IONIZATION OF AIR BY A PLASMA JET THERMAL RADIATION IN THE ACTIVE GEOPHYSICAL ROCKET EXPERIMENTS "FLUXUS" [[1]](#footnote-1)\*)

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Active geophysical rocket experiments “FLAXUS” were conducted with the injection of the high-speed aluminum plasma jet (V ~ 40 km / s, E ~ 3 MJ) into the ionosphere at an altitude of 140 km. Injection was evaluated along and across the geomagnetic field as well. The attempts to numerical simulation have been resulted mainly in qualitative agreement with the observational data on the geomagnetic field perturbations at the last stage of the plasma jet expansion (at large times after the end of injection). Extreme initial plasma parameters require self-consistent consideration of radiation gas dynamical processes and nonequilibrium plasma kinetics at the onset of an injection.

A hypothesis for the excess ionization and excitation of the ionosphere under the influence of thermal radiation from an aluminum jet is proposed in current work. The time dependence of the parameters of the ionizing source was calculated using numerical simulation of the initial stage of plasma jet dynamics under the radiation gas dynamical model [1]. The excitation and ionization of the ionosphere by the thermal radiation was estimated by means of a 4-component plasmochemical model for O+, O2+, N2+ and NO+ ions [2]. The background parameters were calculated using the MSIS90 and IRI2016 models for the “FLUXUS” experiment (February 15, 1999, 5:20 local time, 140 km altitude). The main physical processes were as follows: the heating of electrons by thermal radiation, energy losses in elastic collisions with positive ions, in elastic and inelastic collisions with atoms and molecules of ambient air, in rotational and vibrational excitation of oxygen and nitrogen molecules. Analytical approximations for all considered processes of energy losses were used [3]. The calculations show that the thermal radiation from aluminum plasma at the initial stage of its dynamics creates an ionization precursor with a tens of times higher electron temperature and a concentration four orders of magnitude higher than the background one.

References

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