LUNARAD – A Study of Radiation Shielding Technologies in Cis-lunar Space

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LunaRad is a collaborative project between the California Polytechnic State University's CubeSat Laboratory (CPCL), Kyushu Institute of Technology in Japan, and Nanyang Technological University in Singapore. The concept was proposed to the NASA CubeSat Launch Initiative for a launch onboard Artemis 2. The LunaRad project's primary mission targets the study of four types of radiation shielding technologies in cis-lunar space. The first shielding is aluminum, the most common material used for spacecraft structures. The other three shielding materials considered are used in astronaut suits and include ortho fabric (polybenzimidazole-based material), urethane coated nylon, and neoprene coated nylon. The shielding capabilities will be evaluated based on total ionization dose (TID) measurements using MOSFET sensors. To complement TID measurements, the analysis of linear energy transfer of protons and heavy ions will be carried out. In addition to its primary mission, LunaRad will carry three secondary payloads: a chip scale atomic clock (CSAC), a camera, and an in-house developed radio for deep space communication. The CSAC payload is included to partially demonstrate navigation capabilities in cis-lunar space, the camera payload is included as a critical part of the outreach efforts undertaken by CPCL, and the in-house developed radio for deep space communication is included as part of CPCL efforts to develop a low cost radio with minimal mass, volume, and power requirements as a complement to the IRIS radio developed by NASA's Jet Propulsion Laboratory. In addition, the LunaRad project aims at creating hands-on, project-based learning opportunities and STEM awareness for more than fifty undergraduate and graduate students, who will be involved in the full LunaRad project life cycle. In particular, CPCL will engage the students in the design, manufacturing, test, integration, and operations of the CubeSat bus and payloads. The CPCL students have rich expertise across industrial manufacturing, mechanical, computer science, electrical, and aerospace engineering disciplines. In the presentation, the mission and CubeSat overall architecture will be discussed along with the mission risk analysis as well as the schedule and budget estimates.

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