using optical electronics is possible, but creation of a database (similar to that existing for the large space objects) suitable for accurate prediction of their motion, is considered to be unrealistic. These data can be used only for statistical models, which describe the motion of a group of bodies as a Poisson's random process, and give results, which are too rough to be used for estimation of the hazard of collision of individual objects.

Analysis of models leads to the conclusion that the strict deterministic models cannot be supported by the input experimental data, but on the other hand the available statistical data do not provide acceptable estimates of the risk of approach. In addition to these two classical models of motion of the orbital objects, there are the so-called «semi-deterministic» models, which allow obtaining the same parameters as those derived from the deterministic models. The distribution of the minimal distances between the approaching objects is one of such parameters. This characteristic is regarded to be the main index of space debris population. Obviously, if a means were provided for measuring this index, the hazard of collisions between space debris and operating satellites could be predicted more precisely.

The main goal of the experiment is to develop a technique for experimental research of orbital object characteristics, which evaluates the risk of operating spacecraft being damaged by space debris. An important feature of the experiment is to obtain not only the spatial distribution of the objects around a spacecraft orbit but also the distribution of minimal distances to these objects during their approach to the ISS.

Small space objects move in clusters formed by explosions and destruction. Ground tracking station control gives evidence that some orbital parameters of the objects forming the cluster are highly localized. These data are related to the catalogued objects (> 10 cm), but the degree of localization of small-sized (several centimeters in size) objects can be also assessed, when the available models of explosion and destruction, as well as of evaluation of debris orbits are applied. Our approach is based on a priori data on localization of orbital characteristics of space objects. Knowing the region of space debris parameter localization, it is possible to determine a set of angles of approach of the objects to the spacecraft and their relative velocities. The relative velocities obtained permit the distance to the objects to be estimated using just the results of positional measurements.

The experimental complex will consist of a wide-angle optical system (telescope) equipped with a CCD camera to detect object images and with instruments to process the coordinate measurement results. The control system software will provide orientation of this system, taking into account the dependence of the direction of an object approach on time.

The proposed experimental complex will enable all the dangerous objects in the vicinity of a 5-km zone of the ISS to be recorded.

«Lightning» Experiment

DIAGNOSTICS OF ACTIVE EXPERIMENT DISTURBANCES IN THE NEAR-EARTH SPACE

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At present active experiments which affect the space environment through powerful radio emissions, charge carrier injection, chemical agent ejection and some side effects accompanying launches and flights of the space rockets, industrial explosions, on-board technological operations are the main methods for studying the physical processes in near-Earth space. These methods allow simulation and triggering of the natural phenomena, which occur during various geophysical disturbances and plasma diagnostics.

The goal of the experiment is to develop on-board active experiment procedures and carry out monitoring of the disturbances initiated by these experiments. It will allow simulation and study of mechanisms of their formation and evolution.

This research will be based on the following idea. A powerful artificial local influence on the near-Earth space can lead to release of energy present in the radiation belts, as well as to large-scale and global disturbances in the ionosphere and magnetosphere. The disturbance velocity can be up to 100 km/s.

Complete diagnostics of artificial disturbances in the near-Earth space will be performed using different remote sensing instrumentation, namely the partial reflection complex with the antenna of 300 by 300 m, the unit of active Doppler monitoring in the range of 1.5-30 MHz, systems for passive Doppler monitoring in the range from 30 kHz to 30 MHz, radio receiver devices of the «Transit» and «Czikada» systems for receiving signals of the navigation satellites, ionosphere stations, magnetometers. They allow diagnostics of the disturbances in the altitude range from 60 to 1000 km.

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«Control» Experiment

GENERATION OF ARTIFICIAL PLASMA FORMATIONS IN SPACE AND MONITORING OF THEIR LOCAL PARAMETERS

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Creation of artificial plasma formations in near space and modification of their parameters, as well as parameters of the ionosphere are important both for better understanding of the electrodynamic properties of the near space and for many practical purposes, such as communications, energy transmission from one space object to another, etc. The process of plasma generation in space is limited because of power-intensity, overall dimensions and weight of a plasma source.

Within the framework of this experiment, new mechanisms and techniques are proposed for plasma generation and parameter control of both the artificial plasma formations and the ionosphere. Use of on-board helicon plasma sources is proposed for producing plasma formations with densities of up to 10^{12} cm^{-3} and electron temperature of 3-5 eV in the continuous-wave and pulsed modes. Experiments completed in the US have demonstrated that such a source with the diameter of about 15-20 cm and length of 20-30 cm requires the magnetic field of about 50 oersted and HF-generator of about 1 kW power at the frequency of 13.56 GHz. Due to the fact that the velocity of the plasma flow for such a helicon generator is equal to 10^6 cm/s, it is impossible to study the temporal evolution of the plasma clots inside a limited volume of a laboratory facility.

In previous experiments modification of parameters of plasma formations in the near space was generated by explosions of atomic devices («Argus» program) or by the charge-particle beam injections («Araks», «Zarnitsa» projects), or by the action of powerful fluxes of electromagnetic radiation directed from the ground-based sources. In the latter case the elementary mechanisms of heating of charged particles are the pair collisions of plasma particles. This is a rather slow process. It is also accompanied by excitation of a wide spectrum of turbulent plasma pulsations, as well as by small changes of plasma temperature.

We propose using the process of local stochastic motion instability of the charged particles in the field of a few electromagnetic waves for plasma heating. According to analytical estimation and numerical simulation, the evolution of such an instability results in faster plasma heating (about 100 periods