Astrophysics, Dynamical Systems and Fractals - past and future

A conference to mark
the formal retirement of
Professor Mircea V. Rusu

Magurele, Romania, 26-27 April, 2007

ORGANIZERS

Scientific Advisory Board:

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Marilena Mierla
Adrian S. Popescu
Ana Vasile
Alina Istrate
+ other present and former
students of Prof. Rusu

CONTENT

INTRODUCTION

This conference is dedicated to Professor Mircea V. Rusu on the occasion of his retirement from the Department of Physics, University of Bucharest where he has conducted research and taught generations of students for almost 48 years. This meeting also gives us the opportunity to gather together researchers from disciplines like Astrophysics and Dynamical Systems & Fractals to present some of the latest advances in these fields.

The aim of this meeting is to celebrate the many initiatives launched and developed by Professor Mircea V. Rusu during his career at the University of Bucharest. He was appointed as a lecturer in 1959 at the Atomic and Nuclear Physics Department. He was continuing his career as a senior lecturer and reader, and associate professor. He began by teaching Atomic Physics, Physics of Molecules, Experimental Methods in Nuclear Physics, Physics and Technology of Nuclear Materials, Particle Accelerators, Introduction to Nuclear Physics, Theory of Irradiation Effects in Solids, and Methodology of Physics Teaching. The teaching programme spans from the second year of undergraduate studies to the final year of the Master programme. He has also initiated three courses for the Master programme: Introduction to Fractals and Dynamical Systems, Simulations and Visualization in Physics, and Introduction to Astrophysics.

Throughout his time at the university, he has continued to support and to develop the courses offered, with a particular emphasis on establishing links with other disciplines. He is a gifted professor beloved by all those he taught over the years. He coordinated the Master thesis of about 170 students. He insisted that the university should establish strong links with the educational establishments abroad. As a result, he has established since 1997 via the Socrates/Erasmus European Project bilateral agreements for teaching and exchange in astrophysics, as well as students mobility, with University of Turin, Italy (Prof. A. Ferrari), University of Bonn, Germany (Prof. P. L. Biermann), Meudon

Observatory-Paris, France (Prof. Z. Mouradian), and University of Athens, Greece (Prof. E. Livaniou-Rovitis). Many of his students have distinguished career as either research group leaders or professors at universities spread over the all word.

Member of prestigious organizations, including the European Physical Society, and winer of several awards, such as the Award of the Romanian Academy for Physics (1974), he worked on a large variety of research domains of physics. Among them, Magnetic Resonance and Spectroscopy, Physics of Disordered Materials (and Systems), Systems and Time evolution -- Chaos and Fractals in Complex Systems; Dynamics of System Evolutions, Computer Modeling, Nondestructive Methods of Characterizations of Materials, Physics of Plasma Welding, and Analysis of Conditions for Cold Fusion onset in Solids.

In the field of astrophysics, his research activity was focused on Nonlinear Dynamics and Fractals in Astrophysics: Planetary Surface Morphology Analysis, Stability and Chaos in Solar System, Cosmic Rays and Particle Astrophysics, Nucleosynthesis in Sun and Stars, Fractal Properties of the Tail of the Radio Galaxy Jets, Chaotic Behavior of the Unipolar Magnetic Regions on Sun's Surface, Physics of Solar Granulation, Sunspot Models, Numerical Analysis of the Wolf's Number Time Series, The Inverse Problem for Asteroids Light Curve Modeling, Gravity Theories, Radioastronomy, and research on Radio Wave Propagation, Phenomena in Plasma of Radiofrequency, and Sun's Radio Emission.

He is the one of the owners of two patents on Laser Beam Detection using Quartz Crystals (1982) and Fractal Antenna for Automotive Application (2001). His teaching and research activities came together in the creation of an astronomy and astrophysics group at the University of Bucharest -- The Association of Amateurs Astronomers from Faculty of Physics -- which, for many students, was a first step in preparing for their career in astrophysics.

This conference is organized in appreciation of the influence and impact that Professor Mircea V. Rusu has had on his students and collaborators over several decades.

SCIENTIFIC PROGRAM

Thursday 26 April

08:30 – 09:00 – Participants registration
09:00 – 10:00 – Opening Session (P. Biermann, M. Stavinschi, N. Pazmany)
Topic1: Solar and Stellar Physics
Session 1
Chair: P. Biermann
10:00 – 10:35 – C. Demetrescu: Long-Term Variations in the Geomagnetic Field. Any Connection to the Solar Activity? (invited)
10:35 – 11:00 – A. Oncica: Neural Network Forecast of some Solar and Geomagnetic Indices during the 24th Solar Cycle

11:00 – 11:30 – Coffee Break & Poster Session

Session 2
Chair: P. Biermann
11:30 – 11:55 – D. Besliu-Ionescu: Recent Developments in Solar Quakes Studies
11:55 – 12:20 – M. Mierla: Study of the Minimum Solar Corona on the Period August-October 1996
12:20 – 12:45 – G. Maris : Spectral Analysis of the High-Speed Streams in the Solar Wind
12:45 – 13:10 – C. G. Palivan: Metal Proteins in Self-Assembling Copolimer Nanovesicles: New Hybrid Materials (**Atomic Physics**)

13:10 – 14:30 – Lunch

Session 3
Chair: D. Casetti-Dinescu
14:30 – 14:55 – A. S. Popescu: Heliospheric Electric and Magnetic Fields
14:55 – 15:20 – V. Tudose: Scenes from the Life of an Exotic X-ray Binary
15:20 – 15:45 – D. Grecu: Dusty Plasma in Space Sciences

Topic2: Cosmic Rays – Observations and Theory
15:45 – 16:20 – P. L. Biermann: Origin, Interaction and Propagation of Energy Cosmic Rays (invited)

16:20 – 16:50 – Coffee Break & Poster Session

Session 4
Chair: D. Casetti-Dinescu
16:50 – 17:15 – P. G. Isar: Radio Emission in Atmospheric Air Showers Measured by LOPES in Coincidence with KASCADE-Grande Observations
17:15 – 17:40 – G. E. Pavalas: The ANTARES Detector and Nuclearite Search with ANTARES
17:40 – 18:05 – O. Tascau: The Pierre Auger Observatory - A Window to UHCRs Understanding
18:05 – 18:30 – V. V. Grecu: Substitutional Disorder in Gallogermanate-like Crystals (**Atomic Physics**)

20:00 – Conference Dinner

Friday 27 April

Topic3: Galaxies and Cosmology
Session 5
Chair: V. Mioc
09:00 – 09:35 – D. Casetti-Dinescu: Assembling the Milky Way Halo: Clues from Stellar Kinematics and Abundances (invited)
09:35 – 10:00 – A. Font: Reconstructing the Formation Histories of the Milky Way and Andromeda Galaxies
10:00 – 10:25 – L. I. Caramete : The Magnetic Field Topology in Galactic Winds
10:25 – 10:50 – I. Dutan: Magnetic Connection Model for Launching Relativistic Jets in Active Galactic Nuclei

10:50 – 11:20 – Coffee Break & Poster Session

Session 6
Chair: V. Mioc
11:20 – 11:45 – S. Paduroiu: The effects of free streaming on warm dark matter haloes: a test of the Gunn-Tremaine limit
11:45 – 12:10 – A. Vasile: Combined Analysis of the Cosmic Microwave Background Radiation (CMB) and Large Scale Structure (LSS) Measurements
12:10 – 12:35 – G. Dobrescu: Measuring Fractal Dimension from Micrographs (**Fractals**)
12:35 – 13:00 – G. Maris: Outstanding Results of Romanian Researchers in Solar and Solar-Terrestrial Physics (2000-2006) (**Romanian Solar Research**)

13:00 – 14:15 – Lunch

14:15 – 15:30 – Special Session
Professor Mircea V. Rusu

15:30 – 16:30 – Round Table
Astrophysics at Magurele – past and future
Moderator: S. Paduroiu

16:30 – 17:00 – Coffee Break & Poster Session

17:00 – 18:00 – Round Table
Astrophysics at Magurele – past and future

END OF MEETING

Poster List

1. S. Chita, The pre-supernova circumstellar medium around massive stars
2. C.-D. Constantinescu, The Skyes above Bucharest
3. V. Debattista, I. Ferreras, A. Pasquali, A. Seth, S. De Rijcke, L. Morelli, The Binary Nucleus in VCC 128: A Candidate Supermassive Black Hole in a Dwarf Elliptical Galaxy
4. I. Ene, A Fractal Approach of the Electromagnetic Waves Propagation over the Landscape
5. R. Ene and I. Ene, Surface Electric Discharge as a Microstrip
6. A. Fazacas, Quintessence arising from Modified Gravity
7. L. Husti-Tesileanu, Theoretical Fits for Barium Stars
8. K.-H. Kampert and O. Tascau, Research Oportunities at the University Wuppertal
9. E. Livaniou-Rovithis, Algol-type Binaries with Oscillating Primaries
10. I. C. Maris, J. Bluemer, M. Roth, T. Schmidt and M. Unger for the Pierre Auger Collaboration, Method to deduce the UHECR energy spectrum by the Pierre Auger Observatory
11. C. Oprea, M. Mierla, C. Dumitrache , Four Days of AR09644 Developments
12. K. Persson, C. Rusu, B. Ottosson, LTCC packaging for Microsystems
13. M. D. Popescu and G. J. Doyle, Where are the roots of the fast solar wind?
14. H. Rödjegard, C. Rusu, K. Malmstöm, G. Andersson, Frequency and temperature characterisation of 3-axis accelerometer
15. O. Tascau and K.-H. Kampert, Pierre Auger - The Largest Cosmic-Ray Detector Ever Built
16. O. Tascau, K.-H. Kampert, IceCube: A Kilometer-Scale Neutrino Observatory
17. O. Tesileanu, A. Mignone, S. Massaglia, Simulations of Radiative Shocked YSO Jets: Time-dependent Ionization and Cooling

Abstracts - Talks

Recent Developments in Solar Quakes Studies

D. Besliu-Ionescu[1,2], A. Donea[1], C. Lindsey[3], P. Cally[1]
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[2]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[3]Colorado Research Associates Division NorthWest Research Associates, Inc., Boulder, US

In order to create a 3-D profile of a seismic source, from the corona to the subphotospheric level, we have performed a multi-wavelength analysis of an active region that hosted an acoustically active solar flare. Detailed results and images will be presented for a few solar quakes.

Origin, Interaction and Propagation of Energy Cosmic Rays

P. L. Biermann[1,2,3]
[1]Max-Planck Institut fur Radioastronomie, Bonn, Germany
[2]Dept. of Astronomy and Physics, University of Bonn, Germany.
[3]Dept. of Physics and Astronomy, Univerisity of Alabama, Tuscaloosa, USA.

The high energy cosmic ray particles are the most energetic particles known to us in the universe. In studying their sources, interaction and propagation, many young students from Romania have contributed, and are still contributing today -- and all of them have been students of Mircea Rusu. There are students connected to AUGER, to LOPES, to MAGIC, to identify some experiments; they have contributed to the physics of black holes, plasma physics, cosmology, gravitational physics, magnetic fields, and many other aspects. Those students, who came from Romania to Bonn, and then spread through the world, now have reached locations like Chicago,

Illinois, USA; Tuscaloosa, Alabama, USA; Utrecht, Amsterdam, Nijmegen, in the Netherlands; Zürich, Switzerland; Melbourne, Australia; Dortmund, Wuppertal, Potsdam, Bonn and Karlsruhe, Germany, and other locations. I will describe the physics and outline specifically the work of these young scientists.

The Magnetic Field Topology in Galactic Winds

L. I. Caramete[1,2] and P. L. Biermann[1,3,4]
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[2]Institute of Space Science, Bucharest-Magurele, Romania
[3]Dept. of Astronomy and Physics, University of Bonn, Germany.
[4]Dept. of Physics and Astronomy, Univerisity of Alabama, Tuscaloosa, USA.

The origin of the cosmic ray and of ultra high energy cosmic rays is one of the key points of interest in the scientific community. Considering the fact that the particles in the cosmic rays could be charged, if one wants to reconstruct the path from the source to us, he has to know the configuration of the medium and especially of magnetic fields in the interstellar environment. After we develop a model for the plasma flow in our Galaxy and for the configuration of magnetic fields in the magnetohydrodynamical approximation we are planning to apply this model to observations in order to better adjust the different initial conditions for the flow. The next steps will be to modify the characteristics of the flow in order to apply the model to different spiral galaxies and to extend this approach for the outflows in the early universe and off course there is the question of the nature of the dynamo in our Galaxy as a source for the galactic magnetic field with the outward cosmic rays being responsible for the αω-dynamo as discuss by Parker.

Assembling the Milky Way Halo: Clues from Stellar Kinematics and Abundances

D. Casetti-Dinescu, T. Girard, S. R. Majewski and Y-W. Lee
Yale University, Dept. of Astronomy, New Haven, USA

I will review the current results from photometric, spectroscopic and kinematical surveys aimed at mapping the properties of the Galactic halo. I will then discuss the observational results in the context of formation models of a Milky-Way type galaxy.

Long-Term Variations in the Geomagnetic Field. Any Connection to the Solar Activity?

C. Demetrescu and V. Dobrica
Institute of Geodynamics, Bucharest, Romania

The relationship between the solar activity and short-term variations in the geomagnetic field has been known for a long time. As a matter of fact, the study of geomagnetic phenomena such as geomagnetic storms and substorms, bays and pulsations, together with astronomical observations and studies, made possible the advancement of solar and magnetospheric physics and the development of the solar-terrestrial science. However, 95-98% of the observed geomagnetic field has internal sources, being mainly produced by a dynamo process in the external core of the Earth (the main geomagnetic field) and by magnetic rocks in the lithosphere (the lithospheric field). The time evolution of the main field is currently believed to be characterized by intervals of constant secular variation interrupted by episodes of sudden (1-3 years) steps in the secular acceleration, called geomagnetic jerks.
In the present paper we analyze 100-150 years-long series of geomagnetic annual means from several geomagnetic observatories and show the presence of components with periods of 11, 22, and ~80 years, superimposed on a steady variation. While the first one is clearly related to the solar activity (the sunspot cycle), the larger

amplitude of the 22-year and ~80-year variations points out to core sources, possibly controlled, however, by the solar activity too (the magnetic and the Gleissberg cycles), but the coupling mechanism is unclear as yet. A discussion on the long-term geomagnetic activity and its relationship with the solar activity is included as well.

Measuring Fractal Dimension from Micrographs

G. Dobrescu[1], F. Papa[1], M. Anastasescu[1], V. Lazarescu[1], E. Balabanova[2], N. I. Ionescu[1]

[1]Institute of Physical Chemistry "Ilie Murgulescu", Romanian Academy, Bucharest, Romania,

[2] Institute of Electronics, BAS, Bulgaria

The purpose of our work is to overview some fractal dimension computational techniques from micrographs. STM, SEM, AFM, CLSM and TEM micrographs of different physical systems were analyzed. Dynamic scaling parameters and universality classes were investigated in some cases.

The fractal dimension and the dynamic scaling parameters of surface topography changes on a larger scale of Cu(110) surface in 10mM HCl electrolyte at different potentials using STM images analysis were computed. Three classes of universality were obtained: first, for the dissolution region, at anodic potentials $\alpha = 0.59$ and $\beta = 0.60$; second, for constant potentials, the temporal scaling parameter $\beta > 0.5$, as in the case of diffusion-bias, and $\alpha \approx 0.5$ which is an argument that in the system correlated noise is important; third, at cathodic potentials, $\alpha = 0.62$ and $\beta = 0.5$, defining a new universality class for surface restructuring, random deposition with correlated noise.

An in situ time-series STM images of Pd deposition on Au(110) were used to compute dynamic parameters. Also box-counting method was used to compute fractal dimension of images produced by thresholding.

The fractal analysis of the CSLM-images of GaAs(100) surface has been carried out by dint of conversion of the gray level of each pixel in height. For computing the fractal dimension of GaAs surfaces, we

chose two of the routines proposed for characterization of the fractal surfaces: the height correlation function method and the variable length scale analysis.
The variable length scale method is more suitable for higher scaling range than the correlation function method because of the necessity to have enough points in an interval ε x ε to compute rms deviation $R_{q\varepsilon}$, averaged over n_ε, meaning that ε must be high enough for a good statistic. The variable length scale analyses of the GaAs(100) surface, clean and treated with Na_2S and $(NH_4)_2S$, yields better results, by extending the scale range to higher values and giving information concerning the fractal behavior on a larger scale domain. Also, AFM images of GaAs(100) were analyzed. The importance of cut-offs limits is revealed by comparing results from AFM and CLSM images.
SEM images of $La_{1-x}Sr_xMnO_3$ samples were computed using height correlation function method and variable scale method. Scanning electron micrographs of pure and doped lanthanum manganites reveal that the samples have fine particles with a small tendency of agglomerates formation with different shapes and high porosity. All $La_{1-x}Sr_xMnO_3$ (x=0-0.3) samples present the crystallite size in 37-43 nm range and high surface area values.
The modified "mass-radius" method is used to compute fractal dimension of TEM micrograph of silica powders samples. Two samples of silica powders were analyzed: sample A, with BET surface area $S=400m^2/g$ and sample B with BET surface area $S=53m^2/g$. Both samples have higher fractal dimensions meaning that strong aggregation occurs. The sample A has a higher fractal dimension than sample B, according to their BET surface. Also, for sample B, at shorter scale range of 2nm-20nm, one can compute a fractal dimension of 2.73±0.01 with correlation coefficient = 0.999. Taking into account the lower values of scaling ranges we assign this fractal dimension to correlations between points situated at different depths, and separated in micrograph's plane by lower distances.

Magnetic Connection Model for Launching Relativistic Jets in Active Galactic Nuclei

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We propose an alternative model for launching relativistic jets in active galactic nuclei (AGN) from an accreting Kerr black hole (BH) by converting both the binding energy of the accreted gas and the BH rotational energy transferred form the BH to the accretion disk into energy in the jet by means of the magnetic connection between the BH and the accretion disk. The extractable spin energy of the BH may be transferred to the accretion disk through closed magnetic field lines which connect them, i.e, by magnetic connection, providing a supplementary energy source particularly for a low-accretion rate disk. Adding these two energy sources (the rest-mass energy flow in the disk and the spin energy of the BH transferred to the accretion disk), we derive the launching power of the jets. To do this we integrate the energy conservation law over the inner disk, where the frame dragging effect takes place, for both the sub-Eddington and Eddington accretion rates. We find the launching power of the jets ranges from $\sim 10^{45}$ erg s^{-1} to $\sim 10^{47}$ erg s^{-1} for a BH of 10^9 Ms. In the case of a very low accretion rate, a magnetic connection spin-down of the BH powers the jets, so that the jet-launching efficiency can reach values close to unity. That is, almost all of the power used to launch the jets is borrowed from the BH extractable rotational energy, thus the jets can still be driven even though the contribution of the rest-mass energy of the accreted flow is very low. The consequences of the proposed model for the spin evolution of the BH in AGN, as well as its relevance to the observational data, are described.

Reconstructing the Formation Histories of the Milky Way and Andromeda Galaxies

A. Font
Institute for Computational Cosmology, University of Durham, UK

In hierarchical cosmologies, large galaxies like the Milky Way and Andromeda (M31) form through the accretion and tidal disruption of smaller (satellite) galaxies. Evidence of these processes remains imprinted in the observed stellar properties of the galactic halo and debris from tidally-disrupted satellites. I will show how combining information about the age, chemical abundance, and phase-space distribution of these stars can be used to reconstruct the formation histories of the Milky Way and M31. I will illustrate this approach using a suite of high resolution N-body models of Milky Way- and M31-like galaxies formed in a hierarchical Lambda CDM Universe. Finally, I will compare these theoretical results with recent observations from state-of-the-art wide field surveys of these galaxies.

Dusty Plasma in Space Sciences

D. Grecu and A. T. Grecu
National Institute for Physics and Nuclear Engineering "Horia Hulubei", Dept. of Theoretical Physics, Magurele, Romania

What differentiates a dusty plasma from an usual one is the presence of massive particulates of different forms and sizes. They are either positively or negatively charged depending on the surrounding plasma environment. Then a dusty plasma can be defined as a complex admixture of charged particulates, electrons, ions and neutrals. It exhibits new and unusual behavior, and provides the possibility to explore new collective modes of oscillation, instabilities, as well as new coherent nonlinear structures. It can be found everywhere starting with the interplanetary space, comets, planetary rings, earth's atmosphere and can be produced and studied in laboratory conditions. It seems to play an important role in fusion

plasma devices. The aim of this talk is to review some situations from space science and laboratory experiments where dusty plasma exists. The basic characteristics of this complex system are briefly mentioned. Further on different linear waves (dust acoustic waves, dust ion-acoustic waves, dust lattice waves) are discussed, and a special attention is given to the topic of possible nonlinear structures (solitary waves, envelop solitons, shock waves) which can exist in a dusty plasma. The last twenty years have seen a growing interest in studying the physics of dusty plasma, and now it became a new discipline of plasma science with many and interesting applications.

Substitutional Disorder in Gallogermanate-like Crystals

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The substitutional disorder occurs when two or more cations can occupy, with well defined probabilities different positions in the lattice. The mean stoichiometry is preserved, but, depending on the ions distribution on sites, local crystalline fields have various values. Such variation can be put in evidence by spectroscopic measurements, sensitive to the value and crystalline field symmetry. Such disorder is frequently encountered in solid state.
We shall concentrate upon one crystal from this class, *langatate, LGT*. Its formula is $La_3Ga_{5.5}Ta_{0.5}O_{14}$. There are 4 cationic positions in this lattice, dodecahedral distorted Thomson cube (3e, occupied by La^{3+}), octahedral (1a-O_h, occupied with equal probabilities by Ga^{3+}/ Ta^{5+}), and 2 tetrahedral positions (3f and 2d, occupied by Ga^{3+}). The disorder is due to the distribution of Ga and Ta ions on the octahedral positions. That is one of the simplest cases. The general symmetry is trigonal with P321 space group.
Two techniques will be used to put in evidence this disorder: Electron Paramagnetic Resonance, EPR, of Cr^{3+} ions introduced as

an impurity in the crystal. This ion occupies preferentially the octahedral position. It feels the disorder induced by the next neighbor O_h positions. The second technique is the fluorescent spectroscopy of Eu^{3+} ions. This rare earth ion enters in the 3e position; the dodecahedral and octahedral positions are in the same planes, perpendicular on the trigonal axis. Broadening and splittings of the resonance lines are discussed in terms of the different local crystalline fields.

Radio Emission in Atmospheric Air Showers Measured by LOPES in Coincidence with KASCADE-Grande Observations

P. G. Isar[1,2] for the LOPES Collaboration
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[2]Institute of Space Sciences, Bucharest-Magurele, Romania

When Ultra High Energy Cosmic Rays interact with particles in the Earth's atmosphere, they produce a shower of secondary particles propagating toward the ground. LOPES (LOFAR Prototype Station) is an absolutely calibrated array of 30 dipole antennas investigating the radio emission from these showers in detail and clarifying if the technique is useful for large scale applications like LOFAR (Low Frequency Array) and the Piere Auger Observatory. The LOPES experiment is co-located and measures in coincidence with the air shower experiment KASCADE-Grande in Forschungszentrum Karlsruhe, Germany.

Outstanding Results of Romanian Researchers in Solar and Solar-Terrestrial Physics (2000-2006)

G. Maris[1], D. Besliu-Ionescu[2,3], A. C. Donea[3], M. Mierla[2], E. Moise[4], A. Oncica[2], M. D. Popescu[5]

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[5]Armagh Observatory, Armagh, Northern Ireland

The valuable results of the Romanian researchers in different fields of solar and solar-terrestrial researches are revised.

A new index, Q_x, was defined by us in order to give an evaluation of the Soft X-Ray (SXR) flare energy, similarly to the Q index for H□ flares. The Q_x indices are available for the interval 1 January 1976 - 30 June 2006 for the whole solar disk as well as separately for the two solar hemisphere, North and South, and they will be periodically up-dated (COST Action 724, WG 1).

Seismic emission from solar flares is distinguished by its origin in plain view above the photosphere, as opposed to convective emission, which is hidden beneath the photosphere. To understand the physics of the acoustic radiation responsible for solar quakes a systematic survey covering a large number of X-class some M-class solar flares observed by SOHO/MDI during 1996 and 2006 have undertaken.

A number of papers present the dynamics of the solar corona in the minimum phase (1996) and during the ascending phase (1998) of the 23rd solar cycle, using spectral data of LASCO-C1/SOHO experiment. In particular, the emergence of the slow solar wind at the above mentioned solar cycle phases was studied.

A series of contributions subscribe to ongoing efforts to resolve plasma's fine-scale structure and dynamics at the base of coronal holes, aiming to better identify the fast solar wind origin in the Sun's low atmosphere. Data from the highest resolution solar spectrograph, SUMER/SoHO, in EUV emission lines from transition region and

corona were analyzed.
We have also analyzed the cyclic distribution of high-speed plasma streams in solar wind during the 1964-1996 interval (Solar Cycles nos. 20-22) as compared to the classical aspect of the 11-year cycle by sunspot relative numbers (Wolf numbers). Obvious differences in the high-speed stream dynamics in respect to their solar origin (flares or coronal holes) have been established taking into account the stream parameters: the duration, velocity gradient and importance.
The presence in heliosphere of the cool neutral Helium, among the other interstellar neutrals, was analyzed. The neutrals are ionized by charge exchange, photo ionization, and electron impact. Helium is focused by the Sun's gravitational field on the downwind side.
The forecasts of the 24th solar cycle activities using the neural network method were made. We choose to attempt the forecasts of several solar (R, $F_{10.7}$, Q_x) and geomagnetic (*Ap, Kp, aa, Dst*) indices of the 24th solar cycle using the neural network method although the method still suffer from basic problems such as data pre-processing, architecture selection and parameterization. Our forecasts are in good agreement with the other ones for both solar and geomagnetic level of activities during the 24th solar cycle.

Spectral Analysis of the High-Speed Streams in the Solar Wind

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[2]Institute for Space Sciences, Bucharest–Magurele, Romania

The cyclic behavior of the high-speed streams in the solar wind is investigated during the solar cycles Nos. 20–22 (1964–1996) on two different types of streams according to their solar origin: the streams produced by coronal holes (co-rotating) and the flare-generated ones, in keeping with the classification in different catalogues. The analysis is performed taking into account the importance of the streams as well as the relative sunspot numbers (Wolf numbers). The spectral components of the data series have been extracted as amplitude and phase. The same fundamental period, of about 11

years, has resulted for co-rotating and the flare-generated streams from the amplitude analysis. The phase analysis has revealed the specific phase shifts of the two types of streams relative to the minimum and maximum of the solar cycle. The phase differences are explained as being a consequence of the extended solar cycles and the polar magnetic field reversal. Our results can be used in the solar wind perturbation forecasts with direct implications on space weather.

Study of the Minimum Solar Corona on the Period August-October 1996

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The paper presents the dynamics of the solar corona in the minimum phase of the solar cycle (period August-October 1996), using spectral data of LASCO-C1. LASCO-C1 is an internally occulted coronagraph on the SOHO spacecraft. It has a tunable Fabry-Perot interferometer which allows taking spectral scans of selected coronal emission lines. From measured line profiles we deduced physical quantities like temperature and flow velocities along the line of sight. This way, we obtained information on the flow pattern in the low corona (1.1 to 1.6 solar radii).

Neural Network Forecast of some Solar and Geomagnetic Indices during the 24th Solar Cycle

A. Oncica[1] and G. Maris[2]
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[2]Institute of Geodynamics, Bucharest, Romania

The long-term solar cycle predictions rely on meager modeling of underlying physical foundation. Waiting for a full understanding of the solar cycle that would provide the basis of physical predictions methods we must rely on empirical ones. There are many forecasting techniques, all with ups and downs. We choose to attempt the forecasts of several indices of the 24th solar cycle using the neural network method although the method still suffer from basic problems such as data pre-processing, architecture selection and parameterization. For the sunspot relative number, *R*, June 2006 as the next minimum epoch with a value around 18 and, December 2009 as the next maximum epoch with a value of around 145 were obtained. Using the Ohl's method the predicted next *R* maximum is 138, not far from the previous forecast of 145. For the 2800 MHz solar radio flux, the next minimum epochs with an approximate value of 75, on May 2006, and the next maximum epoch with a value of about 195, on December 2009, were forecasted. The time phase of both minima and maxima agrees nicely which gives us hope in a good behavior of our approach.

The forecasts of the geomagnetic indices were also done with the same pre-processing (pseudo-gaussian monthly smoothed mean) and the same neural net for the same forecast horizon. The *aa* forecast gives for late 2008 an absolute minimum value around 11 and the *Dst* forecast gives for mid 2008 a local maximum around –19. The opposite phase behavior of the two indices is clearly maintained over the forecast interval. The Ap and Kp are well correlated during the forecasted interval. However the forecasted next minimum does not resemble with the two previous ones. The high geomagnetic activity in the beginning as well as in the second part of 2005 yr is seen in forecasts.

The effects of free streaming on warm dark matter haloes: a test of the Gunn-Tremaine limit

S. Paduroiu[1], A. Maccio [1,2], B. Moore[1], J. Stadel[1], D. Potter[1], J. Read[1],O. Agertz[1], S. Wilde[1]
[1]Institute for Theoretical Physics, University of Zurich, Switzerland
[2]Max Planck Institut fuer Astronomie Koenigstuhl, Heidelberg, Germany

The free streaming of warm dark matter particles dampens the fluctuation spectrum, flattening the mass function of haloes and imprinting a fine grained phase density limit for dark matter structures. We explore these effects using high resolution simulations of structure formation in a warm dark matter universe. The Gunn-Tremaine limit is expected to imprint a constant density core at the halo center and we verify this with our simulations. The structure formation in the warm dark matter case occurs top-down on galactic scales where the most massive haloes are collapsing first. The halo mass-concentration mass-redshift formation relations are thus reversed with respect to cold dark matter.

Metal Proteins in Self-Assembling Copolimer Nanovesicles: New Hybrid Materials

C.G. Palivan, C. Fraysse, F. Axthelm, W. Meier
University of Basel, Dept. of Chemistry, Switzerland

One of the most powerful approaches in obtaining well-defined scaffolds for three-dimensional (3D) cell culture, DNA-based structures and metal nanostructured materials is the bottom-up design using self-assembly mechanisms. In this way the molecular building blocks undergo spontaneous organization into well-defined and stable nanostructure morphologies (colloidal size particles, core-shell micelles, nanotubes, etc). The presence of metals in these systems changes dramatically their physical and chemical properties leading to composite materials with new behavior and therefore larger technological applications.

In this study we are proposing new hybrid materials based on encapsulation of metal proteins in self-assembling copolymer nanovesicles, or reconstitution of membrane proteins in the membrane of the vesicles. Polymeric nanocontainers of PDMS-PMOXA-PDMS produced by self-assembly of amphiphilic block copolymers offer a better way to the liposome carriers, more stable, while preserving all the other advantages of lipidic systems, such as lack of immunogenicity. Due to the mild way to reconstitute the proteins in the membrane or the inner space of the nanovesicles, they preserved their structure and activity, as established by various spectroscopic and biochemical methods.

The ANTARES Detector and Nuclearite Search with ANTARES

G. E. Pavalas
Institute for Space Sciences, Magurele, Romania

The ANTARES experiment was primarely designed for cosmic neutrino detection as a 12 string underwater telescope in the Mediterranean Sea. Until now, five lines of the detector were deployed and are currently taking data. The nuclearites are hypothetical stable particles, composed of nearly equal amounts of up, down and strange quarks. The nuclearite characteristics and some results of Monte Carlo simulations for nuclearite detection with ANTARES will be presented.

Professor Mircea Rusu Mentor and Founder Member of GIIF and Astroclub "MERIDIAN 0"

N. Pazmany[1] and T. Berger[2]
[1]CT. M. Viteazul, Oradea, Romania
[2]Lic. O. Ghibu, Oradea, Romania

As founder members of GIIF (Group of initiative for learning physics) we collaborated with Prof. Mircea Rusu at countless projects from which we are presenting just two: 1) participation at

WYP ("Physics enlightens the World"- an event where people of the world, over 120.000 from 47 countries, participated in a relay of light to commemorate the 50th anniversary of Albert Einstein's death on April 18, 2005) and 2) foundation of Astroclub "Meridian 0" which is trying to bring to life an older tradition of Oradea Fortress, where it was used to be one of the first astronomical observatory from Europe, founded in XVth century.

Heliospheric Electric and Magnetic Fields

A. S. Popescu
Astronomical Institute of the Romanian Academy, Bucharest, Romania

From the Maxwell equations in the local Minkowski spacetime chart (derived from the DEUS topology) we obtain the relations to be particularized for a solar type star and a massive star, and later to be used for a 3D representation of the electric and magnetic field topology (in heliosphere or in a stellar atmosphere) and of its evolution with the cosmological time.

The Pierre Auger Observatory - A Window to UHCRs Understanding

O. Tascau
Bergische Universitaet, Wuppertal, Germany

The Pierre Auger Observatory (PAO) is an international cosmic ray observatory designed to detect ultra high energy cosmic rays (UHECRs) which have far higher energies than any man-made accelerator can reach, thus they continue to challenge our understanding. These are sub-atomic particles (protons or other nuclei) with energies beyond 10^{20} electron-volts, the energy of a tennis ball traveling at 53.3 miles per hour, but packed into a single proton. They have an estimated arrival rate of just 1/km² per century, therefore, in order to record a large number of these events, PAO has

created a huge detection area, 30 times bigger than Paris, in western Argentina's Mendoza Province. The observatory is designed to study showers through detecting not only the particles, with an array of 1600 water Cherenkov detectors, but also the fluorescence light, using four stations, each with six telescopes overlooking the particle detectors.

The PAO management is hosted by Fermilab and it will have two sites, one in the southern hemisphere (Argentina) and one in the north (U.S.A), in order to view UHECR over the entire sky. More than 300 scientists from all over the world are working to discover the mistery of UHECR around the predicted GZK phenomena.

The Pierre Auger Collaboration is also developing the study of inclined events, and showers with zenith angles above 85° have been seen. This was expected as they had been detected long ago with much smaller arrays, but the richness of the new data is impressive. These events form the background against which a neutrino flux might be detectable. There is an exciting future ahead.

Scenes from the Life of an Exotic X-ray Binary

V. Tudose
Astronomical Institute, University of Amsterdam, The Netherlands

Circinus X-1 is a neutron star X-ray binary system with an interesting and at times puzzling behaviour over a broad range of frequencies, specifically in X-ray and radio. Its quasi-periodic oscillations and X-ray colors exhibit dual properties, the object resembling sometimes a Z source, other times an atoll. The system seems to harbour the most relativistic outflow (likely oriented close to the line of sight) observed so far within the Milky Way. It lies within a radio synchrotron nebula and has variable radio flux densities at cm wavelengths. The radio flares associated to the orbital phase zero reached up to 1 Jy in the late '70s, then have been observed at the tens of mJy level until recently; in 2007 January, Circinus X-1 seemed to have finally reentered an active radio flaring

state, after another brief reactivation in June 2005. Here we present radio observations at cm wavelengths made with ATCA (Australia Telescope Compact Array) and PAMHELA (Parkes, ATCA, Mopra Hobart Electronic Long-baseline Array) and X-ray data taken with RXTE (Rossi X-ray Timing Explorer). The goal is to characterize the system (and its evolution) at arcmin as well as arcsec scales (via radio imaging) and to understand the correlations between the two spectral windows (radio and X-ray).

Combined Analysis of the Cosmic Microwave Background Radiation (CMB) and Large Scale Structure (LSS) Measurements

A. Vasile
Institute for Space Sciences, Magurele, Romania

The discovery of the CMB radiation in 1965 was the final and most important milestone in confirming the Big Bang Theory. The anisotropies of the CMB contain a wealth of important cosmological information, but still not enough for the complete picture of the past, present and future Universe. I will present the acute problem of the degeneracy of cosmological parameters and the importance of combining different sets of cosmological data and finding the most efficient methods to analyze and extract the maximum amount of information from them.

Abstracts - Posters

The Pre-Supernova Circumstellar Medium around Massive Stars

S. Chita
Astronomical Institute, Utrecht University, The Netherlands

Massive stars interact with their surroundings by emitting winds and ionizing photons. Here, we simulate the evolution of the circumstellar medium around stars of 12 Ms, from their birth up to the supernova stage. These stars are expected to expand at least twice into red supergiants (RSGs), with intermediate hot stages where fast winds are emitted. We utilize the stellar parameters as function of time from detailed stellar evolution calculations as input for our hydrodynamic models.

The Skyes above Bucharest

C.-D. Constantinescu
National Institute for Laser, Plasma and Radiation Physics, Magurele, Romania

Photographies of celestial bodies and nocturnal events were taken over Bucharest night time, during several months. The images are presented as a spectacle, giving accurate details of the photographic composition and for the shooting conditions. The intention of this work is to promote astronomy and its beautifulness to young students, as well as to the general public.

The Binary Nucleus in VCC 128: A Candidate Supermassive Black Hole in a Dwarf Elliptical Galaxy

V. Debattista[1], I. Ferreras[2], A. Pasquali[3], A. Seth[4], S. De Rijcke[5], L. Morelli[6]

[1]University of Washington, USA
[2]King's College London
[3] MPIA Heidelberg
[4] CfA
[5] University of Ghent
[6] Pontificia Universidad Catolica

Searching through archival Hubble Space Telescope (HST) images of dwarf elliptical galaxies, we identified galaxies with compound nuclei. HST Wide Field Planetary Camera 2 (WFPC2) images of the Virgo Cluster dwarf elliptical galaxy VCC 128 reveal an apparently double nucleus. The two components, which are separated by 32 pc in projection, have the same magnitude and color. Spectra of this double nucleus are inconsistent with one or both components being emission-line background objects or foreground stars. The most likely interpretation is that, as suggested by Lauer et al. (1996) for the double nucleus of NGC 4486B, we are seeing a nuclear disk surrounding a supermassive black hole (SMBH). This is only the second time an early-type dwarf (dE/dSph) galaxy has been suggested to host a SMBH.

A Fractal Approach of the Electromagnetic Waves Propagation over the Landscape

I. Ene
Onion S.p.A., Italy

In the existing propagation model, the electromagnetic phenomena are divided in effects due to the curvature of the Earth, and shadow effects due to the geographic obstacles. The propagation function over the curvature of the Earth is based on semi-empirical relations and takes into account the radiated power and its frequency, the

effective height of the emitting antennae, the distance between the fix and mobile station, and the type of soil existing near the mobile terminal. The purpose of this investigation is to improve the propagation model of the electromagnetic field generated by an antennae of 900 MHz in a mountain environment (considering and the reflections influence), taking into account the self similar structure of the relief.

Surface Electric Discharge as a Microstrip

R. Ene[1] and I. Ene[2]
[1]Cistelaier S.p.A., Italy,
[2]Onion S.p.A., Italy

In this paper, we summarize the results of the systematic studies performed on the morphology of the high voltage gliding electric discharge patterns on dielectric surfaces, observed on photographic films. In spite of the quite complex patterns observed, a statistical study reveals that the electric discharge has a geometry that can be described best using fractal shapes. The morphology of the pattern could be used to infer some physical properties of the discharge. The discharge being on the surface, behaves like a conducting path on a dielectric substrate. So, the pattern can thus be examined from the point of view of conventional micro strip structure. Hard modeling of some features reveals different characteristics that can be used for making models of the discharge.

Quintessence arising from Modified Gravity

A. Fazacas
University of Bucharest, Physics Faculty, Magurele, Romania

In physical cosmology, dark energy is a hypothetical form of energy which permeates all off space and has strong negative pressure. According to the theory of relativity, the effect of such a negative pressure is qualitatively similar to a force acting in opposition to

gravity at large scales. Dark energy might arise from the particle-like excitations in some type of dynamical field, referred to as quintessence. In cosmology, quintessence is a real form of energy distinct from any normal matter or radiation, or even "dark matter".
In this poster we used two types of frames: Jordan frame and Einstein frame and we want to see how omega (the cosmological constant) varies in those two frames for three species: radiation, cold dark matter, with her densities and the rotational scalar field (quintessence). For this we use the conformal transformation and two equation: Fridmann equation and equation of motion.

Theoretical Fits for Barium Stars

L. Husti-Tesileanu
University of Turin, Dept. of Physics, Italy

Stellar evolution and Neutron sources during the Asymptotic Giant Branch phase are presented. AGB predictions for all heavy elements within a large range of 13C-pocket efficiencies, for stars of about solar metallicity are considered, and compared with a number of spectroscopic observations of barium stars. Agreements and discrepancies between theoretical predictions and observed abundances of the chemical elements are discussed.

Research Opportunities at The Wuppertal University

K.-H. Kampert and O. Tascau
Bergische Universitaet, Wuppertal, Germany

In the context of future prospects for research at the Bucharest University, we present opportunities open at the Wuppertal University. Research in our physics department is carried out on an international level. Students from Romania as well as Switzerland, USA, UK, Italy, Sweden, Poland, Spain, etc. have contributed and are still contributing a lot to various research projects carried out in international teams and collaborations. Examples are cosmic ray

studies with the KASCADE-Grande, LOPES (Germany) and Pierre Auger Experiments (Argentina), neutrino astronomy with IceCube (South Pole), collider experiments CMS (CERN), D0 (Fermilab), nuclear physics (Julic, Germany), atmospheric physics (Scandinavia, Australia, South Pacific) or developments of new detectors at each of these locations. Within the University there are close co-operations with the chemistry, mathematics, and informatics department each of which offers many attractive research opportunities. The department operates the Super-Computer ALiCEnext (the largest computer cluster at german universities at installation time) with 1024 nodes. This serves the computing needs of various research groups and provides a tight link to mathematics and informatics department.

Algol-type Binaries with Oscillating Primaries

E. Livaniou-Rovithis
Athens University, Greece

One of the favourite subjects to lecture via the ERASMUS program with the Bucharest University was variable stars. Any kind of variables: single or binaries. So, for this special occasion I've chosen to present the new class of Algol-type eclipsing binaries, the so-called oEA. In this new class a valuable combination exists: a) eclipses that allows the accurate determination of the binary's elements via the light curve analysis. b) δ like oscillations of the primary mass-accreting component. This new class of variables that number about 20 members is potentially attractive and excellent for asteroseismology studies.

Method to Deduce the UHECR Energy Spectrum by the Pierre Auger Observatory

I. C. Maris, J. Bluemer, M. Roth, T. Schmidt and M. Unger for the Pierre Auger Collaboration
Karlsruhe Institute of Technology, Germany

Taking into account the great advantage of having a hybrid detector a method has been developed -- simulation independent – to determine the energy of the cosmic rays recorded by the surface detector of the Pierre Auger Observatory. The method is based on the isotropy of the cosmic ray flux, with respect to the zenith angle for all energies of interest. It enables to relate the calorimetric measurement of the cosmic ray energy recorded by the fluorescence detector with a surface detector specific quantity, e.g. shower size at 1000 m distance from the core, corrected for the attenuation in the atmosphere. The method of measuring and calibrating the primary energy and the influence of the reconstruction uncertainties on the energy spectrum are presented.

Four Days of AR09644 Developments

C. Oprea, M. Mierla, C. Dumitrache
Astronomical Institute of the Romanian Academy, Bucharest, Romania

We analyze the development of AR09644 in few wavelengths: continuum, EIT and Halpha. The MDI magnetograms are also analyzed and the 3D magnetic field lines are visualized by using a dipolar model.

LTCC Packaging for Microsystems

K. Persson, C. Rusu, B. Ottosson
Imego Insitute, Göteborg, Sweden

A novel packaging platform for the integration of sensors, actuators, fluidic and optical elements together with electronics into a single package is being developed. LTCC is a mature component carrier system with a complete infrastructure for electrical signals, buried passives and production processes. One advantage of using LTCC instead of silicon and glass is the simplicity of making conductors and vias. The newly developed low CTE LTCC gives the opportunity of direct wafer bonding to silicon. The stress caused by the bonding process due to CTE mismatch (3.4 ppm in comparison to 2.6 ppm) can to some extent be compensated by a slightly higher bonding temperature. Silicon and LTCC show similar behavior when used for packaging (low pressure inside the package) while glass tends to be poorer. Simulations for stress induced in the wafer packages during the anodic bonding process has been performed and will be presented.

Where are the Roots of the Fast Solar Wind?

M. D. Popescu and G. J. Doyle
Armagh Observatory, Northern Ireland

A few million tonnes of charged particles leave the Sun every second. This continuous stream of particles - the solar wind - leaks from the Sun's inner atmosphere, escaping its gravity. How is the solar wind accelerated to hundreds of km/s, together with the chain of heating processes that generate and sustain the Sun's hot corona has so far defied a quantitative understanding,despite the multitude of efforts spanning the last half century. In our work, we analyse data acquired with the SUMER spectrograph and the EIT imager on SoHO in coronal holes, being particularly interested to find the fast solar wind origins as low as possible in the solar atmosphere. Our results indicate that we have not seen the fast solar wind starting as a

steady outflow in the transition region. Instead, we see bursts of short time brightenings, possibly representing bi-directional jets (explosive events) of different scales, which, because of the open magnetic field structure, could pump plasma into the corona.

Frequency and Temperature Characterisation of 3-axis Accelerometer

H. Rödjegard, C. Rusu, K. Malmstöm, G. Andersson
Imego Insitute, Göteborg, Sweden

Monolithic three-axis accelerometers based on four sensing elements with inclined direction of sensitivity were already suggested. It has been also theoretically shown that these devices have direction independent resolution and frequency response. Full three-axis frequency and temperature characterizations are presented here for the first time, showing excellent potential for use in high performance applications.

Pierre Auger - The Largest Cosmic-Ray Detector Ever Built

O. Tascau and K.-H. Kampert
Bergische Universitaet, Wuppertal, Germany

The Pierre Auger Cosmic Ray Observatory (PAO) is studying ultra-high energy cosmic rays around and above the Greisen-Zatsepin-Kuzmin cutoff, i.e. at energies exceeding 10^{19} eV, the most energetic particles in the universe. When these rare particles strike the earth's atmosphere, they produce extensive air showers made of billions of particles. While cosmic rays with low to moderate energies are well understood, those with extremely high energies remain highly mysterious. The PAO is the first experiment designed to work in a hybrid detection mode. The combination of two complementary detection techniques - 1600 water Cherenkov tanks distributed over 3000 km² and overlooked by 24 atmospheric fluorescence detectors - guarantees high-quality and statistically

significant data. Therefore, it is hoped that the PAO will give answers to the most pressing astrophysical question existing for more than 40 years.

IceCube: A Kilometer-Scale Neutrino Observatory

O. Tascau, K.-H. Kampert
Bergische Universitaet, Wuppertal, Germany

The IceCube Neutrino Detector is a neutrino telescope currently under construction at the South Pole. IceCube is being constructed in deep Antarctic ice by deploying almost 5000 spherical optical sensors at depths between 1,450 and 2,450 meters. The main goal of the experiment is to detect high energy extraterrestrial neutrinos, spanning the energy range from 10^{11}eV to about 10^{21} eV. The detector used the Earth as shield against cosmic ray particles and searches for neutrino-induced up-going showers in the ice. The sources of those neutrinos could be black holes, gamma ray bursters, or supernova remnants. The data that IceCube will collect will also contribute to our understanding of cosmic rays, supersymmetry, weakly interacting massive particles (WIMPS), and other aspects of nuclear and particle physics.

Simulations of Radiative Shocked YSO Jets: Time-dependent Ionization and Cooling

O. Tesileanu, A. Mignone, S. Massaglia
University of Turin, Dept. of Physics, Italy

Our purpose in the framework of the JETSET project is to perform realistic simulations of astrophysical jets, in particular YSO jets. The MHD simulation code we use (Pluto), is developed and maintained at the Turin University by A. Mignone. We developed a new cooling function which greatly improves over the rather simplified implementation of Raymond's algorithm (1992). The cooling function is valid in the following plasma conditions: temperatures

between 2,000 and 200,000K, particle number densities of 1 - 10^5 cm^{-3} and solar element abundances, a range particularly suitable for our applications. The cooling model accounts for the evolution of the following ion species: H, He I and II, C I to V, N I to V, O I to V, Ne I to V, S I to V. These species should give a good approximation of the cooling for the above conditions (see also Raga et al. 1997). Non-equilibrium ionization fractions are computed at runtime. The ionization balance is first computed in equilibrium conditions, and used as initial condition for the MHD simulation.

PROFESSOR MIRCEA V. RUSU

POSITIONS

From 1959 lecturer, senior lecturer and reader, and associate professor at the Atomic and Nuclear Physics Department, University of Bucharest

SELECT AWARDS AND FELLOWSHIPS

1967 Ministry of Education Award for Physics for "Work in the field of Mössbauer Spectroscopy and for the first Mössbauer spectrometer built in Romania"

1974 The Constantin Miculescu Award of the Romanian Academy for Physics for "Group of work in the field of amorphous thin films"

1970 IAEA fellowship at the Clarendon Laboratories, Oxford, Englan - "EPR and ENDOR Studies on some Irradiated Halides"

1971 IAEA fellowship (2 weeks) "AMPERE Summer School", Basko-Polia, Yugoslavia

1974 IAEA fellowship (12 month) Argonne National Laboratory, USA: "Structural Studies of the Amorphous Germanium Films Using Colombian Excited Mössbauer Spectroscopy"

MEMBERSHIP OF PROFESSIONAL ORGANISATIONS

Romanian Physical Society
Romanian Academy Scientist Association
European Physical Society
European Astronomical Society

Teacher's Society for Physics and Chemistry from Romania
Vice-president of the "Physics Education" section of the Romanian Physical Society since 1992

SELECT RESEARCH ACTIVITIES

1. **Magnetic resonance and spectroscopy, development of research devices and methodology of physical measurements**
   - 1962 Construction of an autodyne, NMR apparatus for magnetic field measurements
   - 1963 Construction of the first Romanian low field magnetic resonance spectrometer
   - 1964 Construction of the first microwave, magic-T, spectrometer in Romania
   - 1965 Construction of the first Mössbauer spectrometer in Romania
   - 1965 Methodology of spectrum recording (technique of spectrum accumulation for noise reduction)
   - 1984 Methodology of determination of low concentration gas impurities by neutron activation method in thin films obtained by cathode spattering (argon impurities in a-Ge thin films)
   - 1986 Construction of a "smart" IR spectrometer using a home made ADC interface
   - 1988 Methodology of spectral line deconvolution (Fourier and informational entropy approach)
   - 1988 Methodology of thin films characterization by IR optical reflectance spectroscopy (optical constants, film geometrical parameter: thickness, roughness)

2. Physics of disordered materials (and systems)

1970 Amorphous materials (thin films production, electrical properties, models for deposition, X-ray and EPR measurements for studying film structure)

1975 Oder-disorder transition of the crystalline structure by irradiation with particles and X-ray (neutron irradiation, kinetic of thermal and radiation recovery, entropy and statistics of such processes)

1973 – 1993 - Valence and site disorder in doped magnetic oxides materials (impurities distribution, fractal properties of the distribution, DLA models for impurity diffusion, percolation properties)

1989 Study and characterization of the film surface and roughness (computer simulations of the roughness and the light scattering on such surfaces)

3. Systems and time evolution; chaos and fractals in complex systems; dynamics of system evolutions, computer modeling

1983 Charged particle motion in magnetic fields: model for radio-burst from Solar origin (synchrotron radiation related to charge movement along magnetic force lines emerging from sunspots

1989 Particle acceleration in variable stochastic magnetic fields and instability of trajectories

1980 – 1990 Electric currents and force distribution in metals subject to variable magnetic field

1986 Model for electrode - electrolyte interface noise; application to the deuterium concentration measurements

1988 DLA models for impurity diffusion in crystal

1989 Physical phenomena related to the electrical discharge on dielectric surfaces

1988 – present Noise and noise treatment, 1/f noise in

different natural systems dynamical modeling using cellular automata, model for "normal" noise of Earth dynamics

1990 Chaotic model for learning (theoretical and practical, applications for education technology)

1988 – present Fractal systems and fractal dimension determination, self similarities in natural systems, Fractal phenomena in electric discharges, fractal antennae; Boundary recognition; a difficult problem in modeling the physics behind an image

1988 – present Interdisciplinary applications of fractal and chaos theory

4. **Astrophysics**

- Nonlinear dynamics and fractals in astrophysics: planetary surface morphology analysis, stability and chaos in solar system, luminous and electrical phenomena in planetary atmospheres, cosmic rays and particle astrophysics, Nucleosynthesis in Sun and stars, fractal properties of the tail of the radio galaxy jets, Chaotic behavior of the unipolar magnetic regions on Sun's surface, physics of solar granulation, sunspot models, Numerical analysis of the Wolf's number time series, The inverse problem for asteroids light curve modeling, theory and experiments, and gravity theories
- "Electrolysis experiments in microgravity conditions" (02/04 – 30/07/2003), 6th ESA Students Parabolic Flight Campaign July 2003, "Zero-g experiments", Bordeaux, France
- Radioastronomy, and research on radio wave propagation, phenomena in plasma of radiofrequency, Sun's radio emission

Miscellanea

1980 – 1990 Nondestructive methods of characterizations of materials: Förster magnetic fault detectors, magnetic tape rack detection, acoustic emission defects detection

1988	Physics of plasma welding (in magnetic fields)
1991 – present	Problems related to the crack mechanisms, models for fracture, and fragmentation
1988 – 1989	Metal deformation in pulsed magnetic fields
1989	Analysis of conditions for cold fusion onset in solids
1987 – present	Biosensors and physical methods in biology
1970 – present	Methodology and problems of teaching science (physics) and learning
1987 – present	Computers in education

PATENTS

1982	Laser beam detection using quartz crystals
2001	Fractal Antenna for Automotive Applications, Adam Opel AG, Germany, 2001

OTHER POSITIONS

1992 – 1994	Associate researcher at BIOTEHNOS Institute, Bucharest
1995 – 1998	Associate researcher at Institute of the Science of Education, Bucharest
1996 – 1997	Expert II at the National comity for nuclear Energy (CNEA)
1999 – present	Associate researcher at the Astronomical Institute of the Romanian Academy

CONFERENCES AND PROGRAMS ORGANIZED

1997 – 2002	Co-organizer of the Romanian Internet learning Workshop (RILW)
1997 – 2004	Organizing at the faculty visiting professors from France for teaching astrophysics
1998 – 1999	Events implied by the total solar eclipse from 1999; co-organizer of the "The International School for Young astronomers" (YSIA-24)
2003, 2005	Co-organizer of the International Conference "Interdisciplinary Application of Fractal Analysis", Bucharest, Romania

ACTIVITIES IN EUROPEAN PROJECTS

1. Tempus mobility program, JEP-07596/94, Paris-Orsay, 1997
2. Socrates/Erasmus coordinator, establishing bilateral agreements:
   a) for teaching and exchange in astrophysics with University of Turin, Italy, University of Bonn, Germany, Meudon Observatory-Paris, France, and University of Athens, Greece
   b) intensive project: Romanian Internet Workshop, 1997 – 2002
3. Romanian representative for World Year of Physics, WYP2005

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