University of Crete
Department of Physics
Section of Astrophysics & Space Physics

Annual Report for 2015

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Image Credit of Cover Page
Top: View of the Skinakas summit with the telescope domes and the housing quarters (see Sect. 3.1).
Middle: the receiving antennae of the SESCAT experiment near Chania (see Sect. 3.2).
Bottom: the 1.3m telescope of Skinakas Observatory inside its dome (see Sect. 3.1).

1. INTRODUCTION

The present document summarizes the activities of the members of the Section of Astrophysics and Space Physics at the Department of Physics of the University of Crete, during the 2015 calendar year. The staff of the Section consisted of 15 PhD research scientists, 8 graduate students and 4 technicians. Members of the Section were involved in teaching undergraduate and graduate courses at the University of Crete, while doing research in the fields of Theoretical and Observational Astrophysics, as well as in Atmospheric and Ionospheric Physics. Their research has been funded by national and international research grants, and in 2015 it resulted in 40 papers published in refereed journals, that is 2.67 papers per PhD researcher. Significant efforts were also devoted in the operation and improvement of the infrastructure and hardware at Skinakas Observatory and the Ionospheric Physics Laboratory. This document was prepared in January 2016, based on contributions from all members of the Section. The final editing was done by K. Tassis.

2. Personnel

2.1. PERSONNEL OF THE SECTION

The staff associated with the Section of Astrophysics and Space Physics consists of 15 PhD research scientists, 8 PhD students, and 4 technicians.

The 9 Physics faculty members of the Section during the period of the report were Vassilis Charmandaris (Prof.), Christos Haldoupis (Prof. - retired), Nikolaos D. Kylafis (Prof.), John Papamastorakis (Emeritus Prof.), Iossif E. Papadakis (Prof.), Vasiliki Pavlidou (Assist. Prof.), Kostas Tassis (Assist. Prof.), Ilias M. Vardavas (Assoc. Prof.) and Andreas Zezas (Assoc. Prof.). Pablo Reig (Principal Researcher at the Foundation for Research and Technology – Hellas) is also affiliated with the Section. Researchers in non-tenure track positions holding a PhD degree were Dr. Jeff Andrews, Dr. Dmitry Blinov, Dr. Laure Ciesla, Dr. Eleni Vardoulaki and Dr. Steven Williams. Support staff associated with the Skinakas Observatory were Mr. Anastasios Kougentakis, Dr. Eythymios V. Paleologou, Mr. George Paterakis, and Ms. Anna Stiakaki.

PhD students during this period were Konstantina Anastasopoulou (with A. Zezas), Tassos Epitropakis (with I. Papadakis), Ioannis Liodakis (with V. Pavlidou), Alexandros Maragkoudakis (with A. Zezas), Alexandros Psychogyios (with V. Charmandaris), Gina Panopoulou (with K. Tassis), Charalampos Politakis (with A. Zezas), and Aris Tritsis (with K. Tassis).

2.2. PERSONNEL CHANGES AND NOTABLE EVENTS

In September 2015, Associate Professor I. Vardavas retired after 23 years of service to the Department of Physics.

In October 2015, Dr. Eleni Vardoulaki moved to a postdoctoral position of the University of Bonn (Germany) and Dr. Laure Ciesla moved to a postdoctoral position at CEA/Saclay (France).

In the fall of 2015, Dr. Steven Williams and Dr. Jeff Andrews joined the group of Prof. Zezas, as postdoctoral researchers coming from the National Observatory of Athens and Columbia University (USA) respectively. Hera Vasileiou (BSc, Univ. of Thessaloniki) and I. Psaradaki (BSc, University of Crete) joined the MSc program of the Department.

In October 2015, Prof. I. Papadakis was elected Chairman of the Department of Physics.

In November 2015, Dr. A. Zezas was promoted to Associate Professor.

Dr Nikos Benas has moved to a post-doctoral position at the Royal Meteorological Institute of the Netherlands (KNMI) from October 2015.

PhD student Georgia-Virginia (Gina) Panopoulou was one of the seven young researchers from Greece that participated in the 65th Lindau Nobel Laureate Meeting. Gina was selected by the scientific review panel to be one of the 672 young researchers from 88 countries aged up to 35 (PhD students, postdocs, young faculty) that work on the fields of medicine, chemistry and physics.

3. FACILITIES

3.1. SKINAKAS OBSERVATORY

The Skinakas Observatory operates as part of a scientific research collaboration between the University of Crete and the Foundation for Research and Technology-Hellas (FORTH[1]). Faculty and staff of the Section using the facilities of Skinakas, are also affiliated members of the Institute of Electronic Structure and Laser (IESL[2]) of FORTH. IESL provides additional hardware and logistics support towards the research of the members.

Only the 1.3 m telescope was fully operating at Skinakas Observatory in 2015. This telescope is a Modified Ritchey-Chrétien telescope with a 1.3 m aperture (focal ratio of f/7.6), which was built by DFM Engineering and Zeiss and became operational in 1995. The 30 cm telescope (focal ratio f/3.2) was also operating, but on a limited time period. A number of modern instruments are permanently available on the 1.3 m telescope. These include several optical CCD cameras with complete filter sets, a long slit optical spectrograph, a high resolution (R=38,000) echelle spectrograph, as well as a near-IR wide field camera.

The RoboPol[3] Collaboration, consisting of the Skinakas Observatory, the California Institute of Technology (USA), the Inter-University Center for Astronomy and Astrophysics (India), the Max-Planck Institute for Radio Astronomy (Germany), and the Nicolaus Copernicus University (Poland), continued the normal operations of RoboPol, a novel-design optical polarimeter mounted on the 1.3 m telescope of Skinakas Observatory. The main scientific aim of this collaboration is the study of optical polarization of AGN and other transients, as well as of the configuration of magnetic fields in the interstellar medium.

[1] For more information on FORTH visit: http://www.forth.gr
[2] For more information on IESL visit: http://www.iesl.forth.gr
[3] For more information on RoboPol visit: http://robopol.org/

The main projects during the 2015, April-to-November, observing period were:

- Photometry and Spectroscopy of Binaries with a compact star companion.
- Near-infrared observations of HMXB and nearby galaxies
- Fast Photometry of cataclysmic variables
- AGN monitoring observations
- Optopolarimetric monitoring of gamma-ray--loud blazers and other active galactic nuclei
- Target of Opportunity optopolarimetric follow-up of gamma-ray bursts
- Magnetic field mapping of interstellar clouds using absorption-induced optical polarization properties of light from background stars

The tradition of "open nights" continued and the Observatory was open to the public for 5 nights, from May until September 2015. They were very successful, with a "full-house" capacity at each night.

More details on Skinakas Observatory, the quality of the site, the telescopes, and the available instrumentation can be found in its recenty updated web page at: http://skinakas.physics.uoc.gr

3.2. Ionospheric Physics Laboratory

The Ionospheric Physics Laboratory (IPL), in collaboration with Stanford University, continued the un-interrupted operation of a narrow-band very low frequency (VLF) receiver experiment throughout 2015, and maintained its VLF database. This experiment is used for studying VLF signatures and propagation effects in the lower ionosphere during times of intense atmospheric electrical activity and the occurrence of transient luminous events (sprites and elves) in the upper atmosphere.

4. Courses

A number of elective undergraduate and graduate courses, directly related to the research areas covered by the Section, were offered as part of the teaching responsibilities of the faculty members. For the caldendar year 2015 these were:

- Spring Semester 2015
  - "Astrophysics II"
  - "Astrophysics III"
  - "Production and Transfer of Radiation"

- Fall Semester 2015
  - "Astrophysics I"
  - "Atmospheric Environment"
  - "Observational Cosmology"
  - "High Energy Astrophysics"

5. Scientific Research

Here we present a brief description of the major research projects in which members of the Section were involved in 2015. These are grouped by research area and the scientists associated with each project are indicated in parentheses.

The scientific publications that resulted from this work, over the same period, are presented at the end of the report in section 12.

5.1. THEORETICAL ASTROPHYSICS

- Black-hole X-ray binaries: Over the past several years, a rich phenomenology has been accumulated regarding black-hole X-ray binaries. When the sources are in the, so-called, hard X-ray state, a compact jet is always present. In the, so-called, soft X-ray state, no jet is ever detected. In the hard-to-soft transition, the jet disappears eruptively, while in the soft-to-hard transition the jet reappears in a smooth way. All this phenomenology has been explained with a physical model and only one free parameter, the mass-accretion rate. (Researcher involved: N. Kylafis).

- Anomalous X-ray pulsars: Extremely interesting observations have been made recently on the hard X-ray spectra of Anomalous X-ray Pulsars (AXPs). The hard X-rays have luminosity comparable to that of the soft X-rays and they are pulsed, with the rotational period of the neutron stars involved. The pulsed fraction of the hard X-rays increases with the energy of the photons and it becomes ~100% at ~100 keV. In addition, the pulse shape changes with X-ray energy. A model to explain all of the above has been worked out. (Researchers involved: N. Kylafis, A. Zezas).

- Monte Carlo simulations of Compton upscattering in accreting black-hole binaries: A major issue in High-Energy Astrophysics is where the high-energy, power-law emission occurs in black-hole X-ray binaries. One possibility is the hot, inner, accretion flow and the other is the jet. In a series of papers, we have advocated for the jet and have explained a number of observational constraints using a simple jet model. In a recent paper, we have been able to explain a challenging correlation between the observed cut-off energy of the spectrum and the observed phase lag between the hard and the soft X-rays, using the same simple jet model. (Researchers involved: N. Kylafis, P. Reig).

- Simulations of Galactic star-forming regions: non-equilibrium chemodynamical multi-fluid non-ideal MHD simulations of star-forming molecular cloud cores. Identification of observable quantities (such as molecular species ratios) that can distinguish between theories of star-formation. Calibration of frequently used molecular species (such as OH for Zeeman observations) for measurement of magnetic fields. (Researchers involved: K. Tassis, A.Tritsis)

- Sources of the gamma-ray background: Modeling of astrophysical populations that may be contributing to the diffuse gamma-ray sky, such as star-forming galaxies, blazars, and millisecond pulsars. Development of techniques to decompose different contributions to the gamma-ray background and to identify possible exotic signals, such as an annihilation signature from dark-matter subhalos in the Galaxy (Researchers involved: I. Liodakis, V. Pavlidou)

- Large-scale Structure Formation in the Universe: the formation of large-scale structure in the Universe is a cosmic battle between expansion inertia, gravity, and the accelerating influence of dark energy. Using analytic and semi-analytic calculations we follow the formation and growth of structure under different cosmologies. In universes with dark energy, the ultimate fate of structure formation is the halting of structure growth -- a state which can leave

observable imprints in the mass-radius relations of local-universe structures such as groups and clusters of galaxies. (Researchers involved: V. Pavlidou)

- Astrostatistics: Application of statistical methods in astrophysical problems. Recent projects include: assessing the significance of apparent correlations between average AGN fluxes at different wavelengths, derivation of star-formation histories from colour-magnitude diagrams, analysis of data taking into account calibration uncertainties, derivation of spectral parameters from X-ray hardness ratios (Researcher involved: A. Zezas as member of the California/Harvard/ASC Astrostatistics Collaboration, V. Pavlidou).

5.2. Observational Astrophysics

5.2.1. Observational Galactic Astrophysics

- X-ray variability of X-ray binaries (XRB): BHB consist of a black hole orbiting a regular star. When part of the material from the optical companion is accreted on the compact object the system brightens in X-rays. Hard X-ray observations provide a valuable probe of the emission region near the compact object. One of the main features of the environment in the vicinity of the black hole is the iron emission line at 6.4 keV. The goal here is to study the relationship between the line parameters with other observables (mass accretion rate, hardness of the spectrum). We employ advance timing techniques, such as, time lags, Fourier-resolve spectroscopy, and power spectrum analysis (Researchers involved: P. Reig, I. Papadakis).

- Characterization of the variability time scales in Be/X-ray binaries (BeX): BeX consist of a neutron star orbiting a O9e-B2e main-sequence star. the letter "e" stands for emission, as instead of the normal photospheric absorption lines the optical spectra of Be stars display emission lines. Strong infrared emission is another defining characteristic of Be stars. A third observational property is that the light from a Be star is polarized. The origin of these three observational properties (emission lines, infrared excess, and polarization) lies in a gaseous, equatorially concentrated circumstellar disc around the OB star. This disc constitutes the main source of variability in BeX and the fuel that powers the X- ray emission through accretion. the main objective of this project is to characterize the optical/IR variability time scales of Be/X-ray binaries in correlation with their X- ray activity. In the past year we focused on the photometry, while the spectroscopic and polarimetric monitoring programme continued. In particular, we presented more than 15 years worth of BVRI observations of 20 high-mass X-ray binaries. We found that donors in Be/XB exhibit larger amplitude changes in the magnitudes and colours than those hosting a supergiant companion. The amplitude of variability increases with wavelength in Be/X-ray binaries and remains fairly constant in supergiant systems. When time scales of years are considered, a good correlation between the X-ray and optical variability is observed. In addition, we provided a large number of secondary standard stars in each field, which can be used to perform differential photometry and also in studies that require fast-time sampling. (Researchers involved: P. Reig, A. Zezas)

- Study of the aperiodic variability of X-ray pulsars during giant outbursts. The main goal of this project is the definition and unified characterization of

accretion-powered pulsar spectral states during giant outbursts. In the last twenty-five years, the discovery of different "states" in the X-ray emission of black-hole binaries (BHB) and neutron-star Low-Mass X-ray Binaries (LMXBs) constituted a large step forward in the understanding of the physics of accretion onto compact objects. While there are numerous studies on the timing and spectral variability of BHB and LMXBs, very little work has been done on High- Mass X-ray Binaries (HMXBs). We have found that Be/X-ray pulsars trace two different branches in the hardness-intensity diagram: the horizontal branch corresponds to a low-intensity state of the source and it is characterized by fast color and spectral changes and high X-ray variability. the diagonal branch is a high-intensity state that emerges when the X-ray luminosity exceeds a critical limit. The two branches may reflect two different accretion modes, depending on whether the luminosity of the source is above or below a critical value. This critical luminosity is mainly determined by the magnetic field strength, hence it differs for different sources. The details of this work can be found in Reig & Nespoli (2013, A&A, 551, A1). (Researchers involved: P. Reig)

- Ultraluminous X-ray sources in nearby galaxies. A subset of ultraluminous X-ray sources (those with luminosities of less than $10^{40}\,\mathrm{erg\,s^{-1}}$) are thought to be powered by the accretion of gas onto black holes with masses of ~5–20 $M_{\odot}$. the X-ray and radio emission are coupled in such Galactic sources; the radio emission originates in a relativistic jet thought to be launched from the innermost regions near the black hole, with the most powerful emission occurring when the rate of infalling matter approaches a theoretical maximum (the Eddington limit). Only four such maximal sources are known in the Milky Way. We have performed radio and X-ray observations of a bright new X-ray source in the nearby galaxy M 31, whose peak luminosity exceeded $10^{39}\,\mathrm{erg\,s^{-1}}$. the radio luminosity is extremely high and shows variability on a timescale of tens of minutes, arguing that the source is highly compact and powered by accretion close to the Eddington limit onto a black hole of stellar mass. Continued radio and X-ray monitoring of such sources should reveal the causal relationship between the accretion flow and the powerful jet emission. (Researchers involved: P. Reig)

- Polarization studies of the Interstellar Medium: After suffering absorption by interstellar cloud dust, starlight may become polarised if the dust grains have a preferential alignment induced by the interstellar magnetic field. Studies of this polarisation with the RoboPol instrument can reveal the magnetic field structure in interstellar clouds, giving important clues about the role of magnetic fields in the star formation process. (Researchers involved: G. Panopoulou, K. Tassis, D. Blinov)

- Studies of the Structure of Inrterstellar Molecular Clouds: study of the filamentary structure of interstellar molecular clouds as revealed by multiwavelength observations (sub-mm, optical) in conjunction with optopolarimetric mapping of the magnetic field that permeates the clouds. (Researchers involved: G. Panopoulou, I. Psaradaki, K. Tassis)

5.2.2. Observational Extragalactic Astrophysics

- Study of X-ray sources in the Small Magellanic Cloud: A study of the X-ray

population in the Small Magellanic Cloud is underway, using Chandra observations of the central region of the Small Magellanic Cloud, dominated by a recent burst of star formation. Study of the optical counterparts and characterization of the star formation history in the specific areas of the Chandra sources has been conducted using optical imaging and spectroscopy with the 6m-Magellan Telescope, and the 4m-Anglo-Australian Telescope (2df). Moreover, XMM-Newton time has been awarded (end of 2008) to an international team (PI: Frank Haberl – MPE), of which D. Hatzidimitriou is a member, for the detailed study of the SMC X-ray binary population (Researchers involved: A. Zezas).

- X-ray source populations in nearby galaxies: Studies of the discrete X-ray source populations (in particular accreting sources) in nearby galaxies and their connection with their parent stellar populations (star-formation history, metallicity, etc) and star-cluster parameters. Studied objects cover the full spectrum of galaxies, ranging from dwarf-irregular star-forming galaxies to spiral and elliptical galaxies (Researchers involved: A. Zezas, P. Bonfini).

- Extragalactic supernova remnant populations: Multiwavelength studies of the supernova remnant populations in nearby galaxies using data from the Chandra X-ray observatory and narrow-band data from the Skinakas observatory. the goal of this project is to understand the populations of SNRs in different wavelengths in a variety of environments (Researchers involved: A. Zezas).

- X-ray variability studies of AGN: the work on the the study of the variability properties of the iron line in bright Seyferts, and the study of the "reverberation", negative time lags at high frequencies in a few AGN, using XMM-Newton data, was finally completed, and a paper was submitted to MNRAS. At the same time, a project regarding the energy dependence of the X-ray power-spectra of a few bright AGN was also completed, using XMM-Newton light data. The results should be published in the next year. A collaboration with colleagues from the Astronomical Institute of the Academy of Sciences of the Czech Republic was established. Their theoretical "response" functions of accretion discs to X-ray flashes from "point-like" X-ray sources will be of major significance in the forthcoming study of the iron line variability, which will continue in 2014. (Researchers involved: I. Papadakis, A. Epitropakis).

- Optopolarimetric monitoring of Active Galactic Nuclei: the polarisation properties of the optical (synchrotron) emission from blazers and other AGN encodes important information about the magnetic field configuration in the relativistic jet powering these systems. Using the RoboPol polarimeter, the optopolarimetric properties of about 100 AGN are regularly monitored throughout the Skinakas observing season - the largest-scope such effort in the world today. (Researchres involved: D. Blinov, G. Panopoulou, V. Pavlidou, I. Papadakis, N. Kylafis, K. Tassis, P. Reig)

- Multiwavelength studies of interacting galaxies: This is a comprehensive study of a large sample of interacting galaxies with the Spitzer Space Telescope and the Chandra X-ray Observatory. The goal of this study is to address the connection between galaxy interactions and induced star-formation and AGN activity (Researchers involved: A. Zezas).

- A census of star-forming activity in the local Universe (the Star-formation

Reference Survey): This is a systematic study of the star-formation and AGN activity in a representative sample of IR-selected galaxies in the local Universe. The main goal of this project is to investigate the connection between galactic activity (star formation and AGN) and galactic parameters such as stellar mass, dust content, and morphology. First results from this effort include a mass function of disks and bulges in the local Universe (P. Bonfini's PhD thesis), and a census of AGN activity in local galaxies (Maragkoudakis et al, in prep). (Researchers involved: A. Zezas, A. Maragkoudakis)

- Mid-/Far-infrared and radio continuum properties of Luminous and Ultraluminous Infrared Galaxies (LIRGs/ULIRGs): This project was based on observations with the Spitzer Space Telescope in order to explore the mid-infrared properties of ULIRGs. The main goal is to improve our understanding of the dominant mechanism of the energy source (accretion onto an active nucleus or a super-massive starburst) in these galaxies and ascertain their role in galaxy evolution. There are various components of this project. One major component is the characterization of the mid- and far-infrared emission for a complete flux-limited sample of local LIRGs/ULIRGs, the Great Observatories All-Sky Survey (GOALS) galaxy sample, using the Spitzer and Herschel Space telescopes. A second is the analysis of the radio continuum observations of a GOALS subsample obtained with the VLA and explore the connection between the radio and infrared emission. (Researchers involved: V. Charmandaris, E. Vardoulaki).

- UV to near-IR morphology of Luminous and Ultraluminous Infrared Galaxies (LIRGs/ULIRGs): This project was based on observations with the Hubble Space Telescope of the Great Observatories All-Sky Survey (GOALS) galaxy sample. Its main goal is to develop a consistent morphological classification of these local systems in order to study the evolution of similar galaxies at high-z. (Researchers involved: V. Charmandaris, A. Psychogyios).

- The Spectral Energy Distribution (SED) of distant Infrared Galaxies: This project involved the development and application of state-of-the-art SED fitting models, and in particulate CIGALE in order to understand the power source in high-z galaxies detected in deep extragalactic surveys, in order to quantify the contribution of the elusive Compton thick AGN. (Researchers involved: L. Ciesla, V. Charmandaris).

- Star formation and stellar populations in Compact Groups: This project originated from the analysis of mid- and far-infrared observations of a sample of Hickson Compact Groups obtained with the Spitzer Space Telescope and Herschel Space Observatory. The analysis was extended to a larger sample of ~1700 compact galaxy groups identified in the Sloan Digital Sky Survey, with ancillary data from GALEX and WISE. The main goal is to study the effects of environment on the evolution of galaxies and their nuclear activity (Researchers involved: V. Charmandaris).

5.3. Atmospheric & Ionospheric Physics

- Earth Observation and climate Project: Research work on Earth Observation and the Earth's Radiation Budget is an ongoing project. Modelling work of the radiation forcing of aerosols on a planetary scale includes the effects of aerosols on the solar ultraviolet, visible and near-infrared radiation reaching the Earth's

surface. Model input data include satellite data from the NASA EOS satellites, Aqua and Terra. Ground-based data include the AERONET (Aerosol Robotic Network) site operated in Crete and provided by NASA Goddard. Climate research includes the effects of the El Nino phenomenon on the surface radiation budget over the tropical Pacific ocean. Collaboration with NASA Langley and the Meteorological Institute of the University of Munich on the heat budgets of enclosed seas, such as the Mediterranean, Black and Red seas is ongoing.: (Researchers involved: I. Vardavas).

- Modelling the Evolution of Planetary Atmospheres Project: Research on modelling the evolution of planetary atmospheres has focussed on the development of a radiative/convective-photochemical-microphysical model for the global mean vertical atmospheric structure of the Precambrian Earth and of Titan. the Titan model has been validated against data from the recent Cassini/Huygens mission to Titan. A model for the formation of the haze layer that surrounds Titan has been developed. Work on the evolution of ultraviolet and XUV radiation of G-type solar like stars, which affects the atmospheric chemical composition of planets orbiting such stars, is ongoing with planned applications to exoplanets around G-type stars. (Researchers involved: I. Vardavas)

- Ionospheric and Upper Atmospheric Physics: the research topics under study relate to the plasma physics and electrodynamics of irregular ionosphericphenomena occurring at midlatitude, and problems associated with the interaction and coupling of the neutral mesosphere and lower thermosphere with the earth's ionosphere. During 2015 our research focused on the following topics : 1) the properties and mechanisms relating to the formation and destabilization of midlatitude sporadic E plasma layers (Es), and the role of wind shears and atmospheric tidal, gravity and planetary waves on sporadic E layer morphology and variability. 2) the effects on VLF (very low frequency) electromagnetic wave propagation and VLF response signatures associated with "transient luminous events", such as sprites, elves and gigantic jets, which are atmospheric electricity (thunderstorm and lightning) phenomena in the upper atmosphere and lower ionosphere; modelling the lifetimes of lightning-produced VLF peturbations, 3) meteor trail plasma instabilities and unusually long-lasting meteor echoes observed with VHF (very high frequency) and HF radars, 4) studies of ionospheric resonance phenomena observed in ultra low frequency (ULF) electromagnetic noise recordings with sensitive coil magnetometers, and 4) studies of the annual and seasonal variations of midlatitude sporadic E layers, and 5) Effects of X-ray solar flare events on the lower ionosphere using Arecibo radar incoherent scatter measurements. (Researchers involved: C. Haldoupis)

6. RESEARCH FUNDING

The following projects, funded by national and international agencies, enabled the research activities of the Section during the period of the report.

- EU funded International Research Staff Exchange Scheme Grant for the "The Physics of the Most Luminous Galaxies", (P.I.: V. Charmandaris, budget: €171,800, duration: 2012-2016)

- Marie Curie Career Integration Grant "JetPop", entitled "Unveiling the Physics of the Most Active of Galaxies: Using Blazars as Laboratories to Study Supermassive Black Holes and Relativistic Jets", (P.I.: V. Pavlidou, budget: €100,000, duration: 2012-2016)
- Marie Curie International Reintegration Grant "SFOnset", entitled "Onset of Star Formation: Connecting Theory and Observations Coupling Dynamics and Interstellar Chemistry in Molecular Cloud Cores", (P.I.: K. Tassis, budget: €100,000, duration: 2012-2016)
- ESPA Postdoctoral Fellowship Grant entitled "The Radio Continuum Properties of Luminous Infrared Galaxies", (P.I.: V. Charmandaris / E. Vardoulaki, budget: €150,000, duration: 2012-2015)
- GSRT-Funded "Excellence" (Aristeia I) Grant "RoboPol", entitled "Unveiling the physics of supermassive black holes and relativistic jets with optical polarization of blazars", (P.I.: V. Pavlidou, budget: €330,000, duration: 2012- 2015)
- GSRT-Funded "Excellence" (Aristeia II) Grant, entitled "The Quest for relativistic signals in X-ray light curves of AGN", (P.I.: I. Papadakis, budget: €134,000, duration: 2014- 2015)
- ERC Consolidator Grant "A-Bingos", entitled " Accreting Binary populations in Nearby Galaxies: Observations and Simulations", (P.I.: A. Zezas, budget: €1,242,000, duration: 2014- 2019)
- H2020 RISE, entitled "ASTROSTAT: Development of novel statistical tools for the analysis of astronomical data", (P.I.: A. Zezas, budget: €526,500, duration: 2016- 2020)

7. Collaborations with Other Institutes

Members of the group are actively collaborating with scientists affiliated with the following universities and research institutes:

- Greece
  - Foundation for Research and Technology – Hellas (FORTH), Heraklion
  - National Observatory of Athens, Athens
  - Technical Education Institute of Crete, Dept. of Electrical Engineering, Heraklion
  - University of Athens, Dept. of Physics, Athens
  - University of the Aegean, Dept. of Environment, Mytilene
  - University of Ioannina, Dept. of Physics, Ioannina

- International
  - Astronomical Institute of the Czech Academy of Sciences, Czech Republic
  - Aalto University, Finland
  - California Institute of Technology, Spitzer Science Center, Pasadena, CA, USA
  - CEA/Saclay, Service d'Astrophysique, Paris, France
  - Cornell University, Astronomy Department, Ithaca, NY, USA
  - Eötvos-Lenard University, Budapest, Hungary
  - ETH, Zurich, Switzerland
  - Geophysical Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria
  - Harvard University, Center for Astrophysics, Cambridge, MA, USA
  - Hebrew University of Jerusalem, Jerusalem, Israel
  - Institut d'Astrophysique de Paris, France
  - Max-Planck-Institut für Extraterrestrische Physik, Garching, Germany
  - Max-Planck-Institut für Kernphysik, Heidelberg, Germany
  - Max-Planck-Institut für Radioastronomie, Bonn, Germany

- NASA Goddard Space Flight Center, Greenbelt, MD, USA
- NASA Jet Propulsion Laboratory, Pasadena, CA, USA
- NASA Langley Division of Atmospheric Sciences, Langley, VA, USA
- Nicolaus Copernicus Astronomical Center, Warsaw & Torun, Poland
- Northwestern University, Evanston, IL, USA
- Observatoire de Paris, Paris, France
- Oxford University, Oxford, UK
- Rome Observatory, Rome, Italy
- Shanghai Astronomical Observatory, Shanghai, China
- Stanford University, Palo Alto, CA, USA
- Université de Rennes, Rennes, France
- University of Alicante, Alicante, Spain
- University of Durham, Durham, UK
- University of Napoli Federico, Napoli, IL
- University of Saskatchewan, Canada
- University of Southampton, Southampton, UK
- University of Texas at Austin, Austin, TX, USA
- University of Valencia, Valencia, Spain

8. National & International Committees

During the period covered by this report, members of the Section were in a number of national and international committees. More specifically:

Prof. V. Charmandaris completed his duties as the Editor of the European Astronomical Society Newsletter (2005-2015) and was a substitute member of the Greek National Committee for Astronomy. From September 2013 he is serving as the Director of the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens. He also serves as the represetative of Greece to the Board of Directors of Astronomy & Astrophysics.

Prof. N. Kylafis is serving as the President of Greek National Committee for Astronomy, as well as a member of the Council of the Univ. of Crete for the 2013-2017 term.

Prof. I. Papadakis commenced his appointment as the Chairman of the Department of Physics in October 2015.
Dr. P. Reig is a member of the Governing Council of the Hellenic Astronomical Society (2014-2016).

Dr. P. Reig participated in the AO-15 XMM-Newton Observing Time Allocation Committee.

Prof. I. Vardavas is on the Editorial Board of the Environmental Modelling and Software Journal.

9. Conference & Workshop Organization

Dr. Laure Ciesla organized an international conference entitled "Gas, Dust, and Star-Formation in Galaxies from the Local to Far Universe" which took place at Chania from 25-29 May 2015, and it was attended by 132 participants. (see

http://www.gdsf2015.org)

Prof. Pavlidou organized an international workshop entitled "Alternative Gravity and Alternative Matter" which took place at the Department of Physics of the University of Crete, May 20-22, 2015. Information about the workshop can be obtained at the website: http://hep.physics.uoc.gr/gravihepcosmo2015/ .

Prof. J. Papamastorakis was the chair of the organizing committee of the "Onassis Foundation Science Lecture Series", which take place at the premises of FORTH every summer. The lectures are principally sponsored by the Onassis Benefit Foundation and selected students from across Europe are financially assisted to attend. A Nobel laureate as well as other leading scientists in the same field, present intensive lectures to students for a week. Typically two and occasionally three lecture series are organized every summer since 2001. the 2015 lectures in Biology were addressing the topic of "Stems cells: from basic biology to translational research" (see http://www.forth.gr/onassis).

10. PUBLIC OUTREACH

All members of the Section are involved in a number of public outreach activities throughout the year. These consist of giving public lectures, mostly in the island of Crete, along with dedicated tours to the facilities of Skinakas Observatory, as well as TV and radio interviews. The group also supports the activities organized by the local amateur astronomical societies in Crete.

The Skinakas observatory opened its doors to the public for five Sunday nights on May 24, June 21, July 26, August 8 and September 6. Hundrends of people visited the observatory where they were guided to the facilities by members of the section and had the chance to look through the main 1.3m telescope.

In the framework of the United Nations global initiative that proclaimed 2015 the International Year of Light and Light-based Technologies, the section organized a series of public lectures and two astronomical photography exhibition.

The first astronomical photography exhibition titled "Otherwordly Light: the visible universe throught the telescopes and cameras of Skinakas Observatory" took place at the Heraklion Municipal Gallery over the two weeks period from the 25th of Spetember to the 9th of October. The exhibit consisted of 100 astronomical photographs taken by Dr. Paleologou using the Skinakas observatory telescopes. Graduate students of the Section hosted guided tours for local high schools.

The second astronomical photography exhibition with the same title took place at the Eugenides Foundation from October 19 2015 to January 3 2016 (see http://www.eugenfound.edu.gr/frontoffice/portal.asp?cpage=RESOURCE&cresrc=4588&cnode=20).

Furthermore there were four public lectures in Heraklion by four memebers of the Section as follows:

- Monday September 28, Title: "Pursuing Truth through Light" speaker: V. Charmandaris
- Wednesday September 30, Title: "The primordial Light and the secrets of the birth of the Universe" speaker: K. Tassis

- Monday October 28, Title: "Light of the galaxies: a journey in space and time" speaker: V. Pavlidou
- Wednesday October 7, Title: "Starlight: revealing the secrets of the life and evolution of stars" speaker: A. Zezas

Two members of the Section gave talks at two TEDx events in 2015:

- Prof. G. Papamastorakis at TEDxAnogeia, August 8, 2015, Anogeia, Crete
- Prof. V. Pavlidou at TEDx UniversityoftheAegean, April 25, 2015, Ermoupolis, Syros

11. VISITORS

A total of 19 scientists visited our Department during the 2015 calendar year in order to collaborate with staff members of the Section and/or give seminars. These individuals were: Prof. Roberto Assef (Univ. Diego Portales, Chile), Prof. G. Bertone (U. of Amsterdam), Dr. Th. Bitsakis (UNAM, Mexico), Dr. P. Bonfini (Swinburne Univ., Australia), Dr. E. Calabrese (Oxford U., UK), Dr. Mayte Costado (Instituto de Astrofísica de Andalucía), Dr. T. Diaz-Santos (Univ. Diego Portales, Chile), Dr. J. Gaskins (U. of Amsterdam, Netherlands), Prof. P. Goldsmith (NASA/JPL, USA), Dr. T. Hovatta (Aalto University, Finland), Dr. G. Maravelias (ASU, Czech Republic), Dr. R. Martinez-Gallarza (CfA, USA), Prof. G. Matt (Roma Tre University, Italy), Prof. M. Milgrom (Weizmann Institute, Israel), Dr. L. Moustakas (NASA/JPL, USA), Prof. S. Sarkar (Oxford U., UK), Dr. F. Schmidt (MPIA, Germany), Dr. H. Spruit (MPIA, Germany), Dr. J.-L. Starck (CEA/Saclay), Prof. J. Trumper (MPE-Garching, Germany), Dr. T. Venters (NASA/Goddard, USA).

12. PUBLICATIONS

The following **40** publications of the members of the Section appeared in print in international refereed journals (according to ISI/WoS, NASA/ADS) during the 2015 calendar year. This corresponds to 2.67 refereed publications per PhD researcher. For each publication, the names of the members of the Section are underlined.

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4. Bitsakis, T., Dultzin, D., Ciesla, L., Krongold, Y., Charmandaris, V., and Zezas, A., *Studying the Evolution of Galaxies In Compact Groups Over the Past 3 Gyr - I. Nuclear Activity.* Monthly Notices of the Royal Astronomical Society, 2015. **450**(3): p. 3114-3126.

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13. D'abrusco, R., Fabbiano, G., and Zezas, A., *Spatial Structures In the Globular Cluster Distribution of the 10 Brightest Virgo Galaxies.* Astrophysical Journal, 2015. **805**(1).
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13. CONTACT

The Department of Physics of the University of Crete is located on a campus 8 km south-west of Heraklion, the largest city in the island of Crete, Greece. At the end of 2015 it consisted of 23 faculty members, as well as a number of research associates and graduate students, working on various fields of theoretical and experimental physics. the postal address of the Section of Astrophysics and Space Physics is:

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