Simultaneous investigation of magnetosphere plasma and spacecraft charging

L.S. Novikov, K.K. Krupnikov, A.A. Makletsov, B.V. Mar'in, V.N. Mileev, M.O. Ryazantseva, V.V. Sinolits, N.A. Vlasova

Skobeltsyn Institute of Nuclear Physics Moscow State University (novikov@sinp.msu.ru / +7 495 939 0896)

Electron and proton energy spectra in the range of 0.1 - 12 keV in geosynchronous orbit (GEO) done on "Gorizont" and "Electro" spacecraft, and in the low-Earth polar one done on "Meteor" spacecraft were measured with electrostatic spectrometers. Data on diurnal variations of magnetosphere plasma fluxes in GEO and data on auroral electron fluxes was obtained for various levels of geomagnetic activity. For grate amount of the experimental data, the plasma parameters were calculated using approximations of one- and two- temperature Maxwell functions. Variations of the registered electrons and protons energy spectra determined by geomagnetic activity and spacecraft charging were studied.

Typical variations of energy spectra detected during the spacecraft charging events enable to estimate the spacecraft electrostatic potential. The significant growth of the negative potential (up to 5 - 7 kV) arising when the spacecraft passes through the Earth's shadow in GEO on vernal and autumnal equinoxes was registered. At high level of the geomagnetic activity, the spacecraft charging up to 1.5-2 kV was observed in sunlit segments of the spacecraft orbit.

Potentials up to 0.5 - 1.5 kV were detected in the low-Earth polar orbit when the spacecraft crossed the auroral oval.

For the both cases above, typical threshold values of the plasma temperature and electron flux corresponding to the beginning of the spacecraft charging were determined. The classification of the electron energy spectra types according to the spacecraft charging levels is presented.

The results obtained may be used for development of the magnetosphere plasma model in GEO and improvement of physical and mathematical models of the spacecraft charging in GEO and in the low-Earth polar orbits.