

Introduction

The National report presents the main results of basic space research obtained by Russian scientists in 2016-2017 years, as well as information on scientific space projects planned for the coming years, including projects developed in accordance with the new Federal space program of Russia for 2016-2025. The results of processing and interpretation of scientific data acquired with the help of Russian scientific equipment and devices installed aboard Russian and foreign spacecraft are presented.

The report was prepared under the scientific and methodological guidance of the Council of the Russian Academy of Sciences (RAS) on Space and the Russian COSPAR National Committee on the basis of the materials provided by the institutes of the RAS and educational institutes responsible for research and experiments implemented in accordance with the Federal Space Program of Russia.

In accordance with the Agreement on cooperation in the field of robotic exploration of Mars and other bodies of the Solar system by robotic means between the Federal space Agency of Russia (Roscosmos) and the European Space Agency (ESA), in March 2016 *ExoMars-2016* mission was launched from the Baikonur cosmodrome. It was the first stage of the joint Russian-European ExoMars program. Scientific payload aboard the *ExoMars-2016* TGO orbiter includes two Russian instruments. The Russian rocket "Proton" with the upper stage "Breeze-M" was used as a launcher. In October 2016 the TGO spacecraft was inserted into an elliptical orbit around Mars and in April 2018 it started its scientific programme. The second stage of the Russian-European *ExoMars* programme, the *ExoMars-2020* mission, which consists of the landing platform (Roscosmos) and the Mars rover (ESA), is currently under development.

The scientific satellite "Lomonosov" was launched in 2016 from the new Russian spaceport "Vostochny". The main goals of this mission are to study cosmic rays, the atmosphere glow, observations and registration of space debris and micrometeorites, studies of ultraviolet and gamma-ray flashes associated with thunderstorm activity in the atmosphere.

The radiotelescope interferometer *RadioAstron* aboard the *Spektr-R* spacecraft launched in 2011 continues to operate successfully on highly elliptical orbit. The scientific package "Plasma-F" aboard *Spectr-R* board registered the fast flux of energetic ions in the solar wind near the bow shock and the magnetosheath. Using

these date, it was possible to construct a Fourier spectrum of the solar wind oscillations, not only in the universal Kolmogorov region of the spectrum (such measurements were carried out earlier), but also in the high-frequency interval, where the energy dissipation of oscillations occurs.

About a hundred experiments in the field of space biology and biotechnology, physical and chemical experiments, studies of the space flight factors effects on the human body, as well as experiments in the study of the Earth and outer space are carried out aboard the Russian segment of the International Space Station.

The report presents the results obtained with the help of Russian scientific instruments within the payload aboard foreign satellites, as well aboard the Russian applied space program as additional payload. Among the latter are the NUCLON package to study of cosmic rays aboard the *Resource-P2* satellite (launched in 2014); the Russian-Italian experiment Rome-Pamela aboard *Resource-DK1* satellite.

The studies of Mars, Venus and the Moon were run with the help of scientific instruments developed in Russia and installed aboard foreign automatic interplanetary stations: *Mars-Odyssey*, LRO, *Mars Science Laboratory - Curiosity* (NASA), *Venus-Express* and *Mars-Express* (ESA). Russian scientists took part in the annual planning of observation programs and research of space gamma ray and X-ray sources of the international astrophysical observatory *Integral* within 25% quota of observational time, allocated for Russia.

Russian and German scientists prepare the orbital observatory *Spektr-RG*, which includes two instruments: the German *eRosita* and the Russian ART-XC X-ray telescopes, for studies of the Universe in the gamma ray and X-ray energy ranges.

The series of the *Spektr* observatories will be continued by the *World Space Observatory – UV*. This observatory will contain a telescope with a diameter of the main mirror of 1.7 meters.

The Russian space industry and scientists develop a program for Moon investigation. The first stage of this program includes two landers: *Luna-25*, *Luna-27* and the orbiter *Luna-26*. The count of the projects comes from the last Soviet mission *Luna-24*, which delivered lunar soil samples from the Sea of Crises in 1976.