UNIVERSITY OF CRETE
Physics Department
Section of Astrophysics and Space Physics

Faculty members (in 1998):

C. Haldoupis, Associate Professor (Experimental Ionospheric Physics)
D. Hatzidimitriou, Assistant Professor (Observational Astrophysics)
N. Kyliafis, Professor (Theoretical Astrophysics)
J. Papamastorakis, Associate Professor (Observational Astrophysics)
K. Tsinganos, Professor (Theoretical Astrophysics)
I. Vardavas, Associate Professor (Theoretical Environmental Physics)
J. Ventura, Professor (Theoretical Astrophysics)

Research staff with PhD on grant money (in 1998):

J. Contopoulos (Theoretical Astrophysics)
B. Crock (Environmental Physics/Observational Astrophysics)
F. Mavromatakis (Observational Astrophysics)
E. Paleologou (Observational Astrophysics)
I. Papadakis (Observational Astrophysics)
G. Vlastou (Environmental Physics)

GENERAL DESCRIPTION OF RESEARCH

Research in Astrophysics and Space Physics - both theoretical and observational – covers
a broad range of subjects, ranging from studies of the Earth’s atmosphere/ionosphere, to the
study of distant galaxies. Within our Solar System, research is concentrated on the dynamics
of solar plasmas and the solar wind, as well as the evolution of planetary atmospheres. In
our Galaxy, young stellar objects, white dwarfs, neutron stars, black holes, planetary nebulae,
supernova remnants, globular clusters, and RR-Lyrae variable stars. Beyond our Galaxy, on
the star formation history and evolution of galaxies in the Local Group, on dust distribution
in spiral galaxies, astronomical MASERS, jets and other exotic phenomena in active galactic
nuclei and quasars.

The data used are obtained from a variety of optical telescopes (Skinakas, AAT, CTIO),
radio telescopes (VLBI, AT), the Hubble Space Telescope, several satellites and radars.

The scientific impact of the Section is quantified with about 10 - 15 publications in
refereed journals per year and about 5 - 10 invited talks in international conference proceedings
per year.

The main research activities of the Section, as well as a description of the activities of
the Skinakas Observatory, are given below.
SPECIFIC RESEARCH WORK

Research on the evolution of planetary atmospheres and that of the Earth's atmosphere is being conducted with the use of computer simulation models of atmospheric composition, radiation field and thermal structure. These models generate the vertical structure of the atmosphere's temperature and the concentrations of the molecular constituents. The research fields include the evolution of the earth's climate in relation to solar and geological evolution, and the atmospheres of Titan and Mars. Research is also carried out on atmospheric ozone in the upper atmosphere, and on other environmental issues such as the energy balance of the Earth's surface/atmosphere, and sustainable water resource exploitation.

Research in ionospheric physics, such as investigation of coherent radio wave backscatter phenomena from, magnetic aspect-sensitive, electrostatic plasma waves in the lower ionosphere. Operation of HF (Valensole system in South France) and VHF (SESCAT system in Crete) Doppler radars at midlatitude for ionospheric backscatter Doppler measurements. Experimental and theoretical study of plasma instability mechanisms and electrodynamics in the midlatitude $E$ region ionosphere, in the presence of sporadic $E_s$ layers and atmospheric gravity waves. Ionospheric Auroral zone plasma studies of coherent and incoherent scatter phenomena using the European Incoherent Scatter Scatter. Wind potential and turbulence studies and applied research on wind energy problems using wind measurements and mass-consistent models.

Modern observations, including recent ones with the Hubble Space Telescope, have shown that our Universe is replete with dynamic plasmas and enigmatic outflows. One area of research is the study of solar plasmas, i.e., magnetofluids in the interior of the Sun and its dynamic atmosphere and solar wind. Another broad direction of active research concerns astrophysical plasmas, such as stellar winds, collimated outflows from young stellar objects and accretion disks, jets associated with enigmatic binaries and symbiotic stars, relativistic outflows from galactic objects or active galactic nuclei and quasars probably fueled by supermassive black holes.

Research in Theoretical High Energy Astrophysics including, in particular, the physics of high magnetic fields, pulsars, neutron stars, radiative processes, radiative transport and spectral formation in these objects, accretion onto neutron stars and black holes in binaries, and gamma-ray burst sources.

Research in Theoretical Astrophysics is also in subjects related to modelling of astronomical objects and transfer of radiation of all wavelengths in various astronomical environments. Specific objects of research are: a) X-ray sources (white dwarfs, neutron stars, black holes), b) astronomical MASERs and c) spiral galaxies.

Using the 1.3m Telescope at Skinakas Observatory, research is done in observational astrophysics including the study of the morphology and chemical composition of Supernova Remnants and Planetary Nebulae (using observations through narrow band interference filters and spectrophotometry), with the aim of better understanding the emission processes and the last stages of stellar evolution (e.g., detection of extended halos in planetary nebulae resulting from stellar winds). Also, study of galactic globular clusters with the purpose of better determining their ages and distances (using RR-Lyrae variables), as well as of investigating in detail various stages in stellar evolution. Also, using large telescope facilities (both spectroscopic and direct imaging, in the optical and radio, in Australia with the AAT and AT and Chile at CTIO), study of star formation history, chemical evolution, and dynamics of Local Group Galaxies, including the Magellanic Clouds, and the dwarf spheroidals (Carina, Sculptor, Fornax).
SKINAKAS OBSERVATORY

The favourable climatological conditions prevailing in Crete (large number of clear-sky nights per year) combined with the high mountains, place the island of Crete among the best locations in Europe for high quality astronomical observations. These facts were influential in the establishment of the Skinakas Observatory.

The Skinakas Observatory has been built and operates as part of a scientific research collaboration between the University of Crete, the Foundation for Research and Technology-Hellas (FORTH) and the Max-Planck-Institut für Extraterrestrische Physik of Germany (in charge of the Greek side is Professor J. Papamastorakis and of the German side Professor G. Haerendel). The site of the Observatory, chosen on scientific and functional grounds, is the Skinakas summit of Mount Ida (Psiloritis), at an altitude of 1760 m and 60 km from Heraklion.

In 1985 a road 2.5 km long was built to the Skinakas summit and the first observatory building was constructed, housing since 1986 a telescope with a 30 cm reflector of focal ratio f/3.2. A 200 m² residential building was completed in 1988.

Since a 30 cm telescope is too small for research purposes, it was decided in 1990 and in the framework of the collaboration between the three Institutions (University of Crete, FORTH, Max-Planck Institut) to significantly extend the Skinakas installations by building a larger observatory containing a telescope with a 1.3 m reflector, which is the biggest telescope installed in Greece to date. The inauguration of the new telescope took place in October 1995.

The new Observatory, built entirely of metal, has a dome of 8 m diameter. The telescope is of Ritchey-Cretien type with focal ratio f/7.6 and a maximum field of view of 45 arcmin. The optical components were manufactured by the Karl-Zeiss Company in Germany. The mount and computer-driven control system of the telescope (which also controls the rotation of the dome) were constructed by DFM Engineering (USA); it is of similar design to that of the Harvard Smithsonian Observatory.

The instrumentation of the 1.3 m telescope includes:

- A Focal Reducer which reduces by 1.9 the focal length of the telescope. In addition, it allows for low resolution spectroscopic measurements.
- An Autoguider.
- Three CCD cameras: one with 1024 x 1024 pixels and two with 800 x 2000 pixels. A fourth CCD camera (1024 x 1024 pixels) has been ordered.
- A tip-tilt system for the reduction of the atmospheric seeing (typical seeing on Skinakas is about 1 arcsec or less) is under construction and will be completed in 1998.
- A high resolution (R=35000) Echelle Spectrograph is under construction and will be commissioned in 1998.
- An infrared camera (for the spectral region 1µ - 2.4µ) is at the design stage.

The main ongoing astronomical projects at the Observatory of Skinakas include:

- studies of planetary nebulae (imaging faint halos, 2-D mapping of abundances),
- supernova remnants (imaging of known SNRs, optical detection of X-ray emitting SNRs),
- globular clusters (horizontal branch, CMD, age, RR Lyrae),
- distribution of dust in spiral galaxies,
- low-resolution spectroscopy of X-ray active stars.
PUBLICATIONS

1993

I. Journal Publications (alphabetical by first author)


II. Publications in Conference Proceedings (alphabetical by first author)


1994

I. Journal Publications (alphabetical by first author)


II. Publications in Conference Proceedings (alphabetical by first author)


3. “Low-mass X-ray Binary Models for the Supersoft X-ray Sources in the Large Magellanic


1995

I. Journal Publications (alphabetical by first author)


8. “Cross Correlations of Simulated Blazar Flaring Data”, S. J. Litchfield, E. I. Robson


II. Publications in Conference Proceedings (alphabetical by first author)


1996

I. Journal Publications (alphabetical by first author)


II. Publications in Conference Proceedings (alphabetical by first author)


1997

I. Journal Publications (alphabetical by first author)


5. “Simultaneous Observations of E Region Coherent Radar Echoes at 2m and 6m Radio


II. Publications in Conference Proceedings (alphabetical by first author)


FUNDING DURING 1993 - 1996. Person in Crete was Principal Investigator

1. Three grants under the Human Capital and Mobility Program of the European Union.
2. One grant under the ENVIRONMENT Program of the European Union.
3. Two grants under the INTAS Program of the European Union.
4. Two grants under the ERASMUS Inter-University Cooperation Program of the European Union.
5. Three NATO grants for International Collaboration in Research.
6. Five grants under the Π.ΕΝ.Ε.Δ. Program of the General Secretariat for Research and Technology of Greece.
7. Two grants under the Bilateral Greek-British Scientific Collaboration Program.
8. One grant under the Bilateral Greek-French Scientific Collaboration Program.
9. One grant under the Bilateral Greek-Italian Scientific Collaboration Program.
10. One grant under the ENVIRONMENT Program of the Regional Office of Crete.
11. Several grants to support visits to other Research Institutes, participation at International Conferences and observing at major Observatories.

FUNDING DURING 1997. Person in Crete was Principal Investigator

1. One grant under the ENVIRONMENT Program of the European Union.
2. Two grants under the INTAS Program of the European Union.
3. One grant under the ERASMUS Inter-University Cooperation Program of the European Union.
4. Three NATO grants for International Collaboration in Research.
5. One ‘Small Research Grant’ from the American Astronomical Society.
6. Five grants under the Π.ΕΝ.Ε.Δ. Program of the General Secretariat for Research and Technology of Greece.
7. Two grants under the Bilateral Greek-British Scientific Collaboration Program.
8. One grant under the Bilateral Greek-French Scientific Collaboration Program.