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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. The mission has successfully completed Phase-A. LUMIO is a 12U CubeSat, with a mass of less 24 kg, which will be released into Lunar orbit by a mothership and using its propulsion system will be able to reach its operative orbit, a halo orbit about the Earth–Moon L2, 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. A careful evaluation of the risk associated with the use of COTS in the harsh radiation environment encountered in interplanetary orbit is of critical importance for the LUMIO mission in order to meet the ambitious scientific goals. In this paper we will present the extended radiation analysis performed during Phase A. Monte Carlo simulations based on GEANT4 were performed using state-of-the-art environment models for solar particles and cosmic rays fluxes available 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 will be used as input for the Phase B of the mission.