

РОССИЙСКАЯ АКАДЕМИЯ НАУК  
RUSSIAN ACADEMY OF SCIENCES

**НАЦИОНАЛЬНЫЙ ДОКЛАД  
О РЕЗУЛЬТАТАХ ФУНДАМЕНТАЛЬНЫХ  
КОСМИЧЕСКИХ ИССЛЕДОВАНИЙ В РОССИИ  
ЗА 2006–2007 ГОДЫ**

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**NATIONAL REPORT  
ON THE RESULTS OF FUNDAMENTAL SPACE  
RESEARCH REALIZED IN RUSSIA  
DURING 2006-2007**

МОСКВА  
MOSCOW  
2008

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## INTRODUCTION

**1.** In the previous year of 2007, one had celebrated the 50-year anniversary of the First artificial satellite launch that manifested the beginning of the Space Age. It was the event that allowed one to establish a new science — the space research, thus having opened a way to seemingly impossible opportunities: to look behind the dense barrier of the Earth's atmosphere hiding from us crucial information about the Universe, to send robotic missions to Solar system bodies, to walk over the surface of the Moon and to develop realistic projects of a manned spaceflight to a neighboring planet in the coming decades. It is undoubted and surprising, however, that the launch of Sputnik, which had been developed in association of the scientific program — the International Geophysical Year 1957—1958 — was of tremendous value not only to a narrow community of scientists, but also, without any exaggeration, to the entire mankind. It was this event that became the basis for the development of new branches of industry and for the space utilization applicable for all kind of human activities. The very fact that one had managed to put the soon-developed space opposition of the superpowers on the rails of peaceful competition for space leadership is a remarkable aspect of the Sputnik-related history. This competition had become a crucial factor, which prevented the 'cold war' to be converted into the 'hot' one: some tensions between the superpowers were released through the space race which resulted in remarkable achievements of the both parties. It took just half a century — an instant from a historical point of view — for tens of countries to join the 'space club' and for the space exploration to become a routine task.

Various events in different countries were devoted to the 50 anniversary of Sputnik launch. In October 2007 the International Forum "Space: Science and Challenges of the XXI century" was held in Russia. It included several symposia dedicated to the main branches of scientific space research that were carried out in Moscow and Saint-Petersburg. On the ceremonial meeting the greeting address from S.B. Ivanov, the First Deputy Chairman of the Government of Russian Federation have been read out, devoted to the 50<sup>th</sup> anniversary of the First Sputnik launch. Welcoming speeches were delivered by A.F. Andreev and A.I Grigoryev, vice-presidents of the Russian Academy of Sciences, A.N. Perminov, the Head of the Federal Space Agency, E.A. Panteleev, Minister of the Moscow City Government, Head of the Moscow City science and industrial policy Department; M. Griffin, Administrator of the US National Aeronautics and Space Administration; J.-J. Dordain, Director-Generale of the European Space Agency; N. Sabotinov, the Chairman of the Council on Space Affairs of the Bulgarian Academy of Sciences, P. Wolanski, the Chairman of the Council on Space Affairs of the Polish Academy of Sciences and others. D. Badarc, Manager of the UNESCO Moscow Office, addressed the meeting with the testimonial from M. Barbosa, Deputy Director-Generale of UNESCO. On the plenary session L.M. Zelenyi, the Director of the Space Research Institute of Russian Academy of

Sciences, presented the report “Fifty years, that changed our view of the world”, devoted to the main scientific achievements that have become possible with launches of artificial Earth satellites. R.-M. Bonnet, President of Committee on Space Research (COSPAR), in the report “Space for the Future” related on the prospects of space research.



*A.N. Perminov*



*A.F. Andreev*



*M. Griffin*



*J.-J. Dordain*



*L.M. Zelenyi*



*R.-M. Bonnet*

At the plenary session of scientific part of the Forum review reports of the Russian and foreign scientists on the most actual problems of space science and technology have been delivered. Presented on this session were the reports by professor M.I. Panasyuk (Russia), professor A. Nishida (Japan), academician R.A. Sunyaev (Russia), academician A.I. Grigorjev (Russia), professor T. Owen (USA), academician V.E. Fortov (Russia), professor J. Blamont (France), professor G.M. Polischuk (Russia), professor J. Head (USA) and professor M. Zuber (USA).



*M.I. Panasyuk*



*A. Nishida*



*R.A. Sunyaev*



*A.I. Grigorjev*



*T. Owen*



*J. Blamont*



*G.M. Polischuk*

Members of the round-table discussion «Space: international cooperation and space technology for human progress» were R.Z. Sagdeev, academician of Russian Academy of Science, A.A. Kokoshin, the deputy of the State Duma of the Russian Federation, S. Eisenhower, Chairman Emeritus of the Eisenhower Institute, professor V.Z. Dvorkin. Discussed were the problems of the international cooperation in the field of outer space exploration. Participants of the discussion emphasized the necessity to develop new principles of organization of international cooperation in space.



*S. Eisenhower*



*A.A. Kokoshin*

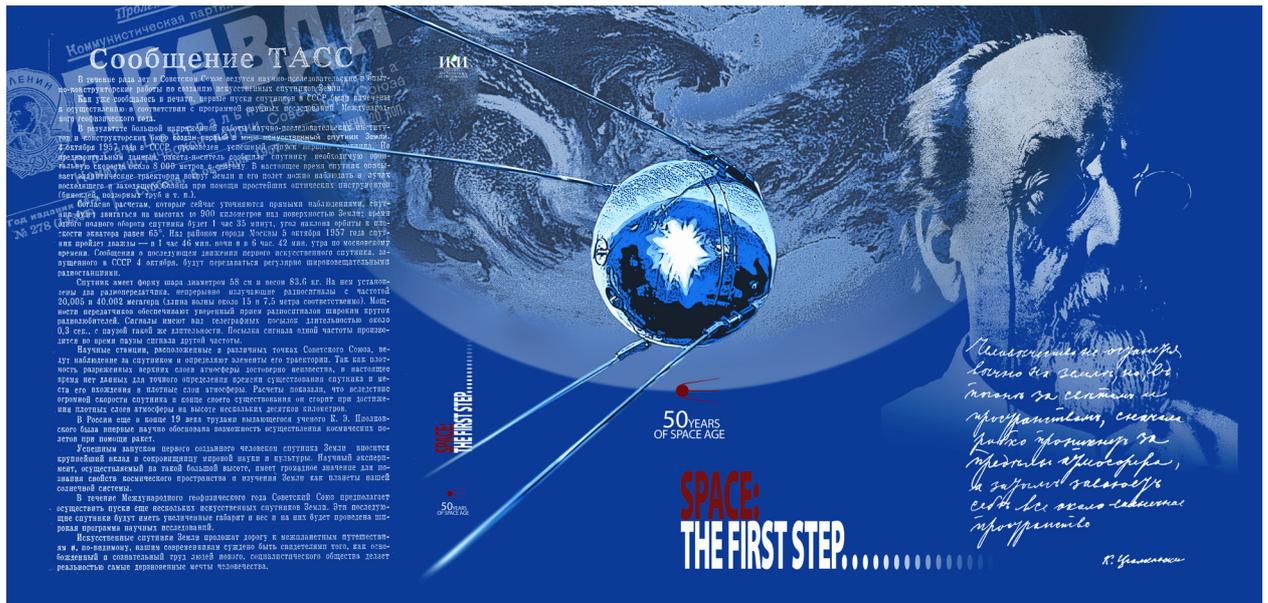


*R.Z. Sagdeev*

The exhibition «Space science — Past and Future» have been held during the Forum, presenting main results of the accomplished space missions and current projects of the Federal Space Program 2006—2015, as well as perspective plans. Participants of the exhibition were institutes of the Russian academy of Sciences, Federal Space Agency and the main institutions included in its structure: S.A. Lavochkin Science and Production Association, S.P. Korolev Rocket and Space Corporation “Energia”, the Keldysh Research Center and others as well as a number of scientific institutes of the higher educational school (the Skobeltsyn Institute of Nuclear Physics and the Shternberg Astronomical Institute of the Lomonosov Moscow State University; Institute of Cosmophysics and Institute of Astrophysics of the Moscow Engineering Physics Institute, etc.); Institute of Biomedical problems of the Russian Academy of Sciences.



In commemoration of the First Sputnik launch Space Research Institute of the Russian Academy of Sciences had published a book “Space: the First Step», collecting works of about 50 prominent scientists, engineers, cosmonauts, writers, public figures of the different countries having connected their life and work with space. The articles are memoirs, impressions, reflections on the role of the First Sputnik, place of space research in the modern world and the influence that this event have had on their personal life and the destiny of mankind. The book gives many-sided representation of the way the world and our ideas of it has changed in the first 50 years of a space age.



Currently the book of proceedings of the international Forum “Space Research: Sight in the past. Sight in the future” is being published.

**2.** The present report contains the results of fundamental space research obtained by Russian scientists in 2006–2008 and also outlines the plans of forthcoming launches of scientific spacecraft developed according to the Federal Space Program for years 2006—2015 approved by the Government of Russia. The report is prepared under the direction of the Council on the Space Affairs of the Russian Academy of Sciences. It is based on the documents supplied by scientific research institutes of RAS and higher educational institutions responsible for research and experiments carried out in accordance with the Federal Space Program of Russia.

The report represents the results of thematic processing of scientific information (space related data) gathered by Russian scientific equipment on Russian and foreign spacecraft (S/C) during the accomplishment of research and observational flight programs.

Two Russian orbital spacecraft carrying scientific equipment as incidental payload were launched in June 2006. Russian-Italian cosmic ray apparatus RIM-PAMELA devoted to the study of nature of the dark matter and scientific apparatus

ARINA for the study of high-energy charged particle bursts for earthquake forecasts have been installed on *Resurs-DK* spacecraft (launched on the 15th of June 2006). *Konus-A* instrument dedicated to the detailed study of gamma-ray bursts, jointly with American spacecraft *Wind*, as a follow-up of Russian-American experiment “Vsplesk” (*Burst*) have been installed on the second orbital s/c (launched on the 25th of June 2006). The element abundances maps of the Martian surface used for searches of regions with enhanced concentration of subsurface liquid water and water-ice have been produced using the results of Russian experiment HEND (gamma- and neutron emission studies in the framework of MSP-2001 project) onboard NASA spacecraft *Mars-Odyssey* launched on the 7<sup>th</sup> of April 2001. Valuable information regarding the Martian surface mineral composition and atmosphere composition as well as the results of the Venusian atmosphere and plasma environment study were obtained in the framework of ESA’s projects *Mars Express* (launched by Russian rocket on the 2<sup>nd</sup> of June 2003) and *Venus Express* (launched on the 9<sup>th</sup> of November 2005 by Russian rocket).

Presented are the results of the comprehensive studies of the physics of the Sun and Sun-Earth connections carried out with the use of Russian-Ukrainian orbital s/c *Koronas-F* (operational lifetime from the 31<sup>st</sup> of July, 2001 till the 6<sup>th</sup> of December, 2005) and proprietary results in high-energy astrophysics, obtained by Russian scientists within the framework of observational flight program of ESA observatory INTEGRAL. Original results of comprehensive data analysis of cosmic plasma, energetic particles, Sun and Sun-Earth connection, which was gathered earlier by *Interball*, *Cluster*, *Wind*, SOHO and other foreign missions.

The results of the priority research of the functional state of the various human and animal systems being subject to spaceflight conditions, which represents one of the main problems of space biology and medicine have been obtained by Russian scientists. The importance of the study is implied by the urgency in the development of the scientific basis for future long-term manned missions. Four biomedical experiments in the field of space medicine and physiology have been accomplished in the years 2006—2007 in the framework of Long-term Program of Applied Research on the Russian Segment of International Space Station.

Presented in the report are the scientific goals and characteristics of scientific equipment associated to space projects of the Federal Space Program of Russia, which are in the final stage of preparation for launch in 2008–2012. Among them, in the first place, *Koronas-Foton* project for physics of the Sun and Sun-Earth connections study. The main goals of the project are: study of the energy accumulation and its transformation into the energy of accelerated particles during solar flares, studies of acceleration mechanisms of energetic particles, their propagation and interaction in the solar atmosphere, correlation studies between solar activity and physical and chemical processes in the Earth’s upper atmosphere. *Phobos-Grunt* project is aimed at the Phobos — the Martian satellite — sample return as well as at the study of Martian system, including Mars, its satellites and near-Mars environment. The accomplishment of this project will be an important step in the investigation of the Solar and Mars systems origin and evolution. Aside of scientific goals of the project, the realization of this mission is an important part

in the preparation for the series of future missions for Martian soil sample return and manned expedition to Mars. Space project RESONANCE is devoted to the study of wave-particle interaction and plasma dynamics in the Earth inner magnetosphere and the auroral region. Two pairs of satellite will be inserted into the magneto-synchronous orbits. Such orbits allow one to carry out extended measurements in a particular flux tube — that last up to 40 minutes in the tube, anchored in the ionosphere over the heating facility. One satellite is to be located in the North, the other one in the South hemisphere.

Also in the report presented are the results of a number of other research as well as characteristics of scientific equipment aimed at studies of and experiments on astrophysics, Moon and Solar system planets studies, Sun-Earth connections and cosmic ray physics utilizing Russian and foreign automated s/c and ISS.

# RAS Space Council

The Space Council of the Russian Academy of Sciences (RAS) was established in February 1992 in order to coordinate the activity of Russian scientific institutes and organizations in the field of fundamental space research (FSR).

The Council consists of prominent scientists and experts in the field of FSR, responsible representatives of RAS institutes, higher educational institutions, Roscosmos, Roshydromet and other interested organizations of Russia.

The main goals of the Space Council are the following:

- to forecast the development of this field of research;
- to form together with the Federal Space Agency (Roscosmos), of the project and plans of the Russian Federal Space Programme realization;
- to perform the examination of investigation programmes and plans, scientific level and state of works;
- to estimate the efficiency of the results obtained;
- to determine scientific-technical policy, arrangement and coordination of international cooperation;
- to coordinate the activity of institutes and organizations on public informing about plans and results of the works in the field of FSR.

The RAS Space Council structure includes:

1. Section “Space Biology and Physiology”  
(chairman — academician *Grigoryev A.I.*)
2. Section “Materials Processing in Space”  
(chairman — academician *Ossipyan Yu.A.*)
3. Section “Earth Observation”  
(chairman — academician *Laverov N.P.*)
4. Section “Solar System”  
(chairman — academician *Zelenyi L.M.*)
5. Section “Extra Atmospheric Astronomy”  
(chairman — academician *Boyarchuk A.A.*)
6. Section “Space Ray Physics”  
(chairman — doctor of Physics *Panasyuk M.I.*)
7. Coordinating Committee on interactions with COSPAR and IAF  
(“Intercosmos” Council, chairman — academician *Boyarchuk A.A.*)

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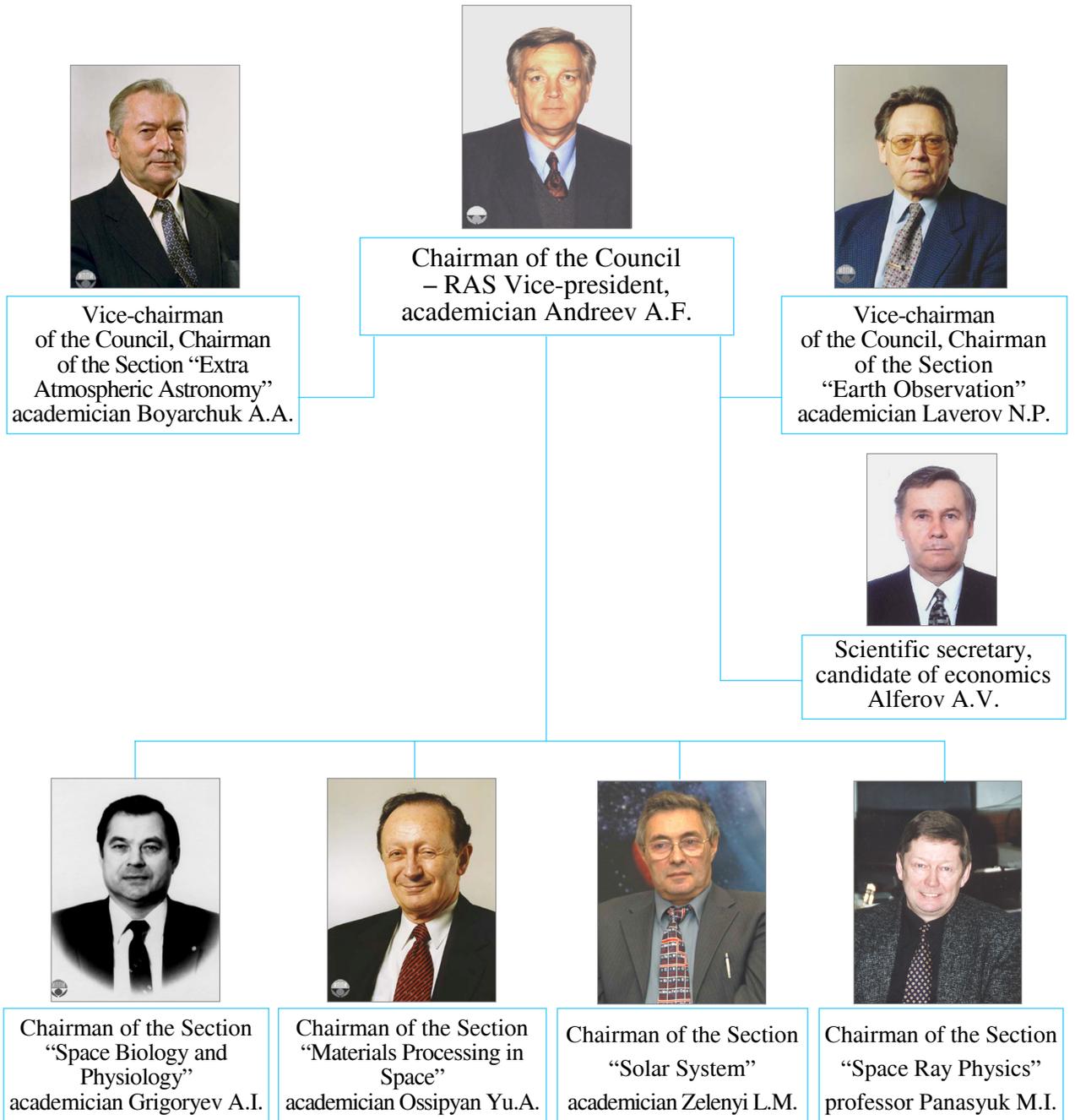
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