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MODELLING THE IRRADIATION EXPERIMENTS OF MICROBIC FILMS WITHIN THE BOREALIS PAYLOAD

Abstract

BOREALIS (Biofilm Onboard Radiation Exposure Assessment Lab In Space) is one of the missions within the Italian Space Agency's ALCOR space program, based on using CubeSats nanosatellites. The mission objective is to investigate the combined effect of microgravity, ionizing radiation, and anti-radiation drugs on film of microbic populations at different orbital altitudes. The project foresees that, after a first set of experiments in a 700 km altitude orbit, BOREALIS will be transferred with a low-thrust manoeuvre to an altitude of 2000 km for a second set of experiments. According to the method developed for the ABCS mission [1], using SPENVIS [2] and IRENE [3] codes, we have defined the contribution of Trapped Particles (TP), Galactic Cosmic Rays (GCR) and Solar Energetic Particles (SEP) sources for both the parking and transfer orbits. The orbital sources have been used to simulate a preliminary conceptual FLUKA [4] model of the BOREALIS payload with zones with different shielding degrees hosting two sets of similar microbial film plates. The simulations constitute a first attempt to compare the dose delivered on the ideal CdTe and Si detector outside and inside the payload model with the dose and dose equivalent delivered to the biomaterials in the plates. As expected, the simulated TP contribution dominates the estimate of both physical and equivalent doses delivered to biofilms. The simulated responses of the detector are coherent with this figure. Biasing techniques also permitted a meaningful convergence in the case of the minor GCR and SEP contributions to dose. The adopted shielding solution differentiates the 20-40 percent the dose uptake between films in homologous irradiation

positions. Discussing the complete set of preliminary results allows for consideration of where the future works will be assessed to increase the simulation accuracy by comparing the predictions with desirable future BOREALIS experimental outcomes.

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