

# HIPPARCHOS

The Hellenic Astronomical Society Newsletter

Volume 3, Issue 7

ISSN: 1790-9252



1993-2023





# Contents

## HIPPARCHOS

Volume 3, Issue 7 • July 2023

ISSN: 1790-9252

Hipparchos is the official newsletter of the Hellenic Astronomical Society. It publishes review papers, news and comments on topics of interest to astronomers, including matters concerning members of the Hellenic Astronomical Society.

### Editorial board

- **Georgios Balasis**  
(National Observatory of Athens)
- **Konstantinos Gourgouliaos**  
(University of Patras)
- **Elias Koulouridis**  
(National Observatory of Athens)
- **Konstantinos Tassis**  
(University of Crete)

### Contact person

Georgios Balasis  
Institute for Astronomy, Astrophysics,  
Space Applications and Remote  
Sensing (IAASARS), National  
Observatory of Athens (NOA)  
Lofos Nymphon, PO Box 20048,  
11810, Athens

Tel: +30-210 810 9185

E-mail: gbalasis@noa.gr

### Editorial Advisors

- **Vassilis Charmandaris**  
(University of Crete)
- **Athanasios Papaioannou**  
(National Observatory of Athens)
- **Maria Petropoulou**  
(National and Kapodistrian  
University of Athens)

**Message from the President** ..... 3

**Addresses on the 30<sup>th</sup> year anniversary of HelAS** ..... 4

### SUMMARY OF ALL MAJOR ASTRONOMY RESEARCH UNITS IN GREECE

**Astrophysics and Space Physics at the Department of Physics  
of the National and Kapodistrian University of Athens** ..... 7

**Section of Astrophysics, Astronomy & Mechanics,  
Department of Physics, Aristotle University of Thessaloniki** ..... 11

**Astronomy and Astrophysics,  
Department of Physics, University of Patras** ..... 13

**University of Crete, Department of Physics** ..... 15

**Laboratory of Astronomy, Physics Department,  
University of Ioannina** ..... 16

**Department of Electrical and Computer Engineering,  
Democritus University of Thrace** ..... 17

**National Observatory of Athens (NOA)** ..... 19

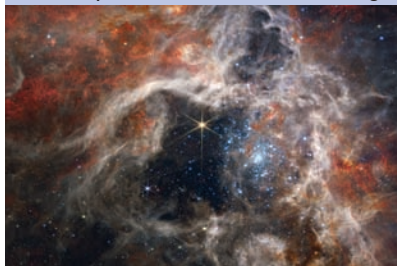
**Research Center for Astronomy and Applied Mathematics,  
Academy of Athens** ..... 24

**Office of Space Research and Technology,  
Academy of Athens** ..... 26

**The Institute of Astrophysics - FORTH** ..... 27

**The Hellenic Space Center** ..... 29

Printed by ZITI Publications • www.ziti.gr



Cover Image: A Cosmic Tarantula, Caught by NASA's Webb

In this mosaic image stretching 340 light-years across, Webb's Near-Infrared Camera (NIRCam) displays the Tarantula Nebula star-forming region in a new light, including tens of thousands of never-before-seen young stars that were previously shrouded in cosmic dust. The most active region appears to sparkle with massive young stars, appearing pale blue.

Credits: NASA, ESA, CSA, STScI, Webb ERO Production Team



## Message from the President

**O**n May 25, 1993 an endeavor which started nearly a decade earlier became a reality. Thanks to the hard work and selfless effort of a few colleagues with a vision, and the support of 66 more professional astronomers in Greece and abroad, the Hellenic Astronomical Society (HelAS) was formally founded.

Today, 30 years later, on the occasion of the 16<sup>th</sup> Conference of HelAS, which takes place in Athens between June 26 and 28, 2023, we will have the privilege to celebrate this major anniversary for the future of Greek Astronomy.

The Society has formally reached a stage of “maturity”. Going into its fourth decade it has a total of 303 members, and despite the brutal effects of the arrow of time, we are all happy that 32 of the original founding members are still with us, with many of them presenting their scientific results in the Conference. In

addition to those, the Society now has 206 ordinary members, 56 junior and 9 associate members. It is worth pointing out that 40% of our members work or study in 24 countries outside Greece, with the majority of them living in the US, UK, Germany and France. This international perspective of our members, many of which maintain close collaborations with astronomers in Greece or return back in permanent positions has had a major positive effect in the advancement of astronomy in our country.

During the 16<sup>th</sup> Conference of HelAS in June, we will once more learn and discuss about exciting scientific discoveries in which many Greek astronomers are involved, as well as hear about the upgrades our national research infrastructures. The current Governing Council of HelAS decided that it will also be the time to honor the past Presidents of the Society who have offered their time and

energy in order to improve the Society and shape the advancement of astronomy in Greece. Acknowledging the substantive effort of our colleagues it is also a clear sign of maturity.

Following a tradition which started with the 20<sup>th</sup> year anniversary of HelAS, this special issue of *Hipparchos* includes a brief summary of all major astronomy research units in Greece, as well as the thoughts of some of the past Presidents. Thus, it will hopefully act as a second “time capsule”, which may provide some useful perspective to the future members of our Society, who may wish to look back on the state of astronomy in Greece in 2023.

---

*Vassilis Charmandaris*  
*President of Hel.A.S.*

---



# 1993-2023

### Address by G. Contopoulos



**T**he Hellenic Astronomical Society (Hel. A.S.) has now completed its first 30 years of existence. When it started (in 1993) it had about 40 members, but now its membership has grown to more than 300. All these years Hel. A.S. has played an important role as regards the collaboration of Greek astronomers and has provided an excellent image internationally. It has organized several meetings and it has issued the very successful journal "Hipparchos". There is no doubt that its prospects for the future are excellent and I give my best wishes to all its members.

### Address by P. G. Laskarides



**A**s I have explained in my 2013 message to the HELAS members, our Society was born from a general dream of the founding astronomers of these days, but the man behind the sparking of the flame was the late John Seiradakis. Therefore, I believe that this celebration of the 30 years of the successful trajectory of HELAS should be dedicated to John, since it comes short after his passing away. Personally I believe that the past and present state of our Society and the number of new and young members enrolled year after year guarantee its long and glorious life ahead. I shall try to keep touch with the Society and to participate in the General Meetings as long as my health permits, and I argue the other founding members of the Society to do the same.

### Address by K. Tsinganos

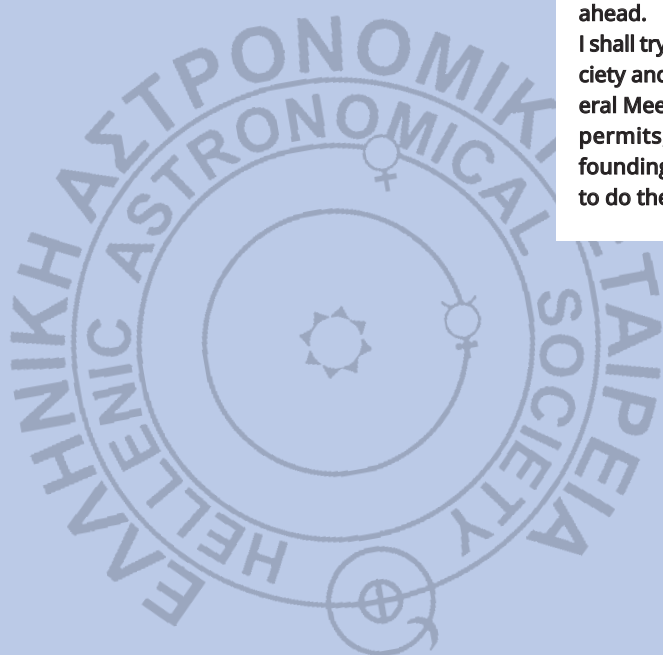


**T**he publication of a special issue of the official annual newsletter HIPPARCHOS, of the Hellenic Astronomical Society (Hel.A.S.), on the occasion of the completion of 30 years since the establishment of the Society is an opportunity to reflect on the past and conjecture on the future of Hel.A.S. Up to now and thanks to the efforts and ideas of its governing councils, Hel.A.S. has developed in the last 30 years a network of actions which all together show that it has become a modern astronomical society. To substantiate this claim, I list briefly in the following this network of actions.

► The contents and the quality of the 33 issues, till today, of the annual newsletter HIPPARCHOS, which is remarkable and a testimony of the high standards of all activities of Hel.A.S. Even today, it is worthwhile and highly recommended, not only to our members, to read various past special issues of HIPPARCHOS dedicated to, for example, the International Year of Astronomy (2009), the status of the observational astronomy in Greece (Sept. 2007), proceedings of the various Hellenic astronomical conferences, etc. If those 33 issues of HIPPARCHOS were bookbinded, this volume could be an ideal gift to international colleagues.

► The Electronic Newsletter which is distributed by e-mail sharply at the beginning of each month to all members of Hel.A.S. with e-mail access. This short newsletter contains brief news, announcements of conferences and job openings in Greece, as well as other news which could be of interest to the members of the Society.

► Speaking of the 15 astronomical conferences which Hel.A.S. has been organizing uninterruptly every other year at various parts of Greece, they have been outstanding not only by the state of the art talks by members of our So-



# 1993-2023



ciety, but also by the participation and invited talks of distinguished astronomers and astrophysicists coming from respected Universities and research institutions from all over the world. As examples, during the 6th Hellenic Astronomical Conference at the National Observatory of Athens, 15-17 September 2003, E.N. Parker, distinguished service professor at the Univ. of Chicago, USA and the founder of Heliospheric Physics, delivered an invited talk on *Magnetohydrodynamic discontinuities and the formation of X-ray coronae in astrophysics*. It is remarkable that the so-called Parker-theorem, explaining the heating of the solar and stellar coronae, has been observed recently via the Parker Solar Probe in the *campfires* and *switchbacks*. The Parker Solar Probe is the only NASA mission named after a living person, as Eugene Parker is credited with developing the theory behind the solar wind in the late 1950's. Other distinguished invited speakers at the Hellenic Astronomical Conferences include Riccardo Giacconi, who won the Nobel Prize for Physics in 2002 for his seminal discoveries of *cosmic sources of X-rays, which helped lay the foundations for the field of X-ray astronomy*, Reinhard Genzel, who has been awarded the 2020 Nobel Prize in Physics *for the discovery of a supermassive compact object at the centre of our galaxy* and were present during the Joint European and National Astronomical Meeting for 1997 (JENAM-97) and the 6th European and 3rd Hellenic Astronomical Society Conference (2-5 July 1997, Thessaloniki). Also, Stamatis Krimigis, Space Department Head, Johns Hopkins University, Applied Physics Laboratory and member of the Academy of Athens, who spoke on *The Dynamic Magnetosphere of Saturn as revealed by the Cassini Orbiter: 2004-2009* and Joachim Truemper, former director of the Max Planck Institute for Extraterrestrial Physics, who spoke on *Current Problems in Neutron Star Physics*, both at the 9th Hellenic Astronomical Conference, 20-24 September 2009, Athens, etc.

► Starting in 2014, Hel.A.S. organizes a Summer School every even year. These Hel.A.S. thematic summer schools provide scientific training to younger members, graduate students and junior post-doctoral researchers: *Physical Processes and Data Analysis in Heliophysics* (Athens, 1-5 September 2014), *Nuclear Activity in Galaxies* (Athens, 11-15 July 2016), *Neu-*

*tron Stars and Gravitational Waves* (Thessaloniki, 8-12 October 2018) and *The Milky Way Galaxy - Formation and Evolution* (Athens, 25-27 July 2022).

► Establishment of the *Best Ph.D. thesis prize*. This prize is awarded every two years during the conference of Hel.A.S. It recognizes the quality of the research work of the junior members of the Society working in the field of Astronomy and Astrophysics. The prize is restricted to members of Hel.A.S. who have successfully defended their thesis in a University either in Greece or abroad, during the period of the award.

► Thanks to the efforts of the current president prof. V. Charmandaris, Hel.A.S. has compiled a database of more than 600 individuals of Greek descent, who have obtained a PhD in Astrophysics, Dynamical Astronomy, or Space Physics, either in Greece or abroad. More in detail, for each PhD holder the database provides information regarding the PhD awarding institution and supervisor(s), the thesis title and link to the manuscript, when available, as well as the last known position and affiliation of the author. In some cases a brief biography is also included. An interesting appendix with the relevant statistics is also provided, listing the country of the PhD institution and the last known position of the PhD holder.

► An equally interesting information is provided for the more than 300 members of Hel.A.S., as of today. This online version of the directory of the members of the Hellenic Astronomical Society, shows that currently the Society has 303 members, two thirds of which are associated with Greek academic institutions.

► Finally, an amazing link is finally provided for the physics and astronomy-trees of several members of Hel.A.S., again an initiative of the current president prof. V. Charmandaris. For example, one can learn if among his/her physics-tree great/great/grandparents could be Schwarzschild, or Heisenberg, Gauss, or Bernoulli, etc!

Altogether, then judging from the above actions, we are all delighted to witness the great steps the Society has taken over the past 30 years to become, in this relatively short period, a modern astronomical society of high standards.

I wish from the bottom of my heart that Hel.A.S.' future governing boards continue the upward trajectory of the Society.

## Address by N. Kylafis



It is with great pleasure that I recall the history of HelAS. It all started with the first Greek Astronomical Conference in 1992, when the foundations were laid for the creation of HelAS. Since then, its course has been upward and this can be seen from the scientific quality of both its members and its conferences. I have said it many times that there is no future if the new generation is not better than the previous one. I have closely followed the development of Astronomy in Greece over the last 40 years and I am happy about its steady positive slope. I am very proud of the new generation of Greek Astronomers! Greek Astronomy enjoys the respect of the international community.

There is a tradition in HelAS that there is only one candidate for President in the elections (pre-selected by the previous presidents). This has worked well and has kept the Society united. What I wish for HelAS is that it stays united and sets high goals.

## Address by L. Vlahos

I have been a proud member of the governing council of Hel.A.S. for several years. As I happened to return to Greece from the U.S.A. around the time our society was established, I have had the opportunity to follow its rapid growth all these years. My impression is that the atmosphere of mutual respect among the members of our society working in Greece or abroad has been growing all these years, and increasingly more young colleagues seek opportunities to return and work in Greek institutions or establish collaborations through national, European, or international research programs. Maintaining a high standard of excellence in the selection of new members or promotion of existing members in all Greek research establishments has been challenging, but I am proud to say we have so far succeeded. This atmosphere of mutual trust should be maintained and improved in the coming years, in order to maintain the important support of the young generation for our future programs. As you all know, our section of astronomy and astrophysics in Thessaloniki has helped numerous young astronomers to study abroad and to develop internationally recognized careers. Some of them have now returned and are working in Greece or have been frequent visitors of our institutions. This trend, of helping young students gain the experience of working abroad, is now a common practice in all Greek institutions focusing on astronomy and astrophysics, and has created a large pool of excellent Greek scientist who are now active members of our society.

Our society established several modern tools to improve the rapid communication between its members, such as,

1. The annual newsletter "HIPPARCHOS,"
2. The electronic newsletter that is published at the beginning of each month,
3. Monthly internet-based colloquia,
4. Yearly conferences,
5. Regular summer schools, etc.

Personally, I have had the opportunity to contribute to several excellent,



internet-based, weekly colloquia with participation from many different Greek institutions.

I should also mention that members of our society have been instrumental in establishing many large-scale facilities, and that funding for research from European and Greek institutions is also growing. Further, I am excited about the newly established HELLENIC SPACE CENTER. The establishment of this institution was discussed in many past meetings of Hel. A.S. and is now a reality.

The way we work in observational astronomy is going to change radically over the coming years, and new techniques borrowed from artificial intelligence, machine learning, and other modern computational tools, will allow us to see deeper into the complex processes of astrophysical phenomena. This means that we will need the help and participation of the young generation of astronomers to enter this growing field of research.

Members of our society have established a healthy and fruitful interaction with the societies of amateur astronomers, with highly invested high school teachers inspiring young students to work in astronomy, and volunteers with an interest in astronomy establishing new means for bringing the rapid developments in astronomy closer to the public.

Allow me close by mentioning that I wish the late colleague John Hugh Seiradakis was here today. Giannis did so much for the establishment and the growth of our society. We miss you so much Giannis. I look forward to celebrating the 40th anniversary of our society in 2033!

## Address by A. Mastichiadis



Anniversaries are times not only for celebration but also for recollection and, perhaps, introspection. The 30th anniversary of Hel.A.S. gives us therefore such an opportunity for an overall assessment of the oeuvre of our Society. Certainly thirty years is a long time (not astronomically speaking!) and during this time the field has grown fast and has diversified a lot, posing many challenges to all. Without going to a detailed account of the various activities and initiatives taken over the years which are, undoubtedly, well known, I feel that that the Society has accomplished to a large extend its mission to serve the Greek Astronomers, here and abroad. Comparing to its beginnings, I see a very positive gradient: we have been able to abolish some naturally formed initial suspicions, to utilize the available human resources and the up-to-date technology, and, most importantly, to attract the younger generation of Greek Astronomers and to make them trust their Society. I think that a major reason for the latter is the fact that all of Society's activities are taking place in a good atmosphere. This is apparent at the meetings of the Governing Councils (I can readily testify on this as I have been an eyewitness for eight years) which then diffuses outwards to the General Assemblies and, of course, to the Conference Dinners. I can only hope it keeps that way as this, when combined to a well-meant professionalism, is the golden rule for building a strong, healthy Society which is there for serving its members and not some personal agendas. I am looking forward for the 40th!



# Astrophysics and Space Physics at the Department of Physics of the National and Kapodistrian University of Athens

Editor: D. Hatzidimitriou

Co-authors: T. Apostolatos, I. A. Dagitlis, K. Dasyra, K. Gazeas, S. Kazantzidis, A. Mastichiadis, M. Petropoulou, N. Vlahakis.

The Section of Astrophysics, Astronomy and Mechanics (SAAM) of the Department of Physics of the National and Kapodistrian University of Athens (NKUA) was established in 1983 and currently comprises nine faculty members (Th. Apostolatos, I. A. Dagitlis, K. Dasyra, K. Gazeas, D. Hatzidimitriou, S. Kazantzidis, A. Mastichiadis, M. Petropoulou, N. Vlahakis), who are actively engaged in research in Theoretical, Observational and Computational Astrophysics, Space Physics, and General Relativity.

## 1. Educational activities

The SAAM is an integral part of the Physics Department of NKUA and contributes to the teaching of a large number of undergraduate and graduate courses, both in Physics and Astrophysics. In particular, the undergraduate program offers four compulsory courses and eight electives in Astrophysics and Space Physics. These include "Introduction to Astrophysics" (including laboratory exercises), "Fluid Dynamics", "Stellar Physics", "Advanced Astrophysics Laboratory", "High Energy Astrophysics", "Astrophysical Fluids", "Galaxies", "Applied Optics", "Space and Solar Physics", "Observational Techniques and Data Analysis in Astrophysics" (for both undergraduates and graduates), and "General Relativity" (for both undergraduates and graduates). Each year, approximately 40-50 Physics students choose to specialize in Astrophysics. Short research projects and the final diploma thesis provide opportunities for undergraduate students to engage in research, which is strongly encouraged. The graduate program (with a duration of 18 months) is part of the Master Studies Program in "Physics", which offers three specializations, one of which is in Astrophysics. There are several advanced courses offered, namely "Basic topics in Astrophysics", "Space Physics", "General Theory of Relativity", "Galactic and Extragalactic Astronomy", "Obser-

vational Techniques and Data Analysis in Astrophysics", "Space Systems and Space Weather", "High Energy Astrophysics", "Plasma Astrophysics", "Solar Physics", "Cosmology", "Computational Astrophysics", "Dynamical Astronomy" and "Stellar Structure and Nucleosynthesis". The SAAM Space Physics Group contributes with courses to the Inter-institutional Master Studies Program, STAR.

Typically, there are approximately 20-25 first and second-year MSc students specializing in Astrophysics. There is also a significant number (currently 37) of active PhD candidates in Astrophysics and Space Physics, who work toward a Doctorate Degree in Physical Sciences. Some of these candidates conduct a significant portion of their research in collaborating institutions, primarily the Institute for Astronomy, Astrophysics, Space Applications, and Remote Sensing (IAASARS) of the National Observatory of Athens and the Research Center for Astronomy and Applied Mathematics (RCAAM) of the Academy of Athens. The educational activities are supported by two well equipped laboratories with a total of 40 work stations (PC's). The Gerostathopoulion Observatory, which hosts a 40-cm optical telescope, provides excellent training opportunities to students. SAAM has recently procured a radio interferometer. This instrument will be mounted on the rooftop of the Department of Physics and will be primarily utilized for instructing students on the principles of radio astronomy and for outreach activities.

## 2. Research

The research conducted by the academic staff of the SAAM covers several different fields of Astrophysics and Space Sciences. The main areas of current active research include plasma astrophysics, high-energy astrophysics, stellar and galactic physics, galaxy formation and

evolution, physics of ultra-compact objects, gravitational waves and space physics.

Research at the SAAM is largely supported by external funding, obtained through competitive research proposals. Specifically, over the past five years SAAM members (including post doctoral researchers) have been principal investigators (PIs) of ten research projects (1 EU Horizon-2020, 2 ESA, 4 HFRI, 1 NSRF, 1 MERAC, 1 IKYDA) and local node PIs of six projects (2 EU Horizon Europe, 2 ESA, 2 COST).

The mean annular rate of refereed publications per staff member for the last 5 years, is 4. The total number of citations to the published work of the current SAAM staff members reaches 50000 (source NASA-ADS, April 2023).

A significant number of SAAM members actively participate in international consortia, panels, and committees. Furthermore, they have held or are currently holding positions in esteemed national and international institutions (such as the International Astronomical Union, the Hellenic Astronomical Society, and the Hellenic Space Center), or are members of editorial boards (one is chief editor) of international journals.

Finally, two members of the SAAM staff have been honored with the L'Oréal-UNESCO for Women in Science International Awards.

### 2.1 Astrophysical plasmas

The study of magnetized plasmas is a long-standing activity at SAAM and has three primary components.

The first is related to the study of instabilities in magnetized plasmas. Understanding the physics of the various instabilities and finding their timescales is an important problem in astrophysical and laboratory plasmas. The onset of relativistic magnetized jets in Active Galactic Nuclei (AGN) and Gamma Ray Bursts (GRBs), as well as in X and Z-pinch Laboratory plasmas, is studied using nu-

merical simulations, but mostly analytical work in the linear regime.

The second field of research is the study of the magnetic acceleration mechanism in astrophysical jets. The formation of jets in a variety of astrophysical settings is often attributed to the action of magnetic fields, that efficiently tap the rotational energy of the source and accelerate plasma to high bulk velocities. The SAAM research group have examined the problem in both non-relativistic and relativistic flows in the framework of special relativity, and continue the study in the context of general relativity, trying to understand the way the spacetime around a rotating black hole affects the bulk acceleration and collimation of jets.

The third subject focuses on the way the dynamics of astrophysical jets are affected by Ohmic resistivity, including changes to bulk acceleration and collimation, as well as the features of discontinuities and shock jump conditions.

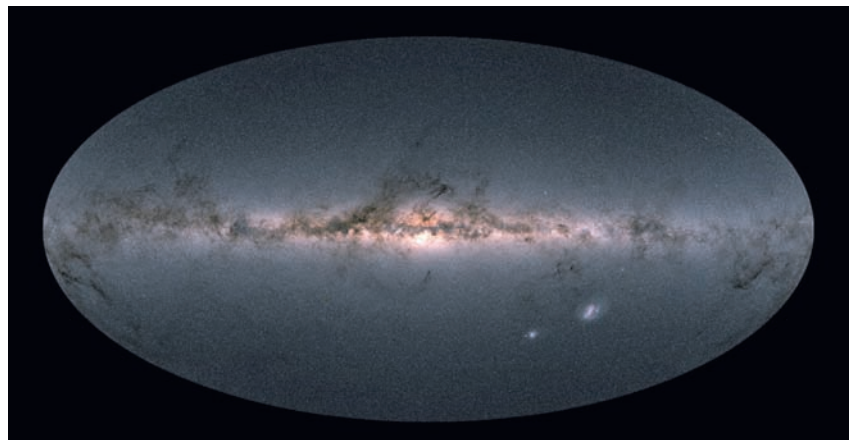
## 2.2. High Energy Astrophysics

High-energy astrophysics (HEA) explores the most energetic phenomena in the Universe, such as stellar explosions, bursts of radiation from magnetars and neutron star mergers, accretion onto compact objects that reside in stellar binaries or in the centers of galaxies, jet formation and radiation. These phenomena are discovered by detecting high-energy electromagnetic radiation as well as non-electromagnetic messengers (neutrinos, cosmic rays and gravitational waves). Theoretical models and numerical simulations are critical for the interpretation of multi-messenger data, especially in the light of rapid multi-messenger follow-up campaigns, future neutrino and GW discoveries, and wide field astronomical surveys.

The main focus of research on these subjects within SAAM is high energy processes in relativistic outflows such as the jets in AGN and GRBs. By using state-of-the-art numerical codes for the radiative transfer in these environments it has been possible to calculate self-consistently the multi-wavelength photon spectra of these objects along with the expected neutrino and cosmic-ray production spectra, long before the dawn of multi-messenger era. The HEA group has been actively involved in NASA review panels, science working groups of future missions, like HEX-P, and in international research programs,



**Figure 1:** Composite image of Crab nebula, a prototypical high-energy source (X-rays: blue; Optical: purple; Infrared: magenta). The image is constructed using observations obtained between March 2000 and November 2003. The image is about 5 (10 light years) across. Credit: X-ray: NASA/CXC/SAO; Optical: NASA/STScI; Infrared: NASA-JPL-Caltech.



**Figure 2:** The Milky Way galaxy based on Gaia DR2 data (2018). Credit: Gaia Data Processing and Analysis Consortium (DPAC); A. Moitinho, A. F. Silva, M. Barros & C. Barata, University of Lisbon, Portugal.

like the Collaborative Research Center (CRC) “Neutrinos and Dark Matter in Astro- and Particle Physics” led by the Technical University of Munich.

While the HEA group of SAAM offers expertise in theoretical high-energy astrophysics, it is important to note that the research in this field is necessarily interdisciplinary, uniting theoretical calculations and simulations, along with multi-messenger observations as well as collaborations with research groups around the world.

## 2.3 Stellar and Galactic Physics

Stellar physics has traditionally been a pivotal research area within the SAAM, encompassing investigations into stellar evolution (including its final stages), stellar binaries (including stellar mergers), stellar variability, asteroseismology, star

clusters, and stellar populations in the Milky Way and its satellites.

The European Space Agency’s (ESA) Gaia mission, which has been launched in 2013 and remains in operation, has substantially impacted the field of stellar physics by providing precise distances to billions of stars and information on their spatial movement, variability, binarity, and a suite of derived astrophysical parameters. The advent of the Gaia era has brought about a revolution in our understanding of the structure and evolution of the Milky Way galaxy and galaxies in the Local Group.

SAAM members have been involved in the Gaia mission since its early stages of preparation and continue to play an active role in the Data Processing and Analysis Consortium (DPAC) of Gaia. The collaboration leading the ESA Gaia proj-



ect has been awarded the 2023 Lancelot M. Berkeley Prize.

The Athens group has committed to working with DPAC until 2030, at which point the final data release of Gaia is scheduled to occur.

## 2.4. Galaxy Formation and Cosmology

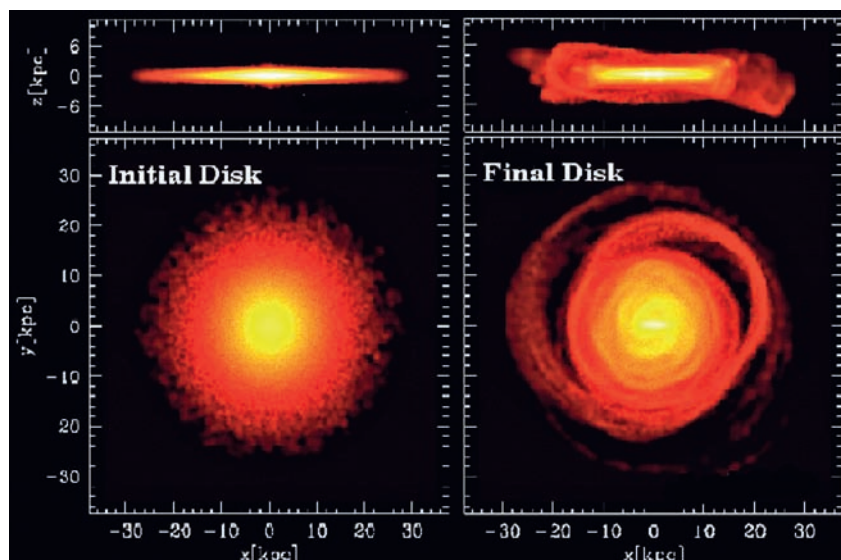
SAAM research in this area is primarily

focused on the formation of galaxies, the role of dark matter, and the creation of supermassive black hole binaries in galaxy mergers. To investigate these areas, modern theoretical tools such as N-body simulations on parallel supercomputers are employed. In the future, with the expected progress in algorithms and supercomputer technolo-

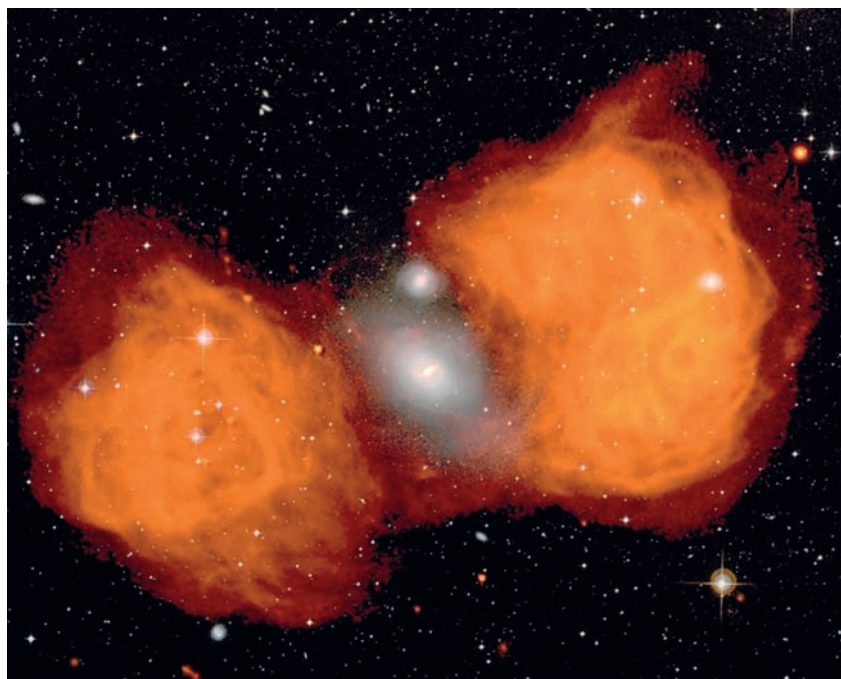
gy, there are plans to develop more realistic theoretical models for galaxies and galactic structure. The ultimate goal is to compare the theoretical models with observations from missions such as the James Webb telescope and Gaia.

## 2.5. Galaxy Evolution

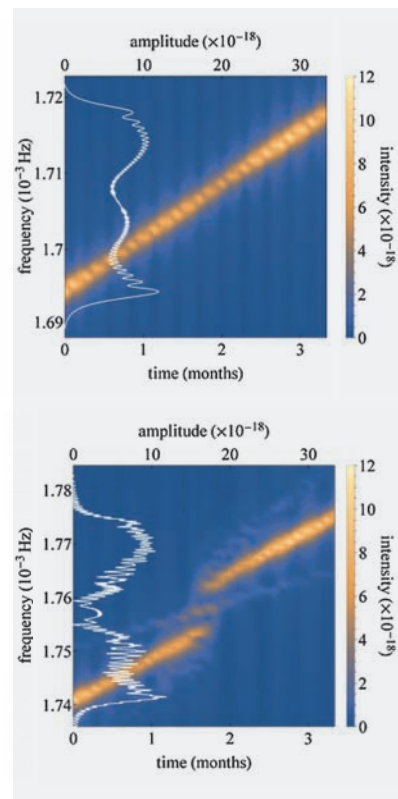
Galaxy evolution is driven by either secular or violent processes. The SAAM research group studies changes of various galaxy properties (such as their content in stars, gas, dust content) with cosmic time and changes of stellar kinematics during galactic collisions. Recently, emphasis has been placed on the modifications incurred to the gas content and star formation of galaxies by feedback mechanisms that are initiated when matter falls onto supermassive black holes in their centers. Numerous surveys of local and distant galaxies from large ground-based facilities have been used for this purpose. Observing time has been secured with the James Webb Space Telescope and its MIRI data will be utilized to study the way a jet of relativistic particles launched by a black hole leads to the collapse or dissipation



**Figure 3:** Density maps from N-body simulations illustrating the morphological evolution of the stellar disk of the Milky Way subject to bombardment by a population of satellite galaxies. Encounters with satellites cause substantial thickening and excite a moderately strong bar and extended ring-like features in the outskirts of the disk. Credit: S. Kazantzidis (NKUA).



**Figure 4:** The well known radio galaxy Fornax A, as seen in a combined radio (orange) and optical (white) image. In the radio, the black hole's jet at the center of the galaxy is observed, while in the optical, the stellar emission is detected. Members of the SAAM study this and other similar galaxies over a large part of the electromagnetic spectrum, with the goal to discover how the jet is formed, how it interacts with the interstellar medium leading to collapse or destruction of molecular clouds, thus affecting the star formation rate. Image Credit: NRAO/AUI/NSF.



**Figure 5:** The figure above shows a glitch in the frequency evolution of GWs, when the orbit of a test body crosses a resonance in a deformed Kerr black-hole spacetime (bottom panel). Credit: Destounis, et al. Phys. Rev. Lett. 126, 141102, 2021

of clouds and thus the change in star formation in a nearby galaxy. The second problem studied pertains to the investigation of the way the deformations of binary neutron stars, due to their mutual tidal forces when they approach each other, could reveal the properties of the interior matter and the way these effects could show up as a distinct characteristic in the final stage of their inspiral, encoded in the corresponding gravitational waves.

## 2.7 Space Physics

The research endeavors of the Space Physics group at SAAM include solar-terrestrial coupling and the resulting geospace explosive phenomena such as space magnetic storms and magnetospheric substorms and the underlying

physical processes such as particle acceleration and loss, electromagnetic wave excitation and wave-particle interactions; forecasting and technological aspects of space weather; planetary exploration; understanding of solar influence on terrestrial climate; application of artificial intelligence techniques on space physics problems; contribution to the national space research infrastructure development and microsatellite development and use.

The Group has been actively involved in review panels, working groups and international teams, such as teams that were selected by the International Space Science Institute (ISSI, Bern, Switzerland). They have also contributed to several white papers for the NASA and ESA Science programs.

**Solar System Studies:** SAAM members are involved in research on solar system objects and more specifically on asteroids, leading an international observing campaign of ancient asteroids.

## 3. Outreach activities

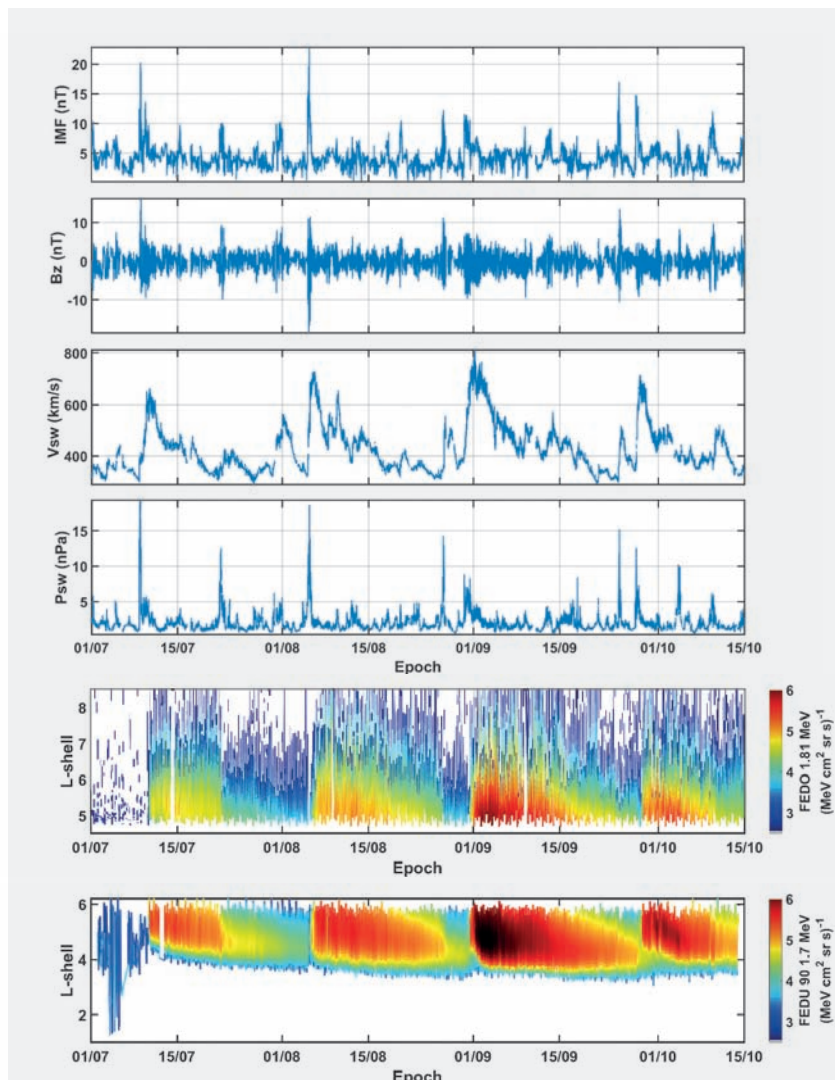
The SAAM members actively participate in outreach initiatives organized by the Gerostathopoulos Observatory ("Public Nights"), the NKUA ("Open Days"), the World Space Week, and other designated outreach events (e.g. the James Webb Space Telescope launch event, or events related to astronomical phenomena such as eclipses, planetary transits etc). The 2022 Europlanet Prize for Public Engagement has been awarded to a SAAM member and the team behind the 'Planets In Your Hand' tactile exhibition. Finally, a SAAM member serves as the National Outreach Coordinator for the International Astronomical Union.

## 4. Future outlook

The SAAM will expand its research capacity over the next two to three years by adding three to four new members of academic staff to its team. These new members will bring their areas of expertise to support the current research activities of the SAAM.

The future development objectives of SAAM are as follows:

- Conducting high-quality research in the fields of astrophysics, space, solar and planetary physics that is recognized nationally and internationally.
- Establishing and maintaining new collaborations and participation in large international experiments such as CTA, IceCube, Virgo/Ligo, Gaia, and others.
- Expanding the network of national and international partners to increase funding opportunities and provide more career opportunities for young scientists.
- Sustaining and enhancing the provision of high-quality education and training for undergraduate and graduate students.
- Disseminating research findings through presentations at international conferences, as well as publishing in international, peer-reviewed journals, and books.



**Figure 6:** Example of the impact of successive High Speed Streams (HSS) of the solar wind on the enhancement of outer belt relativistic electron fluxes at two different satellite orbits – MEO Navigation orbit (Galileo spacecraft) and GTO (Geostationary Transfer Orbit – Van Allen Probes spacecraft). Such events are investigated in detail through multi-spacecraft studies and model simulations, to understand the details of particle acceleration by wave-particle interactions and to facilitate forecasting of such hazardous events in future.



# Section of Astrophysics, Astronomy & Mechanics, Department of Physics, Aristotle University of Thessaloniki



**T**he Section of Astrophysics, Astronomy and Mechanics (AAM) of the Physics Department of the Aristotle University of Thessaloniki consists of two units: a) the Lab of Astronomy and b) the Studitorium of Mechanics, which were founded in 1943. The section currently has 10 faculty members who support the Undergraduate Program Study of the Physics Department by teaching many courses of Mathematics, Theoretical Mechanics, Fluid Mechanics, Astronomy and Astrophysics, Relativity and Cosmology and Dynamical Systems. Also, the section staff teaches Astrodynamics, Astrophysics and computational tools in the M.Sc. of Computational Physics as well as several courses in the M.Sc. of Subatomic Physics and supervises a significant number of student theses. The Secretan telescope and the observatory dome of the AAM have been rebuilt and upgraded recently and the students can be educated efficiently in Observational Astronomy and, additionally, various night events are organized for the public. It participates in the activities of the recently founded Center for the Multidisciplinary Research and Promotion of the Antikythera Mechanism «Ioannis Seiradakis» and collaborates with the Noesis Science Center & Technology Museum.

The members of AAM are involved in many research disciplines. In the last five years more than 6 funded research projects have been completed and currently 5 projects are running. The section has 12 PhD students, 7 postdoctoral researchers and many external collaborators. Its members participate in international scientific groups, such as the VIRGO and LISA groups for the detection of gravitational waves and the investigation teams of DART and Hera space missions. The research infrastructure of the section includes several multiprocessor workstations and the astronomical stations of NOESIS and Holomontas. Holomondas observatory (under refurbishment) hosts a 40cm f/6.5 tracking telescope and a 28cm f/2 survey tele-



scope on a fast-tracking mount, with their auxiliary equipment. The observatory system can be remotely operated, using dedicated software. A second observatory has been built in Thermi (Noesis Station). The installed system features much of the same equipment and automation features as Holomondas (dome control, telescope mount, cameras), hosting a 30-cm tracking telescope and a 20 cm f/2 survey telescope. The telescopes are currently used primarily for satellite tracking activities, asteroid occultations and planetary transits. AAM had a coordinating role in the EU SST Calibration Campaigns for all Greek optical telescopes. Our SST/SSA team participates in the ESA-funded European Optical Network (EON) SST project, as well as other ESA- and EC-funded projects, related to near-Earth objects, planetary defense and science missions.

The research activities of the members of the Studitorium of Mechanics includes:

- Problems in Astrodynamics referred to Space debris (project RedSHIFT), Satellite motion around Earth and Moon (project SELENA), Dynamical environment around asteroids of anomalous shape, the full two-body problem and gravitational interac-

tions in binary asteroid systems, Dynamical environment around binary asteroids (project NEOMAP).

- Applications of the three or N-body problem in asteroid and planetary dynamics. - Currently research is focused on retrograde asteroid motion and resonant chains of multi-planet systems (Laplace resonances).
- Nonlinear oscillations in Hamiltonian and dissipative mechanical systems. Studies include diffusion or energy transport, breathers, hidden attractors and other phenomena. Also, methods of dynamical systems are applied in viral infection spread models.
- Observational astronomy techniques applied to modern celestial mechanics problems. Earth artificial satellite and space debris tracking and attitude estimation using lightcurves. Near-Earth Asteroid orbit refinement using occultations and GAIA astrometric data.

Classical methods of Celestial Mechanics are used e.g. perturbation methods, periodic orbits, stability theory, resonances, chaos indicators, symplectic integrations, theoretical methods of singularity analysis, determination of integrals of motion etc.

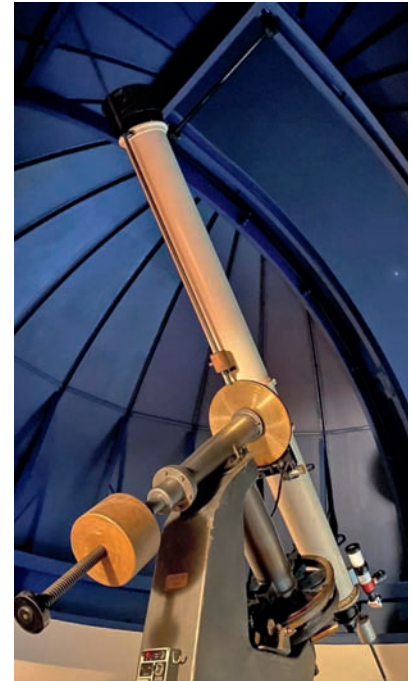
Within the Laboratory of Astronomy, research is focused on the following topics:

- Detection of Gravitational waves with the current LIGO-Virgo-Kagra network. Deep Neural Network algorithms for detection of binary black holes and for constructing efficient template banks. Search strategies for post-merger gravitational waves for binary neutron star systems. Numerical relativity simulations of GW source.
- Inflationary theories, phenomenology of modified gravity and GR-originating theories, dark energy dynamics, dark matter particle models, stochastic gravitational waves originating from primordial tensor modes and prospects of their detectability in LISA-Einstein Telescope, theoretical astrophysics of neutron stars in the context of modified gravity, the theory of electroweak baryogenesis, Higgs portal effects on dark matter and overall effects on primordial gravitational waves, non-trivial topologies of the Universe, the physics of the Hubble tension problem, anisotropic cosmologies. Non-trivial photon dispersion relations effects and their detectability at the Square Kilometer Array and the Cherenkov Array Telescope, cosmological phenomenology in the era of stage 4 CMB experiments.
- Particle acceleration in stochastic electric fields, efficient acceleration in strongly turbulent plasmas. Space weather. Studies also include Laboratory plasmas, with emphasis on non-

linear, complex, and anomalous plasma phenomena (wave-particle interaction, small scale turbulence, plasma transport, self-organized criticality).

- Modeling the structure and global properties of compact objects in GR and modified theories of gravity (exact and approximate solutions, multipole moments, exterior spacetime, universal relations, etc.), and observational tests of these properties using QPOs from accretion discs, X-ray pulse profiles from neutron stars, and GWs.
- Astrophysical tests of GR with compact objects, such as testing for the (non-)Kerr nature of supermassive black holes by either, using GW signals from binary inspirals and QNMs, or observations of their shadow image and its characteristics.

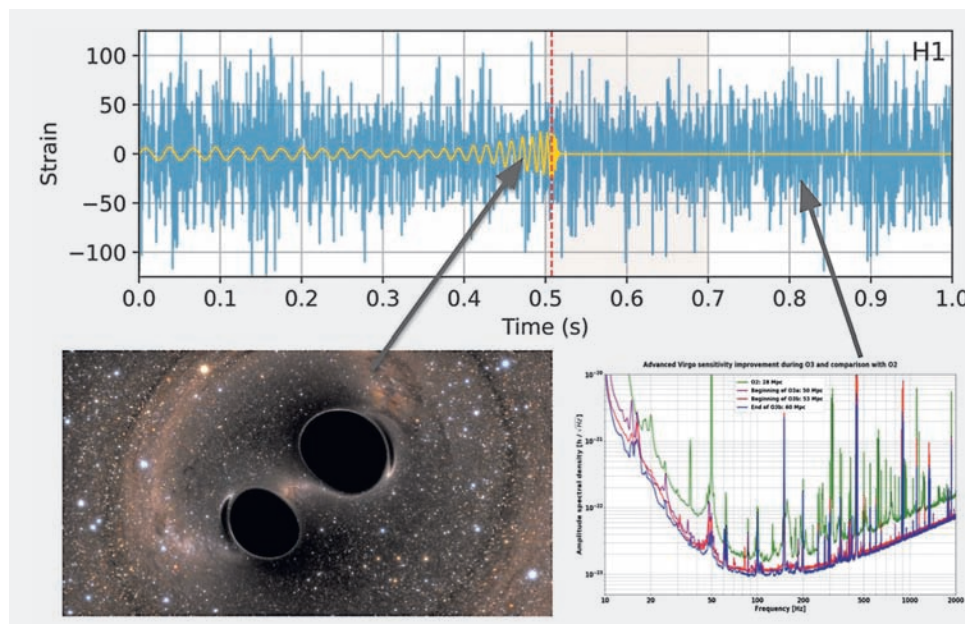
The research output of AAM includes around 300 publications in the last 5 years in refereed journals and proceedings.



**Figure 1:** The Secretan Telescope of AAM located in the observatory of the Aristotle University campus



**Figure 2:** Noesis satellite-tracking sensor – a downscaled version of the current Holomondas system and surveying the EUTELSAT GEO slot.



**Figure 3:** Merging black holes and gravitational wave detection.



# Astronomy and Astrophysics, Department of Physics, University of Patras

**A**strophysics at the Department of Physics of the University of Patras is conducted within the Division of Theoretical and Mathematical Physics, Astronomy and Astrophysics. Two faculty members of the Division teach and perform research within the areas of Astronomy and Astrophysics. Furthermore, an Emeritus Professor, seven PhD students and three Master's students are currently studying topics related to Astronomy and Astrophysics.

The Undergraduate Programme of Studies offers a compulsory module on "Introduction to Astronomy and Astrophysics" (3<sup>rd</sup> year), two compulsory modules within the specialization of Theoretical, Computational, Physics and Astrophysics: "Astrophysics I" and "Cosmology", and three elective modules: "Astrophysics II", "Laboratory Astronomy" and "Laboratory Astrophysics" (4<sup>th</sup> year).

The Postgraduate Programme "Advanced Studies in Physics" in the specialization "Theoretical, Computational, Physics, Astrophysics", offers the following elective modules related to Astronomy and Astrophysics: "Special Topics in Theoretical Astrophysics", "Special Topics in Observational Astrophysics", "Computational Astrophysics" and "Stellar Physics".

Several undergraduate theses every year have topics within the area of Astronomy and Astrophysics and are currently in progress. A more detailed description of the overall activities can be found in the following website:

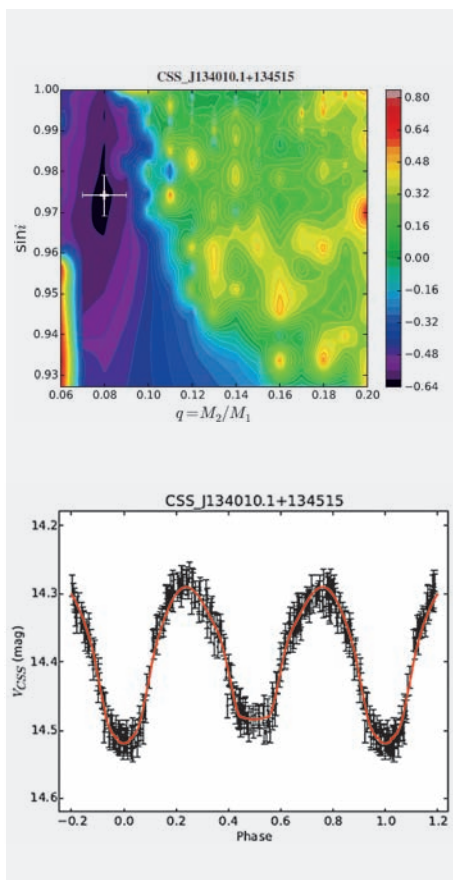
<http://www.astro.upatras.gr/>

The research activities focus on two main areas: Observational Astrophysics and Theoretical Astrophysics.

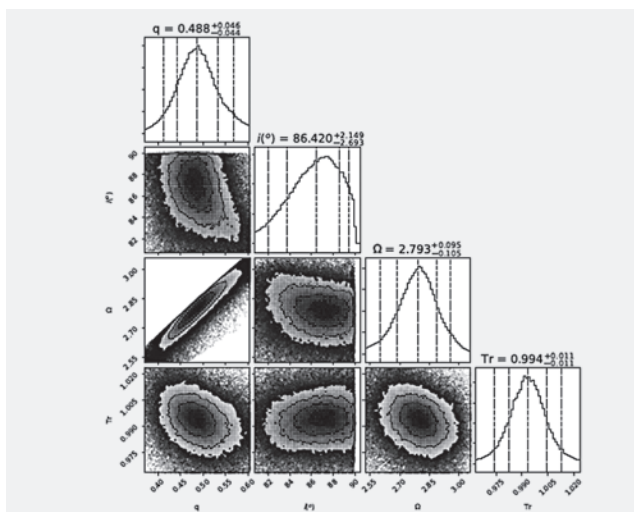
**Observational Astrophysics** at the University of Patras consists of one faculty

member (Assist. Prof. P-E Christopoulou) as well as one associated researcher and four graduate students. Research in Observational Astrophysics is focused on the optical part of the EM spectrum and covers astronomical observations and research on

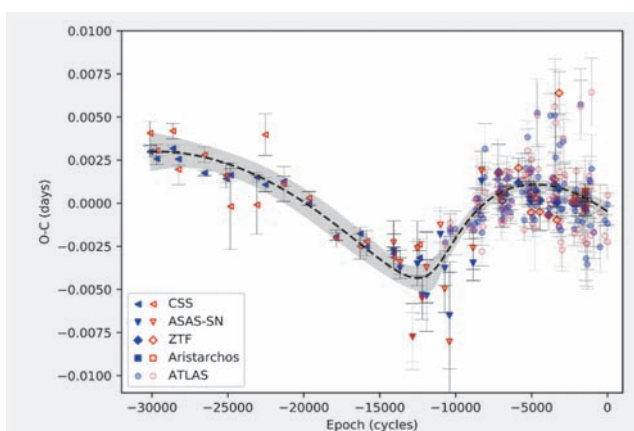
- Stellar variability (structure and evolution)
- Binary and multiple systems (Fig.1)
- Luminous Red Novae candidates (Fig. 1)
- Modelling Eclipsing Binaries, Time-Series Photometry (Fig. 2)
- Detection of circumbinary planets (ETV diagram, Fig. 3)
- Classification of variable stars using artificial intelligence and machine learning.
- Eclipsing binary star parameters estimation via artificial intelligence.



**Figure 1:** Identification and solution of a new CSS (Catalina Sky Survey) low mass ratio binary.



**Figure 2:** MCMC modeling of an Ultrashort period contact EB from ZTF data.



**Figure 3:** ETV diagram of an Ultra-short period binary system

- Variability detection in massive astronomical surveys
- Identification of rare and unusual variables stars in large datasets. Follow-up observations of interesting/unusual targets from space telescopes/surveys (GAIA, TESS, ZTF, ATLAS, WISE, Kepler, ASAS-SN etc) (Fig.3)
- Development of the Observatory Systems

On-site facilities include one 14" telescope and one 16" telescope on computerized Paramount Equatorial Mounts, housed in the Mythodea Observatory on campus, as well as smaller telescopes. The telescopes are equipped for the acquisition of professional-grade imaging and photometric data. Additional resources include a weather station, high-speed computing facilities for astrophysical modeling and data processing/analysis. The Observatory serves some of the main goals of the Physics Department, including teaching fundamental research techniques and carrying out research projects by the students during undergraduate and graduate studies.

Off-site facilities include access to 2.3 m Greek Aristarchos Telescope and to a variety of Chilean telescopes via research programs collaboration.

**The Observational Astrophysics program** is designed to prepare students for graduate studies in Astronomy and

related fields. It combines rigorous academic preparation with a strong research component, which usually culminates in the presentation of original research results at national/international astronomical conferences.

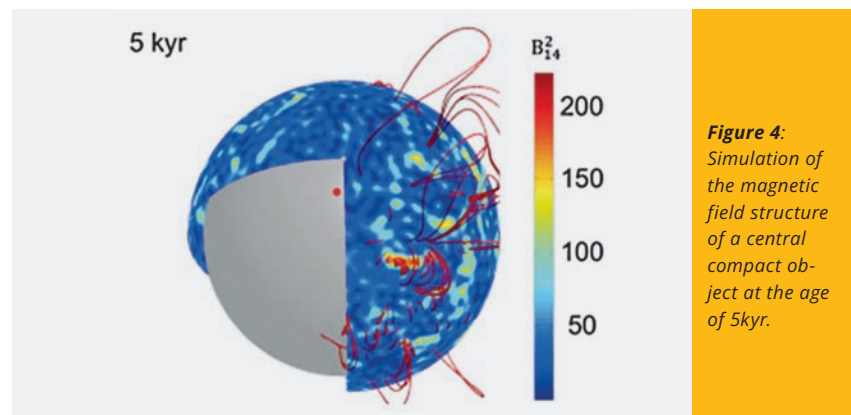
## Theoretical Astrophysics

The Theoretical Astrophysics group consists of one faculty member (Assist. Prof K.N. Gourgoulatos), an emeritus professor (Prof V. Geroyannis), three PhD Students and two Master's students. The group's research focuses in the following areas:

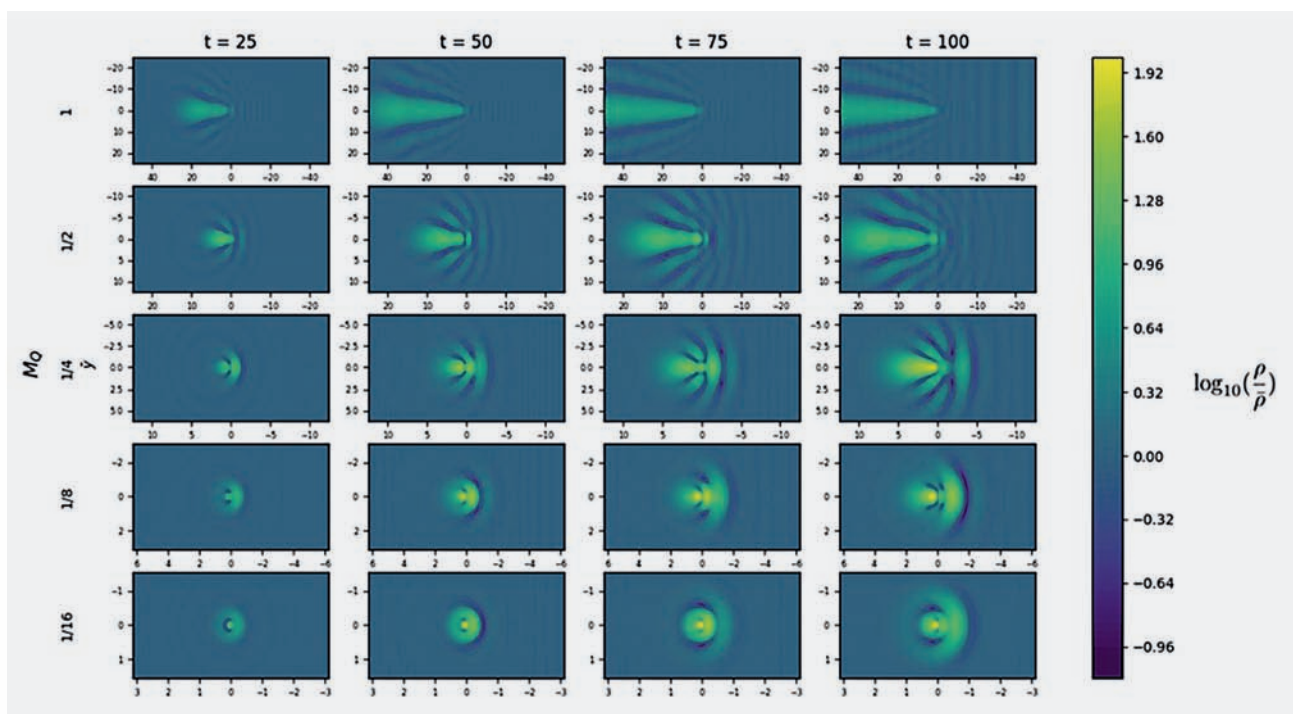
1. Neutron stars – compact objects: The equilibrium and evolution of the magnetic field is studied, focusing primarily on the interior of the star (Figure 4). The resulting models are compared against the thermal, tim-

ing and bursting activity of neutron stars. Furthermore, general relativistic solutions that describe the structure of rapidly rotating compact objects obeying polytropic equations of state are studied.

2. Astrophysical jets: Simulations of astrophysical jets are performed. These simulations resolve questions related to the stability and the role of the magnetic field in relativistic astrophysical jets, with main applications to AGN jets.
3. Dynamics of extrasolar planetary systems and multiple body gravitationally bound systems: The orbits of systems containing a binary central object are simulated, exploring their long-term stability and the excitation of resonant modes. Furthermore, the orbital structure of extra-



**Figure 4:** Simulation of the magnetic field structure of a central compact object at the age of 5 kyr.



**Figure 5:** The wakes that appear onto a fuzzy dark matter halo by a traversing galaxy, while the galaxy experiences dynamical friction.



solar planets in systems with several members are identified.

4. **Astrophysical Hydrodynamics and Magnetohydrodynamics:** Systems of astrophysical interest involving fluids and magnetic fields are studied. These works have applications in multiple contexts, including dark matter (Figure 5), rotating flows and winds.

The group maintains active international collaborations with several Universities, including the University of Leeds, the University of East Anglia, Purdue University, and the University of Alicante. Also, members of the group participate in the Laser Interferometer Space Antenna (LISA) (associate membership), in the COST Action CA21106 - COSMIC WISPerS in the Dark Universe: Theory,

astrophysics and experiments (CosmicWISPerS), (working group membership), and in THESEUS, Transient High Energy Sky and Early Universe Surveyor (consortium membership). Members of the group have participated in the past in the Cherenkov Telescope Array (CTA) and in activities of CA16214 - The multi-messenger physics and astrophysics of neutron stars (PHAROS).

## University of Crete, Department of Physics

By: Prof. Iossif Papadakis

**T**he Section of Astrophysics and Space Physics in the Physics Department of the University of Crete was established when the University and the Department was founded in 1978. In 2023, the time of this report, the permanent personnel consist of five faculty members and two emeriti professors. A major milestone in the development of the astrophysical research in Crete has been the establishment, in 2018, of the Institute of Astrophysics of the Foundation for Research and Technology – Hellas (IA-FORTH). All faculty members of the Section of Astrophysics and Space Physics are affiliated members of the new Institute, and all of their grants are managed through the Institute.

Research in Astrophysics and Space Physics in Crete is both theoretical and observational and covers a broad range of subjects, from studies of X-ray binaries in our Galaxy to the study of distant quasars and blazars. Within our Galaxy, research is concentrated on the study of the physics and chemistry of the ISM and of the dense molecular clouds, of neutron stars, black holes, planetary nebulae and supernova remnants. Be-

yond our Galaxy, areas of investigation include star formation mechanisms, history and evolution of galaxies in the Local Group, dust distribution and infrared properties of spiral, starburst and ultra-luminous infrared galaxies, jets and other exotic phenomena in active galactic nuclei and quasars. A lot of attention has been given recently to the development of new statistical tools for the analysis of big data sets, to the study of the magnetic field in our Galaxy, to the theoretical study of ultra high energy cosmic rays, to Cosmological studies of dark matter and dark energy, as well as potential observational tests of inflationary theories.

The datasets used for our research are obtained from a variety of ground based optical telescopes including Skinakas Observatory. Space-borne facilities, such as the Hubble Space Telescope in the optical, CHANDRA, and XMM in the X-rays, ISO, Spitzer and Herschel in the infrared, are also being used. Locally, the research activities of the Section are mainly supported by the Skinakas Observatory, a common research infrastructure of the University

of Crete and FORTH, which was founded in 1986.

The Section offers a broad range of both undergraduate and postgraduate astronomy courses to the students at the University of Crete. A competitive one-year Master's program offers an MSc degree in Astrophysics, while motivated students may also continue towards a PhD degree in Astrophysics. The majority of the postgraduate students receive research fellowships throughout the duration of their studies. A total of 52 MSc degrees and 21 PhD degrees in astrophysics have been awarded so far by the Department of Physics. Currently, there are 15 PhD students and 12 MSc students enrolled in the two programs, conducting research under the supervision or co-supervision of one of the Section faculty members.

More details on the research activities of the Section, as well as astrophysics curriculum and past annual reports are available at:

<https://www.physics.uoc.gr/en/content/astrophysics>



## Laboratory of Astronomy, Physics Department, University of Ioannina

**A**strophysics research and teaching at the University of Ioannina is performed by the Laboratory of Astronomy which is part of the Section of Astrophysics of the Physics Department. The Laboratory of Astronomy consists of Profs C.E. Alissandrakis (Emeritus), V. Archontis, A. Nindos, S. Patsourakos, and G. Throumoulopoulos, Drs. K. Moraitis and J. Zhuleku (post-doctoral researchers), as well as five PhD students.

The research activities of the Laboratory of Astronomy are focused on solar and space physics, space weather, as well as laboratory plasma physics. Physical processes occurring in the solar atmosphere and the interplanetary medium are studied both observationally and theoretically. Observations are obtained from both ground-based and space-borne observatories, and practically cover the entire electromagnetic spectrum (from hard X-rays to radio wavelengths). The research covers

all layers of the solar atmosphere and all levels of solar activity from the so-called “quiet” Sun to solar active regions and solar eruptive phenomena. The research oriented to the analysis and interpretation of observations is coupled with the development and analysis of large-scale numerical experiments (simulations) that are capable of realistically reproducing several aspects of the observed phenomena. Space weather, that is the impact of solar eruptive phenomena on the Earth is also studied. Furthermore, equilibrium (static, resistive, as well as equilibria with flows), stability, and transport phenomena (including the impact of plasma flows on magnetic topology) in both laboratory and astrophysical plasmas are studied using primarily analytical methods.

Funding for the research activities of the Laboratory has been provided in part by a number of national and international grants. All members of the Laboratory are actively collaborating with scientists from universities and research institutes in Greece and abroad. The faculty members of the Laboratory have been involved in teaching undergraduate and graduate courses at the University of Ioannina. They are also involved in public outreach activities (giving public lectures, mostly in the Ioannina region, as well as TV and radio interviews). The phone numbers and emails of the members of the Laboratory of Astronomy can be found in the contact page of the Department of Physics at:

<http://www.physics.uoi.gr/el/node/42>



# 1993-2023



# Department of Electrical & Computer Engineering, Democritus University of Thrace

The Democritus University of Thrace (DUTH) - Department of Electrical and Computer Engineering (ECE) was established in 1977 and has extensive experience and involvement in space science, Experimentation, Technology and Modeling of the Space Environment; in parallel it has a leading role in educating the next generation of Greek Space Scientists and Engineers, through an extensive curriculum as well as opportunities to participate in cutting-edge space science and experimentation projects. The main DUTH activities in **Space Science** are focused in space plasma electrodynamics, with the processing and analysis of energetic particles, plasma and electromagnetic fields data obtained by a long series of NASA, ESA, ISAS, INTERKOSMOS and RAS Spacecraft, such as: the early Explorers 33, 34 & 35, IMP-6, 7 & 8, Pioneers-10 & 11, Voyager-1 & 2, Helios-1 & 2, ISEE-1, 2 & 3, AMPTE/CCE, Ulysses, Geotail, Interball Tail & Interball Aurora, ACE, WIND, Demeter, Cluster-II (4 Satellites), THEMIS (5 Satellites), the Van Allen Probes mission (2 satellites) and Arase. Based on the above experimental data, DUTH has been active in theoretical studies of Energetic Particle and Plasma Phenomena in Solar, Interplanetary, Magnetospheric and Ionospheric Physics. DUTH personnel have extensive experience in **Space Experimentation**, through participation as Principal Investigator or Co-Investigator in experiments on board 15 Spacecraft, such as: Ulysses (HISCALE experiment), Geotail (EPIC experiment), MARS-96 (RADIUS-MC experiment), Interball (DOK-2 & DOK-S experiments Co-PI), Voyager-1 & 2 (LECP experiment), Cluster-II (RAPID experiment), ACE (EPAM experiment), HotPay-2 rocket (PEEL particle instrument, Co-PI) and SPEKTR-R (MEP Instrument, Co-PI).

DUTH has also acquired extensive expertise in the field of **Space Technology**, in particular in the areas of:

- development of front-end electronics for detector heads (used on DOK-2, DOK-S & RADIUS-MC experiments);
- development of Data Processing Units (used on MARS-96 / Intelligent

- Memory Management Module; CASINI/MIMI DPU; ISS/ICAM, Intelligent Camera for Microgravity Diagnostics);
- Development of radiation-hardened, low power, mixed Analog/Digital ASICs, which are used for the end-to-end development of bigger subsystems;
  - development of innovative high energy density Li-ion batteries, capable of operating in space;
  - development of communications protocols and networks for deep-space communications. In the field of **Space Environment modeling**,

DUTH is actively participating in modeling of:

- the radiation belt environment,
- electromagnetic wave distribution and evolution and
- the electrodynamics of the space environment.

DUTH is a participating institute in the JUICE spacecraft's PEP instrument team, and DUTH personnel and students are preparing efficient, highly parallelized particle tracing simulations to model energetic particles in the Jovian radiation belt environment upon arrival of JUICE at Jupiter's icy moons. Furthermore, DUTH, as consortium leader, has coordinating a multi-national ESA study on the Electrodynamics Study of the Upper Atmosphere, through which state-of-the-art computer models and data-

sets of the Earth's Upper Atmosphere were cross-compared, with the goal to identify knowledge gaps and to provide suggestions to ESA on space exploration missions optimal measurement techniques. DUTH has also developed Daedalus MASE, the mission simulator for the Daedalus candidate mission.

DUTH is actively pursuing **Space Education**, both in the undergraduate and graduate level. In particular, the Telecommunications and Space Research Sector's Electromagnetic Theory Laboratory specializes in space physics, space technology and space applications, offering a large number of space-related studies and activities through:

- an undergraduate program with courses in: Electromagnetism of the Earth's Environment; Plasma Physics; Magnetohydrodynamics; Remote Sensing; Satellite Communications; Space Weather.
- A Graduate Programme, including courses in: Space Applications; Technology of Space Systems; Satellite Communications; Ionizing Radiation; Physics of Planetary Magnetospheres; Space Plasma and Magnetohydrodynamics; Space Electrodynamics; Space Measurement Analysis; Analysis of Experimental Time Series with non-linear dynamics methods.
- multiple opportunities for active participation of students in innovative space missions and projects: for example, DUTH undergraduate and



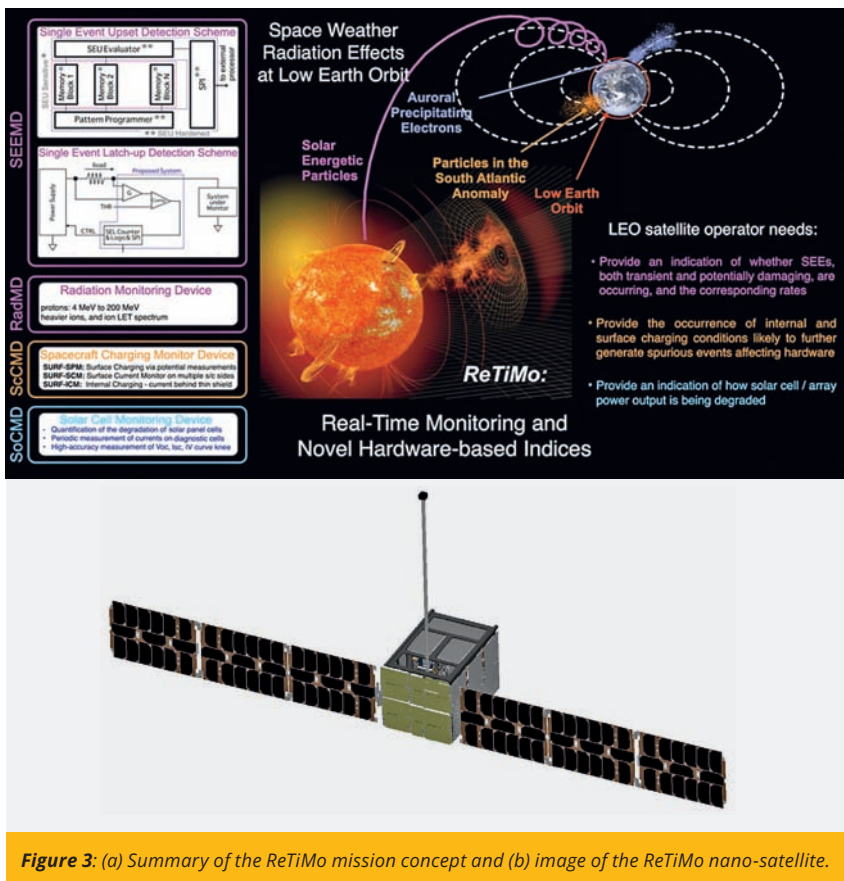
**Figure 1:**  
DUTHSat, a 2U  
CubeSat nano-  
satellite developed  
at DUTH, right  
before shipment for  
launch.

graduate students have designed, built, launched and operated DUTH-Sat, a CubeSat nano-satellite, funded through the ARISTEIA/GSRT program. As part of the project, DUTH scientists and engineers were involved in training and overseeing undergraduate and graduate students as they develop a fully functional miniaturized 2U CubeSat satellite, which was launched in 2017 in the framework of the EU QB50 programme to study the variable and largely unknown edges between the Earth's upper atmosphere and the space environment.

**Recent developments** at DUTH include the successful completion of the feasibility study of the Daedalus mission concept (<https://daedalus.earth/>): The Daedalus mission has been proposed to the European Space Agency (ESA) in response to the call for ideas for the Earth Observation programme's 10th Earth Explorer. It was selected in 2018 as one of three candidates for a Phase-0 feasibility study. The mission design shall allow Daedalus to break through the current spacecraft exploration "barrier" of 150 km and access electrodynamics processes at lower altitudes. Currently, a joint ESA-NASA Lower Thermosphere-Ionosphere Science (ENLoTIS) working group ([https://science.nasa.gov/science-news/NASA\\_and\\_ESA\\_Exploring\\_New\\_Joint\\_Satellite\\_Mission\\_Concepts](https://science.nasa.gov/science-news/NASA_and_ESA_Exploring_New_Joint_Satellite_Mission_Concepts)) is exploring future lower thermosphere-ionosphere (LTI) satellite mission concepts. Recent developments also include the completion of a feasibility study for ReTiMo (Real Time Monitoring) mission: ReTiMo is a mission concept of a nanosatellite equipped with novel sensors and instruments to be launched into LEO, in order to characterize in near-real time the SW threat to the mega-constellations that are becoming part of the critical infrastructure in modern life. ReTiMo will achieve this by measuring scientific parameters relating to Space Weather conditions, as well as engineering parameters that quantify the degradation and anomalous behavior of spacecraft hardware caused by Space Weather. Currently (2023), based on the experience from the DUTHSat 2U CubeSat nano-satellite, DUTH personnel and graduate students are undertaking the development of DUTHSat-2, a 6U CubeSat tasked with three main objectives: (a) obtaining multi-spectral images over sea and land, (b) demonstrating down-



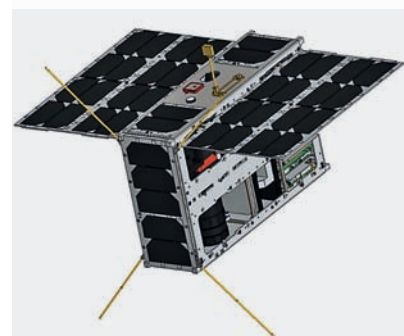
**Figure 2:** Daedalus, a candidate Earth Explorer mission concept as proposed by DUTH to ESA (Sarris et al., 2020)



linking data from a Low Earth Orbit satellite via laser links, and (c) demonstrating downlinking essential telemetry via a novel Essential Telemetry ASIC even in cases where key spacecraft subsystems are not operating.

## References

Sarris, T. E., et al., Daedalus: a low-flying spacecraft for in situ exploration of the lower thermosphere-ionosphere, Geosci. Instrum. Method. Data Syst., 9, 153–191, 2020, <https://doi.org/10.5194/gi-9-153-2020>



**Figure 4:** DUTHSat-2, a 6U CubeSat nano-satellite, currently (2023) under development at DUTH.



# National Observatory of Athens (NOA)



**Mission:** To conduct basic and applied research and provide social relevant services in: (a) Astronomy, Astrophysics, Space Applications and Remote Sensing, (b) Environmental Research and Sustainable Development, (c) Geodynamics.

**Status:** NOA is National Research Center, established in 1842, consisting of three Research Institutes:

1. **Astronomy, Astrophysics, Space Applications and Remote Sensing (IAAS-ARS)**
2. **Environmental Research and Sustainable Development (IERSD)**
3. **Geodynamics (IG)**

It operates a densely distributed network, spread over the whole Greek territory, consisting of about 800 stations: 244 seismological stations (63 seismological stations, 149 accelerometric stations, 32 GNSS stations), 502 weather stations, 4 astronomical telescopes, 4 magnetic stations, an ionospheric station, remote sensing antennas and atmospheric pollution stations. NOA does not only produce new knowledge via cutting-edge basic research but also develops innovative tools and services relevant to Civil Protection. Furthermore, it has a wide range of science dissemination activities provided to the wider society via its well-organized public outreach centers (Thissio, Penteli and Kryoneri Visitor Centers and the Astrogeophysics Museum). In January 2023 the Governing Board of Directors was the following:

**Director:** Professor Manolis Plionis

**IAASARS Director:** Dr. Spyros Basilakos, **IERSD Director:** Professor Nikos Michalopoulos, **IG Director:** Professor Akis Tselentis, Representative of the Researchers: Dr. Vassiliki Kotroni, Representative of the administrative and technical staff: Ms Maria Maniati.

**Staff:** 71 Researchers, 36 Scientific and technical staff, 28 Administrative staff, adding up to a total number of 135 permanent staff. Under contract and in research programs there are additionally 245 employees, including postdoctoral researchers.



*Figure 1: National Observatory of Athens.*

**Finances:** Annual turnover (2022): approx. €19 million

## **Strategic priorities:**

1. Enhancing NOA's Contribution to Basic & Applied Research and Development of New Scientific Areas
2. Developing and Enhancing Innovative Forecasting, Detection, Monitoring and Management Services and tools regarding Natural and Anthropogenic Disasters
3. Promoting NOA as a National Pole regarding Research and Services in the Fields of Data Collection, Mitigation and Adaptation to Climate Change
4. Science Dissemination, Education and Culture
5. Upgrading and innovating NOA's administrative, building and research Infrastructures

**Main assets / Infrastructure:** • 2.3m Ritchey-Chretien Telescope "Aristarchos" - Helmos Observatory (altitude 2350 m), part of the European OPTICON network • 1.2 m Cassegrain Telescope - Kryoneri Observatory, Korinthos area • Newall Telescope, (62.5 cm refractor), Penteli station • Doridis Telescope (40 cm refractor), Pnyka site • 800 ground-based stations • Iono-

spheric station • Hellenic GeoMagnetic Array (ENIGMA) • EUMET cast Satellite Receiving Station • Popular weather site meteo.gr (~350.000 visitors per day and during severe events peaks to ~1.000.000 visitors) • Atmospheric Remote Sensing Station • Atmospheric Pollution Laboratory • Radiation Measurement Laboratory • Atmospheric Chemistry Laboratory • Calibration of Meteorological Instrumentation Laboratory • A mobile atmospheric pollution measurement station • A DOAS (Differential Optical Absorption System) pollution monitoring station • Radiosonde and tethered balloon atmospheric profiling system • National Tsunami Center at the Geodynamics Institute • Astrogeophysics Museum at SINA's historic building.

**Main achievements of NOA:** 323 total publications with ~20000 citations (2022). Implementation of approximately 200 competitive research projects, 2 ERC Consolidator Grants. - Several Marie Curie grants. - Popular Visiting Centers: since 1995, about ~700.000 visitors. - Increasing the numbers of the existing NOA infrastructure (36% increase in the last 6 years of the ground-based stations) - successful financing of building and research infrastructure developments.

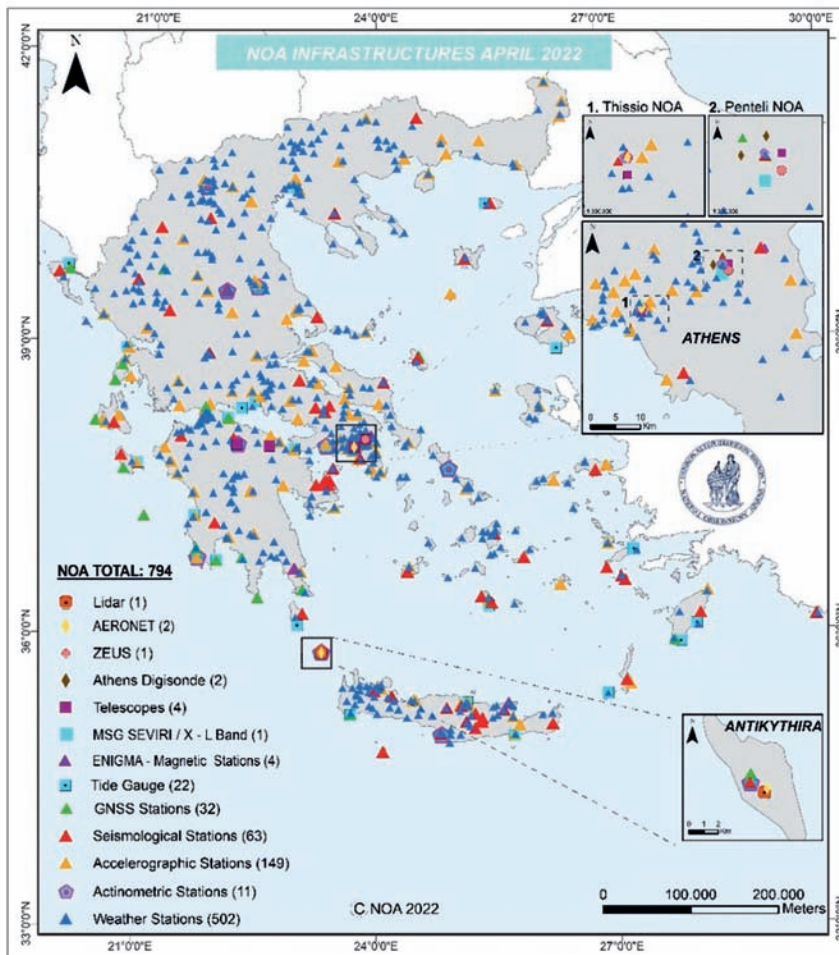


Figure 2: Stations of National Observatory of Athens.

#### Recent emblematic actions/programs:

1. NOA-AEGIS center for "Security, Safety and Hazards Risk Resilience", funded by the RRF (43.4 Meuros)
2. "Panhellenic Observatory of Geosciences & Climate Change in Antikythera" funded by the EIB and the Public Investment Program (22,6 MEuros)
3. Coordination of the "National Network for Climate Change – CLIMPACT" (funded by the Public Investment Program by 6.5 MEuros)
4. Establishment by NOA of the first ESA ground station for the "ScyLight" (funded by ESA by >1.2 MEuros)
5. National Coordination of the SST-SSA in Greece (funded by ESA and the Ministry of Digital Governance by >1.5 MEuros)

#### IAASARS in brief:

The Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS) is one of the three institutes of NOA. IAASARS mission is to carry out state-of-the-art basic and applied research in ground-based and space-borne astrophysics, from distant galaxies to the solar neighborhood, as well as near-Earth space physics, remote sensing and earth observation. At the end of 2022 the permanent staff of the institute consisted of the Director, 27 researchers, 1 secretary and 4 research support specialists. Moreover, 29 postdoctoral researchers, 40/22 PhD/Msc students, and 30 research associated were on contracts, making IAASARS the largest institute in its field in Greece. During 2018-2022, IAASARS research-



ers have published 595 articles in high-impact ISI journals, receiving 38,743 citations, and attracted a total funding of ~25M€ from competitive European and national research grants. It is worth noting that the number of refereed publications, citations and funding has increased respectively by 34%, 96% and 83% compared with the period 2013-2017. The excellence of the Institute is further demonstrated by the two ERC Grants that are currently running, the first one awarded in the field of Earth System Sciences (2017–2023) and the second one awarded in the field of Astrophysics (2018–2023). Recently, IAASARS ReACT research group was awarded an ERC Proof of Concept grant aiming to utilize specific equipment for commercial purposes. On top of that, IAASARS BEYOND Unit of Earth Observation Research and Satellite Remote Sensing – as the leader organization of a European consortium – received an exceptional honor: the First EIC Horizon PRIZE for EPIDEMICS - Early Warning System for Mosquito borne diseases (EYWA). Additionally, IAASARS hosted 2 Marie Curie and 3 HFRI (ELIDEK) fellowships.

The coordination role for IAASARS on space science activities is also critical as it concerns its role as a national hub for the Space Agencies (ESA, EUMETSAT) and other relevant organizations and bodies within the European Union (GEO, WMO). Some highlights include the activity of IAASARS in the European Space Agency (ESA) Space Situational Awareness (SSA) program to improve the monitoring and understanding of potential Earth hazards by developing experimental methods and analysis techniques to study the impact of asteroids on the Moon. ESA has also singled out IAASARS to produce time-domain value-added products for the Hubble Space Telescope Archive. IAASARS well established experience in areas of SSA is confirmed by a recently awarded grant (11M€) from the European Recovery Fund. This grant, which is a fraction of the total grand of NOA-AEGIS project, will be used to build new modern facilities in Kryoneri Observatory devoted to satellite and space debris tracking as well as Near Earth Objects (NEO) detection and tracking.



## IAASARS/NOA Observing facilities:

### Helmos Observatory

Helmos Observatory is a research facility of the National Observatory of Athens (NOA) which is operated by IAASARS. It is located at an altitude of 2340 m on the Aroania/Helmos mountain, near the city of Kalavryta. The Observatory hosts the 2.3 m Aristarchos optical telescope, an f/8 Ritchey-Chretien telescope, designed and built by the German company Carl Zeiss GmbH and inaugurated in 2007.

The telescope is currently equipped with two CCD cameras (a Liquid Nitrogen cooled Princeton Instruments VersArray 2048B and an Andor Ikon-L peltier cooled) both providing a field-of-view of 5'x5' and the RISE-2 exoplanet transit detection system with a field-of-view of 10'x10'. An extensive set of optical filters including both broad-band and narrow-band filters is available. A low/medium resolution fiber-fed spectrometer (ATS) designed and manufactured specifically to obtain spectra of relatively bright (brighter than 18-19 mag) but transient phenomena is in use. A Wide Field Camera (WFAC) optical system, providing a 30'x30' field-of-view, as well as a high-resolution Echelle Spectrometer (MES-AT) are under development.

The facilities of Helmos Observatory include the dome building, which encloses the telescope, the telescope control and the guest house building as well as the building that contains the electrical power equipment that connects the observatory with the public electricity network and the supporting power generators. Complementary facilities include a small dome that encloses the instruments for monitoring the quality of the atmosphere (seeing measurements). The control room of the telescope is located 35 m away and encloses all electronic devices and computers that are necessary for the control of the telescope, the dome and all the scientific instruments that the telescope is equipped with. A small optical/electronics laboratory, supporting activities for the maintenance of the telescope, also operates in this building. The largest part of this building consists of rooms for accommodating the observatory personnel as well as the observers coming to the telescope. Three bedrooms, able to accommodate up to seven people, two bathrooms, a dining room and



Figure 3: The dome building hosting the 2.3 m Aristarchos telescope.



Figure 4:  
Aristarchos telescope  
with 2.3 m aperture  
diameter.

a living room, as well as a fully equipped kitchen are available for the comfort of the personnel and observers. The existing facilities include two more buildings. One of them hosts two power generators (75 kVA and 12 kVA) that support the functionality of the telescope in case of a failure of the power provided by the national power network. The second building, established in 2007, contains the facilities and the power supply devices that are necessary to distribute the electrical power coming from the national network. In November 2009 Helmos Observatory was connected to the National telecommunication network through fiber optics allowing for speeds up to 1 Gb/s for internet connection and data transfer. This network

also supports voice communication via regular telephone lines.

Aristarchos telescope is a full member of the OPTICON-RadioNet Pilot (ORP) project funded by the European Union's Horizon 2020 (H2020) representing the largest and most comprehensive network of facilities/observatories across Europe (and around the world) covering the optical, infra-red, sub-mm and radio wavebands.

Helmos Observatory (Aristarchos telescope) was selected in August 2020 to become the first ground station of the Secure and Laser communication technology (ARTES/ScyLight) program of the European Space Agency (ESA). The large aperture combined with excellent atmospheric seeing conditions of the



site, make Aristarchos a valuable asset for optical communications and quantum key distribution (QKD) and especially suited for lunar and deep space communications.

The transmitter and receiver laser telecommunication systems were successfully installed by ESA in July and November 2021 with several laser links already demonstrated with the Alphasat telecommunications satellite. The related HOTSPOT (Helmos Observatory iniTiateS oPtical cOmmunicaTion) project, funded by ESA, aims to identify all possible activities that can be carried out at Helmos Observatory in Greece concerning optical, quantum, and deep space communications. In this framework, NOA and ESA have come to an agreement for the upgrade of the Aristarchos telescope. This upgrade is expected to replace the existing control system of the telescope with a modern one making the operation of the telescope more efficient and accurate. Helmos observatory is one of the three optical ground stations in Greece participating in the HellasQCI (part of the EuroQCI european network) aiming at contributing to the safe-keeping of critical data and infrastructures, in domains such as e-government, healthcare, financial industry and many more critical areas. This will be achieved by incorporating systems and technologies based on principles of quantum technology, more specifically by the distribution of quantum keys (QKD) to existing communication infrastructures, which will offer an exceptionally secure form of encryption, offering an extra layer of security. More information about Helmos observatory can be found at: <https://helmos.astro.noa.gr/en/>

### Kryoneri Observatory

Kryoneri Observatory is a research facility of the National Observatory of Athens (NOA) which is operated by IAASARS. It is located in the district of Corinth at the top of mount Kyllini at an altitude of ~900 m, near the village of Kryoneri. The main research infrastructure is the 1.2 m Cassegrain telescope made by Grubb Parsons Co., and installed at the Astronomical Station Kryoneri in 1975 (<https://kryoneri.astro.noa.gr/>). In May 2016, the telescope was vastly refurbished and upgraded by DFM Engineering Inc. for the needs of the Near-Earth object Lunar Impacts and Optical TrAnsients (NELIOTA) project funded by



Figure 5: Helmos implements Quantum Communication Infrastructures through Scylight.



Figure 6: The dome building hosting the 1.2 m telescope at Kryoneri Observatory.

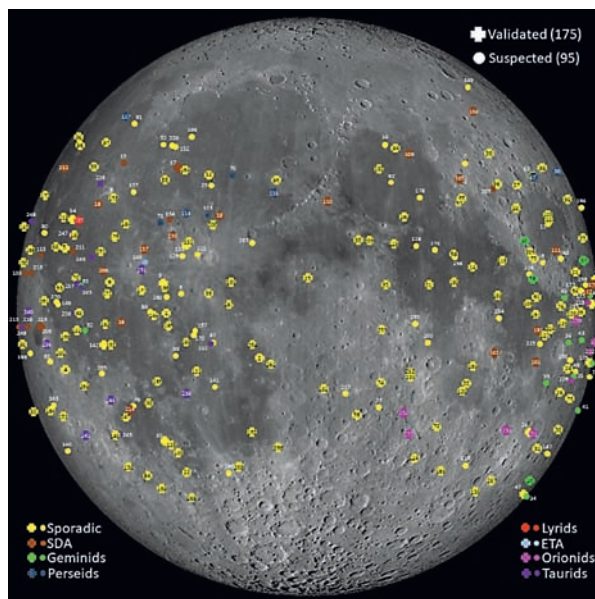


Figure 7: Locations of the detected impact flashes on the lunar surface to date (February 2023).

the European Space Agency (ESA). This upgrade included the conversion of the original optical configuration to a prime focus telescope (f/2.8), the installation of a new control system, dome automation, and the installation of a Prime Focus Instrument (PFI) able to provide a large field-of-view as required for NELIOTA. A dual channel imaging system,

consisting of two fast-frame sCMOS Andor Zyla 5.5 cameras, allows for simultaneous observations in the Red and Infra-red Johnson-Cousins filters. More details about the telescope configuration can be found in Xilouris et al. (2018, A&A, 619, 141). The 1.2 m telescope, is part of the Europlanet Telescope Network (funded under the "Europlanet 2024 Re-



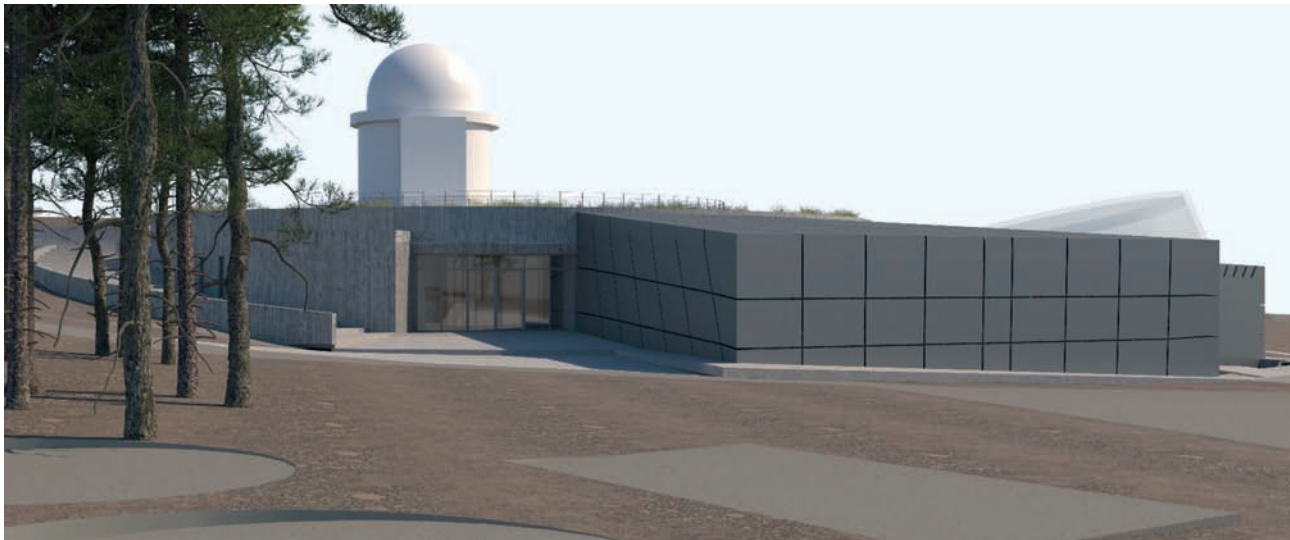


Figure 8: 3D artistic view of the public outreach center, under construction, at Kryoneri Observatory.

search Infrastructure”) allowing access to observers for conducting campaigns related to planetary science topics. NELIOTA (<https://neliota.astro.noa.gr>) monitors the Moon for lunar impact flashes due to collisions of small NE-Os/meteoroids with the surface of the Moon, aiming at determining the frequency and size distribution of small NEOs and meteoroids in the vicinity of the Earth. Until early 2023 over 170 such flashes have been detected, suggesting that 8 meteoroids per hour strike the lunar surface (Liakos et al. 2020, A&A, 633, 112). The majority of these objects have masses less than 100 gr and sizes less than 5 cm, whereas the evolved temperatures of the collisions range between 2000-4500 K.

Kryoneri Observatory also hosts the Manchester-Athens Wide-Field (Narrow-Band) Camera (MAWFC), which aims to conduct a deep survey of the northern sky at high galactic latitudes with the optical filters H $\alpha$ , H $\beta$  and [O III] and angular resolution of  $\sim 1$  arcmin. This project has received funding from the GSRT Aristeia II and KRIPIS funding schemes. The Kryoneri 1.2 m telescope is a calibrated sensor that belongs to the EU Space Surveillance and Tracking (EU SST) network, while a smaller aperture (60 cm) fast moving telescope, soon to be placed in the premises of Kryoneri Observatory, is expected to be dedicated to SST activities. Kryoneri Observatory hosts two Very Wide Field of View (VW-FOV) sensors, belonging to the Polish

Space Agency (POLSA) and developed by Cilium Engineering for observations of objects in Low Earth Orbit using triangulation techniques.

In January 2023 an investment of 4.3 M€ by the local government of Peloponnese was approved to transform the Kryoneri Observatory into a public outreach center. This development is expected to reinforce the already ongoing dissemination and educational activities that take place at Kryoneri Observatory, one of the strategic priorities of NOA. More information about Kryoneri observatory can be found at:

<https://kryoneri.astro.noa.gr/en/>



## Visit our website <http://www.helas.gr>

The above web server contains information, both in greek and english, about the Hellenic Astronomical Society (Hel.A.S.), the major organization of professional astronomers in Greece. The Society was established in 1993, it has more than 250 members, and it follows the usual structure of most modern scientific societies. The web pages provide information and pointers to astronomy related material, useful to both professional and amateur astronomers in Greece. It contains a directory of all members of the Society, as well as an archive of all material published by the Society, including electronic newsletters, past issues of “Hipparchos”, and proceedings of Conferences of Hel.A.S. The server is currently hosted by the University of Thessaloniki.

# Research Center for Astronomy and Applied Mathematics, Academy of Athens

**T**he Research Center for Astronomy and Applied Mathematics (RCAAM) was established in 1959 initially as “Office for Research and Calculations” and it was given its present name in 1966. Its scientific research focuses on the following fields: 1. Dynamical Astronomy, Nonlinear phenomena and Chaos Theory, 2. Galactic Dynamics and Galactic Morphology, 3. Solar and Space Physics, 4. Magnetohydrodynamics and 5. Cosmology. A recently established line of research involves the study of Extremely Low Frequency (ELF) electromagnetic waves in the Schumann (2-50 Hz) region.

The first Supervisor of the Center was Academician Prof. I. Xanthakis, who served until his passing in 1994. Between 1994 -1997 RCAAM was supervised by the Academician Prof. N. Artemiadis. Since 1997 Supervisor is Academician Prof. G. Contopoulos. As directors have served Dr. L. Mavridis (1960-1966), Dr. C. Macris (1971-1979), Dr. C. Poulakos (1981-2001), Dr. N. Voglis (2001-2007), Dr. V. Tritakis (2007, Acting Director), Dr. H.C. Dara (2008), and since 2009 Dr. P.A. Patsis (Acting Director). Eight tenured researchers serve currently at RCAAM, while three more have been elected and are expected to take up duties during 2023. Research is conducted through projects supported by the Research Committee of the Academy of Athens, as well as by national and international organizations and institutions. The mean number of refereed papers per year over the last twelve years is about 33.

In the last 25 years RCAAM was the exclusive organizer of 5 international conferences and workshops, while its members have served as main organizers and members of the scientific organizing committees in more than 94 conferences organized jointly with, or solely by, other institutes. Since its establishment 3 volumes with conference proceedings organized by RCAAM have been published. In addition, two books have been published by the Supervisor of our Research Center, Prof. G. Contopoulos. Finally, RCAAM researchers have served as co-editors of 32 conference proceedings volumes.

RCAAM hosts the “A-EFFORT” solar-flare forecasting service of the European Space Agency (ESA) and has coordinated the “FLARECAST” Consortium of the European Union for the prediction of solar eruptions.

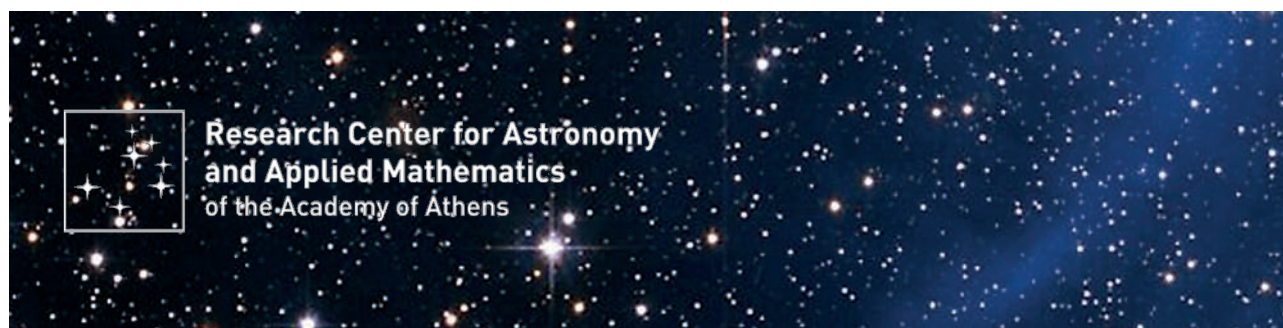
RCAAM publishes since 2016 the annual edition “New Advances in Astronomy”. This is a Greek-language summary of recent advances in Astronomy and Applied Mathematics, associated with research conducted at RCAAM. Our Annual Reports since 2009, including detailed publication lists, can be downloaded in PDF format from the Centers web site (<http://astro.academyofathens.gr/publications.html>).

RCAAM, organizes since 1997 seminars and research talks on a weekly basis. Invited speakers include, besides the researchers and students of RCAAM, Academicians, Professors and distinguished scientists from various universities and research Centers in Greece and abroad.

A total of 470 talks have been organized at the seminars’ room of RCAAM alone, during the period 2009-2022.

Since 2000, RCAAM has hosted 22 post-doctoral researchers, working on in-house scientific projects for 2-3 years on average, financed by the Research Committee of the Academy of Athens, or from external sources. During the same period, 13 PhD students have successfully defended their Doctoral Theses, working at RCAAM under the supervision of researchers of our Center (from the University of Athens, the Democritean University of Thrace, the Aristotle University of Thessaloniki, the National Institute of Astrophysics, Optics and Electronics, Mexico and the University of Florida, USA). Currently 4 PhD students are hosted at RCAAM, while members of our institute participate, as main supervisors, or as members of the supervising committees, in 16 more PhDs (at the University of Athens, the Georgia State University, USA, the University of Ioannina, the Technical University of Athens and the University of Leuven, Belgium). In parallel, 11 Masters students have completed their work and successfully acquired their Masters degrees working at RCAAM, under the supervision of the Center’s staff. Currently, 3 Masters-theses are supervised by RCAAM researchers. Finally, 5 undergraduate students (from the Universities of Athens and Grenoble, France) have completed their Diploma Theses at RCAAM.

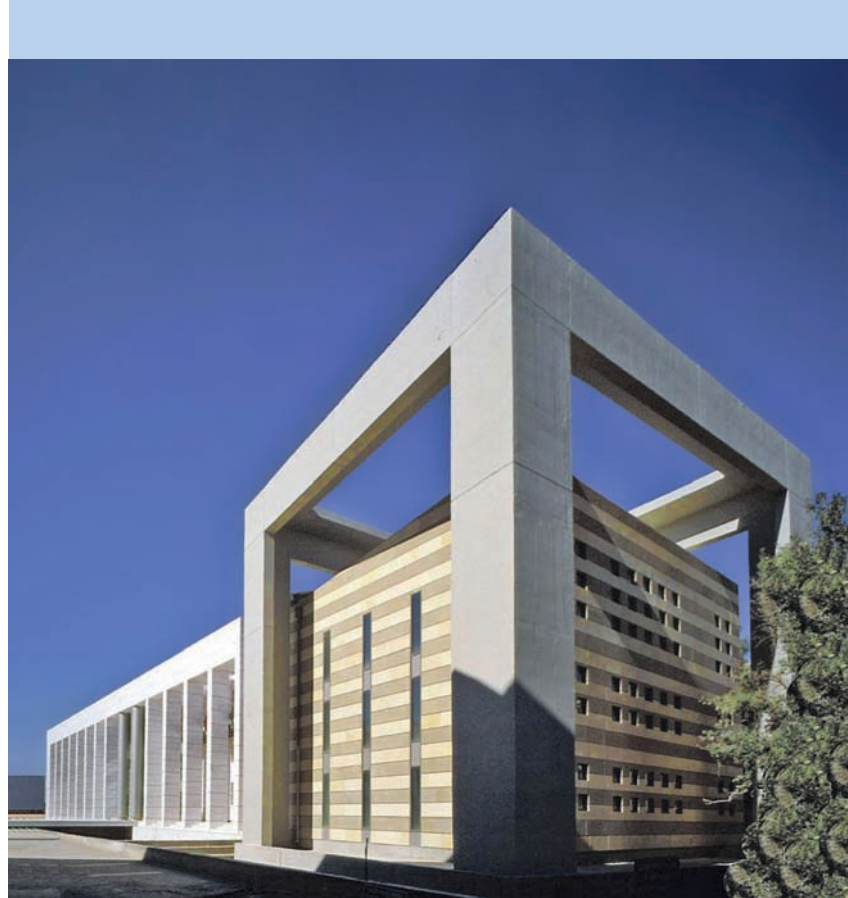
Since 2002, RCAAM researchers have participated in the teaching of mainly





postgraduate disciplines at the University of Athens, but as well in the teaching of undergraduate courses at the same University. They have taught undergraduate courses also at the Georgia State University, USA and the National University of La Plata, Argentina. In addition, they have taught, after invitation, several postgraduate courses in university departments, seminars for students and researchers, and schools organized by universities and scientific associations. Every year RCAAM researchers accept invitations to give talks in international conferences, as well as to stay for longer terms at various institutes abroad in the frame of joint research projects. Current collaborations in common research projects include: University of Helsinki (Finland); European Space Agency (ESA), Paris, Laboratoire d'Astrophysique de Marseille, University of Aix-Marseille, University of Strasbourg, Institut d'Astrophysique Spatiale, University Paris-Saclay (France); Astronomy Department, University of Munich (LMU), European Southern Observatory (ESO), Munich, Max-Planck Institute for Astrophysics, Munich, Max-Planck Institute for Radioastronomy, Bonn (Germany); National Institute of Astrophysics, Optics and Electronics (INNAOE), Puebla, Mexico; University of Padova (Italy); University of Krakow (Poland); Department of Mathematics, University of Cape Town (South Africa); Space Science Institute (ISSI), Bern, (Switzerland); Georgia State University, NASA/Goddard, NASA/Solar Radiation Analysis Group, NASA/Ames (USA).

RCAAM has organized three series of full-year talks for the broad public during the whole year at the Academy of Athens. These were organized in 2009, on the occasion of the "International Year of Astronomy" (11 talks), in 2015, on the occasion of the "International Year of Light" (8 talks) and in 2019, on the occasion of the IAU Centennial (9 talks). Besides these series of talks, RCAAM researchers give many pub-



Research Center for Astronomy and Applied Mathematics,  
Academy of Athens,  
Soranou Efessiou 4, Athens, GR-11527,  
Greece  
Tel. (+30) 210 6597169 (P. Patsis)  
Fax (+30) 210 6597602  
E-mail: keaem@academyofathens.gr

lic outreach talks and publish popular articles for newspapers and journals, among appearances on television and radio programs.

Details about the activities of RCAAM can be found in the web page:

<http://astro.academyofathens.gr>

which includes the Annual Reports since 2009 (<http://astro.academyofathens.gr/web/about.html>), as well as in the spe-

cial volume "The work and the contribution of the research centers, offices and institutions of the Academy of Athens", issued by the Academy of Athens in 2022. (<http://www.academyofathens.gr/static/THE-WORK-AND-THE-CONTRIBUTION.pdf>)

# Office of Space Research and Technology, Academy of Athens

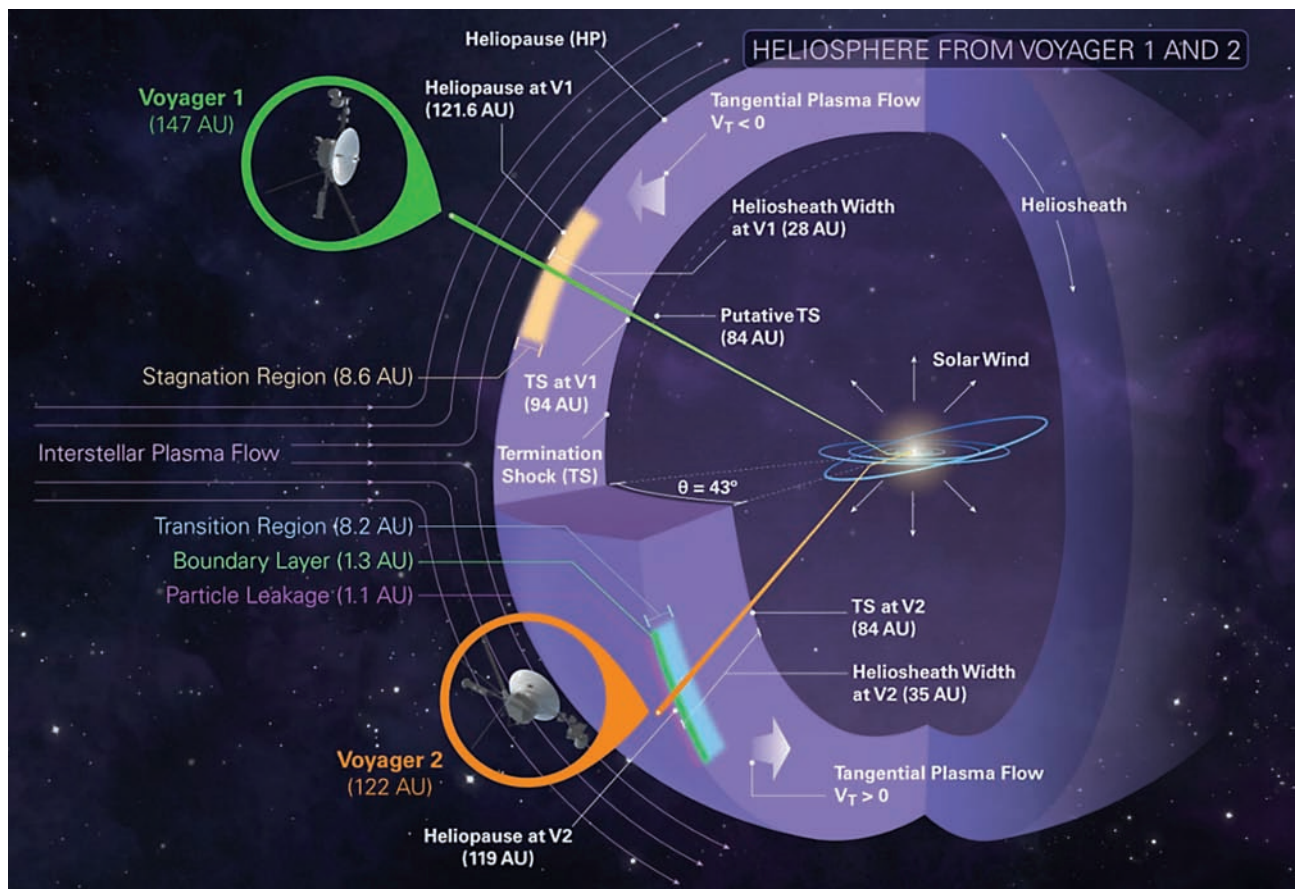
The Office of Space Research and Technology (OSRT) was established in February 2006, following the election of Prof. Stamatios M. Krimigis to the chair of “*Science of Space - Theory and Applications*” of the Academy of Athens on November 4, 2004. The Office operates in direct response to the aims and scopes of the Academy of Athens (AoA), conducting research and public outreach in the fields of Space and Magnetospheric Physics, Planetary Physics, Heliospheric Physics and Plasma Physics, with emphasis in the analysis of data provided by past and ongoing space missions.

From its early stages, OSRT became a major player in leading international Space Science and Technology collab-

orations (PI and/or Co-I) pushing the envelope across the field of Space Science Research and Technology in a diverse range of research activities, such as NASA's and/or ESA's Voyager 1 & 2, Cassini-Huygens, MESSENGER, Parker Solar Probe, JUPITER ICy moons Explorer (JUICE) and New Horizons missions. The Office continues to be at the forefront of recent developments at an international level, with many substantial contributions in cutting-edge scientific and technological endeavors, such as the NASA funded SHIELD DRIVE Science Center (Boston, USA) and the study of the innovative Interstellar Probe space mission (Johns Hopkins/APL). Other science projects of OSRT include on-going collaborations with important research

institutes such as the Johns Hopkins University (USA), the Max Planck Institute for Solar System Research (Germany) etc.

New results are constantly being published in books and major international peer-reviewed scientific journals, as well as in presentations in major international conferences. Within a seventeen-year period, the OSRT has contributed more than 300 peer-reviewed scientific publications (12% in *Nature* and *Science*) and more than 20 White Papers. The OSRT has organized and/or co-organized several international conferences, workshops and/or sessions in leading organizations around the globe (e.g., MOP, AGU, COSPAR etc.), while its members have received multiple awards from ma-



**Figure:** A sectioned view of the global heliosphere summarizing the most important findings of Voyager 1 and Voyager 2 that have transcended through the boundaries of our solar bubble, north and south of the ecliptic plane, respectively; the termination shock, the heliosheath and the heliopause. The two spacecraft are now surveying through interstellar space (Krimigis, S., R. B. Decker, E. C. Roelof, M. E. Hill, C. O. Bostrom, K. Dialynas, G. Gloeckler, D. C. Hamilton, E. P. Keath & L. J. Lanzerotti, *Nature Astronomy*, 3, 997-1006, 2019).



for international institutions for their exceptional contributions in science and technology.

Furthermore, OSRT has participated in a plethora of public engagement activities in a broad range of interests, such as talk and colloquiums in research institutes and universities, public presentations/discussions in open events and schools, as well as interviews in regional and international media. Finally, the OSRT has been engaged in a several educational activities, such as the supervision of MSc and Ph.D degree theses.

Details concerning the activities of OSRT can be found at the web page: <http://www.academyofathens.gr/en/research/office/space>, whereas a brief presentation of the contributions of OSRT through the recent years (2006-2021) can be found in the newly published volume of the Academy of Athens entitled *"The work and the contribution of the Research Centres, Offices and Institutions of the Academy of Athens"* (2022): [http://www.academyofathens.gr/static/](http://www.academyofathens.gr/static/THE-WORK-AND-THE-CONTRIBUTION.pdf)  
**THE-WORK-AND-THE-CONTRIBUTION.pdf**

**Office of Space Research  
and Technology,  
Academy of Athens**

**Supervisor:** Prof. S. M. Krimigis

**Research Associates:**

Dr. K. Dialynas, Dr. N. Sergis

**Address:** 4, Soranou Efessiou str.,  
11527, Papagos, Athens, Greece.

**Tel.:** 210-6597667

## The Institute of Astrophysics - FORTH

*By: Prof. Vassilis Charmandaris  
Director of IA-FORTH*

**T**he Institute of Astrophysics (IA) of the Foundation for Research and Technology – Hellas (FORTH) was formally founded on March 2, 2018 and it commenced its operations in mid-2019. IA-FORTH (<https://www.ia.forth.gr>) was the natural evolution of the very active Crete Astrophysics Group that had already been operating for nearly 30 years within the Institute of Electronic Structure and Lasers (IESL) – FORTH and the Department of Physics of the University of Crete.

From 2005 until the end of 2022 the members of the Astrophysics Group, which are now part of IA, have published ~810 refereed papers, while they were awarded ~11.6MEuros in competitive research funding, including 3 prestigious ERC Grants. Moreover, they have contributed to the training of 19 PhD students and 32 postdocs, 22 of which have since moved to permanent positions in academia (16 in institutions outside Greece).

Currently, spring of 2023, the core of the Institute in addition to the director consists of 4 researchers, and 4 affiliated faculty, as well as 10 postdoctoral researchers and 14 PhD and 12 MSc students.



**FORTH**  
INSTITUTE OF ASTROPHYSICS

The main goals of IA are to:

- perform cutting edge research in select areas of theoretical and observational astrophysics
- train students and early-stage researchers in acquiring technical and analytical skills so as to address outstanding open questions in astrophysics and beyond
- engage the local community in astronomy public outreach activities and to provide educational resources for students and the general public
- serve the local and greater Greek society through actions that promote technological innovation, opportunities for enterprises and economic growth, and national security

Details on the research activities of the IA-FORTH are available in its annual re-

ports ([https://www.ia.forth.gr/annual\\_reports](https://www.ia.forth.gr/annual_reports)), while samples of the latest noteworthy results can be seen on the web page of its research highlights (<https://www.ia.forth.gr/highlights>)

The main research facility of IA-FORTH though is Skinakas Observatory (<https://skinakas.physics.uoc.gr/en>), which was founded in 1984 by FORTH, the University of Crete, and the Max-Planck Institut für Extraterrestrische Physik (MPE), in Germany. The Observatory is located at a distance of 50km from the city of Heraklion, on top of Psiloritis mountain, at an altitude of 1750 meters and since 2018 it is currently jointly operated by the Institute of Astrophysics – FORTH and the Dept. of Physics of the University of Crete. It is worth mentioning that despite its proximity to Heraklion the quality of the atmosphere at Skinakas Observatory is superb, making it an ide-



al location for high-level astronomical observations.

The first telescope at Skinakas was a small wide field 30cm telescope, which was equipped with the first optical CCD camera in Greece. The 1.3m telescope became operational in October 1995 and remained the largest telescope in Greece until 2007. A third 0.6m robotic telescope was installed in 2006. A new 1m class telescope has been ordered and it is expected to be operational in 2024.

Identifying cutting edge science areas and obtaining state of the art specialized instruments to tackle pertinent problems has been a tradition at Skinakas Observatory at IA-FORTH. In the past, such science enabling instruments included OPTIMA, an extremely fast  $\mu\text{sec}$ -cadence photometer. Over the past decade Robopol (<https://robopol.physics.uoc.gr>), an extremely accurate photopolarimeter in operating successfully on the 1.3m telescope, producing spectacular results.

Currently three major projects are underway at the Observatory:

- The PASIPHAE (Polar-Areas Stellar-Imaging in Polarization High-Accuracy Experiment - <http://pasiphae.science/>) project, led by Prof. K. Tassis, is a planned polarization survey of stars at high Galactic latitudes, aiming to clear the path towards

the detection of the imprint on primordial light of the moment of creation of the Universe, while also providing the first 3D tomographic map of the magnetic field of our Galaxy. PASIPHAE, which relies in two wide field optical polarimeters installed on the 1.3m telescope at Skinakas and a 1m telescope in Sutherland South Africa, is an international collaboration between FORTH, Caltech in the US, IUCAA in India, the South African Astronomical Observatory, and the University of Oslo in Norway.

- ARGOS is a concept (TRL2) for a leading-edge, low-cost, sustainable “small-D, big-N” radio interferometer, that will map the sky for multi-messenger signals with high speed and sensitivity, while delivering science-read datasets to the community. It will directly address multiple fundamental scientific questions, from the nature of dark matter and dark energy to the origin of fast radio bursts. The project, details of which are available at <https://argos.ia.forth.gr/>, is led by Dr. J. Antoniadis and it is a collaborative effort of FORTH and the Univ. of Piraeus in Greece, CEA Saclay in France and the Max-Planck-Institute for Radio Astronomy in Bonn, Germany.

- The Total-Coverage Ultra-Fast Response to Binary Mergers Observatory (TURBO) is a project, funded by NSF in the US and led by Prof. Patrick Kelly (Univ. of Minnesota). It will develop two state-of-the-art robotic telescope facilities at Magdalena Ridge Observatory, New Mexico (USA) and at Skinakas Observatory. At each site, TURBO will consist of large-format CMOS detectors mounted on sixteen 0.25-meter diameter optical tube assemblies. Within two seconds of a trigger alert, TURBO will start to obtain continuous, multi-band imaging of over  $\sim 120$  square degrees. By searching more quickly than existing facilities, the telescopes will identify new, brightening sources on the sky and obtain early data. The project will also monitor nearby galaxies for very young supernovae. Prime candidates to be followed will be mergers of black holes or neutron stars creates gravitational waves.

Finally, IA-FORTH and Skinakas observatory are actively participating in national and European applied research projects, such those related to space-to-ground laser communication with quantum cryptography (Scylight, HellasQCI), as well as monitoring satellites in low and medium earth orbit in the context of the EU-Space Surveillance & Tracking.



# The Hellenic Space Center

**T**he Hellenic Space Centre (HSC) is the national Greek space agency, established by law in August 2019; the HSC Governing Board was appointed in January 2020. COVID-19, which was declared a pandemic in March 2020, had the effect of a very slow pace for all consecutive administrative actions needed for the full operation of the HSC, because its supervising Ministry for Digital Governance carried the main responsibility for the development and implementation of online governance tools urgently needed during the pandemic.



Figure 1: The HSC logo.

Selected activities of the HSC during its first three years of operation are listed below:

- i. Fulfilment of all pending legal and financial obligations of the HSC predecessor (ELDO – the Hellenic Space Organization) was completed by summer 2020. This was an obligatory action for the HSC and had to be met before any other activity could start.
  - ii. Administrative staffing through secondments of public servants – completed by spring 2021.
  - iii. Preparation of the draft internal regulation of HSC operation and submission to the supervising Ministry for Digital Governance in autumn 2022.
- Points i-iii were of rather mundane nature, but they were nevertheless highly time and effort consuming and absolutely necessary for the effective function of the HSC.
- iv. In September 2020, following the request of the Ministry for Digital Governance, the HSC set up an expert advisory committee, with the mandate of drafting a plan on the characteristics and feasibility and of a national programme of small satellites. The plan was discussed and ratified by the Board of Directors of the HSC and was submitted to the Minister of Digital Governance and the Secretary General of Telecommunications & Post in March 2021.
  - v. In February 2021, the HSC launched a broad consultation with public entities, Universities, Research Centres and Companies, on its proposals for the pillars of the National Space Policy and the formulation of a Strategic Action Plan for the next five years, which had begun to be drafted in December 2020. Taking into account the views and comments gathered through the consultation, the HSC formulated the final version of its proposals, which were officially submitted to the Minister of Digital Governance and the Secretary General of Telecommunications & Post in July 2021. The proposals are posted at: <https://hsc.gov.gr/assets/6-2021.pdf>
  - vi. In February 2021, the HSC launched a consultation with public sector bodies in order to compile a list of users of satellite data and services. Information was received from the following entities: Ministry of Development & Investments, Ministry of National Defence, Ministry of Labour and Social Affairs, Ministry of Maritime and Island Policy, Ministry of Environment and Energy, Ministry of Civil Protection, Ministry of Tourism, Region of Attica, Region of Thessaly, Region of South Aegean, Region of Crete.
  - vii. Coordination of a legal-technical study entitled: “Safe operation of remotely piloted aircraft: Proposals for reformulation of the regulatory framework, with a focus on telecommunication systems”. The study was implemented through a cooperation of the Hellenic Space Centre with the National and Kapodistrian University of Athens, under the coordination of Assistant Professor of the School of Law Dr. G. Kyriakopoulos. The study was completed and submitted to the Ministry of Digital Governance in June 2021.
  - viii. Support to the Ministry of Digital Governance through participation in space-related committees, such as the «Horizontal Commission expert group on EU Space Programme (FFPA & Contribution agreements)», the «Sub-group on Space Situational Awareness (SSA)» and the «Sub-group on Copernicus», throughout the months preceding the launch of the European Union’s Horizon Europe research and innovation programme.
  - ix. Participation in the representation of Greek interests in the Technical Committee of the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations.
  - x. Participation in numerous international forums and conferences – for example the GLEX 2021 (Global Space Exploration Conference), the International Space Forum (ISF) Mediterranean Chapter Meeting 2021, the Geneva Science and Diplomacy Anticipator (GESDA) 2022, the Abu Dhabi Space Debate 2022, the SpaceOps 2023 conference, etc.
  - xi. Staffing of the Directorate of Research & Technological Development was completed through a strictly defined competitive process. Nine engineers and scientists were selected among 200 candidates and were appointed by May 2022. Their profiles are available at <https://hsc.gov.gr/en/about/>.



**Figure 2:** The three pillars of the policy on the national needs for satellite services as presented by the HSC at the Thessaloniki International Fair in September 2022: constellation of Greek microsatellites, commercial solutions (satellite tasking and hosted payloads), and capacity building.

- xii. The HSC was the local co-organizer of the 44<sup>th</sup> COSPAR Assembly in Athens in July 2022.
- xiii. The HSC became a full member of the International Astronautical Federation (IAF) and was formally admitted at the 73<sup>rd</sup> International Astronautical Congress in Paris in September 2022.
- xiv. Contacts with a number of counterpart agencies (ASI - Italy, CNES - France, CONAE - Argentina, DLR - Germany, EgSA - Egypt, ISA - Israel, JAXA - Japan, NASA - USA, SSO - Switzerland, UAESA - United Arab Emirates), in order to identify topics of common interest, plan joint activities and facilitate collaborations between Greek and foreign entities. The discussions with the agencies of Italy, Argentina and Egypt have culminated into MoUs that are close to be signed, while ISA invited the HSC to organize a mission of Greek entities to Israel for visits to counterpart Israeli entities.
- xv. Discussions with selected foreign institutions, for example with the NASA Ames Research Center and UCLA, on the identification of common interests and on possibilities of transfer of knowledge.
- xvi. Coordination of the specification

and feasibility study for a national small constellation of Earth Observing small satellites, based on the collection and recording of user needs performed in 2021 - to be completed in autumn 2023.

- xvii. Close collaboration with IKY, the State Scholarships Foundation, for the revival of scholarships for the training of Greek graduate students in facilities of the European Space Agency.
- xviii. Designation as a National Technological Entity in spring 2023.
- xix. Coordination of the national procurement of satellite tasking services for Earth Observation purposes, starting through an open invitation to tender in spring 2023.

Regarding the very last activity, it is important to note that HSC will coordinate and manage, at national scale, satellite data acquisition for civilian applications. Nowadays, direct satellite tasking gives users the ability to commission satellites and capture imagery for a specific area, according to particular parameters and needs. Users can define specific tasking parameters, like: area of interest, tasking time window, incidence angle value, acquisition mode (mono, stereo, tri-stereo), maximum cloud coverage of the scene, etc. Moreover, having direct con-

tact with the specific satellite mission center, it is possible to receive new data within a few hours or within the same day. HSC will exploit these satellite tasking capabilities for a variety of cutting-edge Earth Observation programs. One of the most critical aspects of satellite tasking is being able to address emergency use cases. Satellite tasking is a vital part of the national space strategy as presented by the HSC at the Thessaloniki International Fair in September 2022 (Figure 2).

Next we provide some additional information on the HSC. The Hellenic Space Center belongs to the wider Public Sector and is governed by the provisions of its founding law (4623/2019). The HSC enjoys all administrative, financial, judicial, substantive and procedural privileges of the Greek State; in turn, it is bound to the decisions and priorities of its supervising Ministry. The HSC has the following responsibilities and goals:

- Formulation of the national space policy.
- Elaboration of an action plan, in cooperation with the University and Research community, and public and private stakeholders, to identify national objectives and procedures for achieving these objectives.
- Cooperation with, and mobilisation,



coordination and support of institutions and legal entities of the public and private sectors for the promotion, dissemination and exploitation of the space strategy of Greece.

- Management of national space programmes in scientific research, technological development, research and development of new technologies.
- Participation in European and international organisations, initiatives and forums on space issues.
- Coordination of national representatives in the space sector.
- Development of European and international cooperation, exchange and synthesis of knowledge, innovation and actions in order to maximise the country's participation in European and international space organisations, in European or international space programmes, as well as participation in the design of programmes to serve national, scientific, business and economic interests.
- Contribution to the development and enhancement of technology and space applications, services and ground-based infrastructure for the benefit of domestic industry and research.

- Support of the design of satellites, satellite systems, materials and equipment, including remote sensing activities.
- Cooperation with relevant institutions and agencies for the continuous training of students, young researchers and public officials in space issues.
- Design and participation in the implementation of actions for the understanding of space activities and applications.
- Promotion of standardisation issues and transfer of know-how and good practices in the field of space applications and services.
- Experimental or commercial exploitation of the rights of the State in satellite and space objects, as well as exploitation of related services, resources and assets, following a relevant assignment or authorisation by the Minister of Digital Governance.
- Assistance to the State with regard to satellite and space issues, as well as the provision of advisory services and the preparation of studies for the Ministry of Digital Government regarding the management of the rights and obligations of the State in space, the registration and evaluation of space objects, as well

as the development of satellite systems.

- Coordination of actions aimed at the communication and dissemination of results, technical achievements, applications and tools related to the broader field of Space.
- Implementation of promotional activities for the HSC.

The HSC Governing Board comprises the following members:

- Prof. Ioannis A. Daglis, President, Professor of the National and Kapodistrian University of Athens
- Dr. Nick Sergis, Chief Executive Officer, Space Physicist
- Dr. George Nounesis, Vice-President, Director & Chairman of the Board of the National Centre for Scientific Research "Demokritos"
- Prof. Konstantinos Karantzas, Member, Professor of the National Technical University of Athens
- Prof. Pavlos Sotiriadis, Member, Professor of the National Technical University of Athens
- Prof. Costas Synolakis, Member, Chair of Earth Sciences at the Academy of Athens
- Dr. Athanasios Dimas, Member, Digital Marketing Strategist



1993-2023

## Back issues of Hipparchos

Hipparchos is the official newsletter of the Hellenic Astronomical Society. It is distributed by post to the members of the society. You can download back issues from: <http://www.helas.gr/news.php>

