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THE RADIATION ENVIRONMENT AND EFFECTS ANALYSIS OF THE LUMIO MISSION.

Abstract

The Lunar Meteoroid Impact Observer (LUMIO) is a mission designed to observe, quantify, and characterize the impacts of meteoroids by detecting their flashes on the far side of the moon. These Lunar-based observations offer the opportunity to perform longer data taking compared to Earth-based ones thanks to the fact that they are not limited by illumination, weather and geometry conditions. LUMIO is a 12U CubeSat, with a mass of less than 22 kg, which will be placed on a halo orbit about the Earth–Moon L2 point, where permanent full-disk observation of the Lunar far side can be performed in absence of background noise due to the Earth. Besides the principal instrument of the mission, the LUMIO-Cam, an optical instrument capable of capturing the light flashes in the visible spectrum, which is custom-designed, all other subsystems (e.g. On-board Computer, Propulsion System, Communications, Attitude Determination and Control System, Electrical Power System etc.) are heavily relying on COTS parts. Radiation effects represent in general one of the biggest challenges of a Low Earth Orbit small satellite mission and in the case of a lunar mission such as LUMIO, it becomes of paramount importance to analyse the harsh radiation environment this mission will face in order to design a radiation-tolerant spacecraft. In this paper we will present the extended radiation analysis performed during Phase A. Monte Carlo simulations based on GEANT4 were performed including a realistic 3D satellite geometry model and trapped particles, solar particles and cosmic rays fluxes as predicted by available models in SPENVIS for the selected orbit. The analysis included Total Ionising Dose and Single Event Effects predictions for the most critical electronic components. Recommendations for the LUMIO system design were drawn and used as input for the Phase A spacecraft and mission optimisation.