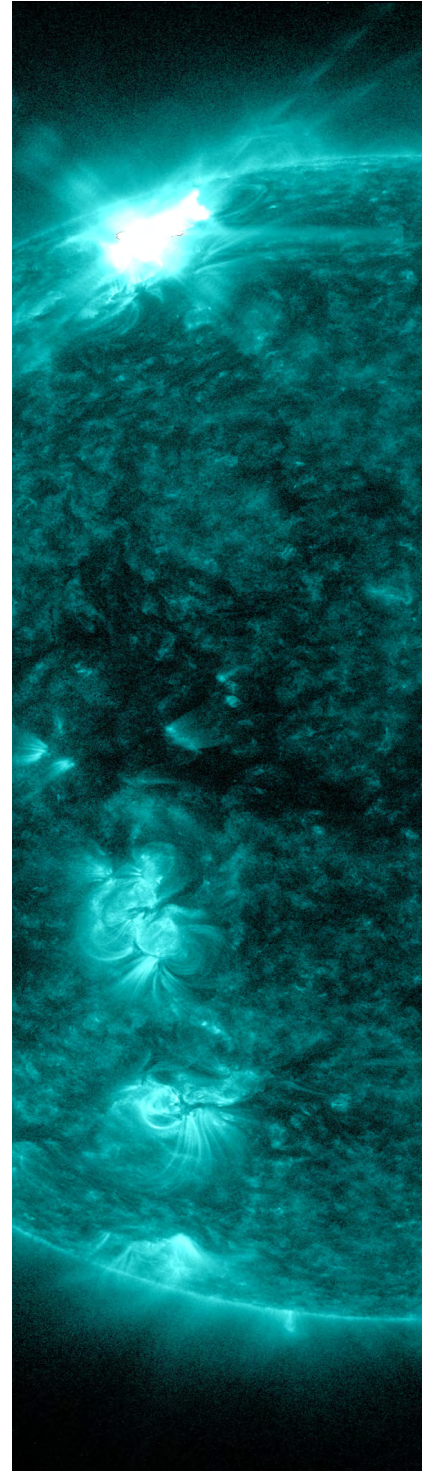
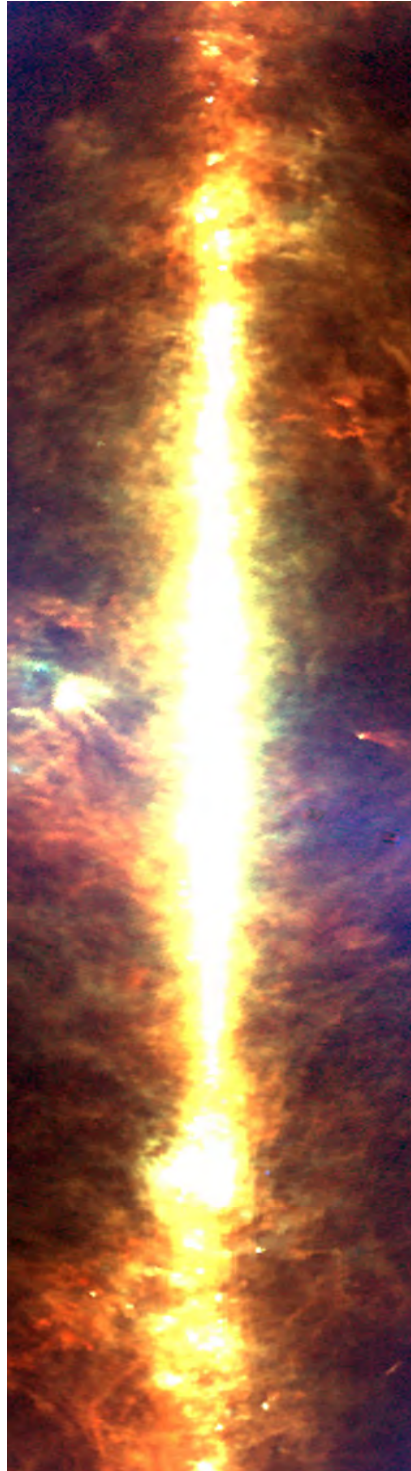
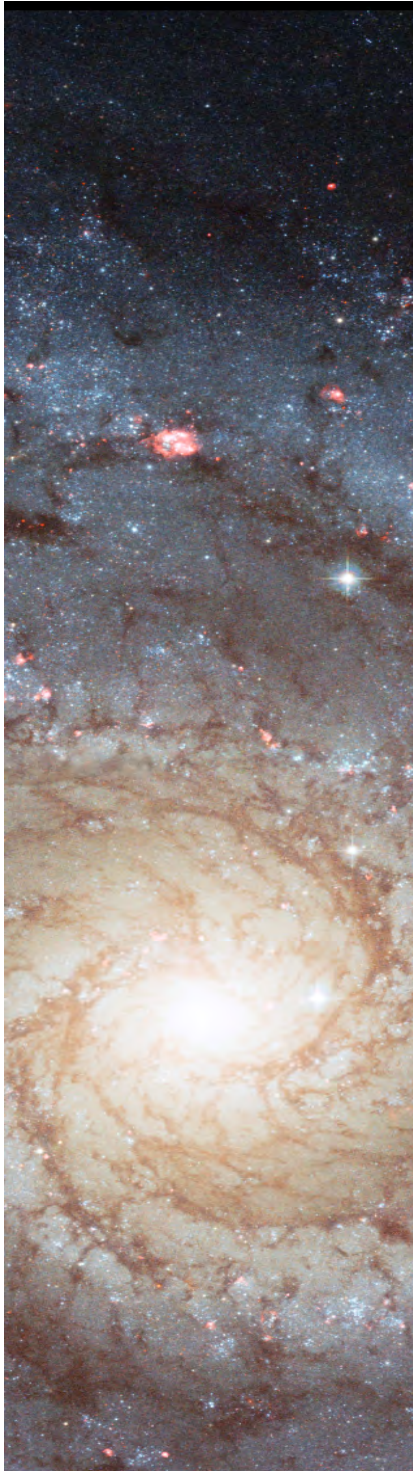


**Research Center for Astronomy
and Applied Mathematics**
of the Academy of Athens



Annual Report 2012

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Staff Members in 2012

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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 2009-12 include the study of the role of Chaos in supporting structures in N-body simulations, the Dynamics of the Milky Way and other galaxies, 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. During 2012 five PhD and one MSc thesis were supervised by RCAAM members. One PhD Thesis has been successfully completed, while four more are in progress. One MSc Thesis has been successfully completed. RCAAM participated in the teaching of the course "Galactic and Extragalactic Astronomy" at the Department of Physics of University of Athens. Finally the postgraduate course "Orbital Theory" at the University of La Plata, Argentina, has been taught by an RCAAM member.

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. RCAAM has also organized with great success a series of talks for the broad public in the Academy of Athens during 2009 in the frame of the International Year of Astronomy. Many other talks for the broad public are given every year. The seminar and talks activities continued during 2012.

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 it 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

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.).

During 2012 the research of Nonlinear Dynamics at RCAAM focused on the structure of phase-space in 2D and 3D Hamiltonian systems by means of numerical and analytical techniques. Using computer-algebraic algorithms developed in our center, it was possible to exploit the tools of canonical perturbation theory, namely the construction of high order resonant normal forms. It thus became possible to study the rate of chaotic diffusion in the resonance web of 3D systems. We also produced a visualization of the phenomenon of Arnold diffusion, and we gave particular applications of these methods in concrete problems of solar and extrasolar system dynamics. There is an ongoing collaboration with the La Plata University on the subject.

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.

Currently we study the stellar and gaseous flows in galactic disks, the photometry and the dynamics of young clusters in the spiral arms of galaxies, dynamical mechanisms acting on bar-spiral systems, the diffusion and escapes of orbits away from the equatorial plane of disk galaxies, the role of supermassive black holes in the centers of galaxies for their global dynamics, as well as various codes for N-body simulations.

In our research we collaborate with colleagues at the European Southern Observatory (ESO), Germany, the Max Planck Institute for Astrophysics, Germany, the University Observatory of Munich, the University Observatory of Strasbourg, France, and the Southwest Research Institute, Colorado, USA.

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 analyzing 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 organisations 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). Several of these colleagues are, at times, invited to visit RCAAM and deliver seminars and lectures. Moreover, RCAAM solar physicists are in continual pursuit of competitive research funding. As a result, RCAAM is a member institution of (1) NASA's Solar Dynamics Observatory Feature Finding Team (SDO/FFT) consortium that provides advanced tools of automatic, real-time solar data analysis, (2) ESA's PROBA-3 mission, as science Co-Investigators of the mission's ASPIICS coronagraph, and (3) the Hellenic National Network of Space-Weather Research, a THALES project funded by the Greek General Secretariat of Science and Technology. The RCAAM currently manages a Marie Curie grant on solar physics sponsored by the European Commission. Further, in 2013, RCAAM will be the Prime Contractor of an ESA Space Situational Awareness (SSA) Contract. A member of RCAAM is Greece's National Delegate to ESA's Science Programme Committee (SPC), Vice-President of the European Solar Physics Division (ESPD) of the European Physical Society (EPS), and a member of the Greek National Committee for Astronomy (GNCA).

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. We have active collaborations with NASA/Goddard (USA), the Aristotle University of Thessaloniki, University College Cork (Ireland), and the University of Crete. Our work is supported by the General Secretariat for Research and Technology with a grant “ARISTEIA” and the European Social Fund.

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.

During 2012 we have been collaborating with the following Institutes: University of Cambridge (UK), INAOE (Mexico), University of Barcelona (Spain), University of Sao Paulo (Brasil), University of Lethbridge (Canada), California State University (USA), IUCAA (India).

Finally RCAAM participated actively in the organization of three (3) international conferences on Cosmology & Gravitation during 2012 and delivered public talks in several High Schools.

Publications in 2012

Publications in International Journals (with refereeing system) of the Scientific Citation Index

1. Contopoulos G., Harsoula M., Lukes-Gerakopoulos G., 2012, Periodic orbits and escapes in dynamical systems, *Cel Mech Dyn Astr.* 113, 255
2. Contopoulos G., Harsoula M., 2012, Chaotic spiral galaxies, *Cel Mech Dyn Astr.* 113, 81
3. Contopoulos G., Delis N., Efthymiopoulos C., 2012, Order in de Broglie-Bohm quantum mechanics, *Jour.Phys.A*, 45, 5301
4. Efthymiopoulos C., Delis N., Contopoulos G., 2012, Wavepacket approach to particle diffraction by thin targets: Quantum trajectories and arrival times, *Ann. Phys.*, 327, 438
5. Delis N., Efthymiopoulos C., Contopoulos G., 2012, Quantum vortices and trajectories in charged particle diffraction, *Int. J. Bif. Chaos* 22, 1250214
6. Patsis P.A., 2012, Dynamical mechanisms supporting barred-spiral structures, *Astron. Astroph.Trans.* 2, 293
7. Patsis P.A., 2012, Structures out of Chaos in barred-spiral galaxies, *Int. J. Bif. Chaos* 22, 123029
8. Efthymiopoulos C., 2012, Hyperbolic normal forms and invariant manifolds: astronomical applications, *Serb. Astron. J.* (invited review) 184, 1
9. Kylafis N. D., Contopoulos I., Kazanas D., Christodoulou D. M. 2012, Formation and destruction of jets in X-ray binaries, *Astron. Astroph.*, 538, 5
10. Gabuzda D. C., Christodoulou D. M., Contopoulos I., Kazanas D. 2012, Evidence for Helical Magnetic fields in Kiloparsec-Scale AGN Jets and the Action of a Cosmic Battery, *J. Phys. Conf. Ser.*, 355, 012019
11. Kalapotharakos C., Contopoulos I. & Kazanas D. 2012, The Extended Pulsar Magnetosphere, *Mon. Not. R. Ast. Soc.*, 420, 2793
12. Kalapotharakos C., Kazanas D., Harding A. K., Contopoulos, I. 2012, Toward a Realistic Pulsar Magnetosphere, *Astroph. J.*, 749, 2
13. Kalapotharakos C., Harding A. K., Kazanas D., Contopoulos I. 2012, Gamma-ray Light Curves from Pulsar Magnetospheres with Finite Conductivity, *Astroph. J.*, 754L, 1
14. Contopoulos I., Papadopoulos D. B., 2012, The Cosmic Battery and the Inner Edge of the Accretion Disk, *Mon. Not. R. Astr. Soc.*, 425, 147
15. Kazanas D., Fukumura K., Behar E., Contopoulos I., Shrader C., 2012, Toward a Unified AGN Structure, *Astron. Rev.*, 7, 92
16. Contopoulos I., Kylafis N.D., Kazanas D., Christodoulou D.M, 2012, Formation and Destruction of Jets in X-Ray Binaries, *Int. J. Mod. Phys. Conf. Ser.*, 8, 287
17. Lima J.A.S., Basilakos S., Costa F.E.M., 2012, New cosmic accelerating scenario without dark energy, *Phys. Rev. D.*, 86, 103534
18. Chavez R., Terlevich E., Terlevich R., Plionis M., Bresolin F., Basilakos S., Melnick J., 2012, Determining the Hubble constant using giant extragalactic H II regions and H II galaxies, *Mon. Not. R. Astr. Soc.*, 425, 56
19. Basilakos S., Polarski D., Sola J., 2012, Generalizing the running vacuum energy model and comparing with the entropic-force models, *Phys. Rev. D.*, 86, 043010

20. Basilakos S., Mavromatos N.E., Mitsou V.A., Plionis M. 2012, Dynamics and constraints of the dissipative Liouville cosmology, *Astropart. Phys.*, 36, 7
21. Basilakos S., Pouri A, 2012, The growth index of matter perturbations and modified gravity, *Mon. Not. R. Astr. Soc.*, 423, 3761
22. Basilakos S., 2012. The Λ CDM Growth Rate of Structure Revisited, 2012, *Int. J. Mod. Phys. D*, 21, 1250064
23. Basilakos S., Dent J. B., Dutta S., Perivolaropoulos L., Plionis M., 2012, Testing general relativity using the evolution of linear bias, *Phys. Rev. D.*, 85, 123501
24. Papageorgiou A., Plionis M., Basilakos S., Ragone-Figueroa C., 2012, A consistent comparison of bias models using observational data, *Mon. Not. R. Astron. Soc.*, 422, 206
25. Basilakos S., Bauer F., Sola J., 2012, Confronting the relaxation mechanism for a large cosmological constant with observations, *J. Cosm. Astropart. Phys.*, 01, 050
26. Elyiv A., Clerc N., Plionis M., Surdej J., Pierre M., Basilakos, et al., 2012, Angular correlation functions of X-ray point-like sources in the full exposure XMM-LSS field, *Astron. Astrophys.*, 537, 131
27. Syntelis P., Gontikakis C., Alissandrakis C., Georgoulis M., Tsinganos K., 2012, Study of the 3D shape and dynamics of coronal loops observed by Hinode/EIS, *Sol. Phys.*, 280, 475
28. Zampeli A., Singleton D., Vagenas E.C., 2012, Hawking radiation, chirality, and the principle of effective theory of gravity, *J. H. Ener. Phys.*, 1206, 97
29. Martens P. C. H., Attrill G. D. R., Davey A. R. et al (+ M. Georgoulis), 2012, Computer Vision for the Solar Dynamics Observatory, *Solar Phys.*, 275, 79
30. Georgoulis M. K. 2012, Are Solar Active Regions with Major Flares More Fractal, Multifractal, or Turbulent than Others? *Solar Phys.*, 276, 161
31. Georgoulis, M. K. 2012, Comment on Resolving the 180-deg Ambiguity in Solar Vector Magnetic Field Data: Evaluating the Effects of Noise, Spatial Resolution, and Method Assumption, *Solar Phys.*, 276, 423
32. Georgoulis M. K., Tziotziou K., Raouafi N.-E., 2012, Magnetic Energy and Helicity Budgets in the Active-Region Solar Corona. II. Nonlinear Force-Free Approximation, *Astrophys. J.*, 759, 1
33. Tziotziou K., Georgoulis M. K., Raouafi N.-E., 2012, The Magnetic Energy - Helicity Diagram of Solar Active Regions, *Astrophys. J. Lett.*, 759, L4
34. Georgoulis M. K., Titov V. S., Mikic Z., 2012, Non-Neutralized Electric Current Patterns in Solar Active Regions: Origin of the Shear-Generating Lorentz Force, *Astrophys. J.*, 761, 61

Publications in Press, already accepted for publication

35. Contopoulos I., 2012, The force-free electrodynamics method for the extrapolation of coronal magnetic fields from vector magnetograms, *Sol. Phys.*, 250
36. Katsanikas M., Patsis P. A., Contopoulos G., 2012, Instabilities and stickiness in a 3D rotating galactic potential, *Int. J. Bif. Chaos* in press (arXiv:1201.2108)
37. Zachilas L., Katsanikas M., Patsis P. A., 2012, The structure of phase space close to fixed points in a 4D symplectic map, *Int. J. Bif. Chaos* in press (arXiv:1205.4575)
38. Gontikakis C., Winebarger A.R., Patsourakos S., 2012, Spectral diagnostic of a microflare. Evidences of resonant scattering in C IV 1548 Å, 1550 Å lines, *Astron. Astrophys.*, in press

Publications in Conference Proceedings and Conference Presentations

39. Patsis P.A., 2012, Mechanisms based on chaotic flows that support structures in barred-spiral systems, in "Assembling the Puzzle of the Milky Way", Le Grand-Bornand, France, C. Reylé; A. Robin; M. Schultheis (eds), EPJ Web of Conferences, Volume 19, 07003, EDP Sciences.
40. Patsis P.A., 2012, Modeling the morphology of disk galaxies by means of orbital theory, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 21, Hel.A.S.
41. Efthymiopoulos C., 2012, Canonical perturbation theory, stability and diffusion in Hamiltonian systems. Applications in dynamical astronomy, lecture notes in "Proceedings of the 3rd La Plata School on Astronomy and Geophysics, Association of Astronomy of Argentina", P. Cincotta, C. Giordano and C. Efthymiopoulos (eds), (146 pages).
42. Contopoulos I., 2012, Towards a Realistic Pulsar Magnetosphere, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 28, Hel.A.S.
43. Contopoulos I., 2012, Nonlinear force-free reconstruction of the global solar magnetic field, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 4, Hel.A.S.
44. DeCesar M., Harding A., Miller M.C., Contopoulos I., Kalapotharakos C., Parent D. 2012, Probing Gamma-ray Pulsar Emission with Light Curve Modeling and Phase-Resolved Spectroscopy, American Astronomical Society, AAS Meeting 219, 217.07
45. Kazanas, D., Fukumura, K., Behar, E., Contopoulos, I. 2012, X-ray Absorbers, MHD Winds, and AGN Unification, Proceedings of "AGN Winds in Charleston", G. Chartas, F. Hamann, K. M. Leighly (eds), ASP Conference Series, 460, 181
46. Basilakos, S., 2012, Testing gravity at cosmological scales, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 15, Hel.A.S.
47. Syntelis P., Gontikakis C., Alissandrakis C., Georgoulis M., Tsinganos K., 2012, On the shape of active region coronal loops observed by Hinode/EIS, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 14, Hel.A.S.
48. Gontikakis C., Winebarger, A.R., 2012, Study of a microflare observed with SUMER and TRACE, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 11, Hel.A.S.
49. Syntelis P., Vourlidis A., Tsinganos K., Gontikakis C., The initiation of a Coronal Mass Ejection as observed by STEREO/EUVI, 10th Hellenic Astronomical Conference, Proceedings of the conference held at Ioannina, Greece, 5-8 September 2011, I. Papadakis, A. Anastasiadis (eds)., 14, Hel.A.S.
50. Ali A.F., Das S., Vagenas E.C., 2012, Generalized Uncertainty Principle and Quantum Gravity Phenomenology, 2012, "Proceedings of The Twelfth Marcel Grossmann Meeting on General Relativity", T. Damour, R.T. Jantzen, R. Ruffini (eds) World Scientific, p.2407

51. Raouafi N.E., Bernasconi P. N., Rust D. M., & Georgoulis M. K., 2012, Micro-Sigmoids as Progenitors of Polar Coronal Jets, Proc. Hinode-3 Meeting (eds. T. Sekii, T. Watanabe, & T. Sakurai), *ASP Conf. Series*, 454, 299
52. Georgoulis, M.K. 2012, On our Ability to Predict Major Solar Flares, EAS Symposium on The Sun: New Challenges, JENAM-2011, V. N. Obridko, K. Georgieva, & Yu. A. Nagovitsyn, (eds), *Astrophys. and Space Sci. Proc.*, 30, 93
53. Katsanikas M., 2012, Simple Instability in a 3D autonomous Hamiltonian system of galactic type in “Proceedings of the Third La Plata International school in Astronomy and Geophysics: Chaos, Diffusion and non-Integrability in Hamiltonian systems-Applications to Astronomy”, Asociación Argentina de Astronomía Workshop Series, 3, 367-372.

Visits to other Institutes

Panos Patsis

Dr. Patsis was invited as a Scientific Visitor and went to the European Southern Observatory (ESO) and the Max-Planck Institut für Astronomie on July (1 month), where he collaborated with Dr. P. Grosbol and Dr. T. Naab, on Observations of Spiral Galaxies in Near-Infrared wavelength and Galactic Disks simulations using N-Bodies simulations respectively.

Dr. Patsis also visited the University of Thessaloniki where he collaborated with Dr. K. Fathi within the framework of the “Feeding supermassive Black Holes” project.

Christos Efthymiopoulos

Dr. Efthymiopoulos visited the School of Astronomy and Geophysics of La Plata University, Argentina, for 2 months, where he gave a series of 15 two-hour lectures, teaching the postgraduate course of “Theory of Orbits” as a visiting professor.

Spyros Basilakos

Dr. Basilakos visited, after invitation, the Physics Department of the University of Barcelona, Spain, on May 2012, where he collaborated with Prof. Sola’s group on Cosmology research.

Constantinos Gontikakis

Dr. Gontikakis participated in a work meeting for the inauguration of the THALES program titled “Greek National Network for Space Weather Research”, in Thessaloniki (11-12 June 2012). He also participated in an one-day meeting in Paris (4-5 July 2012) and a similar one in the University of Athens (14-15 November 2012) regarding the electronics platform of the ASPIICS coronagraph.

Manolis Georgoulis

Dr. Georgoulis participated in a work meeting for the inauguration of the THALES program titled “Greek National Network for Space Weather Research”, in Thessaloniki (11-12 June 2012). He also visited the Johns Hopkins University / Applied Physics Laboratory, at Laurel, MD, USA, on 31 August 2012. He participated as National Representative in 5 meetings of the Space Science Programme Committee of ESA, in France.

Scientific Proposals and Grants

During 2012 the following RCAAM proposals were approved:

1. I. Contopoulos' proposal for "The Origin of Astrophysical Magnetic Fields" programme was approved by the Ministry of Education, in the framework of ARISTEIA Action for 2012-2015 and was funded with 276,000 Euros.
2. M. Georgoulis' proposal titled "Self-Organized Criticality and Turbulence" was approved for funding by the International Space Science Institute.

Organization of Conferences, Meetings and Other Events

RCAAM coorganized with the Eugenides Foundation (15 October 2012) an event for celebrating European Southern Observatory's 50 years anniversary. During the event Dr. P. A. Patsis and Dr. J. Spyromilio (ESO) presented talks on ESO and its future astronomical facilities (E-ELT).

Dr. C. Efthymiopoulos organized an one-day workshop on "Fundamental problems in Quantum Physics", in the framework of COST (European COoperation in Science and Technology) action MP1006, in Athens, on March 2012.

Dr. I. Contopoulos organized in collaboration with N. Kylafis and D. Gabuzda, a special session workshop on "Formation and disruption of jets in black- hole binaries and AGNs" during the EWASS 2012 conference, in Rome on July 6th 2012.

Dr. S. Basilakos, participated in the Scientific Organizing Committee of the "Half a Century of X-ray Astronomy", in Mykonos, 17-21 September 2012.

Dr. E. Vagenas participated as member of the Organizing Committee of the International Conference on Recent Developments in Gravity (NEB15), in Chania, Crete, 20-23 June 2012.

Dr. E. Vagenas was a member of the International Coordinating Committee of the "13th Marcel Grossmann Meeting on General Relativity" in Stockholm, Sweden, 1-7 July 2012.

Dr. E. Vagenas was the Chairman for the "International Conference on Mathematical Modeling in Physical Sciences", in Budapest, Hungary, 3-7 September 2012.

Dr. E. Vagenas co-organized the "Gravity, Quantum and Black Holes" Workshop, in Budapest, Hungary, 4-5 September 2012.

Participation in Conferences and Talks

G. Contopoulos

1. *"The Nature of Reality"* talk during the Inaugural Event for the new president installation at the Academy of Athens, on 12 January 2012.
2. *"The Purpose of Science"*, talk at the Special Annual Celebratory meeting of the Academy of Athens, on 28 December 2012.

P.A. Patsis

1. *"Orbital theories behind bars and spirals in disk galaxies"* invited talk at the European Southern Observatory (ESO), Garching, Munich (18.07.2012)
2. *"Orbital Dynamics of Spiral Arms"* talk at the University of Thessaloniki (19.9.2012) (within the framework of the "Feeding supermassive Black Holes" project)
3. *"The European Southern Observatory"*, talk at the 50 years anniversary event for the European Southern Observatory (15.10.2012) at the Eugenides Foundation.

C. Efthymiopoulos

1. *"Chaos in de Broglie - Bohm Quantum Mechanics and its Physical Consequences"* in Quantum Malta 2012, "Fundamental Problems in Quantum Physics", organized by the "COST Action MP1006", European Science Council, April 2012
2. *"Spiral Structure in Galaxies: open problems in stellar dynamics"* in the "55th Reunion of the Astronomical Association of Argentina», Mar del Plata, September 2012
3. *"Open problems in advanced physics and their relation to astronomy"* three seminar series at the Institute of Radioastronomy IAR, of La Plata: i) Standard model of particle physics, ii) dark matter, iii) alternative theories of gravity, October 2012
4. *"The Role of Chaos in de Broglie - Bohm quantum mechanics"* at the "Fundamental problems in quantum physics" conference, organized within the "COST action MP1006", Athens, March 2012

I. Contopoulos

1. *"Formation and Disruption of Jets in Black-Hole Binaries and AGNs"*, European Week of Astronomy and Space Science 2012 (EWASS 2012), Special Session 9, Rome, 6 July (invited talk)
2. *"The cosmic battery and the inner edge of the accretion disk"*, NEB 15 - Recent Developments in Gravity, Chania, Crete, 20 June.
3. *"Formation and destruction of jets in black-hole accretion disks"*, National Observatory of Athens, 9 February 2012
4. *"Non-linear magnetic field extrapolation in the solar corona: the force-free electrodynamics method"*, Physics Dept., University of Thessaloniki, 9 May 2012.
5. *"Astrophysical Jets from 'Hairy' Black Holes"*, Physics Dept., University of Crete, 22 November 2012.
6. *"Astrophysical Jets from 'Hairy' Black Holes"*, Physics Dept., University of Thessaloniki, 18 December 2012.

S. Basilakos

1. *"Modern Cosmology: The cosmic history and the fate of the Universe"*, invited talk in the "NEB 15 - Recent Developments in Gravity" conference (20-23 June 2012)
2. *"Dark energy and modified gravity"*, talk at the Physics Dept. of the University of Barcelona (21 May 2012).
3. *"Structure and Evolution of the Universe"*, invited public talk, organized during the "Half a Century of X-ray Astronomy" conference.

C. Gontikakis

1. *"Study of flows and the three-dimensional shape of coronal loops observed by Hinode/EIS, Spectroscopy of the dynamic Sun"*, 18-20 April 2012, University College London, London, UK.

M. Georgoulis

1. *"Automated Detection of Eruptive Structures for Solar Eruption Prediction"*, Invited talk, 39th COSPAR General Assembly, Mysore, India, 14 - 22 July 2012
2. *"Pre-Eruption Magnetic Configurations in the Low Atmosphere of Solar Active Regions"*, Invited talk, 39th COSPAR General Assembly, Mysore, India, 14 - 22 July 2012
3. *"Solar Eruption Essentials: Origin of the Shear-Generating Lorentz Force"*, Invited talk, AOGS-2012 Joint Assembly, Singapore, 13 - 17 August 2012
4. *"Solar Flare Prediction: Progress and Challenges"*, AOGS-2012 Joint Assembly, Singapore, 13 - 17 August 2012
5. *"Solar Flare Forecasting from Solar Orbiter Observations"*, Invited talk, 5th Solar Orbiter Workshop, Bruges, Belgium, 10 - 14 September 2012
6. *"Self-Organized Criticality in the Solar Atmosphere: Universal Property of Solar Magnetism, or Merely One of Eruptive Active Regions?"*, Invited talk, International Space Science Institute (ISSI) Workshop on SOC and Turbulence, Bern, Switzerland, 15 - 19 October 2012
7. *"Buildup of the Pre-Eruption Magnetic Configuration in Solar Active Regions"*, during his visit at the Applied Physics Laboratory at Johns Hopkins, Maryland, USA

S. Carvalho (Post doctoral fellow)

1. Participation in the Euclid Mission Conference, Copenhagen, Denmark, 14-18 May 2012

Education

During 2012, RCAAM researchers gave series of lectures in postgraduate courses, research seminars and Schools, organized by scientific bodies.

Dr. P. A. Patsis, taught part of the course “Galactic and Extragalactic Astronomy” at the Department of Physics of the University of Athens.

Dr. Efthymiopoulos taught the postgraduate course “Theory of Orbits” at the School of Astronomy and Geophysical Sciences of the La Plata University, Argentina.

Dr. I. Contopoulos gave lectures during educational conferences and schools organized by the Hellenic Physical Society:

- “Black Holes, Peristellar Disks and Astrophysical Jets”, HPS Summer School, Eretria, 29 June 2012.
- “Black Holes, Astrophysical Jets and Cosmic Batteries”, HPS, New Philadelphia, 15 December 2012.

Public Outreach

During 2012 RCAAM researchers were invited to give talks for the public and secondary education students:

P.A. Patsis, (1 talk), I. Contopoulos (2 talks), C. Gontikakis (1 talk), E. Vagenas (organized two series of public talks and gave two talks), M. Georgoulis (2 talks and 2 articles)

RCAAM activities were presented in the national public radio (NET) by the acting director Dr. P. A. Patsis. Dr. Georgoulis participated in TV shows on matters of space weather, micro-meteorites and solar and lunar eclipses.

PhD & MSc Theses

PhD theses in progress:

Liana Tsigaridi (Univ. of Athens)

Nonlinear Phenomena in Response Models of Galactic Disks
(supervisor: P.A. Patsis)

Nikos Delis (Univ. of Athens)

Stochasticity in Nonlinear Dynamical Systems
(supervisor: Ch. Efthymiopoulos)

Athena Pouri (Univ. of Athens)

Study of the Nature of Dark Energy by means of Extragalactic High Energy Sources
(supervisor: S. Basilakos)

Ms Pouri was awarded, following written examinations, the astronomy scholarship of the Academy of Athens

George Anastasiou (Univ. of Athens)

Aspects of Bigravity: Black Holes and Cosmology
(supervisor: E. Vagenas)

Ph.D. theses successfully completed in 2012:

Matthaios Katsanikas (University of Athens)

Successfully presented his Ph.D. thesis on “The structure of Phase Space in Hamiltonian systems of 3 degrees of freedom”. The research for this Thesis was carried out in RCAAM under the supervision of P. A. Patsis.

Dr. Efthymiopoulos is a member of the supervising committee for A. Paliathanasis’ Thesis on “Symmetries of nonlinear differential equations and application in Dynamics”, at the University of Athens.

Dr. Gontikakis participated in the supervising committee of the masters thesis of P. Syntelis (Univ. of Athens) “Magnetic Structures on the Sun: Study of the Dynamics of Stellar Loops and Initiation of Coronal Mass Ejection”, that was successfully presented on 28 November 2012.

Dr. Georgoulis and Dr. Gontikakis were appointed as members of the judging committee for I. Kontogiannis doctoral theses that was presented on 5 June 2012.

Dr. Georgoulis is also appointed as member of the judging committee for Mr. Dimitropoulos’ doctoral thesis, at the University of Athens.

Participation in European and Greek Committees

- Hellenic Astronomical Society (HELAS): C. Efthymiopoulos, member of the Governing Council and vice president.
- Hellenic Physical Society: C. Efthymiopoulos, member of the Governing Council.
- Management Committee of MPNS COST Action MP1006: Fundamental Problems in Quantum Physics (C. Efthymiopoulos, member of the administrative board)
- Scientific Program Committee (SPC) of the European Space Agency (ESA): M. Georgoulis
- European Solar Physics Division (ESPD) of the European Physical Society (EPS): M. Georgoulis (Vice President)
- Greek National Committee of Astronomy (2011-13): M. Georgoulis (member of the board)

- Living With a Star Targeted Research and Technology (LWS TR&T): M. Georgoulis (Referee)
- International Jury for the FP7 Odysseus Project: M. Georgoulis (Member)

All RCAAM researchers are referees in international scientific journals, while some are evaluators of international science project proposals and participate in the publishing council of scientific journals.

Dr. Efthymiopoulos is associate editor for the Celestial Mechanics and Dynamical Astronomy journal (Springer) and member of the editorial board for the Serbian Astronomical Journal.

Dr. Vagenas is editor for (1) the Central European Journal of Physics (Springer), (2) Advances in High Energy Physics, (3) Journal of Modern Physics and Applications and (4) Dataset Papers in Physics

Table of Seminars organized by RCAAM during 2012

10/1	Dr. Manolis Xilouris National Observatory of Athens	Nearby galaxies as seen by the Herschel Space Observatory
17/1	Dr. Nikos Delis Research Center for Astronomy and Applied Mathematics of the Academy of Athens	The effect of a central black hole in the degree of chaos and in the secular evolution of galaxies
24/4	Dr. Yannis Kominis National Technical University of Athens	Revision and extension of the Quasilinear Diffusion Theory: General kinetic formulation of wave-particle interactions
31/1	Dr. Christos Efthymiopoulos Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Low-dimensional tori in Fermi-Pasta-Ulam chains
7/2	Dr. Demosthenes Kazanas NASA/Goddard Space Flight Center, USA & Corresponding Member of the Academy of Athens	Some Thoughts on Mach's Principle and a Characteristic Acceleration in the Universe.
14/2	Dr. Ioannis Contopoulos Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Formation and destruction of jets in X-ray binaries.
21/2	Dr. Kleomenis Tsiganis Aristotle University of Thessaloniki	A formation scenario for the Uranian satellites: making the orbits of the satellites compatible with the planet's axial tilt.
28/2	Dr. Zsolt Sándor University of Innsbruck, Institute of Astro- and Particle Physics	Large Vortices: the Birthplaces of Planets?
6/3	Dr. Theodoros Smponias University of Ioannina	Modelling multi-wavelength and particle emission from accreting binary systems.

13/3	Prof. Jacobus van der Weele University of Patras	Spontaneous Cluster Formation in Multi-Particle Flows
20/3	Prof. Xenophon Moussas University of Athens	Recent results from the study of the Antikythera Mechanism: the signature of Archimedes on the eclipses and operation of the instrument, Kepler before Kepler?
27/3	Dr. Anastasios Anastasiadis National Observatory of Athens and the HNSWRN team	Introducing the Hellenic National Space Weather Research Network (HNSWRN)
2/4	Dr. Nikos Prantzos C.N.R.S. - Institut d' Astrophysique de Paris	The chemical evolution of the Milky Way
10/4	Dr. Manolis Plionis National Observatory of Athens	The Hubble constant and the dark energy equation of state using star-forming galaxies
24/4	Dr. Panayiotis Stavrinos University of Athens	Locally anisotropic structure in Finsler Geometry in Relativity and Cosmology
8/5	Mr. Matthaïos Katsanikas Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Phase space structure in galactic potentials of three degrees of freedom
15/5	Dr. Kostas Tziotziou Research Center for Astronomy and Applied Mathematics of the Academy of Athens	A new way of inferring magnetic energy and helicity in solar active regions
22/5	Prof. George Contopoulos Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Escapes of Stars in Galaxies
29/5	Dr. Nikolaos Stergioulas Aristotle University of Thessaloniki	Self-gravitating tori around black holes and their instabilities
5/6	Dr. Konstantinos Thanassoulas Geophysicist	Is a short-time earthquake prediction possible? The problem in view of the Classical Physics
14/6	Prof. Puragra GuhaThakurta Univ. of California/Lick Observatory	Our Neighbor M31: A Close-up View of Galaxy Formation
19/6	Dr. Kyriaki Dionysopoulou Max Planck Institute for Gravitational Physics	General Relativistic Resistive Magnetohydrodynamics with Whisky
26/6	Prof. Joan Solà University of Barcelona	"Constants" of Nature, matter non-conservation and dynamical dark energy
2/7	Dr. Robertus Erdelyi University of Sheffield	Attempt to solve by solar magneto-seismology one of astrophysics great problem: The coronal heating enigma
10/7	Dr. Luciano Darriba Universidad Nacional de La Plata	A comparison of chaos indicators
17/7	Dr. Sofia Carvalho Research Center for Astronomy and Applied Mathematics of the Academy of Athens	CMB lensing research and results

18/9	Dr. Angelos Vourlidas Naval Research Laboratory	How Many CMEs Have Magnetic Flux Ropes and How to Find Out: A Synthesis of 16 Years of Coronagraph Observations
25/9	Dr. Dmitry Sokoloff Moscow State University	Solar Dynamo in Light of Helicity Data
9/10	Dr. Maxim Lyutikov Purdue University & INAF Osservatorio Astrofisico di Arcetri	The Double Pulsar as a Probe of Fundamental Physics
16/10	Dr. Jason Spiromilio European Southern Observatory	The European Extremely Large telescope
30/10	Dr. Costis Gontikakis Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Loop geometry and flows from Hinode/EIS observations
6/11	Dr. Ioannis Georgantopoulos National Observatory of Athens	Compton-thick Active Galactic Nuclei
13/11	Dr. Spyros Basilakos Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Testing Einstein's gravity on cosmological scales
20/11	Dr. Manolis Georgoulis Research Center for Astronomy and Applied Mathematics of the Academy of Athens	Pre-Eruption Evolution in Solar Active Regions: a Coherent Causal Sequence
27/11	Prof. Salvatore Capozziello Universita di Napoli "Federico II" and INFN Sez. di Napoli	Hamiltonian Dynamics and Symmetries in Extended Gravity Cosmology
4/12	Dr. Nikos Pappas University of Ioannina	Angular profile of Particle Emission from a Higher-dimensional Black Hole
11/12	Dr. Danae Polychroni University of Athens, Faculty of Physics	Triggered star formation in the W3 GMC: Does the IMF notice?
18/12	Dr. George Voyatzis Aristotle University of Thessaloniki	Destabilization of planetary systems due to stellar mass loss. Escape of planets.