# Monitoring of Electromagnetic and Plasma Parameters of "Space Weather" on the Russian Segment of the ISS

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The experience of scientific research conducted on Mir Space Station points to the possibility and expediency of using long-duration on-orbit complexes to study space environment factors (SEF) on a long-term basis. Among these observations are monitoring of physical parameters and processes, which have a significant impact on the environment, namely human environment.

The magnetosphere and ionosphere of the Earth are one area of this environment. The knowledge of SEF processes, which can affect a modification of the known protective properties of the magnetosphere and ionosphere, is vitally important for humans. At present the term "Space Weather", which covers the notion of the current and predicted ionosphere and magnetosphere conditions, as well as the disturbance of their parameters of a natural and antropogeneous origin, has gained a wide acceptance. A long-duration monitoring of parameters of the ionosphere and some areas of magnetosphere from the on-orbit stations can give a valuable help, first of all for users of the current ionosphere information (radio communication and navigation), as well as for investigators of the Sun/Earth communications.

To study regularities of ionospheric and magnetospheric disturbances it is required not only to make direct measurements of their parameters, such as a density of charged particles, temperature, potentials of electric fields, electric currents, electromagnetic fields, induction of the Earth magnetic field, but simultaneously indicate sources of their disturbance (Sun and space radiation, ejection from Van Allen belts, radiation generated by the Earth and related to man-caused activity). Such integrated investigations can be provided on the on-orbit stations, in choosing necessary science hardware out of the station payloads.

In this context the use of these observations from the Russian Segment (RS) of the ISS in the European and Worldwide Space Weather Network seems to be rather relevant. Currently a long-term research and applications program for the ISS RS has been generated, covering about 40 space experiments (SE) in geophysics and space physics. The science hardware being developed for the implementation of these SE to a great extent can be used in the interests of Space Weather studies. To combine efforts for production of the required data bank and coordination of current data acquisition, analysis and publication activities it is necessary to prepare the Space Weather investigation program and procedure agreed upon with the hardware developers and experiment scientists concerned. The initiative in preparing such a program can be taken by RSC

Energia jointly with the Institute of Space Research of the Russian Academy of Sciences.

At present the following areas of research are proposed to be incorporated in the Project:

- investigation of spectral densities of electrostatic plasma waves, electromagnetic radiation and electric currents in the ISS proximity (not more than 1.5 m away from the surface) in a range between 0.1 Hz and 10 MHz and indication of their generation sources;
- investigation of constant electric and magnetic fields in a range of (+/- 50 V/m); (+/- 50000 nT) and their gradients in a range of (10-1000 mV/m); (100-1000 nT/m);
- investigation of thermal ionospheric parameters (density of charged particles, temperatures, potentials) and their disturbances;
- measurement of energy and spectral characteristics of thermal electrons and superthermal electrons up to 10 KeV;
- measurement of spatial, time and energy characteristics of proton and electron bursts in a range of 3-30 MeV and 30-100 MeV with an angular resolution of no less than several degrees;
- measurement of spectral radiation composition of the whole solar disk and absolute solar radiation flux in the field of low-energy X-rays and high-energy UV radiation of 0.14-157 nm;
- study of high-energy neutron fluxes with energies up to 10 MeV generated by solar flares with regard to albedo radiation and hard ionizing radiation in a spectral range between 30 KeV and 10 MeV;
- investigation of the ionospheric parameter measurements exposed to artificial plasma fluxes and electroionic particle fluxes;
- investigation of fluctuations of the magnetic and electric fields of the Earth by using time-of-flight measurements of movement of artificial ion and electron fluxes along Larmor orbits in the magnetic field of the Earth.

It is assumed that the investigations will be conducted by using the following science hardware:

- plasma-wave complex as part of combined wave probes, Langmuir probes and potentiometric transducers, three-component flux-gate magnetometers, correlation electron spectrograph, magnetic and electrical antennas with a radio-frequency analyzer and low-frequency radiation analyzer;
- special-purpose spectrometer – telescope;
- UV spectrometer and ionizing radiation radiometer;
- helium isotope-based proportional counters and stilbene-based scintillation sensors;
- pulse plasma injector;
- pulse electron and ion sources based on a neutron generator.

The content of the science hardware being used can be extended as it is put into operation on the ISS RS.

Major objectives of the project:

- selection of time periods and performance of measurements by using the entire set of hardware within single time intervals;

- analysis and generalization of the experimental data with regard to heliophysical environment during measurement sessions;

- database generation and maintenance;

- determination of sources of ionospheric sources;

- search for regularities of disturbances of the ionosphere and magnetosphere parameters;

- clarification of models of basic physical processes in the ionosphere and magnetosphere;

- data bank generation and publication for the Space Weather European Information Network.

It is assumed that the project implementation can be started since 2005 and will last no less than 5 years.