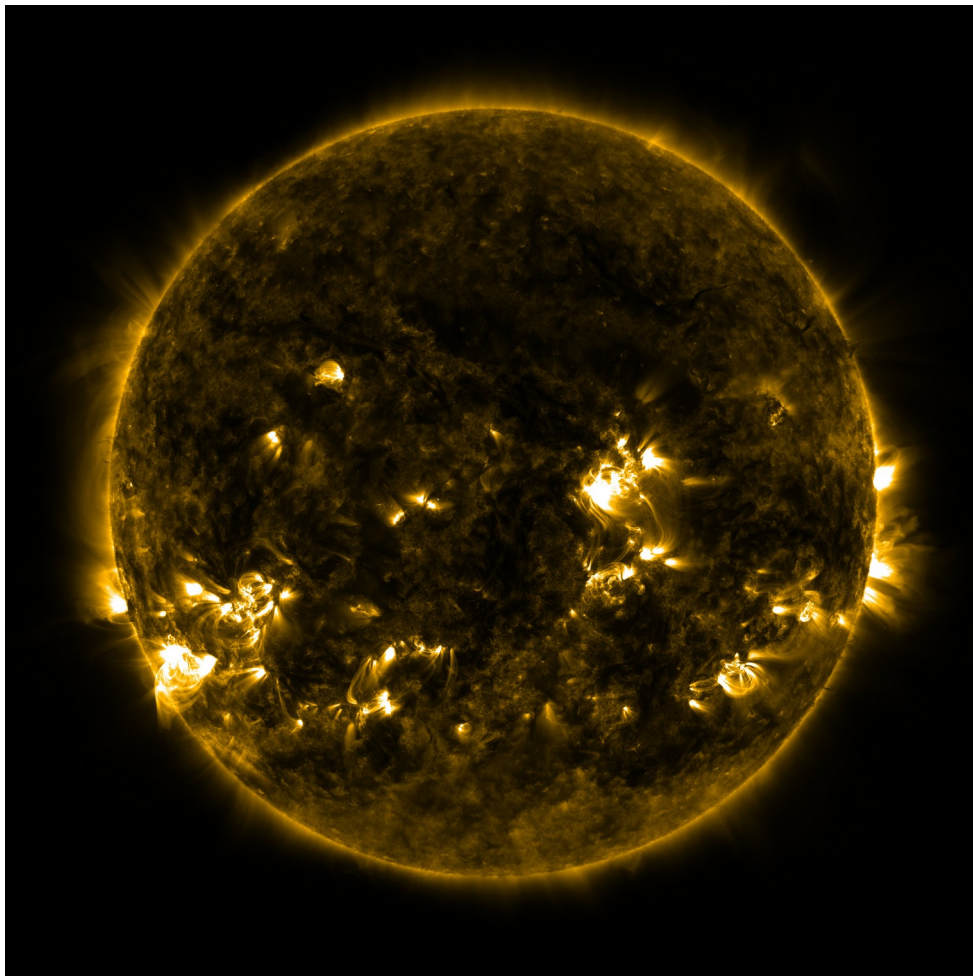


**Research Center for Astronomy
and Applied Mathematics**
of the Academy of Athens

ANNUAL REPORT 2022



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Collaborations Between RCAAM and other research institutes :¹

RCAAM has collaborations with researchers at: National Observatory of Athens (program "6"), University of Padova, Italy (program "26"), Laboratoire d'Astrophysique de Marseille (LAM), University Aix- Marseille, Μασσαλία, France, (program "3"), University of Cape Town, S. Africa (programs "4", "28"), Chinese Academy of Science, Beijing, China (program "3"), Max-Planck Institut für Astrophysik, Munich, Germany (program "5"), European Southern Observatory, Munich, Germany (Program "5"), International Space Science Institute (ISSI) Bern, Switzerland (program "7"), Max-Planck Institut fuer Radioastronomie, Bonn, Germany (program "8"), Instituto de Radio Astronomia Milimetric (IRAM), Granada (program "11"), NASA, Goddard Space Flight Center, Maryland, ΗΠΑ (program "9"), University of Thessaloniki (program "10"), European Space Agency (ESA) (programs "11", "12", "13", "14"), NASA Solar Radiation Analysis Group (SRAG), USA (programs "15", "18"), Georgia State University, USA (programs "15", "17", "20", "21", "22"), University of Helsinki, Finland (program "17"), Lockheed Martin Solar & Astrophysical Laboratory, USA (program "18"), International Space Science Institute (ISSI) Beijing, China (program "22"), University of Catania, Italy (program "22"), NASA Ames Space Flight Center, ΗΠΑ, (program "23"), University of Krakow, Poland (program "27"), University of Bristol, UK (program "28"), Naval Academy of USA (program "28"), Instituto de Ciencias Matemáticas, CSIC, Madrid, Spain (program "28"), Centro Iternacional de Ciencias AC - UNAM,

¹The numbers correspond to the number of the program in the section of the research programs of RCAAM.

Mexico (program "28"), University of Leeds, UK (program "28"), Universidad de Alcalá, Madrid, Spain (program "28").

About us

The Research Center for Astronomy and Applied Mathematics (RCAAM), is one of the Research Institutes of the Academy of Athens.

The main competences of RCAAM are Galactic Dynamics and Galactic Morphology, Nonlinear Dynamics and Chaos Theory, Solar Physics, Magnetohydrodynamics, Cosmology and Gravitation.

We are working towards comparing theoretical results with observational data from ground based as well as from space observatories (VLT, Solar Dynamics Observatory, etc.). The main scientific goals for the period 2022-2023 include the study of the role of Chaos in supporting structures in Nbody simulations, the Dynamics of the Milky Way and other galaxies, the investigation of Chaos in quantum systems, the study of the magnetic connectivity in the active-regions of the solar atmosphere, the investigation of particle acceleration in the pulsar magnetosphere and the time profiles of the resulting high energy radiation, the formation and evolution of Structures in Cosmology as well as the nature of dark matter and dark energy.

A number of young researchers are coming to our Institute and successfully complete their PhD and Masters Theses. The researchers of our institute participate in fourteen (14) supervising committees of PhD and MSc theses. RCAAM members participated in the teaching of the courses "Galactic and Extragalactic Astronomy", "Dynamical Astronomy" and "Cosmology" at the Department of Physics of University of Athens.

RCAAM organizes since 1997 a seminar on a weekly basis, during the whole year, with speakers leading scientists from Greece and abroad. The talks are attended by many researchers, university professors and young scientists. RCAAM has organized in 2002 and 2007 international conferences on "Galaxies and Chaos" and on "Chaos in Astronomy" respectively. This series of conferences is planned to be continued during the next years. Another conference organized with great success by our Institute was the conference "Classical and Quantum Gravity", Crete 2009. Members of RCAAM participated also in the organization of several more conferences in Greece and abroad. Many other talks for the broad public are given every year by the researchers of RCAAM.

History

The Research Center for Astronomy and Applied Mathematics was established in 1959 initially as "Office for Research and Calculations", to promote scientific research in Astronomy and Applied Mathematics and to perform calculations related to these topics. In 1966 has been renamed "Research Center for Astronomy and Applied Mathematics". Since then scientific research has been conducted in the following fields, which are also the current working areas:

- Dynamical Astronomy, Nonlinear phenomena and applications of Chaos Theory in Astronomy
- Galactic Dynamics and Galactic Morphology
- Solar Physics and Relations between Solar and Terrestrial Phenomena
- Magnetohydrodynamics
- Cosmology and Gravitation
- A recently added research field is the study of electromagnetic waves of extremely low frequency (ELF) at 2-50 Hz.

The first supervisor of the "Office for Research and Calculations", and later of the "Research Center for Astronomy and Applied Mathematics", was Academician Prof. I. Xanthakis, until his death on 10 July 1994. During the years 1994-1997 the Research Center was supervised by Academician Prof. N. Artemiadis. After 1997 the supervisor is Academician Prof. G. Contopoulos.

As directors have served in the past Dr. L. Mavridis (1960-1966), Dr. K. Makris (1971-1979), Dr. K. Poulakos (1981-2001), Dr. N. Voglis (2001-2007), Dr. V. Tritakis (2007), Dr. E. Dara (2008). Since 2009 acting director of the Center is Dr. P.A. Patsis. Researchers who have worked in the past in the Research Center were Dr. I. Lyritzis, Dr. V. Petropoulos and Dr. Th. Zachariadis.

Our Research

Nonlinear & Chaotic Dynamics

The research that is carried out in Nonlinear and Chaotic Dynamics has as goal the investigation in depth of chaotic phenomena and the application of Chaos theory in solving astronomical problems as well as problems in dynamics that are encountered in other science disciplines. The term "Chaos" means that the laws of Physics allow limited predictability, despite the fact that these laws are expressed by rigorous mathematical equations. Although the Theory of Chaos was first applied in astronomical dynamical systems, today it finds applications to various phenomena of interest for everyday life (for example: earth and space weather forecasting, earthquakes, development of complex digital networks etc.).

Galactic Dynamics & Galactic Morphology

Galactic Dynamics is the tool to understand the observed Morphology of disk and elliptical galaxies. Our research combines Orbital Theory, N-body Simulations and Hydrodynamics with Observations in large telescopes. The orbital analysis of bars and spirals in 2D and 3D models has revealed the dynamical phenomena that shape the forms of elliptical galactic systems, the spirals of normal and barred-spiral galaxies, as well as the edge-on profiles of galactic disks. In the last years research in this field in our Institute has underlined the role of chaotic orbits in reinforcing the spiral structure in barred-spiral systems and in the dynamics of disk galaxies in general.

Solar Physics

The members of RCAAM working in solar physics possess significant skills and experience in the study and analysis of (1) magnetic loops in the solar corona, (2) particle acceleration processes in reconnecting magnetic configurations, (3) small-scale phenomena in the solar atmosphere, including micro-flares and jets, (4) solar magnetography and related diagnostics, (5) solar eruptions and their connections with the Earth, including eruption prediction, and (6) fundamental properties and complexity of solar magnetism. RCAAM solar physicists perform both data analysis and modeling, routinely analysing data from multiple ground- and space-based instruments and actively collaborating with fellow solar and heliospheric physicists worldwide.

RCAAM solar physicists are active members of multiple international professional organizations and routinely attend and contribute to International Conferences, Workshops, Symposia, as well as to Public Outreach activities aiming to inform and educate the general public on aspects of heliophysics. They participate and organize multiple conferences and convene sessions within wider conferences. They interact and collaborate with colleagues in Greece, Europe in general, the United States, and Asia (China, Japan).

Astrophysical Magnetohydrodynamics

We are investigating the dynamics of electrically conducting magnetized fluids in various systems of astrophysical interest. Over the years, we have developed pioneering semi analytical solutions of the non-linear equations of Magnetohydrodynamics (MHD) in non-relativistic protostellar winds, relativistic galactic and extragalactic jets, magnetized protostellar collapse, the axisymmetric pulsar magnetosphere, and the magnetosphere of rotating black holes. More recently, we have been working on a particular regime of MHD, namely Force-Free Electrodynamics (FFE), and developed a numerical code that we implement in the study of the structure and high energy radiation of the three dimensional pulsar magnetosphere and the solar corona. We are investigating accretion disk magnetic winds as the origin of Warm Absorbers (WA) and Ultra Fast Outflows (UFO) in Active Galactic Nuclei (AGN). We are also actively investigating the role of a novel astrophysical mechanism, the Cosmic Battery, in the origin of astrophysical magnetic fields and in the dynamics of X-ray binaries and astrophysical jets.

Cosmology & Gravitation

In the field of Cosmology, research ranges from observational to fully theoretical aspects of Cosmological physics. In particular RCAAM is interested in: (a) statistical properties of the large scale structures as well as the geometry and topology of the distribution of matter in the Universe, (b) constraints on the cosmological parameters from cosmological data, (c) evolution of perturbations and structure formation in different cosmological models, (d) the nature of dark energy and the possible interaction between dark matter and dark energy, (e) alternative theories (except dark energy) for the accelerated expansion of the universe, and (f) classical and quantum cosmology of scalar fields.

In the field of Gravitation, research is pursued in the following thematic areas: (a) classical problems in General Relativity, (b) alternative theories of gravity, (c) black hole physics and in particular on the computation of Hawking radiation, black hole entropy and the possible solutions of the Black Hole Information Paradox, (d) quantum fields in curved spacetime, and (e) quantum gravity phenomenology.

Scientific Projects

The research staff of RCAAM participated in the following research programs in 2022:

1. **“Dissemination of Scientific Results ”** (up to 31/8/2022). Program of the Research Committee of the Academy of Athens (200/969) (G. Contopoulos, A.C. Tzemos and P. Patsis).
 - 34 hybrid seminars were conducted (both in person and as webinars) at RCAAM, and a special edition of the Center’s publications of the Center (see “Publications” and list of talks in the “Seminars” section).
2. **“Study of the Dynamics of Entanglement and Coherence in Quantum Systems** (2018-2022). (G. Contopoulos, C. Efthymiopoulos and A.C. Tzemos) (non funded).
 - Publications in peer-reviewed journals: **“1”**, **“2”**, **“3”** και **“4”**.
 - Publications in conference proceedings: **“2”**.
 - Talks: **AT-1, AT-2, AT-3, AT-4**.
3. **“Orbital content of galactic bars”** (2019-2022). Program of the Laboratoire d’Astrophysique de Marseille (LAM), University Aix-Marseille, France, in collaboration with RCAAM (P. Patsis, E. Athanassoula, LAM, Y. Wang, National Astronomical Observatories, Chinese Academy of Sciences, Beijing, China, S. Pastras, UOA). LAM supports travel and accommodation expenses of the researchers
 - Publications in peer-reviewed journals: **“8”**, **“9”** and **“10”**.
 - Ομιλίες: **PP-1** και **PP-6**.
 - Research Visits: S.Pastras visited LAM, Marseille, for the needs of the program (May 2 - June 30).
4. **“Numerical investigation of the impact of complex Instability to the phase space structure of dynamical systems with emphasis to barred galaxy models”**. (P. Patsis, M. Katsanikas, RCAAM, H. Skokos, Παν/μιο Cape Town, Cape Town, S. Africa, M. Hillebrand, University of Cape Town, Cape Town, Ν. Αφρική). (2019-2024). The program is funded by the University of Cape Town, supporting trips for Mr. Skokos and Mr. Hillebrand to RCAAM for collaborations within the program.
 - Publications in peer-reviewed journals: **“6”**, **“7”**, **“41”**.
 - Talks: **PP-5, MK-1**.
 - Research visits: Dr. M. Hillebrand at RCAAM (3-8 of September). Dr. Haris Skokos at RCAAM (21 December – 19 January 2023).

5. **“N-body simulations of galactic disks - The relation between observed spiral disk morphologies and the dynamical properties of DM halos”**. (P. Patsis, T. Naab, Max-Planck Institut für Astrophysik, Germany, P. Grosbol, European Southern Observatory, Munich). The Max-Planck Institute für Astrophysik supports visits by Mr. Patsis to Garching. Computational time is provided at the RZG Computing Center, Garching, Germany, where numerical simulations are performed with N-body models.
 - A paper in preparation.
 - Research visits: Dr. T. Naab at RCAAM (11-16 of October).
6. **“Morphological features of disk galaxies, due to nonlinear phenomena”** (P. Patsis, M. Xilouris and I. Alikakos, National Observatory of Athens (non funded)).
 - Publications in peer-reviewed journals: A paper in preparation
 - Observations of spiral galaxies have been conducted with the telescope Aristarchos, at Helmos (30 July – 3 August and 23-26 September).
7. **“Models of VHE Emission in Pulsars: Evaluation of the Current State-of-the-Art and Future Prospects”** (2019-2022). International Working Group of the International Space Science Institute-ISSI Bern, which funds the meetings of the group. Participation from RCAAM: I.C. Contopoulos
 - Talks: **IC-3**.
8. **Study of the Cosmic Battery with the Event Horizon Telescope”** (2021-). (I. Contopoulos and I. Myserlis (MPI Bonn and IRAM Granada)). (non funded).
 - Publications in peer-reviewed journals: **“11”**.
9. **“Study of magnetized winds from accretion disks around Active Galactic Nuclei-AGN”** (2021-). (I. Contopoulos, D. Kazanas (NASA/Goddard)). (non funded).
 - Publications in peer-reviewed journals: **“12”, “15”**.
10. **“The nature of dark energy”** (2011-2018, but the publications are still in progress). S. Basilakos, M. Plionis (University of Thessaloniki), J. Sola (Un. of Barcelona), S. Capozziello (University of Naples), A. Lima (University of Sao Paulo) and N. Mavromatos (King College University of London). Funded by the universities of Barcelona, Naples and S. Paulo.
 - Publications in peer-reviewed journals: **“16”, “17”, “18”, “19”, “20”, “21”, “22”, “23”, “24”, “25”**.

11. **“Development of the ASPIICS Coronagraph for the PROBA-3 Mission”** (2009-). Program of the European Space Agency (ESA) coordinated by the Royal Observatory of Belgium. Principal Investigator: Dr. A. Zhukov, Royal Observatory of Belgium, Belgium. Principal Investigator for Greece: Prof. K. Tsiganos, UOA. Participation from RCAAM, M. Georgoulis and C. Gontikakis.
 - The construction of the instrument proceeded.
12. **“Solar Orbiter Modeling and Data Analysis Working Group (MADAWG)”** (2017-). Program of the European Space Agency (ESA) coordinated by the Research Institute in Astrophysics and Planetology (IRAP) in Toulouse France Principal Investigator: Dr. A. Rouillard, Insitute of Research in Astrophysics and Planetology (IRAP), France. Participation from RCAAM, M. Georgoulis
 - Publications in peer-reviewed journals: **“32”**.
13. **“ESA / SSA SWE Solar Weather Expert Service Center (ESC)”** (2017-2023). Χορηγός: European Space Agency Space Situational Awareness Programme (ESA/SSA). Total budget (for the Academy of Athens): 159.000€. Program Code: 200/902. Principal Investigator: Dr. J. Andries, Royal Observatory of Belgium. Participation from RCAAM, M. Georgoulis. Software engineer: D. Migdakos.
 - This service continues to operate at RCAAM.
14. **“ESA / Space Weather Expert Service Network (SWESNET) (2015 -)”**. Program of the European Space Agency (ESA), coordinated by the Royal Belgian Institute of Space Aeronomy. Participation from RCAAM, M. Georgoulis
 - Talks: **MG-1, MG-3, MG-5, MG-6, MG-9**.
 - Actions: **MF12**.
15. **“Elements: Comprehensive Time Series Data Analysis for the Prediction of Solar Flares and Eruptions”** (2019-2022). Program National Science Foundation (HΠΑ) for the Georgia State University, Atlanta, USA. The program covers the expenses for travelling and accomodation in USA. Sponsor: National Science Foundation. Total budget: 600.000\$. Principal Investigator: Dr. R. A. Angryk, GSU Computer Science Dept. Participation from RCAAM, M. Georgoulis.
 - Publications in peer-reviewed journals: **“26”**.
16. **“Space Weather Awareness Training Network (SWATNET)”** (2021-2025). Program of the European Commitee coordinated by the University of Helsinki. Program code 200/963. Sponsor: European Union, Horizon 2020 Programme, National Science Foundation. 3.128.225€ (486.035€ for the Academy of Athens). Principal Investigator: Dr.

E. Kilpua, University of Helsinki, Finland. Participation from RCAAM, M. Georgoulis in collaboration with profs. A. Nintos and S. Patsourakos from the university of Ioannina.

- Talks: **MG-10** και **MG-11**.
- Conferences;/ Work-meetings: **MG-2, MG-3**.

17. **“NASA Solar Radiation Analysis Group (SRAG), contract entitled ‘GSU Contributions to the Development of Forecasting Capabilities for the NASA SRAG (2019 -)’**. Program NASA/Space Radiation Analysis Group for the Georgia State University, USA, in which M. Georgoulis participates as an external advisor. The program covers the expenses for travelling and accommodation of M. Georgoulis in USA>
18. **“EUVST Student Collaboration”** (2021-2026). Program of NASA for the Lockheed Martin Solar and Astrophysical Laboratory (Palo Alto, California, USA). The program refers only to an educational participation in the Japanese space mission JAXA/Solar-B and covers the expenses for travelling and accommodation in Atlanta. Total budget: 500.000\$. Principal investigator: B. de Pontieu, Lockheed Martin Solar & Astrophysical Laboratory, USA. Participation from RCAAM, M. Georgoulis.
19. **“Elements: Spatiotemporal Analysis of Magnetic Polarity Inversion Lines (STEAMPIL)”** (2021-2024). Program of National Science Foundation (USA) for the Georgia State University, Atlanta, USA. The program covers the expenses for travelling and accommodation in Atlanta. Sponsor: National Science Foundation. Total budget: 600.000\$. Principal Investigator: B. Aydin, Georgia State University, USA. Participation from RCAAM, M. Georgoulis.
 - Publications in peer-reviewed journal: **“3”**.
20. **“Machine Learning-based Solar Energetic Particle Event Prediction Using X-ray, Proton and Electron Flux Data”** (2021-2024). Sponsor: NASA. Total budget: 133.000\$. Principal Investigator: P. Martens, Georgia State University, USA. Participation from RCAAM, M. Georgoulis
 - Publications in peer-reviewed journal: **“27”**.
 - Publications in databases: **“2”**.
21. **“Operationalizing Data-Driven Prediction Tools for Post-Eruption Solar Energetic Particles”** (2021-2023). Sponsor: NASA. Total budget: 494.000\$. Principal Investigator: P. Martens, Georgia State University, USA. Participation from RCAAM, M. Georgoulis.
 - Publications in peer-reviewed journal: **“27”**.

- Publications in databases: “2”.
22. **“Step Forward in Solar Flare and Coronal Mass Ejection (CME) Forecasting”** (2021-2024). Program of the International Space Science Institute (ISSI) – Beijing, China. Principal Investigator: F. Zuccarello, University of Catania, Italy. Participation from RCAAM, M. Georgoulis. The program covers 1-2 week long travelling expenses for work meetings.
 - Talks: **ΜΓ-4**.
 23. **“Machine Learning for Solar Energetic Particle (SEP) Event Forecasting”** (2020-). Program of NASA for the preparation of the space mission ARTEMIS. Principal Investigator: Dr. I. Kitiashvili, NASA Ames Space Flight Center. Participation from RCAAM, M. Georgoulis.
 - Results will be available after the space flight.
 24. **“NASA FIREFLY Mission”** (2021 -). Program of Nasa for the Johns Hopkins University Applied Physics Laboratory (JHU/APL) for the study of the mission concept FIREFLY. Participation from RCAAM, M. Georgoulis.
 - Publications in special volumes without referees: “2”.
 25. **“COSPAR International Space Weather Action Teams (ISWAT)”**. Program of the Committee on Space Research (COSPAR), coordinated by the Community Coordinated Modeling Center (CCMC) of NASA. Participation from RCAAM, M. Georgoulis.
 - Publications in peer-reviewed journals: “28”.
 - Talks: **ΜΓ-2** και **ΜΓ-7**.
 26. **“Marie Curie Innovative Training Network Stardust-R: The asteroid and Space Debris Network v2.0”** (2019-2022). International program funded by the European Union in the framework of the Horizon- action 2020. Total budget: 221.000€ (for the Academy of Athens, 196.000€). Participation from RCAAM, C. Efthymiopoulos, University of Padova/RCAAM and M. Harsoula.
 - Supervision of a foreign doctoral student (E. Legnaro), for 3 years (September 2019), with C. Efthymiopoulos as main supervisor and M. Harsoula as co-supervisor.
 27. **““Support of the operation and the development of international station for the study of Schumann electromagnetic waves”** (2021-2023). Program of the research committee of the Academy of Athens (200/978). Principal investigator: V. Tritakis. Participation from RCAAM, I. Contopoulos. Collaboration with the university of Krakow, Poland.

- The Schumann wave measuring station located at the top of Mount Parnos in Laconia was maintained and supervised.
- Publications in peer-reviewed journals: **"13-14"**.

28. **"Methods of Dynamical Astronomy and of Hamiltonian Chaos in Chemical Dynamics."** (2022-). (Non funded). International collaboration with the Departments of Mathematics of the University of Bristol, UK, and of the US Naval Academy of USA. Participation from RCAAM, M. Katsanikas.

- Publications in peer-reviewed journal: **"34","35","36","37","38","39","40","41","42"**.
- Talks: **MK-2, MK-3**.

Moreover, the research director of RCAAM and as director of the Institute of Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens, Basilakos participated in the following programs:

1. **"Program for the development of broadband network at Helmos Observatory in the framework of the corresponding program of ESA. Total budget: 1.000.000€.."**
2. **"ESPA of Peloponnisos. Program for the dissemination of Astronomy through the Observatory of Kryoneri". Total budget: 362.000€.**

Publications in 2022

Special Editions

1. Dr. P. Patsis was the editor of the special volume "Advances in Astronomy 2021" while the corresponding volume for 2022 is under preparation. This series includes articles which summarize the main results of the researchers of RCAAM. Dr. Patsis was also editor of the annual report of RCAAM for 2021 in a special issue.
2. Dr. Georgoulis participated in the preparation of the special volume "Helicities in Geophysics, Astrophysics and Beyond" (Eds. Kuzanyan K., Yokoi N., Georgoulis M. K. and Stepanov R., 2021, AGU Monograph Series, Wiley, that is going to be published in 2023.
3. Dr. M. Katsanikas was managing guest editor of the special volume "Chaos Indicators, Phase Space and Chemical Reaction Dynamics" (eds. M. Katsanikas, M. Agaoglou and F. Gonzalez Montoya), Physica D, (2022), ISSN: 0167-2789.

Publications in International Journals with Referees

(Published or accepted for publication in 2022 (42 papers in total))

1. Tzemos A.C. and Contopoulos G., 2022, "Born's rule in multiqubit Bohmian systems", *Chaos Solitons Fractals* 164, 112650.
2. Tzemos A.C. and Contopoulos G., 2022, "Bohmian chaos in multinodal bound states", *Found. Phys.* 52, 85.
3. Tzemos A.C. and Contopoulos G., 2022, "Bohmian quantum potential and chaos", *Chaos Solitons Fractals* 160, 112151.
4. Tzemos A.C. and Contopoulos G., 2022, "Chaos and ergodicity in entangled non-ideal Bohmian qubits", *Chaos Solitons Fractals* 156, 111827.
5. Harsoula M., Efthymiopoulos C., Contopoulos G. and Tzemos A.C. 2022, "Perturbed precessing ellipses as the building blocks of spiral arms in a barred galaxy with two pattern speeds", *Astron. Astrophys.* 667, 9.
6. Patsis P.A., Manos T., Chaves-Velasquez L. et al., 2022, "Chaoticity in the vicinity of complex unstable periodic orbits in galactic type potentials", *Phys. D* 429, 133050.
7. Katsanikas M. and Patsis P. A., 2022, "The phase space structure in the vicinity of vertical Lyapunov orbits around L1,2 in a barred galaxy model", *Mon. Not. R. Astron. Soc.* 516, 5232.
8. Pastras S., Patsis P. A. and Athanassoula E., 2022, "Gasflows in Barred Galaxies with Big Orbital Loops—A Comparative Study of Two Hydrocodes", *Universe* 8, 290.
9. Manos T., Skokos C. and Patsis P.A., 2022, "Orbit evolution in growing stellar bars: bar-supporting orbits at the vertical ILR region", *Mon. Not. R. Astron. Soc.* 509, 1995.
10. Wang Y., Athanassoula E., Patsis P.A. and Mao S., 2022, "Periodic orbits of multiplicity higher than one in an N-body barred galaxy potential", *Astron. Astrophys.* 668, A55.
11. Contopoulos I., Myserlis I. Kazanas D. and Nathanail A., 2022, "Direct Imaging of the Cosmic Battery in M87? Not yet.", *Galaxies* 10, 80.
12. Contopoulos I., Strantzalis A., Papadopoulos D. and Kazanas D., 2022, "Gravitational waves from GRB core spin-down", *Mon. Not. R. Astron. Soc.* 509, 174.
13. Tritakis V., Contopoulos I. et al., 2022, "How Effective and Prerequisite Are Electromagnetic Extremely Low Frequency (ELF) Recordings in the Schumann Resonances Band to Function as Seismic Activity Precursors", *Atmosphere* 13, 185.

14. Mlynarczyk J., Tritakis V., Contopoulos I. et al., 2022, "Anthropogenic Sources of Electromagnetic Interference in the Lowest ELF Band Recordings (Schumann Resonances)", *Magnetism* 2, 152.
15. Christodoulou D. M., Laycock S. G. T., Kazanas D. and Contopoulos I., 2022, "Variations of magnetic multipoles in the X-ray binary pulsars Her X-1 and A 0535+26", *Mon. Not. R. Astron. Soc.* 513, 1.
16. Asimakis P., Basilakos S., Mavromatos N. E. and Saridakis E. N., 2022, "Big bang nucleosynthesis constraints on higher-order modified gravities", *Phys. Rev. D.* 8, 084010.
17. Kelesis D. et al. (including Basilakos S.), 2022, "Detecting and analysing the topology of the cosmic web with spatial clustering algorithms I: methods", *Mon. Not. R. Astron. Soc.* 516, 5110.
18. Mehrabi A., Basilakos S., Tsiapi P. et al., 2022, "Using our newest VLT-KMOS HII galaxies and other cosmic tracers to test the Lambda cold dark matter tension", *Mon. Not. R. Astron. Soc.* 509, 224.
19. Papagiannopoulos G., Basilakos S. and Saridakis E. N., 2022, "Dynamical system analysis of Myrzakulov gravity", *Phys. Rev. D.* 10, 103512.
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27. Rotti S., Aydin B., Georgoulis M. K. and Martens P. C., 2022, "Integrated Geostationary Solar Energetic Particles Event Catalog: GSEP", *Astrophys. J. Suppl. Series* 262, 29.
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29. Liu Y. et al. (including Georgoulis, M. K.), 2022, "Changes of Magnetic Energy and Helicity in Solar Active Regions from Major Flares", *Astrophys. J.* (in press).
30. Samara E. et al. (including Georgoulis M.K.), 2022, "Influence of Mid-Latitude Coronal Hole Morphology on the Solar Wind Speed at Earth", *Astron. Astrophys.* 662, A68.
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32. Alipour N. et al. (including Georgoulis M. K.), 2022, "Automatic Detection of Small-Scale EUV Brightenings Observed by the Solar Orbiter / EU1", *Astron. Astrophys.* 663, A128.
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34. Katsanikas M. and Wiggins S. 2022, "The nature of reactive and non-reactive trajectories for a three dimensional caldera potential energy surface", *Phys. D*, 435, 133293.
35. Katsanikas M., Agaoglou M., and Montoya F.G., 2022, "Introduction to special issue: Chaos indicators, Phase Space and Chemical Reaction Dynamics", *Phys. D*, 133385.
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38. Katsanikas M., Hillebrand M., Skokos Ch. and Wiggins S., 2022, "The influence of asymmetry on the dynamics associated with a caldera potential energy surface", *Int. J. Bifurcat. Chaos* 32, 2230030 (Feature article).

39. Katsanikas M. et al., 2022, "Bifurcation study on a degenerate double van der Waals cirgue potential energy surface using Lagrangian Descriptors", *Commun. Nonlin. Science Numer. Simul.* 105, 106089.
40. Agaoglou M., Katsanikas M. and Wiggins S., 2022, "The influence of a parameter that controls the asymmetry of a potential energy surface with an entrance channel and two potential wells", *Regul. Chaotic Dyn.* 27, 232.
41. Hillebrand M. et al. (including Katsanikas M.), 2022, "Quantifying Chaos using Lagrangian descriptors", *Chaos* 32, 123122.
42. Katsanikas M., Hillebrand M., Skokos Ch. and Wiggins S., 2022, "A new type of dynamical matching in an asymmetric caldera potential energy surface", *Chem. Phys. Lett.* (in press).

Publications in conference proceedings and other publications with referees:

1. Kazanas D., Fukumura K., Shrader C. and Contopoulos I., 2022, "Accretion Disk MHD Winds: A Rosetta Stone of the AGN Morphology and SEDs", *AAS High Energy Astrophysics Division Meeting N.19*, *Bull. Amer. Astron. Soc.* 54, 1910650.
2. Tzemos A.C. and Contopoulos G., 2022, "Chaos in 2-d Bohmian Trajectories", *Maple Trans.* 2, article 14369.

Publications in conference proceedings and other publications without referees:

1. Contopoulos G., 2022, "Historical developments", *Hipparchos* 3, 28.
2. Poduval B. et al. (including Georgoulis M.), "Applications of Statistical Methods and Machine Learning in the Space Sciences: Conference Report" *National Science Foundation Public Repository* (in press).
3. Georgoulis M. K., 2022, "COSPAR's 44th Scientific Assembly in Athens: a first for Greece at a historic juncture", *Hipparchos*, 3, 31.
4. Raouafi N.-E. et al. (including Georgoulis, M. K.), 2022, "FIREFLY: The Case of a Holistic Understanding of the Solar Structure and Dynamics of the Sun and the Heliosphere", *White Paper to the Decadal Survey for Solar and Space Physics (Heliophysics) 2024 – 2033*, US National Academies (in press).
5. Poduval, B., et al. (including Georgoulis, M. K.), 2022, "AI-Data in Solar Physics and Space Science: Concerns, Mitigation and Recommendation", *White Paper to the Decadal Survey for Solar and Space Physics (Heliophysics) 2024 – 2033*, US National Academies (in press).

Publications in databases:

1. Nita G. et al. (including Georgoulis M.K.), 2022, "Revisiting the Need for Uniform Semantics and Syntax for Solar Research Cyberinfrastructure: A White Paper of Findings and Recommendations", White Paper submitted to the US National Science Foundation, arXiv, 2203.09544.

Distinctions

1. Dr. S. Vasilakos is an Adjunct Professor (2022-2024) at the European University of Cyprus.
2. Dr. M. Georgoulis was awarded the Committee on Space Research (COSPAR) Appreciation Medal by the President of COSPAR on July 21, 2022, for organizing the COSPAR Athens 2022 – 44th Scientific Assembly from the position of the President of the Local Organizing Committee.
3. Dr. M. Katsanikas had 3 feature articles and a cover in the International Journal of Bifurcation and Chaos. Additionally, he was elected an honorary research collaborator in the Department of Mathematics at the University of Bristol.

Participation in Conferences and Talks

P. Patsis

- PP-1. Invited talk at the Max-Planck Institut fuer Astronomie, Munich, Germany, titled "The flow of material in the disks of spiral galaxies and the location of star-forming regions" (February 8, online).
- PP-2. Participation in the conference "The present and future of Astronomy" organized by the European Southern Observatory (ESO), Munich, Germany (February 14-17, online).
- PP-3. Participation in the seminar "UNESCO: Open Science-Artificial Intelligence. New Horizons, Visions, and Limits" organized by the Mariana V. Vardinoyianni Foundation under the auspices of UNESCO (February 15).
- PP-4. Participation in the conference "Inward bound: bulges from high redshifts to the Milky Way" organized by the European Southern Observatory (ESO), Munich, Germany (May 2-6, online).

- PP-5. Invited talk at the summer school-conference "Dynamical Systems and Complexity" organized by the Complex Systems and Applications Network (COSANet) of the NCSR "Demokritos" in Chania (July 18 – 26), with the topic "Non-linear phenomena shaping the structure of spiral galaxies" (July 19, online).
- PP-6. Invited talk at the seminar "Spirals and bars in galaxies" organized by the KEAEM at the Eastern Hall of the Academy of Athens, with the topic "Open questions about the association of observed structures and orbits in galactic disks" (October 14).

I. Contopoulos

- IK-1. Invited talk at the University of Massachusetts Lowell, USA, titled "Quantum interference: reality or an illusion of the detector" (March 17, online).
- IK-2. Invited talk at the 4th Purdue Workshop on Relativistic Plasma Astrophysics, Purdue University, USA, titled "The role of the current sheet in the pulsar magnetosphere" (May 9-11).
- IK-3. Invited talk by the International Space Science Institute-ISSI Bern Working Group on "Models of VHE Emission in Pulsars: Evaluation of the Current State-of-the-Art and Future Prospects," Bern, Switzerland, titled "The role of the current sheet in the pulsar magnetosphere" (September 12-16).
- IK-4. Invited talk at the conference "Physics Enchants..." of the Union of Greek Physicists, University of West Attica, titled "Science-Pseudoscience" (December 16-18).

M. Georgoulis

- MG-1. Invited talk at the "15th Quadrennial Solar Terrestrial Physics Symposium (STP-15)," India, titled "Prediction of Solar Flares and Predictive Diagnostics of Related Eruptive Manifestations" (February 21 – 25, online).
- MG-2. Oral presentation at the "ISWAT Team Coordination Meeting," Maryland, USA, titled "ISWAT S3 Cluster Paper: Draft Outline" (March 30 – 31, 2022, online).
- MG-3. Participation in working groups and invited talk at the "ESA SWE Service Network Workshop," Darmstadt, Germany, titled "Standalone and Comparative Performance Verification and Validation Tasks" (May 10–12, 2022).

A. Tzemos

- AT-1. Invited talk at the summer school-conference "Dynamical Systems and Complexity," organized by the Complex Systems and Applications Network (COSANet) of NCSR "Demokritos" in Chania, with the title "Order and Chaos in Bohmian Quantum Mechanics" (July 19, online).
- AT-2. Participation in the Maple Conference 2022, Toronto, Canada, with a talk titled "Critical points of the Bohmian quantum flow: A study with Maple" (November 2-5, 2022, online).
- AT-3. Attendance at the "Third Kyoto Workshop on Quantum Information, Computation, and Foundations" conference (October 17-21, 2022, online).
- AT-4. Invited talk by the Complex Systems and Applications Network (COSANet) of NCSR "Demokritos" with the title "Order and chaos in Bohmian Quantum Mechanics" (May 26, online).

Organisation of Conferences and Meetings

1. PP-1. Mr. P. Patsis was the main organizer of the conference "Spirals and bars in galaxies" in the Eastern Hall of the Academy of Athens. Eight (8) presentations were given by distinguished researchers in the field of Galactic Dynamics from the Max-Planck Institut fuer Astronomie, Munich, Germany, the Laboratoire d'Astrophysique de Marseille (LAM), Marseille, France, the Department of Mathematics, University of Padova, Padova, Italy, the European Southern Observatory (ESO), Munich, Germany, the Inter-University Centre for Astronomy and Astrophysics, Pune, India, and researchers from KEAEM (October 14).
2. IK-1. Mr. I. Contopoulos was the coordinator and leader of the International Team of the International Space Science Institute-ISSI Bern on the topic "Models of VHE Emission in Pulsars: Evaluation of the Current State-of-the-Art and Future Prospects" (<http://www.issibern.ch/teams/vheemission/index.php/team/>).
3. SB-1. Mr. Vasilakos was a member of the organizing committee of the international conference on Cosmology, "Tensions in Cosmology," in Corfu with the participation of many prominent scientists, including A. Riess (Nobel Prize in Physics 2012) (September 2022).
4. Mr. M. Georgoulis was
 - MG-1. President of the Local Organizing Committee of the conference "COSPAR Athens 2022: 44th COSPAR Scientific Assembly," Megaro Musikis Athinon & Divani Caravel Hotel. The first hybrid COSPAR conference, held for the first time in Greece. A total of 2850+ registered participants, with physical and online presence (July 16-24, 2022). Website: <https://www.cosparathens2022.org/>

- MG-2. Head of the Scientific Organizing Committee of the School "SWAT-NET School 2: Sun-Earth Interactions," Amalia Hotel, Athens. Training of approximately 20 students within the framework of the European SWAT-NET program (Athens, September 26-28, 2022). Website: <https://swatnet.eu/school-2-sun-earth-interactions/>
- MG-3. Head of the Scientific Organizing Committee of the workshop "SWAT-NET Workshop 3: Solar Activity and Space Weather: Physics Behind the Process," Amalia Hotel, Athens (September 28-30, 2022). Presentation of current topics and training of the 12 students of the European SWATNET program. Website: <https://swatnet.eu/workshop-3-solar-activity-and-space-weather-physics-behind-the-process/>

Seminars

RCAAM, aiming at the continuous effort of informing both researchers and postgraduate students on modern research topics in the field of Astronomy-Astrophysics and nonlinear dynamical systems, organizes weekly seminars. Often, researchers from foreign institutions are funded by their institutes to come and speak at KEAEM seminars and interact with our center's researchers. In 2022, 34 seminars were held at the Center, covering topics in Astronomy, Astrophysics, and non-linear Dynamics.

The seminars included speakers, in addition to the researchers and postgraduate students of the Center, academics, professors, and distinguished scientists from various Universities and Research Centers in Greece and abroad. Below is the list of seminars. This list also includes the 8 talks of the conference titled "Spirals and bars in galaxies," held on October 14th in the eastern hall of the central building of the Academy of Athens, where both members of RCAAM and invited scientists from abroad participated.

SPEAKER SCHEDULE 2022

Konstantinos Kalapotharakos NASA	Interpreting the Thermal and Non-Thermal High-Energy Emission in Multipolar Field Pulsar Magnetospheres (Watch here)	11/1/2022
Athanasios Tzemos KEAEM Academy of Athens	Born's rule in the case of 3 entangled Bohmian qubits	18/1/2022
Konstantinos Gourgouliatos University of Patras	Magnetic Field Evolution in Neutron Star Crusts: Hall effect and beyond	1/2/2022
Haris Anastopoulos University of Patras	Gravitational effects in macroscopic quantum systems	8/2/2022
Ioannis Contopoulos KEAEM Academy of Athens	Quantum Interference: reality or an illusion of the detector?	15/2/2022
Athanasios Tzemos KEAEM Academy of Athens	Chaos and Bohmian Quantum Potential	22/2/2022
Nikolaos Karnesis Aristotle University of Thessaloniki	Detecting Gravitational Waves from space	3/3/2022
Antonios Nathanael National and Kapodistrian University of Athens	Still observing light from the binary neutron star merger first detected in 2017	8/3/2022
Damianos Iosifidis NASA	Perfect Hyperfluids	10/3/2022
Dimitrios Stamatellos University of Lancashire	The formation and evolution of disc-instability planets	15/3/2022
Georgios Doulis University of Lancashire	Entropy as shock indicator in neutron star merger simulations	29/3/2022
Evangelos Melas University of Lancashire	Asymptotic symmetries and representation theory in General Relativity in three and four space-time dimensions	31/3/2022
Spyridon Aleiferis British Atomic Energy Authority	Taming of the stars: How to control fusion plasmas	12/4/2022
Stavros Pastras KEAEM Academy of Athens	Gasflows in barred spiral galaxies by means of two different hydrocodes	29/4/2022

SPEAKER SCHEDULE 2022

Antonios Tsokaros University of Illinois	Numerical general relativity and astrophysics in the era of multimessenger astronomy	3/5/2022
Konstantina Zouloumi KEAEM Academy of Athens	NAAF determination of the multiple pattern speeds and the manifolds in a simulation of a barred spiral galaxy	17/5/2022
Susanna Parenti Institute of Astrophysics and Space, France	Validation of a wave heated 3D MHD coronal-wind model using Polarized Brightness and EUV observations	24/5/2022
Marina Agaoglu Institute of Mathematics, Madrid	Transport processes on a Potential Energy Surface with four wells, four index-1 saddles and an index-2 saddle	9/6/2022
Mattheos Katsanikas KEAEM Academy of Athens	Stickiness in 3D rotating galactic potentials	14/6/2022
Georgios Loukes-Gerakopoulos Czech Academy of Sciences	Celestial Mechanics of Extreme Mass Ratio Inspirals	28/6/2022
Kanak Saha Inter-University Centre for Astronomy and Astrophysics, Pune, India	Growth and survival of bars in disk galaxies	5/7/2022
Christos Efthymiopoulos University of Padova	The information approach to the interpretation of quantum mechanics	12/7/2022
Samik Mitra IIT Guwahati, India	Properties of general relativistic magneto-hydrodynamics accretion flows around black holes in steady-state limit	18/7/2022
Suraj Dhiwar IIT Guwahati, India	Star Formation Quenching in L^* Ellipticals	28/6/2022
Malcolm Hillebrand University of Cape Town	Biophysical chaos: Bubbles in DNA molecules	8/9/2022

SPEAKER SCHEDULE 2022

Panos Patsis KEAEM Academy of Athens	Open questions about the association of observed structures and orbits in galactic disks	14/10/2022
Thorsten Naab Max-Planck Institute for Astrophysics, Garching bei Muenchen	The formation of galactic star cluster populations and orbits in galactic disks	14/10/2022
Mirella Charsoula KEAEM Academy of Athens	The building blocks of the spiral arms in galaxies	14/10/2022
Preben Grosbol European Southern Observatory, Garching bei Muenchen	Interaction between spirals and bars in disk galaxies	14/10/2022
Christos Efthymiopoulos University of Padova	Manifolds and spirals under multiple pattern speeds	14/10/2022
Evangelia Athanassoula Laboratory of Astrophysics of Marseille	Understanding the Formation and Evolution of Bars using Simulations	14/10/2022
Kanak Saha Inter-University Centre for Astronomy and Astrophysics, Pune, India	Revisiting spiral structures in galaxies	14/10/2022
Georgios Contopoulos Academy of Athens	The spiral arms of galaxies	14/10/2022
Thomas Kotoulas Aristotle University of Thessaloniki	Two-parametric families of orbits created by three-dimensional galactic-type potentials	18/10/2022

Teaching

Researchers of RCAAM taught postgraduate courses in university departments, seminars for students and researchers, and schools organized by scientific associations.

- **Dr. Patsis** made a series of 7 seminars for the students of RCAAM in “Galactic Dynamics”.
- **Dr. Basilakos** taught the lesson of Cosmology in the Mathematics and Physics Departments of UOA.
- **Dr. Gontikakis** participated in the teaching of the course of Solar Physics in the 3rd year of the Physics Department of the University of Athens, in collaboration with Prof. G. Daglis, Dr. A. Cheilaris, Dr. Chr. Katsavrias during the winter semester (October -June-December) of the Academic year 2021-2022.

Phds and Masters

RCAAM researchers participate in other PhD supervision committees inside and outside of RCAAM. Specifically, during 2020 RCAAM members supervised the PhD of:

- Dr. Patsis is co-supervisor of the PhD thesis of Magdalini Aggelakopoulou with title “Numerical and theoretical study of 3-d Hamiltonian systems in Finance” (Department of Financial Studies, University of Thessaly. He is also the supervisor of the M.Sc. thesis of S. Pastras (University of Athens) with title: “Comparing hydrodynamics codes for modeling the gas flow in barred spiral galaxies”.
- Dr. Contopoulos supervised the PhD thesis of E. Coutsantonou with title “Study of radiation of the accretion discs around black holes”. He is also member of the advisory committee of the PhD thesis of X. Sinnis (UOA) with title “Study of the stability of relativistic magnetised astrophysical jets” and of the PhD thesis of V. Bisketzis (UOA) with title “Plasma Dynamics in the environment of a rotating black hole”. Finally he supervises the thesis of the postgraduate student V. Spyrou (UOA) with title “Magnetized accretion disks which produce winds” and the thesis of A. Dogas (UOA) with title “New method of using current sheets in the ideal MHD”.
- Dr. Vasilakos supervises the PhD thesis of Ioannis Papagiannopoulos at the University of Athens with title “Study of symmetries in cosmological models of alternative gravity”. Moreover he supervises the PhD thesis of Fotios Anagnostopoulos (UOA) with title “Study of the accelerating expansion rate of the Universe” and the PhD thesis of Pavlina Tsiapi (NTUA) with title “Study of the dark energy via cosmological microwave radiation from Planck”

Finally, Dr. Vasilakos is member in the advisory board of the PhD thesis of A. Papageorgiou (AUTH) with title “Cosmological parameters and dark energy”, A. Triantafyllopoulos (UOA) with title “Finsler geometries and cosmological extensions” and G. Gakis (NTUA) with title “Generalized theories of gravity in the tangent bundle”.

- Dr. Georgoulis was member the advisory board of the Phd thesis of Loukas Xaplanteris at the Department of Physics in UOA with title “Coupling between primary and secondary cosmic radiation coming from galaxies and the sun”. Dr. Georgoulis is member of the board of the Phd thesis of Evangellia Samara, Department of Mathematics of the Katholieke Universiteit Leuven, Belgium, with title “Improved Model for Solar Wind Prediction Including Solar and Stellar Coronal Mass Ejection”.

Dr. Georgoulis is also a member of the Advisory Committee of the thesis of the PhD candidate Aparna Venkataramanasastry in the Department of Physics and Astronomy of Georgia State University, USA, with the indicative title “Space Weather and Solar Flare Prediction”. He was a member of the Advisory Committee of the doctoral dissertation of the doctoral candidate Azim Ahmadzadeh in the Department of Computer Science of Georgia State University, USA, with the indicative title “Machine Learning of Scientific Events: Detection, Classification and Segmentation”.

He is also a member of the Advisory Committee for the candidate’s doctoral dissertation Dr. Sumanth Rotti, Department of Physics and Astronomy, Georgia State University, USA, with the indicative title ‘Solar Energetic Particle (SEP) Event Forecasting Using Machine Learning”.

He is also a member of the Advisory Committee for the candidate’s doctoral dissertation Augustin André-Hoffmann Department of Physics University of Ioannina “Pre-Eruption Magnetic Configuration and Eruption Forecasting”.

He is also a member of the Advisory Committee for the candidate’s doctoral dissertation Shifana Koya Department of Physics University of Ioannina with title “Assessment of the Near-Sun CME Magnetic Field”

In addition he has an advisory role in the work of doctoral candidates Varun Chaturmutha (supervisor: Prof. S. Jefferies, GSU Physics & Astronomy), Varun Chaturmutha (Supervisors: Prof. S. Jefferies, GSU Physics & Astronomy), Maxwell Hostetter, Annie Ji (supervisor: Prof. R. Angryk, GSU Computer Science) and the postgraduate student Xumin Cai (supervisor: Prof. R. Angryk, GSU Computer Science).

Finally he is the supervisor of the BSc. thesis of A. Pantazis (UOA) with title: “Forecast of solar flares”.

- Dr. Gontikakis is the supervisor of the Phd thesis of M. Koletti with title: “Study of the outflow from solar atmosphere”.
- Dr. Harsoula is member of advisory board of the PhD thesis of Constantina Zouloumi with title “Manifold theory of the spires and multiple pattern speeds in simulations of N-body discs” (supervisor C. Efthymiopoulos) and of the PhD thesis of Edoardo Legnaro with title “Orbital dynamics and diffusion to the resonance in the close space environment (supervisor C. Efthymiopoulos).

- Finally Dr. **M.Katsanikas** supervises the BSc. thesis of A. Kontogeorgou (Department of Physics University of Athens) with title: "Orbital study of the 2-d potential of a rotating bar".

Participation in Committees

The members of RCAAM are active members in many national and international scientific committees for the promotion of researchers and university professors in Greece and abroad. They serve also as referees in the main research astronomical journals.

Promotion of Astronomy and Public Outreach

The researchers of RCAAM were invited to give lectures in educational institutions and events for the public. They also wrote articles for the public while their interventions helped to disseminate the research results of the Centre.

- **I. Contopoulos** Lecture on the topic "Images from Space," Holy Monastery of Agioi Pantes, Spetses, August 13.
- **S. Vasilakos** In 2022, gave over 15 interviews to print and electronic media (ERT, MEGA, OPEN, Kathimerini, VIMA, etc.).
- **M. Georgoulis**
 - Personal invitation and intervention at the event of the awarded composer Lina Tonia at the Theocharakis Foundation titled 'Detecting and Touching the Sounds of Space,' February 18, 2022.
 - Participation in a meeting in Chios related to the proposed installation of the telescope of the National Observatory of Athens, which is part of the EuroQCI program of the ESA, February 26, 2022.
 - Interview with Ms. Alexia Liakounakou on the OLFAQ website titled "Dr. Manolis Georgoulis, what's the weather like in space?" March 22, 2022.
 - Invitation to the Megaron Mousikis for the premiere of the award-winning film by director Yannis Vamvakas titled "Chasing Planets for 60 Years – Stamatis (Tom) Krimigis" and related discussions/interventions with journalists, June 23, 2022.
 - Radio interview related to the organization of COSPAR Athens 2022, ERT First Program, with Ms. Nefeli Lygerou, June 30, 2022.

- Radio interview related to the organization of COSPAR Athens 2022, Alpha Radio, with Ms. Ellie Spyropoulou, July 3, 2022.
- Press interview related to the organization of COSPAR Athens 2022 at the Eugenides Planetarium, where I gave a presentation titled "COSPAR Athens 2022: Athens Time," July 5, 2022.
- Radio interview related to the organization of COSPAR Athens 2022, Voice of Greece, with Mr. Prokopis Angelopoulos, July 6, 2022.
- Radio interview related to the organization of COSPAR Athens 2022, First Program, with Ms. Olina Xenopoulou, July 10, 2022.
- Television tribute on ERTNews related to the organization of COSPAR Athens 2022, with host Ms. Andriana Paraskevopoulou and guests Academic Dr. Stamatios Krimizis and the writer, July 11, 2022.
- Radio interview related to the organization of COSPAR Athens 2022, Easy Radio, with Mr. D. Papachaos, July 12, 2022.
- Close collaboration with director Yannis Vamvakas and writing the script for the short film "Eternal Sailors – Eternal Explorers," which was screened at the opening ceremony of the COSPAR Athens 2022 conference, July 18, 2022.
- Extensive radio discussion related to the organization of COSPAR Athens 2022, First Program on the show "The Right Time" with Ms. Natasha Bastea and Makis Provas, July 21, 2022.
- Interview with the newspaper Naftemporiki titled "The first analyses of James Webb's images were made in Athens," by Thodoris Laina, July 30, 2022.
- Invited presentation at the P. Tsakos Foundation in Chios titled "Chios: COSPAR Athens 2022: Historic first for Greece at a significant crossroads," 10th Festival of Astronomy in Chios, August 5, 2022.
- Multiple other brief radio and television interventions during July and August 2022.
- Interview with Ms. Madison Goldberg, scientific journalist and student at New York University and Harvard Science Journalist, regarding the prediction of solar energetic particle (SEP) events, November 18, 2022.
- **V. Tritakis** Two speeches at the Society of Friends of the People: 1) Global change, global problems, and solutions and 2) The Mythology behind the stars.