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Author: Ms. Federica Zaccardi
Sapienza University of Rome, Italy

Dr. Susanna Laurenzi
Sapienza University of Rome, Italy
Prof. M. Gabriella Santonicola
Sapienza University of Rome, Italy

SHIELDING EVALUATION OF POLYETHYLENE/REGOLITH COMPOSITES IN THE MARTIAN RADIATION ENVIRONMENT

Abstract

The environment on the Martian surface is characterized by a complex radiation field that poses serious risks for the astronauts' health. Secondary radiation, mainly composed of neutrons and heavy ions, is produced in the interaction of primary Galactic Cosmic Rays (GCR) and Solar Particle Events (SPE) particles with the Martian atmosphere and regolith. Previous works have mainly focused on radiation analysis outside the Earth magnetosphere, evaluating the shielding capabilities of materials for deep space missions. However, the exploration of Mars requires the estimation of astronauts' exposure risks and the validation of radiation protection methodologies in more realistic radiation scenarios. Further, it is recognized the importance of In-Situ Resource Utilization (ISRU) approaches, which refers to the use and processing of indigenous materials (i.e. regolith), thus reducing the logistic issues related to long-term manned missions. In this work we numerically investigated the radiation shielding effectiveness of polyethylene (PE) loaded with different weight percentages (wt%) of Martian regolith (RG) to combine the high radiation shielding capabilities of the PE matrix with the ISRU concept. The On-Line Tool for the Assessment of Radiation in Space (OLTARIS) software developed by NASA was used to evaluate the radiation shielding properties of PE, RG, PE/RG composites and aluminum (Al) in the Martian radiation environment. Reduction of Dose and of Dose equivalent behind different thicknesses of the shielding materials is evaluated in the GCR and SPE radiation fields at the Martian surface. Results show that PE/RG composites have shielding properties comparable to those of neat polyethylene and offer a significantly higher protection than aluminum and regolith.