nisms 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 of electromagnetic waves). In addition, heating up to much higher temperatures is achieved (mean electron energy is over 1 MeV) and plasma turbulent pulsations are smaller, than those in the cases of other types of heating.

It is known that explosion of an atomic device with the power of 1 megatons generates approximately 1026 electrons. This is consistent with transformation of 1 kg of a material into plasma. A helicon plasma source can create more than 1024 electrons during one hour. Obviously, the power distribution of these particles differs substantially from the distribution of those at an atomic explosion. However, the distribution created by a helicon source can be controlled, and the generated plasma formations will remain compact over a long period of time, due to the low electron energies. With stochastic heating, the electron energy can be rapidly changed in a wide range and can be described as the distribution of particles at an atomic explosion. So, using a helicon source and stochastic heating, it is possible to simulate some processes, which are occurring at explosion of atomic devices in near space.

Other objectives of the experiment are selection of helicon plasma sources, which are the most suitable for on-board operations, and of HF-generators intended for heating the plasma and for deriving the desired function of its particle distribution. A series of laboratory experiments and theoretical modeling of the space plasma parameters will be completed too.

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