UNIVERSITY OF CRETE
DEPARTMENT OF PHYSICS
SECTION OF ASTROPHYSICS & SPACE PHYSICS

ANNUAL REPORT FOR 2010

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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 2010 calendar year. The staff of the Section consisted of 15 PhD research scientists, 7 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 2010 it resulted in 53 papers published in refereed journals, that is ~3.5 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 2011, based on contributions from all members of the Section. The final editing was done by V. Charmandaris.

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, 4 PhD students, 3 Masters students, and 4 technicians.

The 7 Physics faculty members of the Section during the whole period of the report were Vassilis Charmandaris (Assoc. Prof.), Christos Haldoupis (Prof.), Nikolaos D. Kylafis (Prof.), John Papamastorakis (Emeritus Prof.), Iossif Papadakis (Assoc. Prof.), Ilias M. Vardavas (Assoc. Prof.) and Andreas Zezas (Assist. Prof.). Pablo Reig (Researcher B' at the Foundation for Research and Technology – Hellas) and Fotis Mavromatakis, (Assist. Prof. at the Technical Educational Institute of Heraklion) were also affiliated with the Section. Researchers in non-tenure track positions holding a PhD degree were Dr. Nicky Brassington, Dr. Maria Caballero-García, Dr. Elisabete da Cunha, Dr. Tanio Díaz-Santos, Dr. Omaira González-Martín, and Dr. Fabrizio Nicastro. 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 Nikos Benas (with I. Vardavas), Theodore Bitsakis (with V. Charmandaris), Paolo Bonfini (with A. Zezas) and Grigoris Maravelias (with A. Zezas). Master's students were E. Koutra (with A. Zezas), A. Psychogios (with V. Charmandaris) and M. Tsantaki (with A. Zezas). In September 2010 Alexadros Maragoudakis and Marios Mplazoudakis commenced the 2010-2011 Master's program in Astrophysics.

2.2. PERSONNEL CHANGES

Dr. N. Brassington and Dr. M. Caballero-García joined the group in June and October 2010 respectively, as research associates under European Union grants. Dr. E. da Cunha completed her postdoctoral appointment and moved to the Max-Planck Institute for Astronomy at Heidelberg (Germany). V. Charmandaris was on sabbatical leave in the Fall semester of 2010. In November 2010, Dr. Vasiliki Pavlidou (Caltech, USA) was elected as an Assistant Professor of Theoretical Astrophysics and it is expected that she will join the group in the fall of 2011.

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.

The Observatory has two fully operating telescopes. One 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 second is a 0.6 m Cassegrain telescope (focal ratio of f/8) owned by the University of Tübingen (Germany) and co-operated with the Univ. of Crete, which is remotely controlled in a robotic mode via the web. A third 30 cm telescope (focal ratio f/3.2) is also available and was used in a few projects during the 2010 observing season. A number of modern instruments are permanently available on the 1.3 m tepescope. 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 main projects during the 2010 April-to-November observing period were:

- Photometry and Spectroscopy of Planetary Nebulae and SNe Remnants.
- R-band and Hα monitoring of the central region of M31 for the discovery and follow-up photometry of new Novae.
- Photometry and Spectroscopy of Binaries with a compact star companion.
- Near-infrared observations of HMXB
- High speed photo-polarimetry of optical GRB afterglows and X-ray binaries (HMXR, microquasars)
- Fast Photometry of cataclysmic variables

The High Time Resolution OPTIMA Instrument ("OPTIMA BURST"[3]) of the Max-Planck Institut für Extraterrestrische Physik was successfully installed at the 1.3 m telescope and was in operation for the months of June and July 2010.

The tradition of "open nights" continued and the Observatory was open to the public for five nights during the 2010 observing season.

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), maintained operation of its main experimental facility, SESCAT (Sporadic E SCATter experiment), during the summer of 2010. SESCAT, which is the only ionospheric scatter radar that exists in Greece,

[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 "Optima" visit: http://www.mpe.mpg.de/OPTIMA

operates at 50 MHz mostly as a Doppler radar but occasionally also as radio interferometer. It is observing magnetic aspect radio backscatter from electrostatic plasma waves in the E region of the ionosphere during times of strong dense layers of metallic ions, which form at altitudes of ~100 km and are subject to plasma instabilities. In addition, IPL in collaboration with Stanford University, continued (since 2003) the un-interrupted operation of a narrow-band very low frequency (VLF) receiver experiment throughout 2008, 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. Also, since the summer of 2005, IPL operates, in collaboration with the Eötvos-Lenard Budapest University, a second automatic VLF receiver system on a routine basis side by side with the Stanford receiver in the rooftop of the Physics Building. In 2007, a new GPS (Global Positioning System) receiver station was set up in Crete (in collaboration with the Universite de Rennes, France) for continuous monitoring of the ionospheric variability by measuring total electron content and S4 index changes. E and F region EM coupling studies using joint SESCAT and GPS observations are planned for the near future.

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 academic year 2008 these were:

- SPRING SEMESTER 2010
  - "Astrophysics II"
  - "Production and Transfer of Radiation"
  - "Physics of Galaxies"

- FALL SEMESTER 2010
  - "Astrophysics I"
  - "Atmospheric Environment"
  - "Evolution of Planetary Atmospheres"
  - "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 2010. 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 11.

5.1. THEORETICAL ASTROPHYSICS

- Black holes as X-ray sources: Modeling of the spectral states of black-hole X-ray binaries in order to explain their energy spectrum (from radio to X-rays) and the intricate time variability of their intensity. Compton up-scattering of soft photons in the jet seems to be the mechanism for producing the hard X-ray spectrum and the variability observed. Time delays of the optical and the

infrared with respect to the X-rays have been computed in accordance with the observations. (Researchers involved: N. Kylafis, P. Reig).

- Anomalous X-ray pulsars: Extremely interesting observations have been made recently on the hard X-ray spectrum of Anomalous X-ray Pulsars (AXPs). The hard X-rays have luminosity comparable to that of the soft X-rays and it is pulsed, with the rotational period of the neutron stars involved. In addition, the pulse fraction of the hard X-rays increases with the energy of the photons and it becomes ~100% at ~100 keV. A model to explain all of the above, plus the pulsed radio emission observed in some of them, has been worked. A paper was published in 2010 and a second one was submitted for publication. (Researcher involved: N. Kylafis, A. Zezas).

- Time-Evolving Photoionization: Updating and upgrading our in-house time-evolving photoionization code, to include: (a) portability (FITS-IO interface routines allowing general photo-ionizing light-curves, Spectral Energy Distributions, Ionization-Balance inputs, and output spectral fitting with the fitting package "Sherpa" of the Chandra Interactive Analysis of Observations - CIAO - software); (b) detailed time-evolving population level computation; (c) inclusion of fine-structure transitions for low-ionization metals, and (d) radiative transfer computation (Researchers involved: F. Nicastro).

- Astrostatistics: Application of statistical methods in astrophysical problems. Recent projects include: 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).

- Modeling the Spectral Energy Distribution of Galaxies: We use the code developed by da Cunha et al. 2008 in order to model in detail the complete spectral energy distribution (SED) of galaxies from the UV to the sub-mm. The code is applied in a variety of samples drawn from well known surveys (such as GOODS, H-ATLAS, and SDDS) in order to derive physical connection between the dust and star formation properties in these systems (Researchers involved: V. Charmandaris, E. da Cunha and external collaborators).

5.2. Observational Astrophysics

5.2.1. Observational Galactic Astrophysics

- X-ray variability of X-ray binaries (XRB): XRB consist of a compact star (neutron star or 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. The goal here is to study their spectral and timing properties. We analysed the RXTE data from the 2005/2006 ouburst of GRO J1655 and of the 1996-1999, 2002-2003 and 2004-2005 outbursts of GX 339-4. We have fitted hundreds of spectra with phenomenological and more physical models, and we have also characterized the observed flux variations with the use of traditional power and cross-spectral techniques (Researchers involved: P. Reig, I. Papadakis, M. Sobolewska).

- Optical/IR monitoring of 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. The origin of these two observational properties (emission lines and infrared excess) resides 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. Another goal of this project is to investigate the effects of the compact object on the structure and evolution of the circumstellar envelope. One of the most interesting effects is the truncation of this envelope by the neutron star. In this project we wish to find observational evidence of such a truncation (Researchers involved: P. Reig, A. Zezas).

- Search for non-radial pulsations in Be/X-ray binaries: One of the unsolved issues regarding the physics of Be stars is the ultimate mechanism that originates the circumstellar disc. Rotation was identified as an important feature of the central star, and which may be a significant contributor to the generation of the circumstellar medium. There is no general consensus about whether Be stars rotate close to critical velocity (when the centrifugal force counterbalances the gravitational force at the equator) although the latest studies indicate that the mean rotation rate of Be stars is 70%-80% of the critical value. Rapid variability (< 3.5 d) of B and Be stars can be explained as the consequence of non-radial pulsations or a rotational modulation. However, many studies support the notion that short-term photometric and spectroscopic variability is due to nonradial pulsation. The goals of this project are: i) to investigate the role of the nonradial pulsations in driving mass loss from Be stars, ii) compare the periods with those of Be/X in other galaxies and iii) compare the periods with those of isolated Be stars (Researchers involved: P. Reig)

- 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 use both X-ray archived and new data of all the HMXBs displaying major outbursts to generate X-ray color-color and hardness-intensity diagrams to define possible spectral states. Subsequently, we obtain power density spectra and energy spectra to define the timing and spectral properties of those states. We search for correlation between the timing and spectral parameters. Such correlation will provide new insights (by constraining the models) into the accretion physics in HMXBs. (Researchers involved: P. Reig).

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: D. Hatzidimitriou, V. Antoniou, 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; this is the PhD project of I. Leonidaki (NOA, University of Patras)).

- X-ray variability studies of AGN: The second paper from the data analysis of the long XMM look on PKS 0548-508, where we studied the timing properties of the X-ray light curves of the source was completed and accepted for publication. More work on this enormous data set (as well as on data from Swift/XRT) is in progress. Furthermore, the work on the comparison between the variability properties of AGN and the "enigmatic" Ultra Luminous X-ray sources in neraby galaxies was completed and accepted for publication. The work on the comparison between the X-ray spectral variability properties of luminous, nearby Seyferts on short and long time scales was completed, and the results should be published next year. New projects initiated include the spectral variability study at "hard" X-rays, using Swift/BAT data, as well as the study of the UV spectral shape of Type I AGN, using SDSS data. (Researchers involved: I. Papadakis, O. González-Martín, F. Nicastro, M. Caballero-García).

- The Warm Hot Intergalactic Medium: a) Selection of an optimal UV and X-ray sample for WHIM studies with current - Chandra-LETG and XMM-Newton RGS - and future - HST-COS, IXO and dedicated X-ray WHIM missions like Origin, WHIMEx or Pharos. The selection is based on the brightness of the X-ray sources, F(0.5-2 keV) > 2×10^{-12} ergs/s/cm^2, the Galactic column of hydrogen, $N_H<3\times10^{20}$cm^{-2}, the target redshift (z > 0.3) and the UV brightness (λF_λ(1600A)> 3×10^{-12} ergs/s/cm^2). b) Extensive spectral simulation with current and future X-ray facilities of the Warm-Hot Intergalactic Medium along randomly selected lines of sight from the latest hydro-dynamical simulation for the formation of structures in the Universe. Main aim of this work is to perform feasibility studies and establish the optimal technical parameters for upcoming

WHIM-dedicated or general-observatory X-ray missions. c) Submitted a Chandra Large-Program proposal to observe "the best WHIM target in the X-ray/FUV sky": the proposal was selected for Chandra cycle 12, and the observation will be perfomed in spring 2011. This observation will guarantee the detection of the X-ray WHIM counterparts to two FUV WHIM signposts (a triple-OVII system and a very broad Ly-alpha absorber) and will either guarantee for the first time an uncontroversial, high statistical significance detection of the bulk of the missing baryons, or the falsification of the current theoretical models in the context of a Λ-CDM cosmology. The program will also serve as baseline for all future observations of the WHIM with current instrumentations and for defining and tuning instrument parameters for new WHIM-dedicated mission concepts. d) 2 Point Angular Correlation Function (2-PACF) analysis of the Chandra- and XMM-COSMOS field, in narrow energy band centered around the K-alpha triplets of the main He-like metals (O, Ne, and Mg), and comparison of this analysis with hydrodynamical simulations of these fields that include WHIM. The aim of this analysis is to extract a residual indirect WHIM signal from the data, and evaluate through simulation the statistical significance of this signal. We also use these narrow-band XMM and Chandra images to cross-correlate with galaxy structure in the COSMOS field, at selected redshifts, with the aim of extracting a signal of direct WHIM emission correlated with Large-Scale Structures. This research is being performed together with colleagues at the MPE in Munich (Germany) and the 3rd University of Rome in Rome (Italy) (Researchers involved: F. Nicastro).

- Gamma Ray Bursts: a) Study of the multi-epoch high-resolution optical spectra of Gamma-Ray Burst (GRB) optical afterglows, aimed to measure the distance and the physical state (density, temperature, ionization degree, etc.) of the associated absorbing material along the line of sight, from the GRB. This study has made extensive use of our Time-Evolving Photoionization code and was mainly based on the observed opacity changes in the fine-structure lines of FeII. b) Study of the soft X-ray (0.1-2.5 keV) LogN-LogF (i.e. number of sources N with soft X-ray fluence >F: fluence = Flux * Time) of all Gamma-Ray Burst triggered by the high-energy wide-field Swift detector BAT and followed up in the soft X-rays with the Swift XRT detector (Researchers involved: F. Nicastro).

- 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).

- Mid-infrared properties of Luminous and Ultraluminous Infrared Galaxies (LIRGs/ULIRGs): This project uses mostly observations of the Infrared Spectrograph as well as the cameras IRAC and MIPS on the Spitzer Space Telescope in order to explore the mid-infrared properties of ULIRGs. The main goal is to improve the understanding of the dominant mechanism of the energy source (accretion onto an active nucleus or a super-massive starburst) in these galaxies. There are various components of this project. One major component is the characterization of the extended mid-infrared emission for a complete flux-limited sample of local LIRGs/ULIRGs - the Great Observatories All-Sky Survey (GOALS) galaxy sample - in order to further establish a connection between low and high redshift infrared luminous systems. Substantial effort is

also being devoted in the theoretical modeling of the spectral energy distribution of ULIRGs dominated by star formation, using the code of da Cunha et al. 2008. Preparatory work for the implications of this work in upcoming observations off deep surveys with the Herschel Space Telescope is being conducted (Researchers involved: V. Charmandaris, E. da Cunha, T. Díaz-Santos).

- Star formation and stellar populations in Hickson Compact Groups: This project is based on mid-infrared observations of a sample of Hickson Compact Groups obtained with the Infrared Space Observatory and the Spitzer Space Telescope. Additional near-infrared imaging data of the Palomar 5 m telescope, and Skinakas 1.3m telescope are being used in order to map in detail the star formation activity and old stellar population of these systems (Researchers involved: T. Bitsakis, V. Charmandaris, E. da Cunha, T. Díaz-Santos).

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, N. Hatzianastassiou (Univ. of Ioannina), C. Matsoukas (Univ. of the Aegean), K. Pavlakis, A. Fotiadi, C. Papademas (Univ. of Ioannina)).

- 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, P. Lavvas)

- Ionospheric and Upper Atmospheric Physics: The research topics under study relate to the plasma physics and electrodynamics of irregular ionospheric phenomena occurring at midlatitude, and problems associated with the interaction and coupling of the neutral mesosphere and lower thermosphere with the earth's ionosphere. During 2010 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 electrodynamic coupling between the

unstable Es plasma and midlatitude ionospheric "spread F" and the generation of large electric fields in patchy sporadic E plasma layers, 3) the role of plasma density gradients on the generation of short scale electrostatic plasma waves in the ionospheric E region, 4) the effects on VLF (very low frequency) electromagnetic wave propagation and VLF response signatures associated with "transient luminous events", such as sprites and elves, which are atmospheric electricity (thunderstorm and lightning) phenomena in the upper atmosphere and lower ionosphere; modelling the lifetimes of lightning-produced VLF peturbations, 5) meteor trail plasma instabilities and unusually long-lasting meteor echoes observed with VHF (very high frequency) and HF radars, and 6) studies of ionospheric resonance phenomena observed in ultra low frequency (ULF) electromagnetic noise recordings with sensitive coil magnetometers, and 7) studies of the annual and seasonal variations of midlatitude sporadic E layers, and 8) Effects of X-ray solar flare events on the lower ionosphere (Researchers involved: C. Haldoupis, N. Christakis, N. Ambrosiadi, and A. Mika)

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 Transfer of Knowledge grant for the "Development of an Astrophysics Center in Crete", (P.I.: N.D. Kylafis, budget: €741,000, duration: 2006-2010)
- EU funded FP7 Programme grant for the "Development of Space Astrophysics in Crete", (P.I.: N.D. Kylafis, budget: €1,120,000, duration: 2008-2011)
- John Latsis Foundation Grant: "Water Resources of Greece under Climatic Change", (P.I. I. Vardavas, budget: €40,000, duration: 2008-2010)
- Marie Curie International Reintegration Grant: (P.I.: A. Zezas, budget: €100,000, duration: 2008-2011)

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 the Aegean, Dept. of Environment, Mytilene
  - University of Ioannina, Dept. of Physics, Ioannina

- INTERNATIONAL
  - Anglo-Australian Observatory, Australia
  - California Institute of Technology, Spitzer Science Center, Pasadena, CA, USA
  - CEA/Saclay, Service d'Astrophysique, France
  - Cornell University, Astronomy Department, Ithaca, NY, USA
  - Danish Space Research Institute (DSRI), Denmark
  - Eötvos-Lenard University, Budapest, Hungary
  - ETH, Zurich, Switzerland

- Free University of Berlin, Germany
- Geophysical Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria
- Harvard University, Center for Astrophysics, Cambridge, MA, USA
- Imperial College, UK
- Institut d'Astrophysique de Paris, France
- Institute of Physics of the Earth, Russia
- Lawrence Livermore National Lab, CA, USA
- Leiden Observatory, Leiden, The Netherlands
- Max-Planck-Institut für Extraterrestrische Physik, Garching, Germany
- Max-Planck-Institut für Kernphysik, Heidelberg, Germany
- Miami University, Oxford, OH, USA
- NASA Goddard Space Flight Center, Greenbelt, MD, USA
- NASA Langley Division of Atmospheric Sciences, Langley, VA, USA
- NASA Marshal Space Flight Center, Huntsville, AL, USA
- National Space Science and Technology Center, Huntsville, AL, USA
- Nicolaus Copernicus Astronomical Center, Warsaw & Torun, Poland
- Observatoire de Paris, France
- Royal Observatory Edinburgh, UK
- San Diego State University, CA, USA
- Shanghai Astronomical Observatory, Shanghai, China
- Stanford University, Palo Alto, CA, USA
- Tel Aviv University, Israel
- Université de Rennes, France
- University of Alicante, Spain
- University of Arizona, Tucson, AZ, USA
- University of Durham, Durham, UK
- University of Oulu, Finland
- University of Saskatchewan, Canada
- University of Southampton, UK
- University of Texas at Austin, Austin, TX, USA
- University of Valencia, Spain
- University of Zielona Gora, Kepler Institute of Astronomy, Poland
- Warsaw University Observatory, Poland

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 second term as the Secretary of the Hellenic Astronomical Society for a second term (2008-2010). He continued his duties as the Editor of the European Astronomical Society Newsletter (since 2005).

Prof. C. Haldoupis served as evalutor for the 2010 European Union FP7 proposals on Space Physics.

Prof. N. Kylafis was an ordinary member of the Greek National Committee for Astronomy (GNCA) and a substitute to the representative of Greece to the Optical Infrared Coordination Network for Astronomy (OPTICON). He was elected as the President of the Hellenic Astronomical Society for the 2010-2012 term. He is also serving as the Dean of the School of Sciences of the Univ. of Crete for the 2008-2012 term.

Prof. I. Papadakis was elected as the Sectretary of the Hellenic Astronomical Society for the 2010-2012 term

Prof. J. Papamastorakis was a substitute member of the Greek National Committee for Astronomy.

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

9. Conference & Workshop Organization

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 2010 lectures in Computer Science were addressing the topic of "Network and Information Security" (see http://www.forth.gr/onassis).

O. González-Martín, N. Kylafis, F. Nicastro, I. Papadakis, P. Reig, and A. Zezas organized a conference entitled "High Energy View of Accreting Objects: AGN and X-ray Binaries". The conference took place in Agios Nikolaos, Crete, from 5-14 October 2010, and it was attended by ~120 colleagues from all over the world. Special emphasis was put on encouraging intensive discussions during and after each talk, a strategy that contributed significantly to the success of the workshop (see http://astro.physics.uoc.gr/Conferences/xworkshop)

V. Charmandaris, E. da Cunha, T. Diaz-Santos, and N. Kylafis, organized an international conference entitled "Challenges in Infrared Extragalactic Astrophysics II", on 26 Sep. – 1 Oct. 2010. The conference took place in Agios Nikolaos, and was attended by ~75 scientists from all over the world. Emphasis was put on encouraging intensive discussions during and after each talk, a strategy that contributed significantly to the success of the workshop (see http://astro.physics.uoc.gr/Conferences/irmtg10/)

10. Visitors

A total of 29 scientists visited our Department during the 2010 calendar year in order to collaborate with staff members of the Section and/or give seminars. These individuals were: Dr. V. Antoniou (CfA, Harvard Univ., USA), Dr. S. Bianchi (3rd Univ. of Rome, Italy), Dr. W. Brinkman (MPE-Garching, Germany), Prof. D. Burrows (Penn State Univ., USA), Dr. P. Casella (Univ. of Southhampton, UK), Prof. G. Chartas (Charleston College, USA), Mr. M. Chatzopoulos (Univ. of Texas at Austin, USA), Dr. D. Elbaz (CEA/Saclay, France), Dr. A. Fragkos (Northwestern Univ. USA), Dr. H.S. Hwang (CEA/Saclay, France), Ms. S. Juneau (Univ. of Arizona, USA), Prof. P. Kalas (Univ. of California, Berkeley, USA), Dr. C. Kouvaris (Free Univ. of Brussels, Belgium), Dr. G. Kanbach (MPE-Garching, Germany), Dr. D. Kazanas (NASA/GSFC, USA), Dr. S. Kazantzidis (Ohio State Univ., USA), Prof. S. Kulkharni (Caltech, USA), Dr. E. Le Floc'h (CEA/Saclay, France), Prof. Yu-Qing Lou (Tsinghua Univ., China),

Dr. G. Magdis (CEA/Saclay, France), Dr. E. O'Sullican (Univ. of Birmingam, UK), Dr. V. Pavlidou (Caltech, USA), Prof. R. Perna (Univ. of Colorado, Boulder, USA), Prof. A. Redhead (Caltech, USA),), Dr. D. Rigopoulou (Univ. of Oxford, UK). Prof. J. Trumper (MPE-Garching, Germany), Dr. K. Tassis (JPL, USA), Prof. N. Thatte (Univ. of Oxford, UK), Dr. M. van Adelberg (Georgia Tech., USA),

11. PUBLICATIONS

The following 53 publications of the members of the Section appeared in print in international refereed journals (according to ISI/WoS) during the 2010 calendar year. This corresponds to ~3.5 refereed publications per PhD researcher. For each publication, the names of the members of the Section are underlined.

1. Andrade-Velázquez, M., Krongold, Y., Elvis, M., Nicastro, F., Brickhouse, Nancy, Binette, L., Mathur, S., Jiménez-Bailón, E., "The Two-Phase, Two-Velocity Ionized Absorber in the Seyfert 1 Galaxy NGC 5548", 2010, ApJ, 711, 888
2. Antoniou, V., Zezas, A., Hatzidimitriou, D., Kalogera, V., "Star Formation History and X-ray Binary Populations: The Case of the Small Magellanic Cloud", 2010, ApJ, 716, 140
3. Baes, M., Fritz, J., Gadotti, D. A., Smith, D. J. B., Dunne, L., da Cunha, E., Amblard, A., Auld, R., Bendo, G. J., Bonfield, D., Burgarella, D., Buttiglione, S., Cava, A., Clements, D., Cooray, A., Dariush, A., de Zotti, G., Dye, S., Eales, S., Frayer, D., Gonzalez-Nuevo, J., Herranz, D., Ibar, E., Ivison, R., Lagache, G., Leeuw, L., Lopez-Caniego, M., Jarvis, M., Maddox, S., Negrello, M., Michałowski, M., Pascale, E., Pohlen, M., Rigby, E., Rodighiero, G., Samui, S., Serjeant, S., Temi, P., Thompson, M., van der Werf, P., Verma, A., Vlahakis, C., "Herschel-ATLAS: The dust energy balance in the edge-on spiral galaxy UGC 4754", 2010, A&A, 518, 39
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8. Caballero-García, M. D., Fabian, A. C., "X-ray reflection in a sample of X-ray bright ultraluminous X-ray sources", 2010, MNRAS, 402, 2559
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