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Space Weather Prediction and Protection of Space Missions from Its Effects (3)

Author: Dr. Ekaterina Tverdokhlebova
Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,
katya.tverdokhlebova@gmail.com

Mr. Anatolyi Korsun
TSNIIMASH, Russian Federation, korsun_ag@mail.ru
Dr. Evgeny Morozov
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation,
katya.tverdokhlebova@gmail.com
Dr. Valery Garkusha
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation,
vigarkusha@gmail.com
Dr. Georgy Karabadzhak
TSNIIMASH, Russian Federation, gfk@tsniimash.ru
Dr. Anatoly Golovko
Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,
anatoly.golovko@mail.ru
Mr. Flur Gabdullin
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation,
flur.gabdullin@gmail.com

SAFETY AND EFFICIENCY OF SPACECRAFT ACTIVITIES IN PLASMA ENVIRONMENT

Abstract

At orbit flight automatic or manned spacecrafts (SC) are exposed to both natural space factors and an artificial environment. The natural space factors are the following: ionospheric plasma, the Earth's magnetic field, the solar radiation, and the ionizing fluxes. The artificial environment contains dust, gas, and plasma flows. The combined action of all above factors increases with the prolongation of spacecraft active life. The importance of one or another factor and its hazard depend on a spacecraft mission, orbit parameters, peculiarities of spacecraft structure and onboard system operation. There are the disturbing and damaging effects of the spacecraft environment, i.e. they have the reversible or irreversible consequences. Therefore the estimation of SC environment effects on the onboard systems and structure elements is the required design phase to ensure the safety and efficiency of SC activity. Due to operation activities of onboard plasma devices an additional, so called "technogenic" environment is arisen around the spacecraft –its own atmosphere (SCOA). The values and composition of SCOA parameters are time variable and 3D-heterogeneous. Their distributions depends on several factors: primary gas-plasma flows like coatings outgassing, jets of liquid and plasma propulsions, releases of drainage system, etc., peculiarities of onboard system design, for example, power supply, space fluxes. The predictions of SCOA effects on spacecraft operation are to be based on the correct mathematical models of every physical process and its integration with respect to concrete conditions and specific purpose. The examples of spacecraft / plasma environment interaction are given in the paper with regard to different SC missions, from the International space station up to a geostationary automatic satellite. A comparison of the calculated results with the experimental data is presented. Techniques and devices are proposed to ensure the safety

and efficiency of the SC activity under the influence of the plasma environment and electrophysical factors of space.