simulations of FR-I Jets

Dr. Konstantinos Gourgouliatos

University of Leeds

Active Galactic Nuclei power jets that reach high Lorentz factors (γ ~20) and contain sufficient energy to outshine their host galaxy. Several such jets demonstrate flaring behaviour: while they are narrow and collimated close to the origin, they undergo a stage of rapid expansion and their overall structure becomes disordered after a few kiloparsecs. In this talk, I will present simulations of jet evolution. I will use initial conditions of axially symmetric jets in equilibrium to investigate the development of instabilities. While these jets suffer minimal changes when used to initialise axially symmetric simulations, they are significantly disrupted due to Rayleigh-Taylor instability when full 3-D simulations are performed. I will discuss the implications of these results in the context of FR-I jet observations.

Active Galactic Nuclei selected by optical variability in the GOODS South field

Mr. Ektoras Pouliasis

IAASARS, National Observatory of Athens

We aim to identify Active Galactic Nuclei (AGN) through optical variability in the GOODS South deep field, as part of the validation and verification process of the ESA project "Hubble Catalogue of Variables". We used z-band (F850LP filter) images taken over 5 epochs spanning 6 months and performed aperture photometry using SExtractor to derive the light curves of the sources. Two statistical methods (standard deviation & interquartile range) were employed for variability search, resulting in a sample of 192 variable sources. After removing known stars and supernovae, the final sample of AGN candidates consisted of 163 extended and 12 point-like sources of which the vast majority have either a spectroscopic or photometric redshift. The most reliable method to validate the AGN candidates is the presence of X-ray emission, hence we cross-matched our sources with the published Chandra X-ray catalogue in the CDF-S (7 Ms). All the point-like sources emit in X-rays and have been reported as Quasars in the literature. The extension of the remaining sources in addition to the variability indicates that our sources are galaxies hosting an AGN. Out of all the 538 X-ray sources that lie in the GOODS South field, 50 sources show optical variability in our survey (~10%), while we derived X-ray flux upper limits for 125 sources. The AGN without X-ray counterparts are optically fainter (=24.3 mag) than the detected X-ray AGN (=22.2 mag). Also, the redshift distributions of the AGN sample with and without X-rays are comparable and extend up to z 4 with mean values of 0.98±0.79 and 1.25±0.87, respectively. The average X-ray luminosity 3-sigma upper limits in the [2-10 keV] band for the sources not detected in X-rays are $<5.7\times10^40$ ergs/s, suggesting that these are associated with low luminosity AGN. The 125 AGN candidates of our catalogue not recovered in X-rays represent 40% of the AGN population classified through the X-ray selection. Our work emphasises the importance of optical variability surveys for finding AGN, which remain undetected even by the deepest X-ray surveys.

Studying the ULX population of the X-ray starburst galaxies NGC 3310 and NGC 2276

Ms. Konstantina Anastasopoulou

University of Crete/FORTH

Zezas Andreas (University of Crete/FORTH), Gkiokas Vaggelis (University of Crete)

We present results from Chandra observations of the X-ray starburst galaxies NGC 3310 and NGC 2276. Previous studies showed that these spirals galaxies exhibit interesting morphologies where NGC 3310 has a circumnuclear star-forming ring triggered from a minor interaction and NGC 2276, which is also member of a small group of galaxies, exhibits a compressed side (west) as it moves supersonically through the intragroup medium of the NGC 2300 group. We detect 30 discrete sources with luminosities above $2x10^{38}$ erg/s in NGC 3310, and 17 discrete sources with luminosities above $5x10^{38}$ erg/s in NGC 2276. Furthermore we extract spectra for all the sources and find that all but 5 sources (in NGC 3310) are fitted well with an absorbed power-law model. The majority of the sources have photon indices of 1.7-2.0, typical for X-ray binaries and their hardness ratios are consistent with the photon indices in the same regime. NGC 3310 has in total 14 Ultra Luminous X-ray sources (ULXs) the majority of which lay in the star-forming ring. It also has a variable nucleus with no sign of an AGN. Based on these observation we investigate whether the different regions of the galaxy (rings, spiral arms) follow the existing scaling relations between X-ray binary luminosity and SFR. In NGC 2276 we see an intriguing excess of ULXs in the west (compressed) side of the galaxy. More interestingly the overall luminosity of the ULXs is ~5 times larger on the west side while the star formation rate and metallicity on the two sides of the galaxy are comparable. We argue that this tentative excess of ULXs in the shocked side of the galaxy most likely reflects the difference in the age of the stellar populations which makes makes it a perfect laboratory to study the connection between ULXs and the age of the stellar populations. finally we discuss these results in the context of other star-forming galaxies with Large ULX population and/or strong star-forming activity.

Radio properties and feedback implications of brightest group galaxies in the Local Universe

Dr. Konstantinos Kolokythas

IUCAA

One of the most important environments to study the evolution of galaxies, where feedback has the greatest impact on galaxy formation, is galaxy groups. By using an optically-selected statistically-complete sample of 53 nearby groups (CLoGS), observed at both radio (GMRT) and X-ray (Chandra and XMM-Newton) frequencies, we have characterized the radio-AGN population in groups and examined their impact on the intra-group gas and member galaxies. In this regard, here I present the first results from the low-frequency GMRT radio survey of the nearby (<80 Mpc) central brightest group ellipticals from the high richness CLoGS sub-sample, itself statistically complete. Using the sensitivity to older electron populations at 235 MHz and the resolution of 610 MHz as a key to identify past and current AGN activity, I will discuss the radio detection statistics, the variety of morphologies seen in radio and the AGN power and energy output that central group radio sources present in our sample. In addition, I will combine these results with information on the group environment that they lie into, with findings from the X-ray observations and compare these properties with the results of other surveys.

Detection of extragalactic Supernova Remnants

Ms. Maria Kopsacheili

IAASARS, National Observatory of Athens

Zezas Andreas (IESL/FORTH & University of Crete/CfA), Leonidaki Ioanna (IESL/FORTH & University of Crete), Boumis Panayotis (IAASARS, National Observatory of Athens)

Supernova remnants (SNRs), are objects of high importance since they provide significant amounts of energy to the Interstellar Medium while at the same time they depict the end-point state of massive stars (M > 8 solar masses). In order to investigate the physical properties of these objects and their interplay with their environment, we have embarked in an extensive investigation of the SNR populations, focusing on galaxies of different morphological types. In this work, we present new candidate SNRs detected in spiral galaxies, based on deep narrow-band Hα and [S II] images observed with the 4m Blanco telescope in La Serena, Chile. The new detections were identified based on the [SII(λ6716,6731)]/Hα(6563) flux ratios. These new sources in combination with the sample of candidate SNRs we have identified in irregular galaxies, give a more complete census of SNRs and allow us to: a) investigate differences in the excitation, spatial distribution and their association with SNRs in other wavebands between different galaxy morphological types, and b) construct their Hα luminosity function.

The Star Formation Reference Survey Ha emission line campaign: Description and first results.

Mr. Konstantinos Kouroumpatzakis

University of Crete / FORTH

Zezas Andreas (University of Crete / F.O.R.T.H.), Wilner Steven (Harvard-Smithsonian Center for Astrophysics), Maragkoudakis Alexandros (University of Crete), Ashby Matt (Harvard-Smithsonian Center for Astrophysics)

We present the first results from the Hα emission line observations of the Star Formation Reference Survey (SFRS). The SFRS sample, which is selected from the IRAS PSCz survey covers a variety of different star formation conditions and benefits from multi-wavelength coverage (UV to far - IR). Overall these combined data allow us to use all available star formation rate (SFR) tracers as well as broad-band spectral energy distribution fits to give a complete picture of the obscured and unobscured star-forming activity, stellar mass (M*), dust temperature, and interstellar medium (ISM) properties in a sample that is characteristic of the star-forming galaxies in the local universe. The Hα emission line is one of the most commonly used tracers of young stellar populations and recent SFR. We compare the Hα emission in galaxy wide and sub-galactic scales with other star formation tracers (UV, mid-IR, Far-IR) which trace star formation in different time scales.

The most obscure AGN at low and high redshift

Dr. Ioannis Georgantopoulos
National Observatory of Athens

The most obscured sources detected in X-ray surveys, the Compton-thick AGN present great interest both because they represent the hidden side of accretion but also because they may signal the phase of AGN birth. We analyse the NUSTAR observations from the serendipitous observations in order to study the Compton-thick AGN at the deepest possible ultra-hard band (>10 keV). We compare our results with our SWIFT/BAT findings in the local Universe, as well as with our results in the CDFS and COSMOS fields. We discuss the comparison with X-ray background synthesis models finding that a low fraction of Compton-thick sources (about 15 per cent of the obscured population) is compatible with both the 2-10keV band results and those at harder energies.

Ultra-Luminous X-ray sources in Chandra Source Catalog 2.0 and a master catalog of nearby galaxies

Mr. Konstantinos Kovlakas
University of Crete

Since the first detections of ultra-luminous X-ray sources (ULXs) by the Einstein Observatory, they have been subject of numerous observational and theoretical studies. Understanding ULXs is important because they probe the highest accretion rate sources (super-Eddington luminosity). The correlation with host galaxy properties, such as star-formation rate (SFR), stellar mass and metallicity are crucial in shedding light to their nature and evolution. Statistical studies of large samples of ULXs have played an important role in understanding these rare objects (typically 1-2 per galaxy), made possible by Chandra and XMM-Newton observatories. In order to study ULX populations in the local universe and their connection with their host galaxy we have compiled a catalog of all HyperLEDA galaxies within a volume of 200 Mpc. For this sample we have included distances based on the most accurate indicators and SFRs, stellar masses and metallicities based on several multiwavelength indicators (ranging from fiR to UV). This publicly available catalog can also be a great resource for local-universe studies of the community. By cross-matching with the Chandra Source Catalog, we provide the most up-to-date catalog of ULXs in the local universe. We discuss the population of ULXs based on this analysis and their association with galaxies of different types (N > 1500).

The sub-galactic and nuclear main sequences for local star-forming galaxies

Dr. Alexandros Maragkoudakis
University of Crete / FORTH
Zezas Andreas (University of Crete) Ashby Matthew (Harvard- Smithsonian Center for Astrophysics) Willner Steven (Harvard- Smithsonian Center for Astrophysics)

Examining the relation between fundamental galaxy properties such as the star formation rate (SFR) and galaxy mass, commonly known as the "main sequence" (MS) of galaxies has been a subject of extensive study, but only recently there has been evidence that MS-like correlations are also present at sub-galactic scales. Using a sample of 246 nearby star-forming galaxies (SFGs) we demonstrate that a sub-galactic main sequence (SGMS) relating star formation rate surface density (Σ_{SFR}) and stellar mass density (Σ_{M_*}) holds down to ~1 kpc scales. We found that the SGMS has similar characteristics to the global MS, and because star-formation is primarily a small-scale phenomenon the SGMS can be considered as more fundamental. Comparison of the SGMS slope for different morphological types shows that late-type galaxies (Sc-Irr) have steeper, close to unity, slopes compared to early-type spirals (Sa-Sbc). This is interpreted in terms of gas content variations between different morphological types. We find that sub- or super-linearity in the SGMS slope may be reported when the considered SFR-M* range is limited, or the samples are not fully representative. We have further demonstrated that the SGMS constructed from sub-regions within individual galaxies has on average the same characteristics as the composite SGMS from all galaxies. We further established that the nuclear SFR also correlates with total galaxy mass, forming a distinct sequence from the standard MS of star-formation, that can be useful for studying bulge growth, and for characterizing feedback processes connecting AGN and star formation. finally, we have introduced a novel approach in the SED modeling of galaxies, by incorporating spectroscopic information from narrow spectral regions of the optical spectrum alongside the photometric data. Our method, which is particularly useful in the era of IFU surveys, can set better constrains on the derived galaxy properties, suppressing degeneracies, and help in the decomposition of the star-forming and AGN component in composite galaxies.

The hard X-ray view of galaxies

Dr. Andreas Zezas
University of Crete

We present the results from our on-going campaign of hard X-ray observations of nearby galaxies with the NuSTAR X-ray telescope. These observations allow us to detect individual accreting binaries at energies above 10keV in galaxies within and beyond the Local group (e.g. M31, M83, NGC253) . The extended energy coverage of NuSTAR allows us for the first time to classify the X-ray binaries in terms on their accretion state and the nature of their compact objects. We will discuss the diagnostic tools for the characterization of the accreting binaries, and our results regarding the nature of the accreting binaries in the studied galaxies.

Quasars with periodic variability as milliparsec supermassive black hole binary candidates

Ms. Maria Charisi
Columbia University/Caltech

Supermassive Black Hole Binaries (SMBHBs) should be fairly common in galactic nuclei as a result of frequent galaxy mergers. The binaries are expected to spend a significant frac- tion of their lifetimes at sub-parsec separations. Hydrodynamical simulations of circumbinary disks predict that the mass accretion rate onto the BHs is periodically modulated on timescales comparable to the orbital period of the binary. Therefore, SMBHBs may be recognized by the periodic modulation of their brightness. We performed a systematic search for periodic variability in a large sample of quasars, in the photometric database of the Palomar Transient Factory. We identified 33 quasars with statistically significant periodicity and short periods of a few hundred days.

Temporal evolution of high energy radiation in type IIn Supernovae

Mr. Dimitrios Kantzas
University of Athens
Maria Petropoulou (Purdue University) and Apostolos Mastichiadis (NKUA).

The dominant models that can describe the non - thermal radiation by high energy astrophysical objects, can be divided into two categories, i.e. the leptonic and the hadronic ones. The former one suggests that the high energy radiation is produced by physical processes associated to a population of highly relativistic electrons. On the other hand, the hadronic model, assumes that the observed gamma ray emission originates from a population of relativistic protons. The physical process which is responsible for the emission in this case could be the non elastic proton - proton collisions. In this physical process, relativistic protons interact with thermal ones and as a consequence, secondary particles such as charged and neutral pions, muons, neutrinos and photons are produced. In this talk we present the results of the radiation from proton - proton collisions as applied to type IIn Supernovae. This type of Supernova has different properties than the usual types due to the presence of a very dense upstream medium, of the order of $10^7 - 10^12 percm^3$, which has been formed by the progenitor's mass loss. Consequently, if protons do manage to accelerate at the shock wave, then it is much more possible for proton proton collisions to occur at such type of sources. In the meantime, the aforementioned thick upstream medium seems to play a significant role in the temporal evolution of the non - thermal radiation emitted by these sources. We will present some preliminary results and discuss their relevance to potential observations.

Gaseous flows and star-forming dynamical mechanisms in the spiral arms of barred-spirals

Dr. Panos Patsis
RCAAM, Academy of Athens

The morphology, the strength and the longevity of the spiral arms in galaxies are directly linked to the dynamical mechanisms that form and support them. In the standard paradigm for the flow in galactic discs material rotates around the galactic center. The stellar flow has as backbone a set of elliptical, stable periodic orbits which precess as their Jacobi constant varies monotonically. In the corresponding gaseous flow the spiral arms are condensations produced by a shock wave, formed as gas flows into the potential minima of an effective potential. Material flows through the arms. On the other hand, according to the more recent idea of "chaotic spirals", i.e. of spirals supported by stars in chaotic motion beyond corotation, the flow is along the spiral arms. In the present work I investigate the stellar and gaseous flows in *barred-spiral* models having corotation at various radii in the disks. I compare the dynamical conditions under which clumps of over-densities may appear on the spiral arms in ordered and chaotic gaseous spirals.

High-cadence photometry of bright Type Ia Supernovae with the 2.3m Aristarchos telescope

Ms. Emmanouela Paraskeva
IAASARS, NOA & NTUA

Alceste Z. Bonanos (IAASARS, National Observatory of Athens), Zoi T. Spetsieri (IAASARS, National Observatory of Athens & National University of Athens)

Rapid variability in the light curves of Type Ia supernovae (SNe Ia) has the potential to provide a better understanding of nearly every aspect of SNe Ia, from their explosion physics to their progenitors. We present results of high-cadence monitoring of the optical light curves of three bright SNe Ia: 2016gsn (ASASSN-16la), 2016gfr and ASASSN-16kz (2016gsb) using the RISE2 camera on the 2.3m Aristarchos telescope to search for rapid variability. The supernovae were monitored over four nights with a cadence of 10-20s and high precision differential aperture photometry was derived. Differential light curves with respect to all comparison stars available on each night, as well as reconstructed light curves after implementing the Trend filtering Algorithm (TFA; Kovacs et al. 2005) are presented. We derive the decline rate of each supernova on each night and quantify the precision of our photometry and variability in the light curves, after accounting for sources of systematic error. We encourage further high-cadence photometric monitoring of bright SNe Ia with the goal of investigating the intraday behaviour of their light curves.

On the flaring gamma-ray activity of quasar 3c279

Prof. Apostolos Mastichiadis
University of Athens

Petropoulou Maria (Purdue University), Florou Ioulia (NKUA), Mastichiadis Apostolos (NKUA)

The flat spectrum radio quasar 3C 279 is one of the best studied Active Galactic Nuclei and thus it can be used as a testbed for multiwavelength modeling of the underlying emission processes. Recently the source exhibited an unprecedented minute-scale variability at gamma-ray energies >100 MeV. We will discuss the way this observation constraints the emission models, puting emphasis on the different variants of the hadronic model of blazar emission and we will propose possible scenarios that could successfully reproduce both the spectral and the temporal behaviour of the source.

Connection between optical polarization plane rotations and gamma-ray flares in blazars

Dr. Dmitry Blinov
University of Crete

We investigate the previously suggested connection between rotations of the polarization plane in the optical emission of blazars and their gamma-ray flares in the GeV band. The homogeneous set of polarization plane rotations detected in the frame of the RoboPol project is analysed together with the gamma-ray data provided by Fermi-LAT. We confirm that polarization plane rotations are indeed related to the closest gamma-ray flares in blazars and the time lags between these events are consistent with zero. Amplitudes of the rotations are anticorrelated with amplitudes of the gamma-ray flares. This is presumably caused by higher relativistic boosting in blazars that exhibit smaller amplitude polarization plane rotations. Moreover, the time scales of rotations and flares are marginally correlated.

Spectral and temporal properties of BeXRB pulsars during supper-Eddington outbursts

Mr. Georgios Vasilopoulos
MPE

Nearby galaxies are well suited for investigating X-ray source populations in environments different to 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. In this talk, I will focus in the X-ray spectral and temporal properties of 3 Be/X-ray binary pulsars located in the MC that have been observed the recent years with XMM-Newton during super-Eddington outbursts. Phase-resolved spectral analysis has revealed the presence of a non-pulsating soft thermal component. By analysing multiple observations, corresponding in different luminosity levels we argue that this component could not originate from the surface of a traditional thin disk, but most probably this emission is a result of reprocessed emission from material located near the NS magnetospheric radius. Interestingly, we s find that the temperature of this component does not change much with the luminosity of the system, in contrast to its size that increases with increased luminosity. We argue that this indicates the formation and expansion of an envelope around the magnetosphere of the NS.

The physical properties of galaxies with Spitzer/IRS spectra: SED modeling

Prof. Vassilis Charmandaris
NOA & Univ. of Crete

Vika Marina (IAASARS, National Observatory of Athens), Ciesla Laure (CEA/Saclay), Diaz-Santos Tanio (Univ. Diego-Portales, Chile), Magdis George (Univ. of Copenhagen, Denmark), Xilouris Emmanuel (IAASARS, National Observatory of Athens)

We provide a detailed analysis of the whole galaxy sample with mid-IR spectra in the 5-35mu range by Spitzer/IRS, publicly available in the Cornell Atlas of Spitzer/IRS Sources (CASSIS), for which available broad-band photometry from UV to 22mu. The Spectral Energy Distribution (SED) of ~1200 galaxies, sampled at 14 bands, is fitted using CIGALE, a state of the art model which relies on the energy balance between the absorbed stellar and the dust emission, while taking into account the possible contribution due to the presence of an active galactic nucleus (AGN). The emission of Spitzer/IRS galaxies with z < 0.1 is mostly dominated by star-formation (SF), galaxies in the mid-redshift bin are a mixture of star forming and AGN dominated galaxies, while half of the galaxies with z > 0.5 show moderate or high AGN activity. Additionally, using rest-frame NUV-r colour, Sérsic indices, optical [OIII] and [NII] emission lines we explore the nature of these galaxies by investigating further their structure as well as their star-formation and AGN activity. A subsample of ~350 systems for which far-IR Herschel photometry is also available is used to create average SEDs as a function of infrared luminosity and specific star formation rate. These SEDs which can be useful in revealing the physical properties of galaxies at high-z, with limited wavelength coverage.

Multi-wavelength structure analysis of galaxies in the WINGs

Mr. Alexandros Psychogyios
University of Crete

Charmandaris Vassilis (NOA, University of Crete), Vika Marina (NOA) Haussler Boris (European Southern Observatory), Poggianti Bianca (INAF-Astronomical Observatory of Padova), Moretti Alessia (INAF-Astronomical Observatory of Padova), Fasano Giovanni (INAF-Astronomical Observatory of Padova), Gullieuszik Marco (INAF-Astronomical Observatory of Padova), Bettoni Daniela (INAF-Astronomical Observatory of Padova)

The study of local galaxy clusters is of paramount importance as they enable us to easily quantify changes in the properties of galaxies as a function of the baryonic density in the environments, and to put constraint as a reference "zero-point" for comparison with studies at higher redshifts. The WIde-field Nearby Galaxy cluster Survey (WINGS, Fasano et al. 2006) is a wide-field multi-wavelength imaging and spectroscopic survey in 77 nearby galaxy clusters. We continue the ongoing analysis of the WINGS datasets using regarding the morphological structure of cluster member galaxies using the state of the art software GALAPAGOS (Barden et al. 2012). We will present a multi-wavelength structure analysis of 9 galaxy clusters. We fit single-Sérsic functions relying on three optical (u, B and V) and two near-infrared (J and K) bands simultaneously. We measure the magnitudes, effective radius (Re), the Sérsic indices, axis ratio and position angle. We focus on the properties of 700 member cluster galaxies dividing our sample into ellipticals (E), lenticulars (S0), early-type and late-type spirals based on their Hubble Type (Fasano et al. 2011; MORPHOT). We find that Es have the larger Sérsic indices in all bands. S0s have Sérsic indices similar but never Larger than Es, while early spirals and late type spirals have Sérsic indices closer to 1. For all cluster galaxies the Re is smaller in NIR compared to optical to wavelengths. Spirals have the Larger values of Re in all bands while E and S0 are the galaxies with the smaller Re in all bands. finally, we show how the structure parameters change along the distance from the center of the cluster as well as with the local density.

Using Machine Learning Techiques to estimate photometric redshifts for X-ray sources

Ms. Vasileia Aspasia Masoura
IAASARS, National Observatory of Athens

Photometric redshifts (photo-z) have become a necessity in observational astronomy nowadays. Current and future studies (e.g. XMM, eROSITA, DES, Euclid) will provide us with large datasets that contain hundreds of thousands of sources. Spectroscopy is expensive in telescope time and challenging to complete for Large samples, thus photot-zs is the only mean to calculate redshifts for these catalogues. Many photo-z estimation methods exist in the literature and can be divided into two main categories: the template fitting and the machine learning techniques. These methods have been successfully applied for the photo-z estimation of galaxies (e.g. SDSS). In the case of Active Galactic Nuclei (AGN) photometric redshifts have been estimated for optical QSOs, but for X-ray AGN only SED fitting techniques have been used. AGN SEDs though are more complicated than galaxies' SEDs due to host contamination and therefore the photo-z estimation via the template fitting can be tricky and unreliable. In this talk I will present photometric redshifts for X-ray AGN that have been estimated using for the first time, machine learning techniques (TPZ). The X-ray sample consists of 1,031 sources in the H-atlas field. For the photo-z estimation we have used optical, mid- and near-IR photometry. I will present the accuracy of the derived photometric redshifts and compare them with spectroscopic estimations as well as with photometric redshifts calculated using other machine learning methods (neural networks; ANNz)

Consequences of the detection of optically thin and highly excited CO in the wind of the radio galaxy IC5063

Dr. Kalliopi Dasyra
University of Athens/NOA

Using ALMA, we recently proved that the molecular gas in the jet-driven wind of IC5063 is more highly excited than the molecular gas in the disk of the same galaxy. The CO(4-3)/(2-1) flux ratio significantly exceeded the upper limit of 4 for optically thick gas, and it approached the upper limit of 16 for optically thin gas. In jet-impacted regions, near wind starting points, the CO molecules often had excitation temperatures of 30-100K. At such temperatures and column densities, the mass of the accelerated gas can be an order of magnitude lower than that previously measured (for CO at typical ISM conditions). The consequences of this result are two-fold: winds may be somewhat less important for galaxy evolution than previously thought, but they may be considerably more easy to detect at low and high redshifts with ALMA and other sub-millimeter arrays.

Poster presentations

The surprisingly Large dust and gas content of quiescent galaxies at z>1.4

Prof. Georgios Magdis
Niels Bohr Institute

Early type galaxies (ETG) contain most of the stars present in the local Universe and, above a stellar mass of ~5e10 Msun, vastly outnumber spiral galaxies like the Milky Way. These massive spheroidal galaxies have, in the present day, very little gas or dust, and their stellar populations have been evolving passively for over 10 billion years. The physical mechanisms that led to the termination of star formation in these galaxies and depletion of their interstellar medium remain largely conjectural.

In particular, there are currently no direct measurements of the amount of residual gas that might be still present in newly quiescent spheroids at high redshift. In this talk I will show that quiescent ETGs at z~1.8, close to their epoch of quenching, contained 2-3 orders of magnitude more dust at fixed stellar mass than local ETGs. This implies the presence of substantial amounts of gas (5-10%), which was however consumed less efficiently than in more active galaxies, probably due to their spheroidal morphology, and consistently with our simulations. This lower star formation efficiency, and an extended hot gas halo possibly maintained by persistent feedback from an active galactic nucleus (AGN), combine to keep ETGs mostly passive throughout cosmic time.

Hunting Binary Quasars

Dr. Eleni Kalfountzou
European Space Agency

Santos-Lleo Maria (ESA/ESAC, Madrid, Spain), Chatzigiannakis Dimitris (Aristotle University of Thessaloniki), Trichas Markos (Airbus, UK)

Supermassive black holes (SMBHs) were first proposed to account for the energy source of active galactic nuclei (AGNs). Now it is well known that nearly every galaxy hosts a SMBH in its center. At the same time, in a ΛCDM universe, galaxies grow by hierarchical merging. During the merger, the SMBHs from each progenitor will sink to the center of the merger remnant, and therefore it seems inevitable that the two SMBHs will form a gravitationally bound system, known as an SMBH binary. Merging SMBHs are expected to be the strongest source of gravitational wave radiation to be detected by space-based laser interferometers. However, the exact temporal evolution of these binaries, which directly determines their detection rates, remains uncertain from both a theoretical and observational perspective. Quasar pairs can be classified in physical pairs, gravitational lenses and projected associations. Quasars in physical pairs are gravitationally interacting or belong to the same structure (e.g. a cluster of galaxies). They represent a formidable tool to improve our understanding of the evolution of galaxy and dark matter clustering with Cosmic Time, since they can be traced up to very high redshift. They can also provide information about the role of galaxy interactions in triggering nuclear activity. Using optical and X-ray observations we try to address open questions such as: what is the evolution path from binary quasars to single quasars, what is the role of merger-triggered SMBH accretion and its relationship to galaxy evolution, are the host galaxies of binary quasars interacting, are they bound to each other and in the process of merging? We will present our systematic search for binary quasars, evidences for inflows and outflows at these systems and the discovery of a new triple AGN or a black hole recoil candidate.

Blazar Optical Sky Survey - BOSS project (2013-2017)

Prof. Kosmas Gazeas
University of Athens

Blazar Optical Sky Survey (BOSS Project) is a dedicated observational survey with the aim of monitoring known blazars in optical wavelengths. The project was initiated in March 2013 at the University of Athens Observatory (UOAO), performing ground-based optical photometric observations in parallel with orbital (SWIFT/XRT, FERMI/LAT) X-ray observatories. BOSS project has immediately met international attention, attracting the interest of several collaborators worldwide. It is currently running as an international collaboration of the National University of Athens, utilizing the robotic and remotely controlled telescope at the UOAO. Several targets of interest are monitored in the frame of BOSS Project, such as highly variable blazars and AGNs. The targets are continuously observed on a daily basis, with the aim to achieve dense temporal coverage in optical wavelengths. Furthermore, simultaneous observations in high and low energy bands are cross-correlated with BOSS database and crucial information are gathered in order to understand the mechanisms that are taking place in these objects. In this presentation, the main achievements after the first 4 years of operation of the BOSS Project are given, while the advantage of small, robotic and remotely controlled telescopes is highlighted.

The X-ray AGN population behind the disk of M31

Ms. Constantina M. Fotopoulou
University of Athens

Fotopoulou C.(1), Hatzidimitriou D.(1,2), Williams B.F.C.(3), Haberl F.(4), Vasilopoulos G.(4), Pietsch W.(4), Kourniotis M. (2), Bonanos, A. (2), et al. (1) National and Kapodistrian University of Athens, Department of Physics, Greece (2) National Observatory of Athens, IAASARS, Athens, Greece (3) University of Washington, Department of Astronomy, Seattle, USA (4) Max-Planck Institute für Extraterrestrische Physik, Garching, Germany

The majority of hard X-ray sources that have been discovered in the direction of the M31 disk are expected to be AGNs. We have identified spectroscopically 24 AGNs (with redshifts between z=0.1 and z=4.3) counterparts of X-ray sources projected within the M31 D25 ellipse, using the 3.5m APO telescope, the Keck telescopes and the Gran Telescopio Canarias. We note that this area is not covered by the recent LAMOST quasar survey in the direction of M31 and M33. We investigate possible correlation of the derived hydrogen column density and photon index (using an absorbed power law spectral fit in the full, hard and soft X-ray bands) with location within the M31 spiral arms.

Analysis and reduction of imaging observations in optical continuum and Ha emission line of 6 ring galaxies.

Mr. Konstantinos Kouroumpatzakis
University of Crete / FORTH

We present the reduction and analysis of 6 ring galaxies optical and Hα emission line filters observed at the European Southern Observatory (NTT). The reduction was performed with the use of the IRAF, IMWCS, Source Extractor tools and a custom code for performing the photometry. Since the Ha emission traces young stellar populations we measure the galaxy wide recent star formation rate (SFR) and map the locations of star forming regions. In addition we use multi-wavelength archival data in order to compare the galactic properties among the nucleus, circumnuclear regions and the galaxy's rings. In combination with X-ray observations (Chandra) we examine the widely used correlation between X-ray luminosity and SFR in sub-galactic scale.

Probing cosmic-ray particle acceleration in interaction-powered supernovae

Dr. Maria Petropoulou
Purdue University
Kamble Atish (CfA, Harvard) Sironi Lorenzo (Columbia University)

Interaction-powered supernovae (SNe) are associated with an unusually dense circumstellar medium (CSM) that has been modified by the mass loss of the progenitor star during the last stages of its life. They are typically discovered in optical wavelengths, while their detection at radio frequencies tens to hundreds of days after the SN explosion was made possible only recently. Their radio emission is powered by relativistic electrons that can either be accelerated at the SN shock (primaries) or injected as a by-product (secondaries) of inelastic proton-proton collisions. The temporal evolution of the radio emission is expected to depend on the origin of the radiating electrons. Here, we present model predictions about the radio light curves and spectra that can serve as diagnostics for the acceleration of cosmic rays at the shocks of interaction-powered SNe.

Modeling the rapid flare of 3C279 June 2015

Ms. Ioulia Florou
University of Athens

Petropoulou Maria (Purdue University, Department of Physics and Astronomy), Mastichiadis Apostolos (National and Kapodistrian University of Athens)

Flat Spectrum Radio Quasars (FSRQs), a sub class of Blazars, are strong emitters of electromagnetic radiation, with jets pointing close to our line of sight, strong broad emission lines and a rapid variability ranging from minutes to several hours. Quasar 3C279 is one of the most extensively studied FSRQs. In June 2015 the source underwent a giant outburst with a minute scale variability that was observed by Fermi large Area Telescope. In this project we investigate whether a one-zone proton synchrotron model could describe the origin of the observed GeV flare. Specifically we assume that high energy photons are produced by relativistic protons whose distribution is a Log Parabolic function. We find that a Log Parabolic distribution is preferred in this case over a Power Law as it produces a better fit to the observational data and it minimizes the total jet power. In order to explain the fast variability, we assume a small emitting region ($R_{blob} \sim 10^{1}4cm$), which is fast moving with Doppler factors greater than D=50. The gamma rays are assumed to be produced at the outer edge of the Broad Line Region in order to prevent their absorption on soft photons. finally, the total jet power is calculated to be about one order of magnitude greater than the Eddington Luminosity of the source while the particles and magnetic fields are found to be in rough equipartition.

On the connection of radio and gamma-ray emission of blazars

Ms. Stella Boula
University of Athens

Petropoulou Maria (Purdue University, USA), Mastichiadis Apostolos (University of Athens, Greece)

Blazars are a sub-category of radio-loud Active Galactic Nuclei which is characterized by non thermal emission coming from highly relativistic particles. These sources exhibit in some cases a correlation between gamma-ray and radio emission, especially during flaring episodes. In this work we construct a one zone leptonic model in order to explain these correlations. Adopting the hypothesis that high energy photons are produced by relativistic electrons close to the central black hole, we study the evolution of this population of particles as it moves down the jet and loses energy by radiation and adiabatic expansion. Utilizing a numerical code we calculate the multiwavelength emission as a function of the radial distance which can be translated into a time coordinate once the velocity of the emission region is known. In this scenario gamma-rays are produced early on, when the electrons are still very energetic, while radio emission at a later time when the electrons have cooled and the emission region becomes optically thin to synchrotron self-absorption due to expansion. We will discuss the parameters entering our calculations (like the magnetic field strength, the density of relativistic electrons, etc) in connection to the observational data.

Estimating galaxy redshifts with Gaia

Ms. Sophie Tsiatsiou
University of Crete

Bellas-Velidis Ioannis (National Observatory of Athens), Charmandaris Vassilis (NOA & Univ. of Crete)

Gaia is a cornerstone mission of the European Space Agency (ESA) launched in 2013. It will provide unprecedented accuracy astrometry, photometry and low-resolution spectroscopy for about one billion stars up to 20-21 magnitude during more than five years survey of the whole celestial sphere. Higher resolution spectra will be observed for the brighter sources. While its main objective is to take a census of the stellar content of our Galaxy, it will also observe a large number of many other objects, among them over a million of unresolved galaxies. The objective of our work is to extend, towards Larger redshifts, the module Unresolved Galaxy Classifier (UGC) that is being developed for the Gaia ground-based pipeline by the Greek team, member of the Data Processing and Analysis Consortium (DPAC). The UGC uses low-resolution spectra of galaxies observed by Gaia's BP/RP spectrophotometer to classify the galaxies and to estimate specific parameters. Our purpose is to develop an automatic procedure, based on supervised learning, to obtain the redshift of galaxies up to 0.6. A very first step towards this is to prepare a proper library of galaxies spectra with known redshifts and to model the spectra for the BP/RP instrument. Then, the spectral library will be used to train and test the redshift estimator. finally, the procedure will be validated by really observed Gaia spectra. Here we present the new spectral library and the first results from its use to train the redshift estimator. We used the Gaia Data Release 1 to cross-match the observed sources with SDSS DR13 galaxies having spectra taken with BOSS spectrograph. The analysis and selection of the spectra to be modelled for the BP/RP and included in the library is illustrated. The performance of the redshift estimator based on Support Vector Machines algorithm is presented.

FR-type radio sources in COSMOS

Dr. Eleni Vardoulaki
AIfA University of Bonn

Karim Alex (AIfA) Jiménez-Andrade Eric F. (AIfA) Magnelli Benjamin (AIfA), Smolcic Vernesa (Uni. Zagreb), Schinnerer Eva (MPIA) Bertoldi Frank (AIfA), Sargent Mark (Uni. Sussex), finoguenov Alexis (MPE), Delvecchio Ivan (Uni. Zagreb)

Modern radio interferometric surveys, due to improved receiver and correlator capabilities provide higher sensitivity and higher resolution data than past radio surveys, thus revealing a huge variety of radio structures down to uJy levels. Here we present an analysis on the radio structure of 350 radio sources from the VLA-COSMOS 3GHz large Project (JVLA-COSMOS; Smolcic et al. 2017), reaching a resolution of 0.75" with sensitivity of 2.3uJy/beam. These objects were selected on the basis of their extended radio structure and were placed, by visual inspection, in radio classes that follow the FR-type classification of Fanaroff & Riley (1974); approximately half of them are associated with active galactic nuclei (AGN). The purpose of this project is to compare the radio structure of radio AGN to their energetics (e.g. accretion properties) and environment (e.g. X-ray groups in COSMOS, George et al. 2010), and relate these to the different observed FR radio structures to understand the physical mechanisms behind the FRI/FRII dichotomy. We report the discovery of low radio power (log(L3GHz/W/Hz/sr) 22), small scale (30 kpc) classical-double radio sources (FRII) at redshifts z 1, which we are able to resolve due to the unprecedented resolution of 0.75 arcsec (FWHM) of JVLA-COSMOS. Furthermore, our results agree with the scenario that FRII sources are in-falling: at redshifts $z > 1$ FRIIs can be located at the outskirts of the associated X-ray group, but at low redshifts they sit at the centre of the potential well. Finally, we present preliminary results on an automatic (semi-supervised) machine-learning method to classify radio sources with complex radio structures, and discuss the necessity for automatic methods in identifying and classifying radio sources in large, current and future, radio surveys.

Investigating the colors of the galaxies in the nearby Universe

Mr. Angelos Nersesian
University of Athens & NOA

Within the framework of the DustPedia project we study the effect of the cosmic dust on the nearby galaxies. The DustPedia database consists of a wide range of observations covering from the far-UV to the submillimeter and therefore provides us with the unique opportunity to study the physical properties of the cosmic dust and its relation to the stellar radiation field. I will present the results obtained by comparing the different color indices in the optical, near-infrared and far-infrared wavelengths of a sample of ~ 900 galaxies to various physical parameters, such as the star formation rate, the stellar mass and the dust mass that regulate the formation and evolution of galaxies in cosmic scales. Such scaling relations are derived for different galaxy morphological types and environments.

Session 3: Cosmology and Relativistic Astrophysics

Oral presentations

Rayleigh-Taylor instability limits on the magnetic flux in astrophysical black holes

Prof. Demetrios Papadopoulos
University of Thessaloniki

Magnetic fields are believed to play a fundamental role in powering energetic astrophysical sources such as AGNs, XRBs, and GRBs. Extensive theoretical research over the last four decades has most convincingly shown that magnetic fields contribute to the extraction of rotational energy from spinning astrophysical black holes. The fundamental parameter that determines the efficiency of this process is the amount of magnetic flux held in place by the surrounding disk of matter, and this is limited by the Rayleigh-Taylor instability. We show that the Keplerian disk rotation together with the rotation of space-time (Kerr) stabilize the onset of this instability. We also show that the maximum amount of magnetic flux is limited to about one percent of equipartition, in general agreement with numerical simulations.

The energy distribution of electrons in radio jets

Prof. Nikolaos Kylafis
University of Crete
Tsouros Alexandros (University of Crete)

Black-hole and neutron-star X-ray binaries exhibit compact radio jets, when they are in the so-called quiescent, hard, or hard intermediate states. The radio spectrum in these states is flat to slightly inverted, i.e., the spectral index alpha is typically in the range [0 - 0.5]. It is widely accepted that the energy distribution of the electrons, in the rest frame of the jet, is a power law with index p in the approximate range [3 - 5]. A power-law energy distribution of the electrons in the jet is sufficient to explain the flat to slightly inverted spectrum emitted by the jet from radio to near infrared wavelengths, but is it necessary? Contrary to what our thinking was decades ago, now we know that the jets originate in the hot inner flow around black holes and neutron stars. Thus, we have investigated the spectrum that is emitted by a thermal jet with kT in the range [100 - 250 keV]. Under the assumption of a parabolic jet and flux freezing, we have computed the emitted spectrum from radio to near infrared using either a thermal distribution of electrons or a power-law one. We have found that parabolic jets with a thermal distribution of electrons give inverted spectra with alpha in the range [0 - 0.4], while jets with a power-law distribution of electrons give inverted spectra with alpha in the range [0 - 0.2]. The rest of the parameters are kept the same in the two cases. The break frequency, which marks the transition from optically thick to optically thin synchrotron emission, is comparable for the two electron energy distributions. Our conclusion is that, contrary to common belief, it is not necessary to invoke a power-law energy distribution of the electrons in a jet to explain its flat to slightly inverted radio spectrum. A relativistic Maxwellian produces similar spectra. Thus, the widely invoked "corona" around black holes in X-ray binaries may actually be the jet!

Relativistic magnetised cosmological perturbations in the post-recombination era

Ms. Dimitra Tseneklidou
University of Thessaloniki

We study the influence of magnetic fields in the evolution of cosmological perturbations after recombination, using General Relativity and assuming ideal-magnetohydrodynamics.The general kinematic and magnetohydrodynamics equations are linearised considering a Friedmann-Robertson-Walker background and sufficiently weak cosmological magnetic fields. In so doing, we provide a new analytical set of equations, which incorporate not only previous Newtonian studies and refines earlier relativistic work on the subject. Our results show that, at the linear level, the magnetic effect is scale-depended and generally inhibits the growth of density perturbations. Dimitra Tseneklidou, Christos Tsagas

Environmental Dependence of the Abundance function of Dark Matter Halos

Ms. Maria Chira
University of Thessaloniki

Authors: Maria Chira, Maniolis Plionis, Pier-Stefano Corasaniti We study the dependence of the halo abundance function on different environments, defined by the isolation status of the individual halos. We find significant differences of the halo abundances as a function of halo isolation, indicating different rates of halo formation. A double power-law Schether-like function fits extremely well the Abundance function for all halo isolation status; we use its main fitted parameters in order to quantify their behaviour with isolation. We find that the slope of the power-law and the characteristic mass decrease with isolation, a result consistent with formation of less massive halos in lower density regions. However, we find an unexpected upturn of the characteristic mass of the most isolated halos of our sample. We find that the upturn originates and characterises only the higher redshift regime (z>0.456) which implies an evolution of the isolation of the massive, most isolated halos. The cause of such an unexpected behaviour needs further investigation.

Indications for Anisotropy of the Hubble flow

Mr. Konstantinos Tanidis
University of Thessaloniki
Plionis Manolis (University of Thessaloniki)

The Joint Light-curve Analysis (SDSS-II and SNLS samples) is the latest compilation of 740 spectroscopically confirmed SNIa. Considering only SNIa events with z>0.02 to avoid local bulk flows, we constrain the matter density parameter within a flat Lambda-CDM cosmological model. In particular, we derive the strictly standardized mean difference (SSMD) for this parameter between groups of SNIa and the rest of the sample in galactic coordinates. We show that a specific area of the sky yields a rather high SSMD. We also present distinct distributions of SSMD for spatially coherent and random groups among the two galactic hemispheres which are statistically important and constitute evidence for indications of anisotropy of the cosmic expansion within this model.

Relativistic hydrodynamical tori: QPO & PPI

Dr. Antonios Manousakis
CAMK/SQU

We simulate an oscillating polytropic torus with constant specific angular momentum around a Schwarzschild black hole. The goal is to search for quasi-periodic oscillations in the light curve of the torus. The torus is subjected to an initial radial, vertical or diagonal (combination of radial and vertical) velocity perturbation. The hydrodynamical simulations are performed using the general relativistic magnetohydrodynamics code and ray traced using the general relativistic ray-tracing code. We found that a horizontal velocity perturbation triggers the radial and plus modes, whereas a vertical velocity perturbation triggers the vertical and X modes. The diagonal perturbation gives a combination of the modes triggered in the radial and vertical cases. The breathing mode is excited in all cases. We find that the radial eigenmode frequency is independent of the equation of state used. We have further implemented a hydrodynamic simulations of 3D tori, were the Papaloizou-Pringle Instability (PPI) appears and grow with time. I will briefly discuss our very recent findings and the effects of the PPI in the torus variability.

Where the world stands still: cosmology at turnaround scales

Prof. Vasiliki Pavlidou
University of Crete

Tomaras Theodore (University of Crete), Tanoglidis Dimitrios (The University of Chicago)

Our intuitive understanding of cosmic structure formation works best on scales small enough so that bound, relaxed gravitating systems are no longer adjusting their radius; and large enough so that space and matter follow the average expansion of the Universe. Yet one of the most sensitive probes of cosmological models concerns the scale that separates these limits: the turnaround radius, which is the non-expanding shell furthest away from the center of a bound structure. The average matter density within this radius has a distinctly different asymptotic behaviour at early and late cosmic times, sensitively and independently quantifying the matter and the vacuumenergy content of the universe, respectively. I will discuss the possibility of experimentally mapping the evolution of the average turnaround matter-density, the use of such observations as a probe of cosmology independent of our currently employed tools, and the implications of the fact that we currently appear to be living in a transition epoch between the two asymptotes.

Session 4: Stars, Planets and the Interstellar Medium

Oral presentations

Evolution of low mass contact binaries close to the orbital period cut-off

Ms. Georgia Loukaidou
University of Athens

Stellar evolution on stellar systems leads towards angular momentum and mass loss from the systems, due to stellar wind and magnetic breaking. The components within a system gradually approach each other, while the orbits become tighter and the rotation gets faster. Observational investigations of low temperature and low mass contact binaries (or LMCBs) in the solar neighborhood provide essential means for studying a large sample of such systems. The scientific approach is achieved by utilizing photometric observations of contact binary stars with tight orbits, which show short orbital periods, in order to determine their physical and geometrical parameters (i.e. mass, radius, temperature and luminosity) and examine how these parameters evolve through time. The observed orbital period cut-off limit of 0.22 days is a result of evolutionary mechanisms and such systems act as probes in investigating the very evolved stages of systems before their final coalescence. The main goal of this study is the determination of the stellar evolution tracks of these type of LMCBs, which might be correlated to the formation of Blue Stragglers and the rapidly rotating single stars, observed in evolved globular clusters.

Links between protostellar accretion and ejection observed with ALMA

Dr. Odysseas Dionatos
University of Vienna

The birth of Sun-like stars is a complex process where several physical processes are involved but whose respective roles are not yet clear. On the one hand, the young stellar object accretes matter from a collapsing envelope. The gravitational energy released in the process heats up the material surrounding the protostar, creating warm regions enriched in complex organic molecules. On the other hand, the presence of angular momentum and magnetic fields leads to the formation of circumstellar disks and the ejection of matter, in the form of collimated jets and wide-angle outflows. In the time-domain, accretion is most likely episodic causing sudden increases in the luminosity of the system and providing, along with the ejecta, energetic feedback to the system. Moreover, planets form through the accretion of dust and gas within disks that surround young stellar objects. Consequently the initial composition and nature of planets will directly relate to the structure and chemical composition of the disk at the loci where planets are born. When planets form is equally important as disks are observed to evolve in size and possibly mass during dierent phases of star formation while there is growing evidence that planets form synchronously rather than sequentially to their host young stellar objects. The composition and chemical evolution of protostellar disks has therefore a direct consequence to the initial composition of planetesimals. Thanks to the high sensitivity and angular resolution reached by new interferometers (e.g. ALMA, NOEMA), it is not possible to image in great detail the very first phases of low-mass star formation, resolving structures of just a few AU around protostars. In this talk will review recent ALMA observations showing the universal connection between accretion disks and jet formation around embedded protostars. I will report on one of the most dramatic cases recently discovered, the protostellar system SMM1 in the Serpens Main protostellar cluster displaying the early chemical evolution of protostellar disks and a multitude of high velocity jet knots can indicating short-scale episodic accretion outbursts.

PASIPHAE: Clearing the path to inflationary B-modes through optopolarimetric magnetic tomography

Prof. Konstantinos Tassis
University of Crete

An inflation-probing B-mode signal in the polarization of the cosmic microwave background (CMB) would be a discovery of utmost importance in physics. While recent BICEP2 results hinting upon the detection of such a signal rallied enthusiasm, Planck showed that this breakthrough is still out of reach, because of contamination from Galactic dust. To get to the primordial B-modes, we need to subtract polarized emission of magnetized interstellar dust with high accuracy. A critical piece of this puzzle is the 3-d structure of the magnetic field threading dust clouds, which cannot be accessed through microwave observations alone, since they record integrated emission along the line of sight. Instead, observations of a large number of stars at known distances in optical polarization, tracing the same CMB-obscuring dust, can map the magnetic field between them. The Polar Area Stellar Imaging in Polarization High Accuracy Experiment (PASIPHAE) will deliver such a map combining novel-technology wide-field-optimized optical polarimeters and an extraordinary commitment of observing time by the Skinakas observatory in Crete and the South African Astronomical Observatory. We will cover >9000 square degrees in the areas of the sky targeted by CMB experiments, measuring linear optical polarization at 0.2% accuracy of over 360 stars per square degree, a 1000-fold increase over the state of the art. Such a map would not only boost CMB polarization foreground removal, but it would also have a profound impact in a wide range of astrophysical research, including interstellar medium physics, high-energy astrophysics, and galactic evolution.

The Musca molecular cloud: An interstellar symphony

Mr. Aris Tritsis
University of Crete

Molecular clouds are the birthplaces of stars. Their structure and evolution hold the key to understanding the initial conditions of star and planet formation, and the physics that sets the distribution of masses and multiplicities of newborn stars. However, their complexity, their typically turbulent, filamentary, disordered appearance, and ubiquitous projection effects hinder all efforts to model them in detail. An exception to this messy picture is found in a recently discovered class of structures, molecular cloud striations: ordered, low-columndensity, quasi-periodic, elongated structures parallel to the magnetic field. The physics that drives the formation of such striations has remained a mystery since their discovery. We have performed a comprehensive numerical experiment testing all possible driving mechanisms, and we have found that the only viable explanation for the appearance of striations is their formation by magnetohydrodynamic waves generating trapped modes, just like vibrations in a resonating chamber: they are, in every sense, a magnetohydrodynamic "song", with dense filaments being the instrument. We have additionally demonstrated that, by examining the spatial power spectrum of striations, we can find the normal modes of the "resonating chamber", and thus derive the true dimensions of dense filaments, including their previously inaccessible by any means line-of-sight dimension. We have applied such a normal mode analysis towards the Musca molecular cloud - one of the best-studied "dense filaments" in the interstellar medium and, contrary to all expectation, we have unequivocally demonstrated that the Musca filament is not, in fact, a filament: it is a sheet-like structure with comparable line-of-sight and plane-of-sky dimensions, seen edge-on. We discuss the implications of this discovery for the physics of dense molecular cloud formation.

Variability of massive stars in the Virgo Cluster galaxy NGC 4535 with the Hubble Space Telescope

Ms. Zoi-Tzogia Spetsieri
IAASARS, National Observatory of Athens

Bonanos Alceste Z. (IAASARS, National Observatory of Athens), Lianou Sophia (Laboratoire AIM, CEA/IRFU/Service d'Astrophysique), Kourniotis Michalis (IAASARS, National Observatory of Athens), Pouliasis Ektoras (IAASARS, National Observatory of Athens), Sokolovsky Kirill (IAASARS, National Observatory of Athens, Sternberg Astronomical Institute, Moscow State University, Astro Space Center of Lebedev Physical Institute) Gavras Panagiotis (IAASARS, National Observatory of Athens), Hatzidimitriou Despina (National and Kapodistrian University of Athens), Yang Ming (IAASARS, National Observatory of Athens) Kopsacheili Maria (IESL/FORTH & University of Crete), Bellas-Velidis Ioannis (IAASARS, National Observatory of Athens), Whitmore Bradley C. (Space Telescope Science Institute, Baltimore)

Identifying rare types of massive stars at a range of metallicities is the first step toward constraining mass loss mechanisms and evolutionary models of massive stars. We present results of a reanalysis of the Hubble Space Telescope WFPC2 images of the HST Key Project galaxy NGC 4535 in the Virgo Cluster with DOLPHOT (Dolphin 2000) aiming to identify massive stars in this galaxy. The original study of Macri et al. (1999) discovered 50 Cepheid variables in NGC 4535, while our reanalysis using the variability indexes Mean absolute deviation (MAD), interquartile range (IQR) and the von Neumann ratio, yielded 120 additional variables with absolute magnitudes ranging from –4 to -10, which mainly correspond to massive stars. We show the positions of the candidate variables on the color magnitude diagram and present the light curves of the variable candidates in the filters F555W and F814W. Modules for Experiments in Stellar Astrophysics (MESA) Isochrones and Stellar Tracks (MIST) at solar metallicity were used to classify the variables. Among the massive variables detected are several strong red supergiant candidates. This work is a part of the validation of the Hubble Catalog of Variables (HCV) project, which was launched in 2015 at the National Observatory of Athens by ESA, and aims to identify all sources (point-like and extended) showing variability, based on the Hubble Source Catalog (Whitmore et al. 2016).

Towards a complete optical atlas of Galactic Supernova Remnants

Dr. Ioanna Leonidaki
IESL/FORTH & University of Crete

Zezas Andreas (FORTH/University of Crete/CfA), Kypriotakis Giannis (University of Crete), Boumis Panos (IAASARS-NOA)

One of the most noteworthy astrophysical phenomena, Supernova Remnants (SNRs) are responsible for energizing and transforming the Interstellar Medium (ISM) and for triggering star formation, while studying their evolution yields information on the final stages of stellar evolution. Due to their proximity, Galactic SNRs are an ideal laboratory for probing their structure, their evolution and their interaction with their ambient medium. Despite their great importance, it is surprising that a comprehensive multi-wavelength survey of Galactic SNRs has not been conducted so far (only 25% of them have been explored in the optical). In order to perform a comprehensive, multi-wavelength study of the Galactic population of Supernova Remnants, we have embarked in creating for the first time a complete optical narrow-band atlas of the entire SNR population in our Galaxy. We present our first results from the deep narrow-band Hα, [SII], [OIII], Hα imaging for ~40 of the reported ~220 SNRs with no optical observations. We present the morphology, the excitation and shock-velocity maps of the observed SNRs. The data reduction has been performed with a newly developed pipeline, which involves a novel approach for the removal of foreground and background stars, a significant problem in studies of Galactic SNRs. We also compare the integrated optical emission of the SNRs with existing maps in the X-ray, radio and infrared bands (e.g. Chandra, VLA and WISE respectively) which allows us for the first time to probe how their observational characteristics correlate with their age, and therefore their evolution.

Investigating the circumstellar structures of B[e] Supergiants

Dr. Grigoris Maravelias
IFA, Universidad de Valparaíso

Kraus Michaela (AsU-AVCR, Czech Republic; TO, Estonia), Cidale Lydia Sonia (IALP-UNLP, Argentina; FCAG-UNLP, Argentina), Arias Maria Laura (IALP-UNLP, Argentina; FCAG-UNLP, Argentina), Torres Andrea florencia (IALP-UNLP, Argentina; FCAG-UNLP, Argentina), Borges Fernandes Marcelo (ON, Brazil), Aret Anna (AsU-AVCR, Czech Republic; TO, Estonia), Curé Michel (IFA-UV, Chile)

B[e] Supergiants (B[e]SGs) belong to a heterogeneous group of objects also composed of pre-main sequence stars, compact planetary nebulae, and symbiotic objects that display the B[e] phenomenon. This translates into observed characteristics that include strong Balmer lines, low excitation permitted and forbidden emission lines in the optical spectrum, and a strong near or mid-infrared excess due to hot circumstellar dust. Thus, the circumstellar environment around B[e]SGs is very complex, consisting of atomic, molecular, and dusty regions. However, using high-resolution optical and nir spectrographs we are able to investigate these structures in detail. We examine a set of emission features ([OI], [CaII], CO bandheads) to trace their physical conditions and kinematics in their formation regions. For a sample of B[e]SGs in our Galaxy and the Magellanic Clouds, we find that they are surrounded by a series of single and/or multiple equatorial rings of different temperatures and densities, a probable result of previous mass-loss events.

Analysis and Classification of the Spectral States of Cyg X-1 based on INTEGRAL Data

Mr. Alexandros Filothodoros
University of Zielona Gora

Studies of the spectral states are an important diagnostic tool of the black hole (BH) binary systems and Cyg X-1 has been the most studied object in this respect. Up to now, the classification of the spectral states has been based on X -ray data below 12 keV. We present a novel approach to the state identification based on emission in a much wider energy range. Namely, we are using I 14-years INTEGRAL/ISGRI data collected so far, to extract count rates extracted in the 22-40 keV and 40-200 keV energy bands. This way, were able to do a comprehensive analysis over a broad range of the Cyg X-1 spectral states. Our spectral state classification is based on the summed 22 -100 keV count rate plotted against the 40 -100/22 -40 keV hardness ratio. This particular representation of the data allows us to clearly distinguish the hard and soft state, with the summed flux as a primary criterion. In addition,such a state classification results in a better identification of the intermediate state than the classifications based on the soft X-rays. For both the soft and hard state we defined 6 substates based on the hardness ratio value. For each substate we prepared summed spectra with a similar exposure time, accompanied by the corresponding INTEGRAL JEMX1 and JEMX2 spectra in the 4 -12 keV range. These 12 broad-band spectral datasets were analyzed with the two most advanced Comptonization models implemented in the XSPEC fitting package, COMPPS and EQPAIR . Spectral analysis of the high quality substate spectra allowed us to find a correspondence between the parameters of the physical models and the phenomenological classification based on the count rates. Specifically, we observe that our hard/soft state identification exclusively corresponds to the photon index fitted in the 22-100 keV energy band below/above 2, respectively. Moreover, the soft state ISGRI spectra are well approximated by a power law, whereas the hard state spectra show a convex shape due to the thermal Comptonization of a relatively hot plasma. A first general remark is that the hard X-ray spectra can be approximated by a thermal X-ray emission, whereas for the soft state we observe an anticorrelation between non-thermal emission and hardness. The plasma temperature for the hard state is relatively stable around 75 keV. On the other hand, our preliminary results for the soft states how that the plasma temperature is higher. Furthermore, we see that on average the Compton reflection is weaker in the hard state. To determine a full range of the spectral parameters we analyzed almost

The impact of stellar binarity on core-collapse supernovae

Mr. Manos Zapartas
University of Amsterdam

Most massive stars, the progenitors of core-collapse supernovae, are in close binary systems and may interact with their companion through mass transfer or merging before explosion. We use population synthesis simulations to study some statistical properties of the core-collapse supernovae and their progenitors. We test the systematic robustness of our results by running various simulations to account for the uncertainties in our standard assumptions. We first study the delay-time distribution of core-collapse supernovae, i.e., the supernova rate versus time following a starburst, taking into account binary interactions. We find that a significant fraction, ~15%, of core-collapse supernovae are "late", i.e. they occur 50-200 Myrs after birth, when all massive single stars have already exploded. These late events originate predominantly from binary systems with at least one, or, in most cases, with both stars initially being of intermediate mass (4 ~ 8 Msun). The main evolutionary channels that contribute often involve either the merging of the initially more massive primary star with its companion or the engulfment of the remaining core of the primary by the expanding secondary that has accreted mass at an earlier evolutionary stage. Also, the total number of core-collapse supernovae increases by ~14% because of binarity for the same initial stellar mass. The high rate implies that we should have already observed such late core-collapse supernovae, but have not recognized them as such. We argue that o Persei is a likely progenitor and that eccentric neutron star - white dwarf systems are likely descendants. Late events can help explain the discrepancy in the delay-time distributions derived from supernova remnants in the Magellanic Clouds and extragalactic type Ia events, lowering the contribution of prompt Ia events. We discuss ways to test these predictions and speculate on the implications for supernova feedback in simulations of galaxy evolution. We also predict the likelihood of

a companion star being present at the moment of explosion, focusing on stripped-envelope SNe, whose progenitors have lost their outer hydrogen and possibly helium layers before explosion. We use these results to interpret new Hubble Space Telescope observations of the broad-lined Type Ic SN 2002ap 14 years post-explosion.For a subsolar metallicity consistent with SN 2002ap, we expect a main-sequence companion present in about two thirds of all stripped-envelope SNe and a compact companion (likely a stripped helium star or a white dwarf/neutron star/black hole) in about 5% of cases. About a quarter of progenitors are single at explosion (originating from initially single stars, mergers or disrupted systems). The latter scenarios require a massive progenitor, inconsistent with earlier studies of SN 2002ap. Our new data exclude the presence of a main-sequence companion star $> 8\text{-}10 M_o$., ruling out about 40% of all stripped-envelope SN channels. The most likely scenario for SN 2002ap includes nonconservative binary interaction of a primary star initially less massive than about $23 M_o$. We finally study the evolutionary channels of hydrogen-rich (type II) core-collapse supernovae, investigating the fraction of their progenitor that had binary mass transfer, common envelope evolution and/or merging with a companion prior to explosion.

Stellar Winds in Massive X-ray Binaries

Dr. Antonios Manousakis
CAMK/SQU

Strong winds from massive stars are a topic of interest to a wide range of astrophysical fields. In High-Mass X-ray Binaries the presence of an accreting compact object on the one side allows to infer wind parameters from studies of the varying properties of the emitted X-rays; but on the other side the accretor's gravity and ionizing radiation can strongly influence the wind flow. Here I will present a collaborative effort of astronomers both from the stellar wind and the X-ray community. This presentation attempts to review our current state of knowledge and indicate avenues for future progress. I will also briefly discuss the outcome of a multi-wavelength campaign of the supergiant fast X-ray transient prototype IGR J17544-2619 and the knowledge gained to shed light on the elusive behavior of the SFXTs.

Long term evolution of planetary systems with a terrestrial planet and a giant planet

Dr. Nikolaos Georgakarakos
NYUAD

We study the long term orbital evolution of a terrestrial planet under the gravitational perturbations of a giant planet. In particular, we are interested in situations where the two planets are in the same plane and relatively close. We examine both possible configurations: the giant planet orbit being either outside or inside the orbit of the smaller planet. The perturbing potential is expanded to high orders and an analytical solution of the terrestrial planetary orbit is derived. The analytical estimates are then compared against results from the numerical integration of the full equations of motion and we find that the analytical solution works reasonably well. An interesting finding is that the new analytical estimates improve greatly the predictions for the timescales of the orbital evolution of the terrestrial planet compared to an octupole order expansion.

Developing a user-friendly photometric software for exoplanets to increase participation in Citizen Science

Ms. Anastasia Kokori
Dublin City University

Tsiaras Angelos (UCL)

Previous research on Citizen Science projects agree that Citizen Science (CS) would serve as a way of both increasing levels of public understanding of science and public participation in scientific research. Historically, the concept of CS is not new, it dates back to the 20th century when citizens where making skilled observations, particularly in archaeology, ecology, and astronomy. Recently, the idea of CS has been improved due to technological progress and the arrival of Internet. The phrase "astronomy from the chair" that is being used in the literature highlights the extent of the convenience for analysing observational data. Citizen science benefits a variety of communities, such as scientific researchers, volunteers and STEM educators. Participating in CS projects is not only engaging the volunteers with the research goals of a science team, but is also helping them learning more about specialised scientific topics. In the case of astronomy, typical examples of CS projects are gathering observational data or/and analysing them. The Holomon Photometric Software (HOPS) is a user-friendly photometric software for exoplanets, with graphical representations, statistics, models, options are brought together into a single package. It was originally developed to analyse observations of transiting exoplanets obtained from the Holomon Astronomical Station of the Aristotle University of Thessaloniki. Here, we make the case that this software can be used as part of a CS project in analysing transiting exoplanets and producing lightcurves. HOPS could contribute to the scientific data analysis but it could be used also as an educational tool for learning and visualizing photometry analyses of transiting exoplanets. Such a tool could be proven very efficient in the context of public participation in the research. In recent successful representative examples such as Galaxy Zoo professional astronomers cooperating with CS discovered a group of rare galaxies by using online software. Also the project "planet hunters" asked people to discover planets in other solar systems using data from large telescopes. HOPS, being in the same direction, could be an effective way of participating in research whether as an amateur astronomer or as a person of the general public that wants to engage with exoplanetary research and data analysis. The software is free of charge under the scope of astronomical research and education. We plan to create an online platform, inspired by HOPS, in the near future. In this platform, everyone will have access by creating an account as a user. Amateur astronomers, who have obtained their own exoplanet observations, will be able to upload and analyse their data. For people who are not familiar with photometric analysis - amateurs or general public users - data, as well as educational video and audio material will be provided.

Detecting dusty debris disks, exoplanets, and exoplanetary rings using the Gemini Planet Imager, HST and Antarctic observatories

Prof. Paul Kalas
UC Berkeley

I will review progress on our Gemini Planet Imager (GPI) and HST programs that investigate the planetary systems HD 106906 and Beta Pic. The gas giant exoplanet HD 106906b is directly imaged over 700 AU away from its host star and we discovered that it may have experienced a dynamical upheaval based on the warped morphology of the debris disk as revealed by GPI and in new HST/STIS coronagraphic data. The planet itself may have a circumplanetary dust that is resolved with HST. Astrometric monitoring of the exoplanet Beta Pic b using GPI shows that it has a low-eccentricity, nearly edge-on orbit with sma = 9.7 AU, which means that every 22 years the Hill sphere of the planet transits the star. The ingress of the Hill sphere begins in mid-2017, and I will describe our efforts using HST and Antarctic facilities to photometrically monitor the star for transiting circumplanetary rings.

A population study of hot Jupiter atmospheres

Mr. Angelos Tsiaras
UCL

Waldmann Ingo (UCL), Zingales Tiziano (UCL), Rocchetto Marco (UCL), Morello Giuseppe (UCL), Damiano Mario (UCL), Karpouzas Konstantinos (Aristotle University of Thessaloniki), Tinetti Giovanna (UCL), McKemmish Laura (UCL), Tennyson Jonathan (UCL), Yurchenko Sergei (UCL)

In the past two decades, we have learnt that every star hosts more than one planet. While the hunt for new exoplanets is on-going, the current sample of more than 3500 confirmed planets reveals a wide spectrum of planetary characteristics. While small planets appear to be the most common, the big and gaseous planets play a key role in the process of planetary formation. We present here the analysis of 30 gaseous extra-solar planets, with temperatures between 600 and 2400 K and radii between 0.35 and 1.9 Jupiter radii. These planets were spectroscopically observed with the Wide field Camera 3 on-board the Hubble Space Telescope, which is currently one of the most successful instruments for observing exoplanetary atmospheres. The quality of the HST/WFC3 spatially-scanned data combined with our specialised analysis tools, allows us to create the largest and most self-consistent sample of exoplanetary transmission spectra to date and study the collective behaviour of warm and hot gaseous planets rather than isolated case-studies. We define a new metric, the Atmospheric Detectability Index (ADI) to evaluate the statistical significance of an atmospheric detection and find statistically significant atmospheres around 16 planets. For most of the Jupiters in our sample we find the detectability of their atmospheres to be dependent on the planetary radius but not on the planetary mass. This indicates that planetary gravity is a secondary factor in the evolution of planetary atmospheres. We detect the presence of water vapour in all the statistically detectable atmospheres and we cannot rule out its presence in the atmospheres of the others. In addition, TiO and/or VO signatures are detected with 4? confidence in WASP-76 b, and they are most likely present on WASP-121 b. We find no correlation between expected signal-to-noise and atmospheric detectability for most targets. This has important implications for future Large-scale surveys.

A survey for non-transiting planets with Kepler

Mr. Konstantinos Karpouzas
University of Thessaloniki

In addition to a potential transit event, the existence of an exoplanet around a star introduces also out-of-transit signatures in the photometric light-curves. These signatures are present even if the inclination of the planetary orbit is below the critical value for a transit. In this work we search for non-transiting exoplanets in the Kepler data and, in particular, for planetary reflected/emitted light, ellipsoidal variations and Doppler beaming effects. Based on statistics, we estimated that there are approximately 50 detectable non-transiting hot Jupiters in the total Kepler sample, although the total number of non-transiting planets should be around 958. We analysed 196,468 light-curves from all the 17 quarters and found 64 candidates with minimum masses between 3 and 145 Jupiter masses. We report the detection of 14 candidates in the hot Jupiter regime and 11 brown dwarf candidates with masses between 35-55 Jupiter masses, in the so called brown dwarf desert regime of the Mass-Period diagram. Because of the lack of transits, radial velocity measurements are necessary in order to confirm the existence of these candidates.

V912 Per: A new twin low-mass binary with a third component

Prof. Eleftheria-Pan Christopoulou
University of Patras

Papageorgiou Athanasios (Instituto de Astrofísica, Pontificia Universidad Católica de Chile, Santiago, Chile), Siviero Alessandro (Department of Physics and Astronomy University of Padua, Italy), Pribulla Theodore (Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, Slovakia), Vanko Martin (Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, Slovakia)

Binary stars offer the best opportunity for accurate measurements of fundamental properties-radii, masses, effective temperatures of stars, with remarkable precision often better than 2%. These measurements are essential to verify stellar evolution theory such as the mass-radius relationship and to determine the properties of other diverse objects such as white dwarfs, neutron stars, blackholes, and extrasolar planets. Departures of theoretical expectations from empirical data provide a unique opportunity to improve our understanding of important astrophysical processes. We show that the star known as V912 Per is a double-lined eclipsing binary with nearly identical low-mass components. The system seems triple and active, showing Ha in emission. The spectroscopic elements derived from spectra obtained with the High Resolution Echelle Spectrograph on Asiago Observatory, Italy, during December 2014 resulting in a mass ratio of q=0.99499 ± 0.00505 and minimum masses M1sin3i=0.6252± 0.0050 M? and M1sin3i=0.6220± 0.0050 M?. We have extensive differential photometry of V912 Per obtained over several nights between 2013 at Mythodea Observatory and at Helmos Observatory using the 2.3 m Aristarchos telescope (epoch 1) and 2015 (epoch 2) at Helmos Observatory. Phased light curves from epoch 2 show considerable out-of-eclipse variability when compared to epoch 1, enhancing the indication of chromospheric activity of one or both stars. Here we present preliminary modeling from the analysis of the light curves from epoch 2 and the radial velocity curves with PHOEBE scripter, Heuristic Scanning and Genetic Algorithms. In addition, all the available times of light minimum were collected, along with the new calculated from data mining from survey data and new obtained to search for period variability.

The O' Connell effect: one of the most celebrated problems in contact binaries. The cases of: NSVS 13943900, NSVS 10384295 and NSVS 4316778.

Mr. Giorgos Kleftogiannis
University of Patras

Papageorgiou Athanasios (Pontificia Universidad Católica de Chile), Christopoulou Eleftheria-Panagiota (University of Patras)

Modeling with Roche geometry codes does a very good job of fitting the light curve of a contact binary with the exception of certain asymmetries. One of the most perplexing features that eclipsing binaries light curves exhibit is the O' Connell effect, where the two maxima of a photometric light curve of an eclipsing binary are not equally high. So far, this asymmetry has not been convincingly explained aside from a few individual systems. A brief overview of the many theories that have been successfully applied in eclipsing binaries is given, highlighting key results and confrontations between data. In order to take a step forward in developing a conclusive theory to explain the existence of O' Connell effect, we report on the progress of ASSYMETRYCat: a catalogue of eclipsing binaries classified as contact (EC and EW) exhibiting the O' Connell effect initiated in 2013, that makes the most of the growing observational data from large surveys (ASAS, OGLE, OMC and NSVS). Apart from discussing the automated algorithm behind the catalogue and its potential to search for correlations between physical parameters, I further highlight the results of our investigations of three new eclipsing binary systems that exhibit an O'Connell effect and discuss the problems of trying to model spots on a system without some independent determination of the spot parameters. We also examine the correlation between changes in the orbital period and the light curve asymmetry.

Main Sequence Luminosity Functions in the central 1.5 degrees of the main body of the SMC

Mr. Achilles Strantzalis
University of Athens

Hatzidimitriou Despina (University of Athens, National Observatory of Athens), Zezas Andreas (Univeristy of Crete/-FORTH), Antoniou Vallia (Harvard-Smithsonian CfA)

The Small Magellanic Cloud (SMC) is a nearby gas rich dwarf irregular galaxy and interacts both with its neighbouring large Magellanic Cloud and the Milky Way Galaxy. Due to its relatively small mass ($\sim 10^{-}2M_{MW}$) and inter-galaxy interactions, it has an interesting star and cluster formation history and complex geometry. With the 6.5m Magellan Telescope at Las Campanas Observatory in Chile we have acquired multi-filter observations (B, V, R, I) in 5 fields covering the entire area of the main body of the SMC. The SMC presents us with a unique opportunity to study in detail quenching as seen from stellar populations and galactic archeology, as well as the effect of environmental processes (interaction with the LMC and the Milky Way) on star formation processes. The reduction of the data have been completed using IRAF (for astrometry and photometry) and SWARP (for construction of the CCD mosaics). One of the results of this study, presented here, is a map of stellar populations of different ages in the areas studied, using the slope of the main sequence luminosity function.

Molecular cloud filaments: do they really have a characteristic width?

Dr. Georgia Panopoulou
University of Crete

filaments in Herschel molecular cloud images have been found to exhibit a "characteristic width". This finding is in tension with spatial power spectra of the data, which show no indication of this characteristic scale. We use the own-developed automated filTER software to repeat the analysis of Herschel filaments in order to find the source of this discrepancy. first, we analyze artificial "filamentary" images and demonstrate that (i) a characteristic scale should leave an imprint on the spatial power spectrum, and (ii) the methodology adopted for measuring filament widths can introduce a preferred scale in the distribution of widths, even if the data are scale-free by construction. Next, we repeat the analysis on three Herschel maps and reproduce the narrow distribution of widths found in previous studies - when considering the average width of each filament. However, the distribution of widths measured at all points along a filament spine is broader than the distribution of mean filament widths, indicating that the narrow spread (interpreted as a "characteristic" width) results from averaging. Furthermore, the width is found to vary significantly from one end of a filament to the other. Therefore, the previously identified peak at 0.1 pc cannot be understood as representing the typical width of filaments. We find an alternative explanation by modelling the observed width distribution as a truncated power-law distribution, sampled with uncertainties. The position of the peak is connected to the lower truncation scale and is likely set by the choice of parameters used in measuring filament widths. We conclude that a "characteristic" width of filaments is not supported by the available data.

The Hubble Catalog of Variables

Prof. Despina Hatzidimitriou
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We present the ESA "Hubble Catalog of Variables" (HCV) project, which aims to produce a deep (V ~< 27 mag) catalog of variable objects in fields visited multiple times by the Hubble Space Telescope (HST). The HCV is based on the Hubble Source Catalog, which contains photometry for $\sim 10^8$ sources measured on images obtained with the WFPC2, ACS/WFC, WFC3/UVIS and WFC3/IR cameras over the ~25 years of HST operations. The exquisite resolution and long time baseline of this dataset are expected to enable detections of rare transient events, such as tidal disruption events, in addition to various types of stellar and AGN variability. A data processing pipeline for detecting and validating variables, and for creating the catalog, is being developed for installation at the Space Telescope Science Institute. The HCV algorithm first performs pre-processing by applying local zeropoint corrections and rejecting bad measurements, then computes several scatter-based and correlation-based variability indexes and finally, selects candidate variables as sources with variability indexes that are significantly different from sources of similar brightness in the same field. The candidates pass through a validation algorithm to yield the HCV. The HCV will be ingested into the Mikulski Archive for Space Telescopes (MAST) and into the European HST Archive at the European Space Astronomy Centre (ESAC) in 2018.

The new catalogue of delta Sct pulsators in binary systems

Dr. Alexios Liakos
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Niarchos Panagiotis (University of Athens)

The newest catalogue of delta Sct stars in binary systems as well as their fundamental properties are presented. The catalogue contains 203 delta Sct pulsators in 199 binaries, with the sample divided according to the Roche Geometry of the binary systems in order to check for any possible differences in the pulsators' evolution driven by the presence/absence of mass transfer. Statistics and distributions of these pulsating stars in the H-R and M-R diagrams are used to get a good estimate of their evolutionary stage. Furthermore, a boundary of approx. 13 days in orbital period is now established showing that below this limit the proximity of the components has great influence on the dominant pulsational frequency of the delta Scuti stars. Updated correlations between pulsation and orbital periods, evolutionary status, and gravity influence from the non-pulsating companions are also presented.

VLTI/AMBER NIR interferometric observations of the Bracket gamma and high-n pfund emitting regions of the Herbig B[e] star HD50138

Ms. Maria Koutoulaki
Dublin Institute for Advanced Studies

We aim to resolve, spatially and spectrally, the Bracket gamma line in young stellar objects, to understand the origin of such emission thus revealing the structure of the inner disc close to the star. HD 50138 is a 6 solar mass star, presenting the B[e] phenomenon. The evolutionary status of this source is not clear, but it is surrounded by a circumstellar disc containing a large amount of gas and dust. Our interferometric observations show very bright Bracket gamma and faint high -n Pfund line emission. For the first time we are able to spatially resolve the high-n Pfund line emission on this star (they have been spatially resolved in only 2 more objects), which comes from the same region as the Bracket gamma (~ 0.8 au in radius). The combination of high-n Pfund and Bracket gamma lines can be used to constrain the physical properties (T, nHI) of the circumstellar environment.

Poster presentations

Starquakes on the red dwarf EV Lac

Prof. Michael E. Contadakis
University of Thessaloniki

EV lac has been subjected of extending research for many decades at the Stefanion Observatory. Apart of the spectacular flaring phenomena, the results of the analysis of the one colour (B) observations of the Stefanion Observatory at any stage of their activity (quiescence, weak flares, strong flares),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 0.0005Hz (period 33min) and 0.3 Hz (period 3s) not rigorously bounded.. It is interesting that that transient oscillations appear also far apart from the observed flares, during the quiet state of the stars, as a result of the general magnetic activity of the star. The power spectrum of these oscillations resamples that of the solar like oscillation spectra i.e the sunquake spectra. In particular the starquake spectra of EV Lac resamples that of a red subgiant. Keywords: Flare stars-Discrete Fourier Transform an alysis -Brownian Walk noise.

A deep optical study of the Supernova Remnant G 166.0+4.3 (VRO)

Dr. Panos Boumis
IAASARS, National Observatory of Athens

Akras Stavros (Observatório Nacional/MCTIC, Rio de Janeiro), Leonidaki Ioanna (FORTH), Derlopa Sophia (IAASARS, NOA / University of Athens), Alikakos John (IAASARS, National Observatory of Athens), Kopsacheili Maria (University of Crete), Nanouris Nikos (IAASARS, National Observatory of Athens), Mavromatakis Fotis (TEI Crete)

We present the first CCD images of the VRO 42.05.01 (G 166.0+4.3) supernova remnant in Hα+[N II], [O III] 5007 and [S II] at a moderate angular resolution. Low and high-dispersion spectroscopy was also performed at selected areas around this extended remnant. Diagnostic diagrams of the line intensities from the present spectra and the new kinematical observations both confirm the supernova origin. Taking into account our results (i.e. shock velocities, morphological characteristics etc.) together with observations of other wavelengths (i.e. radio), we provide significant information on the interaction between this SNR and the surrounding Interstellar medium (ISM).

Morphokinematical study of the SNR G166.0 +4.3 (VRO)

Ms. Sophia Derlopa
IAASARS, NOA & University of Athens

Boumis Panos (IAASARS, National Observatory of Athens), Akras Stavros (Observatório Nacional/MCTIC, Rio de Janeiro), Steffen Wolfgang (UNAM)

We present a sample of high-resolution echelle spectra of the VRO (G 166.0+4.3) supernova remnant (SNR), along with the velocity line profiles and the position-velocity (P-V) diagrams reduced from these spectra. For the first time P-V diagrams of an SNR are applied to a morpho-kinematical code ("SHAPE"), aiming to reproduce a 3-dimensional structure of the SNR. Here we present the preliminary results of the SHAPE code showing the P-V diagrams of different filamentary structures of the SNR.

Meterwavelength Single-pulse Polarimetric Emission Survey IV: Component Widths and Profile Classification.

Ms. Anna Skrzypczak
University of Zielona Góra

Anna Skrzypczak "Meterwavelength Single-pulse Polarimetric Emission Survey IV: Component Widths and Profile Classification". A detailed study of the structure of the pulsar profile as well as the individual profile components was conducted for the 123 pulsars observed in the Meterwavelength Single-pulse Polarimetric Emission Survey. Using the schemes developed by Rankin (1990, 1993a) we classified the profile morphology for all the pulsars in our sample. This resulted in 52 new classifications as well as 38 pulsars where the classification of the profile morphology was improved using our new data. The different profile classes were associated with different physical parameters like, characteristic age, spindown energy loss, etc. The availability of high quality single pulse data enabled us to separate the individual components of the profile in a large number of pulsars. We measured the 50% width of the components (W50) and found the presence of a lower boundary for the distribution of W50 with the pulsar period (P). We were able to constrain the boundary line using the statistical means of quantile regression which served as a more robust estimate, independent of any geometrical assumptions. We corroborated a P(-0.5) dependence of the lower boundary line for the individual components which was earlier reported for the overall profile width. In addition we also established that the boundary were similar for both the core and conal components. However, our values for the boundary differed from previous studies, where the expected boundary was 2.45 P(-0.5) at 1 GHz, while our corresponding value was 2.01?P(-0.5). We also measured the separation between the adjacent components but these were not as well constrained as the component widths. The individual components are associated with the sparking process in the Inner Acceleration Region (IAR) of the pulsar magnetosphere. Our analysis demonstrate the sparks in the IAR to be more densely packed than previously assumed.

X-ray spectral energy distributions of black hole X-ray binaries

Ms. Konstantina Anastasopoulou
University of Crete/FORTH

Zezas Andreas (University of Crete/FORTH), Sobolewska Malgorzata (Harvard-Smithsonian,CfA), Steiner James (MIT)

We present X-ray spectral energy distributions (SEDs) which we constructed using RXTE spectra of Galactic black hole binaries and NuSTAR spectra of Ultraluminous X-ray sources (ULXs). More specifically we compute black hole SEDs as a function of their Eddington ratio and we discuss the evolution of the SED as the Eddington ratio changes. These SEDs can be used in population synthesis models to compute bolometric luminosities for model source populations. Using these SEDs we also calculate the synthetic spectrum of a galaxy by weighting it based on the X-ray luminosity function of its X-ray binary population above 10^{36} erg/s. We find that the contribution of ULXs changes significantly the shape of the SED as their spectrum shows a turnover at ~10 keV.

Contact Binaries Towards Merging - CoBiToM project (2012-2017)

Prof. Kosmas Gazeas
University of Athens

Contact binaries are the most frequently observed type of eclipsing star system. They are small, cool, low-mass binaries belonging to the Galactic old stellar populations. They follow certain empirical relationships that closely connect a number of physical parameters with each other, largely because of constraints coming from the Roche geometry. As a result, contact binaries provide an excellent test of stellar evolution, specifically for stellar merging scenarios. A Large number of contact binaries exhibits extraordinary behavior, requiring follow-up observations to study their peculiarities in detail. For example, a doubly-eclipsing quadruple system (TYC 3807-759-1 & TYC 3807-759-2) consisting of a contact and a detached binary is a highly constrained system, that serves as an excellent laboratory for testing evolutionary theories. CoBiToM Project is a new observing campaign, which was initiated at the University of Athens in 2012, in order to investigate the possible lower limit for the orbital period of binary star systems before coalescence, as a prediction of stellar evolution prior to merging. Such an investigation will provide crucial information about the final evolutionary stages of these systems and spread light on the origin of stellar mergers and rapidly rotating stars, which are frequently observed in old globular clusters.

Planets, brown dwarfs or nothing around Post-Common Envelope Binaries?

Mr. Konstantinos Zervas
University of Patras

Manthopoulou Eleni-Evangelia (Department of Physics, University of Patras, Greece), Papageorgiou Athanasios (Instituto de Astrofísica, Pontificia Universidad CatÓlica de Chile, Santiago, Chile), Christopoulou Eleftheria-Panagiota (Department of Physics, University of Patras, Greece)

Period or amplitude variations in eclipsing Post-Common-Envelope Binaries (PCEBs) may be due to the presence of additional massive bodies in the system, such as circumbinary planets, among other mechanisms. Here, we have studied two previously-known PCEBs for evidence of such light curve variations, on the basis of new observations at Mythodea Observatory (University of Patras) during (2014-2017) and many previously published times of minima, included multi-year minima times of the SuperWasp survey. The first one, NSVS 07826147 is the seventh eclipsing subdwarf B star + M dwarf (sdB+dM) binary ever found with orbital period of 3.88 hr, significantly longer than the 2.3-3.0 hr periods of the other known eclipsing sdB+dM systems. Its (O-C) behavior is re-examined based on the new eclipse timings that not only fill in the gaps in those already published but also extend the time span of the (O-C) diagram. We re-examined also the up to date (O-C) of the NSVS 14256825 with orbital period ~ 2.65 hr, which was previously attributed to one or two Jovian-type circumbinary planets or a brown dwarf. We consider also the alternate to the third-body hypothesis, the Applegate mechanism .

First photometric and period investigation of two W UMa-type binary systems.

Ms. Spyridoula Tatsiopoulou
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We present the first four-color light curves of 2 overcontact binary systems GSC 02646-01938 and GSC 02530-01632. GSC 02646-01938, discovered by the ROTSE1 CCD survey (P=0.28905261d) was observed during 2011-2017 at Mythodea Observatory (University of Patras) in V, Rc, and Ic bands and spectroscopically at Asiago Observatory. GSC 02530-01632 is a newly discovered W UMa-type binary system (P=0.35888663 d). Complete curves in B, V, Rc , and Ic bands during 2016-2017 were collected for the first time and analyzed with PHOEBE. The total nature of the eclipses results in a reliable photometric mass ratio and a preliminary model of the physical and orbital parameters is investigated with various methods as a global solution. The location of the targets on the HR diagram and the mass-radius plane is compared to the other well -known contact binaries and the evolutionary status of the systems is discussed. Both systems were examined for period variation.

Periodic motions and stability in the regular polygon problem of (N+1) bodies with quasi-homogeneous potentials

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The regular polygon problem of (N+1) bodies is a N-body model where the N-1 of the bodies have equal masses m and are located at the vertices of an imaginary regular polygon, while another body with mass m0 is located at the center of mass of the system. In the resultant force field created by the N primaries, a very small body moves without affecting their motion. The initial statement of the problem was based on the assumption that all big bodies create Newtonian force fields. Here we assume an inverse square Manev-like corrective term in the Newtonian potentials of all the big bodies so as the created potentials are quasi-homogeneous. Our aim is to approximate various phenomena as the radiation pressure of the primaries or the non-sphericity of them. Based on this new consideration we investigate the periodic orbits, the evolution of their families, their parametric variation and their stability in two characteristic cases; (1) the case where only the central body creates such a potential and (2) the Copenhagen case where both primaries do so.

Eclipse time variations in close binary systems: Candidates for systems with exoplanets.

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The detection of circumbinary planets and brown dwarfs using minima timing variability demands low mass eclipsing systems with sharp and deep minima. We report new eclipse timings and investigate the period variations by means of the O-C residual diagram for the detached low - mass eclipsing binary NSVS 06507557 with an orbital period of 0.515 days and the newly detected eclipsing binary HAT-192-01841 with an orbital period of 0.3087 days. Both objects are included in the DWARF project. NSVS 6507557 is a double lined eclipsing binary consisting of a K9 and M3 pre- main- sequence star whereas HAT-192 may be member of a common proper-motion binary system. We collected 2 minima of the first target in the Ic bandpass and 14 minima of the second target in Rc and Ic bandpasses, in 2014 at the Mythodea Observatory (University of Patras). For both objects these were used in combination with archival, HAT and CRTS photometry to derive a new ephemeris and construct the O-C diagram.

NSVS 9743290: New short period totally eclipsed active binary

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We present the first complete and standard BVRcIc light curves and photometric analysis of the eclipsing binary NSVS 9743290, observed in 2015 and 2016 at Mythodea Observatory (University of Patras) with spectroscopic data obtained with 1.82 m telescope at Asiago Observatory, Italy. Preliminary light curve solution shows an interchange between the primary and secondary minima. New period and ephemeris have been calculated for the system. In light and color curves, asymmetry is observed from 2015 to 2016, which is believed to be a result of chromospheric activity in one or both components. By combining, several new determined times of light minimum with few compiled from the literature and new calculated from databases, the period changes were investigated. Using PHOEBE and Genetic Algorithms, a preliminary determination of the geometric and photometric element parameters of the system is derived.

Magnetic activity cycles of HH UMa

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We present results of long-term multicolor photometric observations of the magnetically active eclipsing binary HH UMa. We applied PHOEBE to analyze three sets of light curves during April-June 2013, March 2015 and March 2017 and spectroscopically determined mass ratio from the literature, in order to investigate the light curve asymmetry and the O'Connell reversal cycle and test the proposed scenario that results from flip-flop activity.

The Holomon Astronomical Station

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The Holomon Astronomical Station of the Aristotle University of Thessaloniki was established in 2004 and is located within the facilities of the University Forest in Taxiarchis, Chalkidiki. The main scope of the observatory is to support the training of undergraduate students of the Physics Department. The astronomical station on Mt. Holomon is currently equipped with two telescopes (11 and 10 inches) and with a fully automated software to analyse the data obtained (HOPS). These offer to the students the opportunity to get involved in all the aspects of astronomical research, including planning and executing observations, analysing data and investigating the theoretical aspects of their measurements. Apart from the educational activity that involves the undergraduate students of the Physics department of the Aristotle university of Thessaloniki, events for students from other departments of the university and also for the public are also organised in the Holomon Astronomical Station. From a research perspective, the facilities of the observatory can provide long-term observations of particular targets, observations of targets of opportunity, as well as coordinated observations to other larger telescopes. In this work we present an overview of the on-going activity of the astronomical station, which involves: a) follow-up observations of known exoplanets, aiming in characterising better their properties and in searching for transit timing variations, b) observations of variable stars and c) seeing measurements, which continue to prove the quality of the observations that can be obtain from Mt. Holomon.

Determining the structure and properties of the triple system AV CMi

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In this work, we investigated the existence of a possible companion in the eclipsing binary system AV CMi, inspired by the detection of out-of eclipse transits. We analysed the largest so far number of photometric observations of the system, acquired over a period of two years. Due to the Large depth of the transit, this candidate companion is possibly a brown dwarf or a more massive sub-stellar component. The orbit is of satellite type (S) with a period of 0.5 days around one of the two stars and according to the observations, it presents a high mutual inclination between 8 and 30 degrees depending on which the host star is. In total, our analysis aims in determining whether a third body actually exists and if it does, which star would be the host according to the data. In this sense, we first study the dynamical stability of the orbit. Following, we present a statistical test in order to disentangle between the two cases of the host star. finally, we propose a method to directly confirm the existence of this companion, through observation of it's transits in front of the non-host star, which causes significant non-periodic distortions in the total light-curve.

Follow-up observations of transiting exoplanets with small telescopes

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Currently the number of exoplanets is rapidly growing, with over 3000 planets discovered. This number is expected to grow even more in the future with dedicated missions like TESS and PLATO, which are expected to find additional 3000 and 10000 planets, respectively. While discovering new exoplanets is still important, we have now entered a new era, where the better characterisation of these plants and their host stars is of extreme importance. A technique that is being used to probe the atmosphere of an exoplanet is transit spectroscopy. During a transit, the stellar and the planetary discs overlap, and while a part of the stellar light is blocked by the core of the planet, another, smaller, part is filtered through its atmosphere. For this technique to be as efficient as possible, we to have a good knowledge of the orbital parameters of the planets observed. However, the observing time needed to better characterise all the expected exoplanets is not available in large-scale observatories. Consequently, the small and medium-scale telescopes are expected to contribute significantly. we present here the analysis of 20 observations of transiting exoplanets from the Holomon Astronomical Station in Chalkidiki and the Nunki observatory in Skiathos. The data sets were analysed using the Holomon Photometric Software and aim to calibrate the used instruments and also provide new observations of some of the recently discovered exoplanets from the WASP survey.

Searching for unseen companions in the Qatar-1 system through transit timing variations

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With a hot Jupiter (M=1.09 Jupiter masses, R=1.16 Jupiter Radii) on a period of 1.42 days and an apparent V magnitude of 12.86, Qatar-1 system is one of the best systems that host transiting exoplanets for characterisation from the northern hemisphere

(RA: 20:13:32, DEC: +65:09:43). Qatar-1 b was initially reported to feature transit timing variations with a period of about 190 days that could be the result of either a weak perturber in resonance with Qatar-1 b, or a massive body in the brown dwarf regime (von Essen et al. 2013). However, more recent observations suggest that there are no significant transit timing variations with a semi-amplitude of more than approximately 25 seconds (Collins et al. 2017). In this study we present five additional transit observations of Qatar-1 b from the Holomon Astronomical Station. Despite the small number of new observation, we demonstrate the stability of the instruments throughout five years and the potential of adding more observations in the future, concerning either Qatar-1 b or other exoplanets. The precise estimation of the ephemeris of exoplanets is mandatory for future characterisation missions and long-term observations from small telescopes can contribute.

HOPS: the photometric software of the Holomon Astronomical Station

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We present here a software developed for the analysis of observations from the Holomon Astronomical station. HOPS (HOlomon Photometric Software) is a python-based package which includes a user interface and it is compatible with Linux, OS X and Windows. It is open-source (https://github.com/atsiaras/hops) and it is designed to analyse data from small and medium class telescopes. The basic features included, are: a) reduction, which includes the calculation of master bias/dark/flat frames and the correction of the scientific frames, b) frame selection, which provides interactive graphs for selecting the damaged images, c) alignment, an automatic detection of star patterns in the field of view, despite large shifts or meridian flips, d) photometry, which includes an interactive window for selecting the target and comparison stars and extracts the light-curves using both aperture and PSF photometry, e) transit fitting, which provides the fitting of the transit model on the relative light-curve using mcmc sampling. HOPS makes use of the python package PyLightcurve which is completely developed in Python and provides routines for: a) finding planetary parameters from the open exoplanet catalogue, b) calculating limb darkening coefficients, c) calculating the planetary orbit, d) calculating the transit light-curve model using numerical integration. The PyLightcurve package can be found on github: https://github.com /ucl-exoplanets/pylightcurve.

Gravitational quantization of exoplanet orbits: The system TRAPPIST-1

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We apply the so-called "global polytropic model" to the numerical study of the exoplanetary system TRAPPIST-1. We compare the computed exoplanet distances from their host star with corresponding observations, and quote certain orbit predictions given by the model.

Observations of variable stars from Holomon Astronomical Station

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EV Lacertae is a young (300 million years), M3.5 red dwarf star with strong flare activity. We observed EV Lac in the optical, for three consecutive nights in August 2016. The data obtained were analysed using the Holomon Photometric software and revealed three flares, one for each night. The first, increased the stellar flux by approximately 15% while the following two by approximately 5%. Another interesting group of variable stars includes those that host transiting exoplanets. A remarkable example is WASP-33, which is a Delta Scuti variable star. We observed WASP-33 b both in-transit and out-of transits in an attempt to correct the variability of WASP-33 and extract the corrected transit light-curve.

Application of an automated statistical method to detect star clusters in the Small Magellanic Cloud.

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We have applied an automated statistical method in multi filter observations of four fields covering the central region of SMC. Our aim is to compare our study with catalogs where the identification process did not involve any automated method in order to verify the existence of these clusters and to supplement these catalogs with new potential findings. The data have been acquired from observations with the 6.5m Magellan Telescope at Las Campanas observatory in Chile. For the identification of star clusters we use a modified Friend of Friend (FoF) algorithm alongside other techniques as isopleth contours, radial profiles and CMD's of the identified clusters. Our study is divided in two phases. During the initial phase we use our automated technique to search and identify known clusters in order to define the search parameters of our method. The FoF algorithm is applied with no prior knowledge of the published catalogs. In order to verify the existence of known clusters apart from the FoF algorithm we use surface density isopleth contours of the area where the clusters are located, we construct radial profiles of the clusters and we compare their CMD's with the background. The verified clusters are used to refine our search criteria (radius of cluster, surface density compared to the mean surface density of the studied field etc) that will be used in the FoF algorithm. During the next phase we apply the established search parameters for the discovery of new star clusters. The verification process remains the same as with known clusters, use of contours, radial profiles and CMD's.

V404 cygni hits bullseye: X-ray echoes of the 2015 outburst

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V404 Cyg is a Galactic low mass X-ray binary that exhibited several major outbursts in 1936, 1958, 1989 and 2015, with the latter reaching X-ray luminosities near the Eddington limit of the system. Thanks to its brightness and proximity, V404 Cyg is an ideal laboratory for studying diverse astrophysical problems at high energies, such as X-ray scattering by dust. Here, we report on the first detection of X-ray dust-scattered rings from the Galactic low-mass X-ray binary V404 Cyg during its 2015 outburst . The observation of the system with Swift/XRT on 2015 June 30 revealed the presence of five concentric ring-like structures centred at the position of V404 Cyg. This was the first ever detection of dust scattered rings from this system. Follow-up Swift/XRT observations allowed a time-dependent study of the X-ray rings. By modeling the angular profiles of the dust-scattered X-ray intensity we were able to infer the basic properties of the dust clouds, such as their column density and grain size distribution. This study demonstrates the intriguing prospect of using luminous X-ray outbursts to perform X-ray tomography to our Galaxy for the study of its structure and rotation curve.

The formation of rna in the universe, as a spontaneous chemical phenomenon

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School Advisor

There are indications that in the Universe there is a spontaneous tendency to form RNA, DNA and thus life, such as that of the Earth. It is known that comets contain, among others, HCN, NH3 and Fe. While a periodic comet approaches and then starts moving away from a star, the above mentioned chemical compounds at high temperatures form pyrimidines and at extra low temperatures forms purines with Fe as catalyst. In these compounds nucleotide bases of RNA and DNA are included. The formation of pyrimidines and purines in the aforementioned conditions is known from organic chemistry before the discovery of the structure of RNA. But that was not related to the formation of such compounds in space. The tails of the comets enrich the space with nucleotide bases, in the area around a star, where there are conditions of forming coma and tails of comets. However, in the comets, as well as in the interstellar clouds, the polynucleotide chain skeleton cannot be formed, as cosmic radiation does not allow the formation of such structures. The structure of the RNA will occur when the nucleotide bases of the comets are transported to a liquid aquatic environment of planets or large satellites in which phosphates, CO2 and monosaccharides formation conditions will coexist. This liquid environment should be protected from cosmic radiation. Afterwards a microenvironment will be formed around RNA. RNA with this microenvironment is perhaps the first chemical structure that can undergo Darwinian evolution. Such precursor forms of life could be found on planets or satellites. According to the aforementioned procedure, for the formation of RNA in a celestial object, there are other conditions. For instance the case where chlorate and perchlorate anions have been detected in an aqueous Mars environment, which anions as strong oxidizing agents degrade organic compounds.

The Hubble Catalog of Variables: The use of principal component analysis for the identification of variable sources within the Hubble Source Catalog (v2)

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Principal component analysis (PCA) is being extensively used in Astronomy but not yet exhaustively exploited for variability search. The aim of this work is to investigate the effectiveness of using the PCA as a method to search for variable stars in large photometric datasets. We apply PCA to variability indices computed for lightcurves of thousands of stars in six fields extracted from the Hubble Source Catalogue. This work is part of an ESA project for the construction of the "Hubble Catalog of Variables" (based on the Hubble Source Catalog). The projection of the data into the principal components is used as a stellar variability detection and classification tool, capable of distinguishing between different types of variables (e.g. RR Lyrae stars, Long Period Variables) and non-variables.

Atmospheric stellar parameters in the era of large surveys

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In the last decades due to the growing number of spectroscopic surveys, the number of spectra has increased to several tens of thousands to study the Galactic stellar populations. Current Galactic surveys, such as Gaia-ESO, APOGEE, GALAH, including the promising Gaia mission, rely on the efficiency of the spectral analysis techniques to provide precise and accurate spectral information (i.e. effective temperature, surface gravity, metallicity, and chemical abundances) in the shortest computational time.

In this work, we present a new package to perform complete spectral analyses based on the spectral synthesis technique (Tsantaki et al. 2017, submitted) tested for stars with different rotational velocities and covering a wide range in atmospheric parameters. This method is implemented on the FGK-type Gaia-ESO benchmark stars achieving high precision and accuracy using both high and medium resolution spectra. We show that this methodology can be used for a variety of optical surveys to characterize stellar populations but also planet-host stars.

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