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Radiation Fields, Effects and Risks in Human Space Missions (5)

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IMPROVING TRAPPED PROTON MODEL ON THE LOW-EARTH ORBIT WITH CCSRM CUBESATS MEASUREMENTS

Abstract

This project focuses on precise and systematic studies of trapped proton radiation on the low-Earth orbit. Space radiation is one of the main concerns for space flights. On the low-Earth orbit radiation environment is formed with trapped protons, trapped electrons and the galactic cosmic rays. From the perspective of small satellites, the most significant radiation risks is associated with trapped proton radiation. Fluxes of trapped electrons are the most intense, but trapped electrons can be stopped with a relatively thin shielding. The galactic cosmic rays have the highest penetration ability, but their fluxes are very low. The most damage for electronics from galactic cosmic rays is associated with the radiation induced in shielding thus it is more critical for heavy shielded spacecrafts. At the ISS-like orbit current models do not predict proton fluxes with a good angular, time and spatial resolution and do not describe short time fluctuations. Data collected in this mission will be used to improve model description of proton fluxes on the low-Earth orbit. This paper focuses on scientific goals of the Cubesats Constellation for Space Radiation Measurements (CCSRM) mission currently being designed in Skolkovo Institute of Science and Technology. The constellation consists of 12U cubesats will be placed on a 500 km altitude orbit. Each satellite will be equipped with a proton spectrometer, which measures proton flux spectrum in the energy range from 1 MeV to 250 MeV, covering all directions with a 20 degree resolution. Additional silicon detector measure the net deposited dose inside the spacecraft to estimate risk for electronics and shielding efficiency. We present calculation results of the instrument response function of the proton spectrometer done with GEANT4 Monte-Carlo code. We calculated average dose rates inside the cubesat and optimised the design to elongate mission life time. Also, we tested an approach of using expected datasets for improving model description of proton fluxes on the low-Earth orbit.