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The integration of the Romanian space activities in the European Research Area

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The national co-ordinating body of the space activities is the Romanian Space Agency (ROSA). The objectives of the ROSA are to promote and coordinate development and national efforts in the field, and, as a Government representative, to promote international cooperation. One of the ROSA´s main responsibilities is to coordinate and integrate the activities of the national space research and development programme. On behalf of the Government, ROSA is the national representative in the cooperative agreements with international organizations, such as European Space Agency (ESA) and Committee on Space Research (COSPAR), as well as bilateral governmental agreements.

Presently, Romania has a signed "Agreement between the Government of ROMANIA and the EUROPEAN SPACE AGENCY concerning cooperation in THE EXPLORATION AND USE OF OUTER SPACE FOR PEACEFUL PURPOSES", the first on December 11, 1992 and the one in use on October 6, 1999. In order to associate the European Co-operating States participants with ESA programmes and activities for preparing them in the most efficient manner for future accession to the ESA Convention, ESA has proposed "Plan for European Co-operating States – PECS" at ESA Headquarter Paris, on September 2001. Areas covered by PECS are Space sciences, Earth observation, Telecommunication and navigation, Microgravity research, and Ground segment engineering and utilization. For being involved in this programme ESA invited the following countries: Czech Republic, Hungary, Poland and Romania.

It has to be mentioned that Romania is a party to all major international treaties concerning space activities.

The space activities in Romania are financed by the National AeroSpace Programme on the following main directions are: Space policy and infrastructure, Space Science, Microgravity and Life Sciences, Space Applications, and Aerospace Technology and spin-off.

Institute for Space Sciences

1 Brief history

Institute for Space Sciences (I.S.S.) was founded in 1990, under the name "Institute of Gravitation and Space Sciences", as an independent Institute within the Institute of Atomic Physics. The bases of the Institute were the former “Center for Astronomy and Space Sciences” and the laboratory of Gravitation and Inertial Techniques. In 1993 the Space Engineering laboratory was created. In 1996 the institute became a subsidiary of the National Institute for Laser, Plasma and Radiation Physics as the Institute for Space Sciences (I.S.S.).

2 Main directions for the research & development activity

The Institute for Space Sciences is carrying out fundamental and advanced technological researches in the Cosmic Space Physics and related fields based on the previously acquired own experience and international cooperation. The Institute's R&D activity is based on the concept of covering all experimental and theoretical stages: equipment development, experiments in cosmic space, data processing and interpretation, theoretical researches, cosmic space utilization and communicate and disseminate the information. As a consequence the main directions for the Research & Development activity are *cosmic physics* (cosmic rays and particles, cosmic plasmas and magnetometry, astrophysics), *cosmology, general theoretical and mathematics physics, gravitation and microgravitation, and space technology* (engineering for space research and remote sensing).

3 Institute structure.

Laboratories

1. Space Research Laboratory
2. Space Engineering Laboratory
3. Gravitation Laboratory

Administration

3.1 Space Research Laboratory

- **Basic activities:** Fundamental research in astrophysics, planetary atmosphere and cosmic radiation.
- **Research directions:** *Cosmic rays and nuclear astrophysics, Theoretical physics and astrophysics, and Cosmology.*

3.2 Space Engineering Laboratory

- **Basic activities:** Fundamental and advanced technological research in space magnetometry and plasmas, remote sensing and space technology. Development of control and data acquisition systems for satellite experiments. Development of special computational and treatment techniques for satellite data processing.
- **Research directions:** *On-board data acquisition device design and manufacturing, Experimental data processing and analyzing, and Applications of space communications.*

3.3 Gravitation Laboratory

- **Basic activities:** Fundamental and advanced technological research in gravitation, microgravitation and space dynamics.
- **Research directions:** *Gravitation, Micrograviy, and Celestial mechanics.*

4 National programmes 1999 -2005 / Projects

4.1 Technologies in Aeronautics and Space - AEROSPATIAL

- Theoretical models for the local and global processes in intense fields.
- Tracker for space experiment AMS.
- Background Cosmic Radiation - Planck mission.
- Space plasma physics by satellite data.
- Study of the body motion with potential perturbations – circumterrestrial orbits.
- Models and mechanisms of gravitational waves production and detection.
- NOTTE2 – Search for signals of the solar neutrino disintegration.
- Study of the space debris in circumterrestrial medium.
- Technology & Science Park for aerospace technologies.
- Studies for magnetically fluids in variable magnetic fields.
- Telemedicine.

4.2 Fundamental Researches - CERES

- Cosmic radiation – origin, composition and interactions.
- Study of the nuclear matter in extreme conditions of energy density by relativistic heavy ions.
- Fundamental physical processes in space plasma.
- Researches of elementary particles astrophysics for cosmology.
- The study of the multiple processes in heavy ion collisions at the accelerators.
- The investigation of microstructure of the magnetic nano-materials with fluid properties by neutron scattering at small angles.

4.3 Research and Innovation for Economy - RELANSIN

- Center of Excellence "*Center for Experimental and Theoretical Astrophysics and Applications*"

5 International R&D partners

Space is a domain where the activities are carried out in large cooperations and the projects of the Institute for Space Sciences are developed in international partnership on the basis of Memorandum of Agreements. The list of the institutes and universities cooperating with the Institute for Space Sciences is the following:

- Belgian Institute for Space Aeronomy, Bruxelles, Belgium
- Institute of Atmospheric Physics of Czech Academy, Prague, Czech Republic
- Karlovo University, Prague, Czech Republic
- Laboratoire de Physique des Atomes, Lasers, Molecules et Surfaces, CNRS. France
- Laboratoire des Collisions Atomiques et Moleculaires, Universite Paris Sud, Orsay, France
- Laboratoire Aime Cotton, Universite Paris Sud, Orsay, France
- Department of Mathematics, University of Cergy Pontoise, Cergy Pontoise, France
- Max Plank Institut für Extraterrestrische Physik, Garching. Germany
- Istituto di Tecnologie e Studio delle Radiazioni Extraterrestri, Bologna, Italy
- Dipartimento di Fisica dell'Universita di Bologna, Italy
- Dipartimento di Fisica dell'Universita, Laboratori Nazionali del Gran Sasso, Gran Sasso, Italy
- Laboratorio per lo Studio degli Effetti delle Radiazioni sui Materiali Speciali (SERMS), Terni, Italy
- Joint Institute of Nuclear Research, Dubna, Russsia
- Cankaya University, Ankara, Turkey
- EMBRY - RIDDLE Aeronautical University, Florida, USA

- Department of Physics & Astronomy, University of Pittsburgh, USA
- Brookhaven Science Associates, Brookhaven National Laboratory, Upton, New York, USA

6 Satellites and space stations with our participation

(own experiments or in cooperation)

a) **Magnetometry and cosmic plasmas**

1978 INTERKOSMOS 18
1980 INTERKOSMOS 20
1981 INTERKOSMOS 21
1989 INTERKOSMOS 24 AKTIVNII - MAGION 2
1991 INTERKOSMOS 25 APEX - MAGION 3
1995 INTERBALL 1 - MAGION 4 - TAIL
1996 INTERBALL 2 - MAGION 5 - AURORAL
1996 FAST
1997 EQUATOR - S
2000 CLUSTER II

b) **Cosmic rays**

1972 INTERKOSMOS 6
1974 COSMOS 690
1975 COSMOS 782
1977 INTERKOSMOS 17 & COSMOS 936
1979 COSMOS 1129 & SALIUT 6
1981 SALIUT 6 -
Scientific Program of Romanian cosmonaut
1982 COSMOS 1514 & SALIUT 7
1985 SALIUT 7
1986 COSMOS 1781
1989 COSMOS 2044
1993 COSMOS 2229

c) **Remote sensing**

1996 MIR - PRIRODA

The distribution time of the space experiments with the participation of the Institute for Space Sciences, Bucharest is presented in Figure 1.

7 On ground experiments

The on-ground segment and scientific research, both theoretical and experimental, are very useful either for analyzing and modeling space data or providing data in the research areas uncovered by the *in-situ* space experiments. The Institute for Space Sciences collaborates to some of the most significant world ground experiments such as: MACRO at National Laboratory Gran Sasso, Italy; NOTTE, SLIM, ANTARES, and OPERA in cooperation with the National Institute for Nuclear Research, Italy; BRAHMS at the Brookhaven National Laboratory, USA; ALICE and CMS at Large Hadrons Collider - CERN, Geneva, Switzerland.

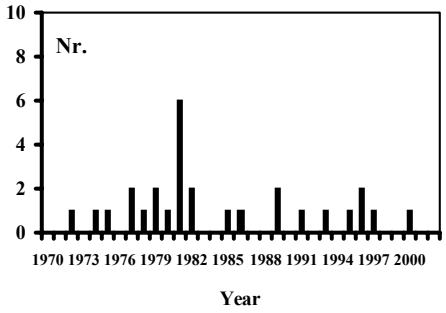


Fig. 1: The distribution of the space experiments carried out by the Institute for Space Sciences with own instruments or in cooperation.

8 Personnel

The institute employs in 2002 a total permanent staff of 86 people and out from the people with academic training 23% are Ph.D. and 21% are Ph.D. students.

In Fig. 2 the distribution of the personnel on different positions is represented

Human resources in Research & Development has to be put in forefront in assuring the development of the knowledge-driven economy which needs a very skilled workforce and research workers are responsible both for producing knowledge and for exploiting it. Due to the level of the brain-drain, for Romania this problem is of vital importance and all measures has to be taken in order to minimize the young people' feeling that they have to leave Romania in order to participate to high level science. The strategy of the Institute for Space Science implies a very careful policy in attracting young researchers. Consequently, the average age in I.S.S. is 36 years.

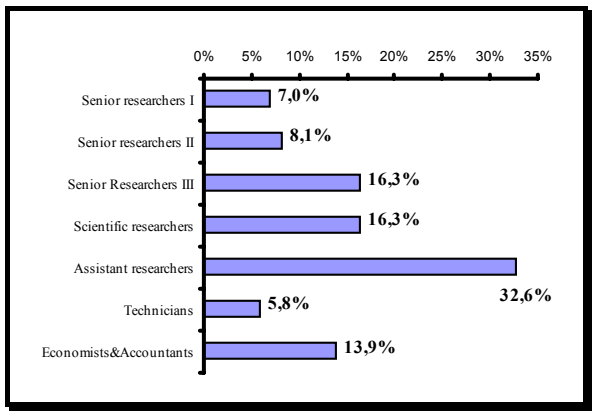
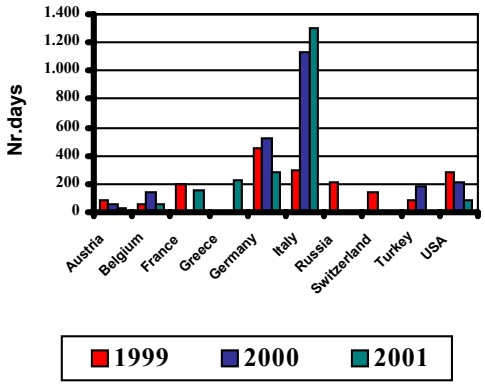


Fig. 2: The personnel distribution

The international projects of the Institute for Space Sciences help also to overcome the isolation feeling of the researchers. The Memorandum of Agreement affords them to work in the institute and universities partners. For 1999, 2000, and 2001 the researchers' mobility is presented in Figure 3. Of course, the main aim for the institute is to be a partner to the world efforts dedicated to the Universe investigations as well as to participate to answering the Fundamental Questions to address by these investigations.



9 Personnel with academic training and scientific results 1991-2001

Scientific performance in terms of the output of research is an indicator for measuring the scientific capacities of a country in creating and disseminating knowledge and the publications are the most used channel in this respect. The scientific performance is an indicator used for comparing between countries.

The main activity of the Institute for Space Sciences is devoted to the fundamental research. Therefore the main results are the contributions to the knowledge-production especially in terms of publications in international journals. In Figure 4 the evolution of the number of researchers and the number of publications are given.

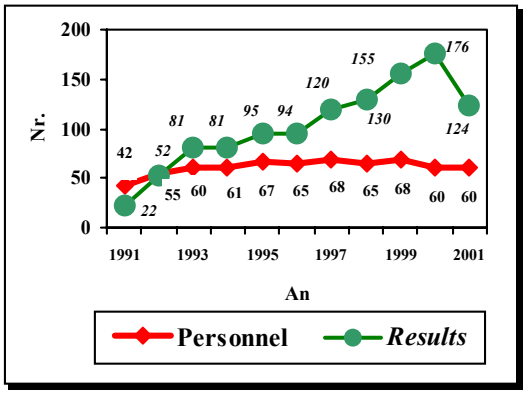


Fig. 4: The total number of the personnel with academic training and the number of publications in international journals or communications at the international conferences.

10 Conclusions

From the activity of the Institute for Space Sciences, Bucharest it is obvious that Romania has high

scientific capabilities to be an actor in the “big sciences” through all the world.

May be one of the highest aims for the world effort in the exploration of space is: “*The significance of the adventure in space is that we are positioning ourselves for perceiving larger truths. Such truths can give us an enlarged sense of human purpose*.” (Norman Cousins, Editor, Saturday Review World)