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

ANNUAL REPORT FOR 2018

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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).
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 2018 calendar year. The staff of the Section consisted of 17 PhD research scientists, 9 PhD 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 2018 it resulted in 39 papers published in refereed journals, that is 2.4 papers per PhD researcher. Significant efforts were also devoted in the operation and improvement of the infrastructure and hardware at Skinakas Observatory. This document was prepared in February 2019, 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 17 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 (Professor), Christos Haldoupis (Professor - retired), Nikolaos D. Kylafis (Emeritus Professor), John Papamastorakis (Emeritus Professor), Iossif E. Papadakis (Professor), Vasiliki Pavlidou (Associate Professor), Kostas Tassis (Associate Professor), Ilias M. Vardavas (Associate Professor - retired), and Andreas Zezas (Associate Professor). Pablo Reig (Research Director 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. Paolo Bonfini, Dr. Fabio Del Sordo, Dr. Ioanna Leonidaki, Dr. Eva Ntormousi, Dr. Grigoris Maravelias, and Dr. Paul Sell. 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), Konstantinos Kouroumpatzakis (with A. Zezas), Maria Kopsacheili (with A. Zezas), Konstantinos Kovlakas (with A. Zezas), Ioannis Kypriotakis (with K. Tassis), Alexandros Psychogyios (with V. Charmandaris), Charalampos Politakis (with A. Zezas), Raphael Skalidis (with K. Tassis).

MSc students during this period were Mr. Stamatios Aliprantis (with A. Zezas), Mr. Ioannis Avgoustakis (with I. Papadakis), Mr. Ilias Kyritsis (with A. Zezas), Mr. George Korkidis (with V. Pavlidou), Mr. Nikolaos Mandarakas (with V. Pavlidou), Mr. Raphael Skalidis (with K. Tassis), Mrs. Sophia Tsiatsiou (with V. Charmandaris), Mrs. Maria-Christina Veli (with V. Pavlidou). Mr. Greg Magkos, a MSc student in the Section of Atomic, Molecular, and Optical Physics of the Department of Physics, also continued his collaboration with our group.

Undergraduate students working with the group were Mr. Konstantinos Avgoullas, Ms. Fotini Bouzelou, Mr. Dimitrios Chatzakis, Mr. K. Droudakis, Mrs. Stamatia-Katholiki Fouka, Mrs. Vivi Georgakaki, Ms. Katia Gimisi, Mr. A. Karakonstantakis, Mr. Antonios Kyriazis, Ms. Lydia Markopoulioti, Mrs. Alexandra Pouliasi, Mr. Alexandros Tsouros.

Two undergraduate students of the Physics Department Aikaterini-Niovi Triantafyllaki and Angelos Karakonstantakis were hired in the Practical Training framework to work at the Skinakas Observatory during the summer months. The students were trained on the use of astronomical instrumentation and on the reduction and analysis of astronomical data.

Sabrina Outmani and Mary Helen Matthews, undergraduate students from the Queen Mary (London University) visited the observatory from 12 July to 13 August for a student internship.

2.2. Personnel Changes and Notable Events

The Institute of Astrophysics was established at the Foundation for Research and Technology – Hellas, becoming its 7th Institute, after a legislation voted in the Greek Parliament on February 26th 2018 becoming formally a law on March 2, 2018. The new Institute is the natural evolution of Astrophysics activities at the University of Crete and FORTH that have been taking place in Crete for many years now. It aims to promote research in the field of Astrophysics, in terms of excellence and innovation and to become a critical parameter for the participation of the Country in international developments relevant to this field.

Vasiliki Pavlidou and Konstantinos Tassis were promoted to Associate Professors of Theoretical Astrophysics at the Physics Department of the University of Crete.

In 2018 one doctoral student joined the group: Mr. Raphael Skalidis (with K. Tassis); five students started working on their MSc degree under the supervision of members of the group: Mr. George Korkidis and Mr. Nikos Mandarakas (with V. Pavlidou), Mr. Ioannis Avgoustakis (with I. Papadakis), Mr. I. Kyritsis (with A. Zezas), and Mr. A. Bertsias (with A. Zezas); eight undergraduate students joined the group: Mr. Konstantinos Avgoullas (with V. Pavlidou), Ms. Fotini Bouzelou (with K. Tassis), Mr. K. Droudakis (with A. Zezas), Ms. Katia Gimisi (with V. Pavlidou), Mr. Antonios Kyriazis (with K. Tassis), Ms. Lydia Markopoulioti (with K. Tassis), Ms. Alexia Nix (with A Zezas), and Mr. G. Savathrakis (with A. Zezas).

In September of 2018 Alexandros Psychogyios successfully defended his PhD thesis entitled "Galaxy Morphology in Different Environments" under the supervision of Prof. Charmandaris.

Dr. Georgia Virginia Panopoulou was awarded the best PhD prize by the International Astronomical Union Division H at the XXXth General Assembly of the International Astronomical Union that took place in Vienna in August of 2018. Dr. Panopoulou's PhD thesis was entitled "Structure and evolution of magnetic molecular clouds: Observational consequences and tests" and was carried out under the supervision of Prof. Tassis.

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 operating full-time at Skinakas Observatory in 2018. 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 for 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.

The development of the WALOP polarimeter at IUCAA, funded by the Stavros Niarchos Foundation, proceeds on schedule so far. A PhD student, I. Kypriotakis, has been recruited to participate in the instrument design, and is currently at IUCAA. Possible commissioning is scheduled for the end of 2019.

The main projects during the 2018, April-to-November, observing period were:

- Polarimetric monitoring of stars to establish a set of polarimetric standards
- Photometry and Spectroscopy of Binaries with a compact star companion
- AGN monitoring observations
- Target of Opportunity optopolarimetric follow-up of gamma-ray bursts and other objects
- Polarimetry, Photometry, and Spectroscopy of Binaries with a compact star companion
- Narrow-band imaging of Galactic Supernova Remnants
- An Hα survey of nearby galaxies

The tradition of "open nights" continued and the Observatory was open to the public for 5 nights, from May until September 2018. They were very successful, with a "full-house" capacity at each night.

[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/

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

3.2. Ionospheric Physics Laboratory

The Ionospheric Physics Laboratory (IPL) continued the operation of a narrow-band very low frequency (VLF) receiver experiment 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.

Since July 2017, IPL is responsible for operating an automatic weather station that is part of a global network run by *Earth Networks* (https://www.earthnetworks.com/). Met measurements on real time and 10-day weather forecast for Heraklion can be seen at:
https://owc.enterprise.earthnetworks.com/OnlineWeatherCenter.aspx?aid=7194

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 calendar year 2018 these were:

- Spring Semester 2018
  - "Astrophysics II" (Galactic and extragalactic astrophysics)
  - "Production and Transfer of Radiation" (Graduate course)
  - "Physics of Galaxies" (Graduate course)

- Fall Semester 2018
  - "Astrophysics I" (Stellar structure and evolution)
  - "Atmospheric Environment"
  - "Observational Cosmology"
  - "Observational Astrophysics"
  - "Astrophysics III" (Graduate course)

A notable change from previous years is that in the fall semester the graduate course Astrophysics III that used to be taught by N. Kylafis was taught again jointly by Prof. Pavlidou and Prof. Antony Readhead (Caltech), who was visiting the department in the fall, with a slightly different syllabus.

5. Scientific Research

Here we present a brief description of the major research projects in which members of the Section were involved in 2018. 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

- Astrophysics of ultra-high-energy cosmic rays: With energies higher than 10^{18} eV, ultra-high-energy cosmic rays are the most energetic particles known. Their origin remains, to this day, unknown, but they are certain to encode important information about the most extreme processes in the Universe. Our group develops novel approaches to their study, including assessing the possibility of back-tracing of their paths through the Galactic magnetic field to uncover their true arrival directions and thus better constrain their origin; develop tests of a multiple-source-population origin; and use gamma rays resulting from intergalactic cascades to identify the location of their sources. (Researchers involved: V. Pavlidou, K. Fouka, D. Chatzakis, K. Avgoullas, E. Ntormousi, G. Magkos)

- 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 and work on it continues. (Researchers involved: N. Kylafis, A. Zezas).

- Modeling the X-ray emission from Black-hole and Neutron-star X-ray binaries: Although significant progress has been made in the phenomenology and modeling of the X-ray emission of black hole transients (BHT) and neutron-star X-ray binaries (NSB) in the last decade, the accretion/ejection phenomena in these systems are still poorly understood. Understanding the emitted spectra is extremely important because it reveals the physical processes giving rise to the high-energy radiation. The way forward must come from the combination of spectral and timing information. Galactic BHT and NSB emit a compact, optically thick, mildy relativistic radio jet when they are in the hard and hard-intermediate states, that is, typically at the beginning and the end of an X-ray outburst. In a series of papers, we have developed a jet model that simulates the process of Comptonization of low-energy photons by very energetic electrons in the jet and have shown through Monte Carlo simulations that our model can explain many observational results. Recently, we found that BHTs as a class exhibit a correlation between the power-law photon index (the slope of the hard spectral continuum) and the time lag between hard and soft photons. In two recent papers, we have shown that we can explain the correlation using our simple jet model and the Cosmic Battery. (Researchers involved: N. Kylafis, P. Reig).

- Astrochemistry: Non-equilibrium chemodynamical multi-fluid non-ideal MHD simulations of star-forming molecular cloud cores. Our group developed and made public the non-LTE line radiative transfer code PyRATE. (Researchers involved: K. Tassis)

- Magnetic Fields in the Interstellar Medium: Our group developed a new technique for estimating the strength of the plane-of-sky magnetic field in interstellar clouds using our earlier discovery that elongated structures in such clouds (striations in molecular clouds, fibres in HI clouds) are imprints of magnetosonic waves (Researchers involved: K. Tassis, 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, G. Korkidis, K. Tassis, E. Ntormousi)

- Astrostatistics: Application of statistical methods in astrophysical problems. Current projects include: assessing the significance of apparent correlations between average AGN fluxes at different wavelengths, analysis of data taking into account calibration uncertainties, derivation of spectral parameters from X-ray hardness ratios, classification of galaxies with respect to their energy source, analysis of noisy imaging data, analysis of LogN-LogS distributions, an MCMC approach for constraining the fomation and evolution of X-ray binary systems. We also held a regular Astrostatistics seminar aiming at the introduction of students and researchers to statistics techniques. (Researchers involved: A. Zezas, V. Pavlidou, J. Andrews).

- Modelling of X-ray binary populations and compact object mergers: Standard methods of modeling the formation and evolution of high mass X-ray binaries rely on a brute force approach and are relatively inefficient. We add a statistical wrapper that uses a Markov Chain Monte Carlo technique to an already built and maintained binary evolution code which focuses computational power on the region of parameter space of interest. This approach allows efficient fitting of observed binary populations, while taking into account their spatial distribution and the spatially resolved star-formation history of their parent stellar populations. (Researchers involved: J. Andrews, K. Kovlakas, A. Zezas).

- Numerical studies of the Galactic Magnetic Field: Magnetic fields lie at the heart of all the outstanding problems in galactic evolution. We are developing the first simulations to include all the core processes of galactic evolution, such as a multi-phase interstellar medium, time-dependent star formation and stellar feedback, and the realistic non-ideal MHD terms necessary for modeling a realistic magnetic field evolution. The simulations are performed with the RAMSES code. (Researchers involved: E. Ntormousi, K. Tassis, A. Kyriazis, V. Pavlidou).

- Evaluating the topology of galactic and extragalactic magnetic fields: We are performing numerical studies to understand how interstellar turbulence and magnetic fields can produce observables that can mask those of primordial gravitational waves. In particular, we produced synthetic maps to test the hypothesis that the magnetic field in the solar neighborhood is helical and to quantify the connection between magnetic helicity and galactic polarized emission. Also, we are doing numerical simulations to understand the role of magnetic fields in extragalactic structures such as the Fermi bubbles, two large structures visible in gamma-rays above and below the Galactic center. (Researchers involved: Fabio Del Sordo, Evangelia Ntormousi)

- Stability of stellar magnetic fields: The presence of magnetic fields in stars is

one of the big mysteries of modern astrophysics. We are performing numerical magnetohydrodynamical simulations aimed at understanding the timescales and the topology needed for these fields to be stable. These numerical work has applications on a large number of stellar types, such as Red Giants, Ap/Bp stars, neutron stars, the Solar core and, in general, all the stars that present a radiative zone. With this model we want to explain the values of magnetic fields observed for some of these stars. (Researcher involved: Fabio Del Sordo)

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. (Researchers involved: P. Reig, A. Zezas)

- Origin of the X-ray emission of accreting pulsars at quiescence. Several recent X-ray observations of accreting pulsars at periods when the mass transfer from the donor star is expected to be minimal, give very intriguing results, including the detection of pulsations. We continued a multi-wavelength observing program aiming at understaning the origin of this X-ray emission and the role of the propeller effect. (Researchers involved: P. Reig, A. Zezas)

- Spectral studies of accreting pulsars at high luminosities. We have embarked in a systematic study of the hard X-ray emission of outbursting accreting pulsars in the Small Magellanic Cloud. The goal of this project is to measure their magnetic field strength from the detection of Cyclotron lines, and the study of their phase resolved spectra at these high luminosities in order to constrain the dominant emission mechanisms and the geometry of the emitting region at different energies. (Researchers involved: A. Zezas, K. Droudakis)

- Wide stellar binaries: With orbital periods in excess of thousands of years, wide

binaries have traditionally been identified by finding common proper motion stars within astrometric catalogs. Using the additional inclusion of parallax measurements, we are developing sophisticated Bayesian algorithms designed to mine the data from the Gaia astrometric satellite. Already, we have used this sample to place new constraints on stellar multiplicity, the strength of gravity in the weak acceleration regime, and the potential for chemical tagging to identify unique Galactic subpopulations. (Researchers involved: J. Andrews)

- The Origin of Ca-Rich Gap Transients: We have put strong constraints on the origin of calcium-rich gap transients, a recently discovered class of transient sources in the luminosity gap between novae and supernovae. By combining our recent Chandra observation of one of these transients with a simple model for fall-back accretion, we have ruled out the model of a white-dwarf being tidally disrupted by an intermediate-mass a black hole. While this observation was the deepest X-ray observation of one of these sources yet, it is consistent with a couple other triggered Chandra observations, strongly arguing against this model. (Researchers involved: P. Sell)

- Characterizing a Sample of Extreme Starburst Galaxies: We are studying a sample of (arguably the most) extreme starbursts using a large collection of observations across the electromagnetic spectrum, from radio to X-ray. The massive galaxies have recently undergone highly disruptive mergers, where a large fraction of the cold gas has been efficiently funneled to the central regions of the galaxy. This results in vigorous, very compact star formation: galaxies roughly the mass of the Milky Way forming stars within a projected area ~10000 times smaller. This then leads to high-velocity (the fastest yet seen at up to ~2000 km/s), starburst-driven, outflows heating up and carrying away a large fraction of the gas mass, thereby rapidly truncating future star formation. Studying these galaxies helps us understand the origin of these outflows and more generally understand galaxy evolution during its most rapid and violent stages. (Researchers involved: P. Sell)

- Properties of the Linear Polarization in White Dwarfs. We performed the first linear polarimetric survey of white dwarfs (WDs). Our sample consists of DA and DC spectral types in the SDSS r magnitude range from 13 to 17. Almost all of the 74 objects of our sample are low polarized WDs with polarization degree (PD) smaller than 1%, while only 2 have PD higher than 1%. There is an evidence that on average the isolated WDs of DC type have higher PD (with median PD of 0.78%) than the isolated DA type WDs (with median PD of 0.36%). On the other hand, the median PD of isolated DA type WDs is almost the same, i.e. 0.36% as the median PD of DA type white dwarfs in binary systems with red dwarfs (dM type), i.e. 0.33%. This shows, as expected, that there is no contribution to the PD from the companion if the WD companion is the red dwarf, which is the most common situation for WDs binary systems. We do not find differences in the polarization degree between magnetic and non-magnetic WDs. Because 97% of WDs in our sample have PD lower than 1%, they can be used as faint zero-polarized standard star in the magnitude range from 13 up to 17 of SDSS r filter. They cover the Northern sky between 13 hour to 23 hour in right ascension and from -11 degrees to 78 degrees in declination. (Researchers involved: P. Reig)

- Imprint of MHD waves in interstellar molecular clouds: Building on previous work that demonstrated that the long parallel structures (striations) that

appear in the outskirts of molecular clouds are the result of fast magnetosonic waves, we have identified and analysed an isolated cloud where such waves establish standing waves: the Musca molecular cloud in the southern hemisphere. By analysing the normal modes present in that cloud, we found that, contrary to the standard paradigm that wanted this cloud to be a prototypical filament, Musca is in fact a sheet-like structure seen edge on. The publication describing these findings resulted in a world-wide press release by the journal Science (Researchers involved: K. Tassis; this work that appeared in 2018 was based on the PhD thesis of A. Tritsis, who graduated from the University of Crete in 2017).

- Sources of gamma-ray emission: Our group demonstrated that optopolarimetric observations can be used Development and demonstration of techniques to identify previously unknown members of this class (Researchers involved: D. Blinov, V. Pavlidou, N. Mandarakas, I. Liodakis, A. Pouliasi)

- Polarization studies of the Interstellar Medium at low extinction regions: 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. To assess the magnitude of the effect a mini survey of three regions of the northern sky with very low dust emission/extinction were performed. Probing the polarization at the low dust extinction regime is important in order to calibrate the expected efficiency of the PASIPHAE survey and set the required time and sensitivity thresholds. (Researchers involved: R. Skalidis, K. Tassis, D. Blinov)

- Demonstration of tomographic mapping of interstellar magnetic field direction: In a pathfinding study for the upcoming PASIPHAE survery, our group demonstrated the technique of Galactic magnetic tomography: using optopolarimetric measuerements of stars with known distances, we were able to measure, for the first time, the direction of the plane-of-sky magnetic field of two distinct clouds at different distances along the same line of sight(Researchers involved: R. Skalidis, K. Tassis, D. Blinov, V. Pavlidou).

- Establishing polarimetric standards: We continued our large program on the search for stable optopolarimetric standards distributed over the sky and over optical magnitudes using the RoboPol polarimeter. (Researchers involved: R. Skalidis, K. Tassis, D. Blinov, V. Pavlidou)

- Narrow-band imaging of Galactic Supernova Remnants: Supernova Remnants (SNRs) are an important tool for understanding the physical processes that take place in the interaction between the shock wave from a supernova explosion and the stellar ejecta and/or the surrounding interstellar material. Narrow band images of SNRs in our Galaxy allow us to study their morphology and map their excitation, important parameters for understanding how the mechanical energy of the shock wave is transferred in the surrounding material. (Researchers involved: I. Leonidaki, A. Zezas, I. Kypriotakis)

- Search for Extrasolar planets in the solar neighbourhood: The search for new worlds around nearby stars is challenging astronomers since the discovery of the first exoplanets at the beginning of the 1990's. By joining new observational campaigns and developing new statistical tools we are tackling

this problem and investigating the presence of exoplanets around the nearest stars to the Sun. In particular we are studying the nearest star, Proxima Centauri, its planetary system as well as its stellar activity and magnetic cycles. (Researcher involved: F. Del Sordo)

5.2.2. Observational Extragalactic Astrophysics

- Study of X-ray sources in the Magellanic Clouds: The Magellanic Clouds provide a unique test-bed to study the X-ray binary populations in sub-solar metallicities. A systematic study of the X-ray source populations in the Small and Large Magellanic Clouds is underway, based on a Chandra X-ray Visionary Program focusing on the central region of the Small Magellanic Cloud (SMC), and archival observations of the Large Magellanic Cloud (LMC). Study of the optical counterparts and characterization of the star formation history in the specific areas of the X-ray sources has been conducted using optical imaging and spectroscopy with the 6m-Magellan Telescope, the 4m-Anglo-Australian Telescope (2df, AAOMEGA), and the 4.1m SOAR telescope. The goal of these studies is to understand the nature of the X-ray binaries in the SMC and LMC and their relation to star-formation history and metallicity. A key result from this work is the direct measurement of the formation efficiency of X-ray binaries at low metallicities. (Researchers involved: A. Zezas, J. Andrews, G. Maravelias, I. Kyritsis, S. Aliprantis).

- X-ray source populations in nearby galaxies: X-ray binaries are a key tool for understanding the evolution of binary stellar systems and the formation of their end-points such as sources of gravitational waves and short gamma-ray bursts. Studies of the discrete X-ray source populations (in particular accreting sources) in nearby galaxies allow us to: (a) probe areas of the parameter space that are not present in our neighbourhood (e.g. different metallicity or star-formation history), and (b) obtain large statistical samples and explore rare types of systems. We have embarked in a systematic study of the X-ray binary populations 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. Sell, K. Anastasopoulou, C. Politakis, J. Andrews).

- Constraining the distribution of supernova kick velocities. Supernova kicks are a critical parameter in the evolution of binary stellar systems with compact objects. They determine the survival of a system, its orbital parameters and its subsequent evolution. We are performing a multi-faceted study aiming at: (a) constraining the kick velocities of X-ray binaries based on modelling their evolution given their observed parameters, and (b) directly measuring their center-of-mass velocities based on their displacement from their birthplaces. (Researchers involved: A. Zezas, J. Andrews, C. Politakis).

- X-ray and radio observations of ultraluminous X-ray sources in nearby galaxies: A subset of ultraluminous X-ray sources (those with luminosities higher than 10^{39} erg/s) are thought to be powered by the accretion of gas onto black holes with masses of ~5–20. 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). Investigations of a new luminous ($>10^{39}$ erg/s) X-ray source in the nearby galaxy M 31, which showed extremely high radio luminosity and X-ray variability on a timescale of tens of minutes, indicate that the source is powered by accretion close to the Eddington limit for a stellar-mass black hole. (Researchers involved: P. Reig).

- Populations of Ultra-luminous X-ray sources in nearby galaxies: Ultra-luminous X-ray sources are an intriguing class of objects with luminosities above 10^{39} erg/s and often reaching extreme luminosities of 10^{40} or even 10^{41} erg/s, well above the Eddington limit for a stellar-mass black-hole. The nature and formation pathways of these sources is an open question, and their understanding is particularly important given their significant contribution in the X-ray output of galaxies. We have performed systematic studies of ULX populations in individual nearby galaxies, as well as, their demographics in large samples of galaxies. Our goal is to constrain the dependence of their populations on the age and metallicity of their parent stellar populations. (Researchers involved: A. Zezas, K. Anastasopoulou, K. Kovlakas).

- Hard X-ray observations of nearby galaxies: The NuSTAR observatory gives us an unprecedented view of the hard X-ray emission from nearby galaxies. We are leading the development of diagnostic tools for the characterization of the compact object and accretion state of X-ray binaries, and their application in X-ray observations of nearby galaxies with the NuSTAR and other X-ray telescopes. (Researchers involved: A. Bertsias, K. Anastasopoulou, 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) the determination of the mass function of disks and bulges in the local Universe, (b), a census of AGN activity in local galaxies, and (c) a study of the relation between star-formation and stellar mass in sub-galactic scales (sub-galactic main sequence). On-going projects include Hα and NIR imaging which will be used for the comparison of Hα and other star-formation rate indicators in a variety of star-forming environments (Researchers involved: A. Zezas, K. Kouroubatzakis)

- Disk and bulge mass functions of star-forming galaxies in the local Universe. Based on morphological decomposition of the bulge and disk components in nearby galaxies drawn from the Star-Formation Reference Survey, we calculate the mass functions and mass-density functions of the budge and disk sub-components in star-forming galaxies (Researchers involved: P. Bonfini, A. Zezas, K. Kouroubatzakis, P. Sell)

- Scalling relations between star-formation, stellar mass and X-ray emission in galaxies. As part of our systematic effort to understand the formation of X-ray binaries we perform systematic studies of the relation between X-ray emission of galaxies and their star-forming activity and stellar mass. These studies are based on large, well-defined samples, such as the Star-Formation Reference

Survey, and a complete sample of all known galaxies within 100Mpc (HECATE). These studies explore the galaxy-wide scaling relations, as well correlations in sub-galactic scales. (Researchers involved: A. Zezas, K. Kouroubatzakis, P. Sell, K. Kovlakas, K. Anastasopoulou)

- 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 imaging data and spectroscopy from the Skinakas observatory, as well as other observatories (e.g. NOAO, CTIO). The goal of this project is to understand the populations of SNRs in different wavelengths in a variety of environments (Researchers involved: A. Zezas, M. Kopsacheili, I. Leonidaki).

- Massive stars in nearby galaxies: Massive stars are important tools for understanding stellar evolution. Observations of massive-star populations in nearby galaxies allow us to constrain their recent star-formation history, their dependence on parameters such as age and metallicity, and their connection with the compact object populations in these galaxies as witnessed in X-ray observations. (Researchers involved: A. Zezas).

- X-ray variability studies of AGN: a) Work on the study of X-ray variability of nearby Seyferts with the use of "flux-flux plots" continued, with the publication of a paper reporting the results from such a study of the XMM-Newton and Nustar data of SWIFT J2127.4+5654. The source is highly variable and the existing data sets allowed a detailed study of the source's spectral variability. We are currently exploring the possibility that the method may be possible to extend to the study of the variable optical/UV emission in AGN. b) We completed the theoretical study of the X-ray time-lags spectra in three very bright, and highly variable sources, using the novel KYNREFREV code. The main objective was to investigate whether the available data can identify a rapidly spinning black hole or not. Work in this research area continues with the application of the new code to the very good quality time-lags spectra of IRAS 13224-3809. In addition, we use the code to study disc reverberation due to X-ray illumination in the case of the lamp-post geometry, and also the effects on the observed light curves, if the source is moving (in the case, for example, of the aborted-jet model). (Researchers involved: I. Papadakis, plus collaborators at Czech Astronomical Obs (relativistic Group), E. Kammoun, and collaborators at IUCAA.) c) Work continues in the development of a propagation fluctuations model, in the case of a "realistic" disc (talking into account properly the gas and radiation pressure dominated regions, scattering effects etc) in the case when a part of the released energy is powering the X-ray source. (Researchers involved: I. Papadakis, I. Avgoustakis). Work continues, on the study of nearby luminous, and distant, faint AGN. (Researchers involved: I. Papadakis).

- Optopolarimetric searches for low-energy counterparts of unidentified Fermi sources: Highly polarized point sources were looked for within the positional error circles of some of the most prominent high-Galactic-latitude gamma-ray sources that are yet to be associated with known systems at lower wavelengths. (Researchres involved: D. Blinov, I. Liodakis, N. Mandarakas, A. Pouliasi, V. Pavlidou)

- 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. Supporting simulations of galaxy interactions are used to model as a function of the merger stage the evolution of the star-forming and AGN activity, and the energy output of the interacting galaxies in different wavebands. The goal of this study is to address the connection between galaxy interactions and induced star-formation and AGN activity (Researchers involved: A. Zezas).

- Evolution of elliptical galaxies and their GC systems. Recent studies of the globular cluster systems in nearby elliptical galaxies revealed intriguing asymmetries and clumping in their two-dimensional distribution. This is a direct probe of the recent merging history of their host galaxies. We continued to explore this phenomenon in large samples of galaxies in the Virgo cluster. In addition we extended this study to an investigation between the fine structure in elliptical galaxies and the stellar-mass deficit in their cores. (Researchers involved: A. Zezas, P. Bonfini)

- 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, using multiwavelength observations. A 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. (Researchers involved: V. Charmandaris).

- Studying the multiwavelength morphology of galaxies in clusters: This project was based on optical and near-IR imagery of clusters obtained via the WIde-field Nearby Galaxy-cluster Survey (WINGS). Its main goal is to explore the evolution of galaxy morphology as a function of wavelength and environment. (Researchers involved: V. Charmandaris, A. Psychogyios).

5.3. Atmospheric & Ionospheric Physics

Earth Observation and climate Project: Research work on Earth Observation and the Earth's Radiation Budget is an on-going 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, V. Georgakaki).

- 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 ionospheric phenomena occurring at mid-latitude, and problems associated with the interaction and coupling of the neutral mesosphere and lower thermosphere with the earth's ionosphere. Research focuses on: 1) studying the effects on VLF (very low frequency) electromagnetic wave propagation and the 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, 2) studying the properties of Global Atmospheric Electric Cirquit, 3) investigating the annual and seasonal variations of mid-latitude sporadic E layers as well as the effect of lightning on sporadic E, and 4) studying the effects of X-ray solar flares 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.

- 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)
- Stavros Niarchos Foundation Grant in support of the project "PASIPAHE" (P.I.: K. Tassis, budget: $1,457,000, duration: 2016-2019)
- Marie Curie Individual Fellowship "ORIGAMI", entitled: "The Origin of the Galactic Magnetic Field", (fellow: Ntormousi, budget: €153,000, duration: 2017-2019)
- ERC Consolidator Grant "PASIPHAE", entitled "Overcoming the Dominant Foreground of Inflationary B-modes: Tomography of Galactic Magnetic Dust via Measurements of Starlight Polarization", (P.I.: K. Tassis, budget: €1,887,500, duration: 2018- 2023) (awarded Dec. 2017)
- IAU Grants "Columba-Hypatia" in support of astronomy related activities that will bring together children of the two divided communities in Cyprus (Co-I's: E. Ntormousi & F. Del Sordo, budget: €10,000), and "Amanar", involving astronomy activities with children of the Canary Islands and the Sahrawi refugee camps in Algeria (Co-I's: E. Ntormousi & F. Del Sordo, budget: €7,500).
- INTEREG "GEOSTARS" entitled "Astronomical Observations and natural environment: Alternative products for the development and promotion of geo-parks in Eastern Mediterranean" (P.I. A. Zezas, budget: €410,000, duration: 2018- 2020) (awarded June 2018)

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
  - Astrophysical Observatory INAF Catania (Italy)
  - Astrophysical Observatory INAF Torino (Italy)
  - Australian National University, Australia
  - California Institute of Technology, Spitzer Science Center, Pasadena, CA, USA
  - CEA/Saclay, Service d'Astrophysique, Paris, France
  - Ecole Normale Supérieure, Paris, France
  - Eötvos-Lenard University, Budapest, Hungary
  - ETH, Zurich, Switzerland
  - Harvard-Smithsonian, Center for Astrophysics, Cambridge, MA, USA
  - Hebrew University of Jerusalem, Jerusalem, Israel
  - Institut d'Astrophysique de Paris, France
  - Imperial College, London, U.K.
  - 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
  - Queen Mary University London (UK)
  - Rome Observatory, Rome, Italy
  - South African Astronomical Observatories, Sutherland, South Africa
  - Stanford University, Palo Alto, CA, USA
  - Université de Geneve, Geneva, Switzerland
  - Université de Rennes, Rennes, France
  - University of Alicante, Alicante, Spain
  - University of Copenhagen, Denmark
  - University of Dundee, UK
  - University of Diego Portales, Chile
  - University of Durham, Durham, UK
  - University of Minas Gerais (Brazil)
  - University of Napoli Federico, Napoli, Italy
  - University of Oslo, Norway
  - University of Southampton, Southampton, UK
  - University of Texas at Austin, Austin, TX, USA

- University of Valencia, Valencia, Spain
- University of Wisconsin-Madisson, USA
- University of Zielona Gora, 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 term as the Director of the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens on Sep 24, 2018. He is member of the Haut Comité Scientifique of Paris Observatory (France), since 2015 and continued serving as the representative of Greece to the Board of Directors and a member of the Executive Committee of the scientific journal "Astronomy & Astrophysics". He is also member of the Executive and Strategy Committee of the OPTICON EC funded coordination network.

Professor N. Kylafis completed in March 2018 his service as the President of Greek National Committee for Astronomy, which had commenced in 2011. In August 2018 he was elected, and commenced his appointment, as member of the Council of the European Astronomical Society.

Professor I. Papadakis continues to serve as the Chairman of the Department of Physics since October 2015.

Professor V. Pavlidou was re-elected as a member of the Governing Council of the Hellenic Astronomical Society. She is also serving as the Management Panel Chair of the RoboPol Collaboration and as a member of the Management Committee of the European COST action PHAROS on neutron star physics.

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

Professor K. Tassis is serving as the Management Panel Chair of the PASIPHAE Collaboration.

Professor A. Zezas is serving as a member of the NuSTAR Users Committee, as well as a member of the ATHENA-WFI Instrument & Science Ground Segment Team

9. Conference & Workshop Organization

The group formally hosted on the 5-6 of November the Board Meeting of OPTICON, EC-funded coordination network. Over the past 20 years supports the multi-national partnerships and Joint Research Activities in fields of astronomical instrumentation and technology development along with Networking Activities and Transnational Access to telescopes across Europe and all over the world.

The group hosted the 9th FERO (Finding Extreme Relativistic Objects) meeting on May 23-25, 2018.

10. PUBLIC OUTREACH

All members of the Section were 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 20, June 24, July 22, August 19, and September 16. Hundreds 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 1.3 m telescope.

The Astronomy Group actively participated in the European Researchers' Night (September 28, 2018), which has become one of the most important events in science for the local community of Heraklion (Crete). As in the previous years the events of 2018 were very successful with large participation of the public. The Skinakas observatory participated with the presence of two senior astronomers (K. Tassis, A. Zezas and P. Reig), one postdoc (E. Ntormousi), 4 PhD students (K. Kouroumpatzakis, M. Kopsacheili, K. Athanasopoulou and R. Skalidis) and one technician (A. Steiakaki). The show included short video projections of the observatory and a selection of pictures of cosmic objects obtained with the cameras of the observatory.

E. Ntormousi, V. Pavlidou, K. Tassis, and A. Zezas gave talks at the 15th year anniversary celebration of the Student's Astronomy Club of the University of Crete that took place at the "Manolis Karellis" auditorium of the city of Heraklion on the 3rd and 4th of November.

E. Ntormousi wrote eight popular science articles for the online magazine "www.ampa.lifo.gr".

On 27 November 2018 V. Pavlidou and K. Tassis participated in the "Astronomy" themed episode of the Dialogues series by the Stavros Niarchos Foundation at the Eugenides Foundation's New Digital Planetarium. The content of the discussion is available here:
https://www.snf.org/en/initiatives/snf-dialogues/dialogues-astronomy-november-2018/
For the needs of this event, the Stavros Niarchos Foundation developed a short video presentation for the PASIPAHE experiment, which they have supported with an infrastructure development grant. The video is available here:
https://www.snf.org/en/newsroom/news/2018/11/snf-presents-%E2%80%A6-pasiphae/

The Science paper by our group on recovering the 3D shape of the Musca molecular cloud received international attention, and was featured in various worldwide science outreach outlets and mainstream media, including Eurekalert!
https://www.eurekalert.org/multimedia/pub/169837.php
New Scientist
https://www.newscientist.com/article/2168614-interstellar-cloud-mapped-by-listening-to-its-magnetic-waves/
the Los Angeles Times,

https://www.latimes.com/science/sciencenow/la-sci-sn-interstellar-cloud-3d-20180510-story.html

Several public outreach videos were produced for this discovery, including the one by our group, available here:
https://www.youtube.com/watch?v=_nbwkGlWEJQ
and the one by New Scientist, available here:
https://www.youtube.com/watch?v=oOwlO2UsocA
and the one by the Australian National University, available here:
https://www.youtube.com/watch?time_continue=4&v=K9cp2FWHGLc

11. VISITORS

A total of 14 scientists visited our Department during the 2018 calendar year in order to collaborate with staff members of the Section and/or give seminars. These individuals were: Dr. Thomas Bisbas (University of Florida, USA), Dr. François Boulanger (ENS/Paris, France), Dr. Simon Candelaresi (University of Dundee), Dr. Tanio Diaz-Santos (Univ. of Diego Portales, Chile), Dr. Busaba Kramer (MPIfR, Germany and National Astronomical Research Institute of Thailand), Dr. Hanae Inami (Centre de Recherche Astrophysique de Lyon, France), Dr. Evanthia Hatziminaoglou (ESO, Garching, Germany), Dr. Vibor Jelic (ASTRON, Netherlands), Dr. K. Kolokythas (IUCAA, Pune, India), Prof. Anthony Readhead (Caltech, USA), Dr. Anna Sajina (Tufts University, USA), Dr. Jean-Luc Starck (CEA/Saclay, France), Dr. Marko Stalevski (Astronomical Observatory of Belgrade, Serbia), Dr. Joakim Trumper (MPE, Germany).

12. PUBLICATIONS

The following 39 publications of the members of the Section appeared in print in international refereed journals (according to NASA/ADS) during the 2018 calendar year. This corresponds to 2.4 refereed publications per PhD researcher. For each publication, the names of the members of the Section are underlined.

1. Angelakis, E., Kiehlmann, S., Myserlis, I., Blinov, D., Eggen, J., Itoh, R., Marchili, N., Zensus, J. A., *Optical polarisation variability of radio-loud narrow-line Seyfert 1 galaxies. Search for long rotations of the polarisation plane*, Astronomy & Astrophysics, 2018, **618**, A92, 13 pp.
2. Andrews, J.J., Zezas, A., and Fragos, T., *dart_board: Binary Population Synthesis with Markov Chain Monte Carlo.* Astrophysical Journal Supplement Series, 2018. **237**(1).
3. Ahnen, M. L., et al. (including Blinov, D. A.)., *Extreme HBL behavior of Markarian 501 during 2012*, Astron. & Astrophysics, 2018, **620**, A181, 23 pp.
4. Arabsalmani, M., Le Floc'h, E., Dannerbauer, H., Feruglio, C., Daddi, E., Ciesla, L., Charmandaris, V., Japelj, J., Vergani, S.D., Duc, P.A., Basa, S., Bournaud, F., and Elbaz, D., *A molecular gas-rich GRB host galaxy at the peak of cosmic star formation.* Monthly Notices of the Royal Astronomical Society, 2018. **476**(2): p. 2332-2338.
5. Blinov, D., Pavlidou, V., Papadakis, I., Kiehlmann, S., Liodakis, I., Panopoulou, G.V., Angelakis, E., Balokovic, M., Hovatta, T., King, O.G., Kus, A., Kylafis, N., Mahabal, A., Maharana, S., Myserlis, I., Paleologou, E.,

Papamastorakis, I., Pazderski, E., Pearson, T.J., Ramaprakash, A., Readhead, A.C.S., Reig, P., Tassis, K., and Zensus, J.A., *RoboPol: connection between optical polarization plane rotations and gamma-ray flares in blazars.* Monthly Notices of the Royal Astronomical Society, 2018. **474**(1): p. 1296-1306.

6. Bonanos, A.Z., Avdellidou, C., Liakos, A., Xilouris, E.M., Dapergolas, A., Koschny, D., Bellas-Velidis, I., Boumis, P., Charmandaris, V., Fytsilis, A., and Maroussis, A., *NELIOTA: First temperature measurement of lunar impact flashes.* Astronomy & Astrophysics, 2018. **612**.
7. Bonfini, P., Bitsakis, T., Zezas, A., Duc, P.A., Iodice, E., Gonzalez-Martin, O., Bruzual, G., and Gonzalez Sanoja, A.J., *Connecting traces of galaxy evolution: the missing core mass-morphological fine structure relation.* Monthly Notices of the Royal Astronomical Society, 2018. **473**(1): p. L94-L100.
8. Brightman, M., Balokovic, M., Koss, M., Alexander, D.M., Annuar, A., Earnshaw, H., Gandhi, P., Harrison, F.A., Hornschemeier, A.E., Lehmer, B., Powell, M.C., Ptak, A., Rangelov, B., Roberts, T.P., Stern, D., Walton, D.J., and Zezas, A., *A Long Hard-X-Ray Look at the Dual Active Galactic Nuclei of M51 with NuSTAR.* Astrophysical Journal, 2018. **867**(2).
9. Caballero-Garcia, M.D., Papadakis, I.E., Dovciak, M., Bursa, M., Epitropakis, A., Karas, V., and Svoboda, J., *Testing the X-ray reverberation model KYNREFREV in a sample of Seyfert 1 Active Galactic Nuclei.* Monthly Notices of the Royal Astronomical Society, 2018. **480**(2): p. 2650-2659.
10. Cao, T., Lu, N., Xu, C. K., Zhao, Y., Madhav Kalari, V., Gao, Y., Charmandaris, V., Diaz Santos, T., van der Werf, P., Cao, C., Wu , H., Inami, H., Evans A., *ALMA Observation of NGC 5135: The Circumnuclear CO(6–5) and Dust Continuum Emission at 45 parsec Resolution*. Astrophysical Journal, 2018. **866**(2).
11. Dietrich, J., Weiner, A.S., Ashby, M.L.N., Hayward, C.C., Martinez-Galarza, J.R., Padilla, A.F.R., Rosenthal, L., Smith, H.A., Willner, S.P., and Zezas, A., *The AGN luminosity fraction in merging galaxies.* Monthly Notices of the Royal Astronomical Society, 2018. **480**(3): p. 3562-3583.
12. Fornasini, F.M., Civano, F., Fabbiano, G., Elvis, M., Marchesi, S., Miyaji, T., and Zezas, A., *Low-luminosity AGN and X-Ray Binary Populations in COSMOS Star-forming Galaxies.* Astrophysical Journal, 2018. **865**(1).
13. Haldoupis, C., *Is there a conclusive evidence on lightning-related effects on sporadic E layers?* Journal of Atmospheric and Solar-Terrestrial Physics, 2018. **172**: p. 117-121.
14. Inami, H., Armus, L., Matsuhara, H., Charmandaris, V., Diaz-Santos, T., Surace, J., Stierwalt, S., Ohyama, Y., Howell, J., Marshall, J., Evans, A.S., Linden, S.T., and Mazzarella, J., *The AKARI 2.5-5 micron spectra of luminous infrared galaxies in the local Universe.* Astronomy & Astrophysics, 2018. **617**.
15. Kammoun, E.S. and Papadakis, I.E., *The nature of X-ray spectral variability in SWIFT J2127.4+5654.* Monthly Notices of the Royal Astronomical Society, 2018. **480**(3): p. 3412-3423.
16. Kylafis, N.D. and Reig, P., *Correlation of time lag and photon index in GX 339-4.* Astronomy & Astrophysics, 2018. **614**.
17. Lazzarini, M., Hornschemeier, A.E., Williams, B.F., Wik, D., Vulic, N., Yukita, M., Zezas, A., Lewis, A.R., Durbin, M., Ptak, A., Bodaghee, A., Lehmer, B.D., Antoniou, V., and Maccarone, T., *Young Accreting Compact Objects in M31: The Combined Power of NuSTAR, Chandra, and Hubble.* Astrophysical Journal, 2018. **862**(1).
18. Lu, N., Cao, T., Diaz-Santos, T., Zhao, Y., Privon, G.C., Cheng, C., Gao, Y., Xu, C.K., Charmandaris, V., Rigopoulou, D., van der Werf, P.P., Huang, J., Wang, Z., Evans, A.S., and Sanders, D.B., *CO (7-6), C I 370 mu m, and N II*

205 mu m Line Emission of the QSO BRI1335-0417 at Redshift 4.407. Astrophysical Journal, 2018. **864**(1).

19. Maragkoudakis, A., Zezas, A., Ashby, M.L.N., and Willner, S.P., *The Star Formation Reference Survey - II. Activity demographics and host-galaxy properties for infrared-selected galaxies.* Monthly Notices of the Royal Astronomical Society, 2018. **475**(2): p. 1485-1507.

20. Marshall, J.A., Elitzur, M., Armus, L., Diaz-Santos, T., and Charmandaris, V., *The Nature of Deeply Buried Ultraluminous Infrared Galaxies: A Unified Model for Highly Obscured Dusty Galaxy Emission.* Astrophysical Journal, 2018. **858**(1).

21. McHardy, I.M., Connolly, S.D., Horne, K., Cackett, E.M., Gelbord, J., Peterson, B.M., Pahari, M., Gehrels, N., Goad, M., Lira, P., Arevalo, P., Baldi, R.D., Brandt, N., Breedt, E., Chand, H., Dewangan, G., Done, C., Elvis, M., Emmanoulopoulos, D., Fausnaugh, M.M., Kaspi, S., Kochanek, C.S., Korista, K., Papadakis, I.E., Rao, A.R., Uttley, P., Vestergaard, M., and Ward, M.J., *X-ray/UV/optical variability of NGC 4593 with Swift: reprocessing of X-rays by an extended reprocessor.* Monthly Notices of the Royal Astronomical Society, 2018. **480**(3): p. 2881-2897.

22. Ntormousi, E., Magnetic fields in massive spirals: The role of feedback and initial conditions, Astronomy & Astrophysics, 2018, **619**, L5

23. Petric, A.O., Armus, L., Flagey, N., Guillard, P., Howell, J., Inami, H., Charmandaris, V., Evanss, A., Stierwalt, S., Diaz-Santos, T., Lu, N., Spoon, H., Mazzarella, J., Appleton, P., Chan, B., Chu, J., Hand, D., Privon, G., Sanders, D., Surace, J., Xu, K., and Zhao, Y., *Warm Molecular Hydrogen in Nearby, Luminous Infrared Galaxies.* Astronomical Journal, 2018. **156**(6).

24. Reig, P. and Blinov, D., *Warped disks during type II outbursts in Be/X-ray binaries: evidence from optical polarimetry.* Astron. & Astrophysics, 2018. **619**.

25. Reig, P., Kylafis, N.D., Papadakis, I.E., and Teresa Costado, M., *The photon-index-time-lag correlation in black hole X-ray binaries.* Monthly Notices of the Royal Astronomical Society, 2018. **473**(4): p. 4644-4652.

26. Reig, P. and Zezas, A., *Discovery of X-ray pulsations in the Be/X-ray binary IGR J06074+2205.* Astronomy & Astrophysics, 2018. **613**.

27. Skalidis, R., Panopoulou, G.V., Tassis, K., Pavlidou, V., Blinov, D., Komis, I., and Liodakis, I., *Local measurements of the mean interstellar polarization at high Galactic latitudes.* Astronomy & Astrophysics, 2018. **616**.

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2018 Annual Report
Published on April 15, 2019
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