Numerical researches of large-scale plasma currents in the top ionosphere and magnetosphere

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For an explanation of results and forecasting of experiments in the top ionosphere and magnetosphere with use of plasma jets and powerful explosions physical models and three-dimensional numerical algorithm on basis of MHD approximation are developed. In the algorithm a new updating of a grid-characteristic method of 2-3 order of approximation with splitting on spatial variable and physical processes is developed. One-speed approximation with plasma and air components and with the account of diffusion of a geomagnetic field in the ionized indignant environment is used.

Calculations of the plasma currents formed by powerful explosions in an ionosphere and magnetosphere $E \sim 10^{19} - 10^{23}$ erg, carried out on various latitudes φ in a range of heights of 100–1000 km are executed. It is shown, that character of development of plasma current for $t \geq 0,3 - 0,5$ s depends much on all three parameters, for smaller time – is determined mainly by initial specific energy E/M. At explosions in a range of heights of 100–120 km there is a basic change in character of current of plasma: initial rigid radiation starts to leave plasma area up to the big distance, the scale of the thermal area starts to exceed the height of a homogeneous atmosphere and vertical movement is not formed inside it, because of quite high density of air the current is two-dimensional long time (up to time about 60 s) and magnetoacoustic wave extending in the top hemisphere, is weak. For heights more than 150 km and average energies the current becomes three-dimensional for time more than 1 second that is connected with presence of the certain angle between a gradient of density and power lines of a geomagnetic field. Initial scattering of plasma for the period of $t \geq 5 - 10$ seconds passes in an ascending jet with the certain inclination and with distribution of weight in a plane of a magnetic meridian. In process of braking plasma the wave which during the order of 20 seconds reaches subpolar areas comes off its front magnetoacoustic. For magnetosphere explosion with $E \geq 10^{23}$ erg break through magnetosphere and a leaving of a part of plasma on tens thousand kilometers is observed.

It is shown, that at expansion of plasma in near-equatorial areas development of flutter instability and formation of jet current is possible. The detailed theoretical analysis of the obtained numerical results is executed and the good consent with experiment "Starfisch" is observed.