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Radiation Fields, Effects and Risks in Human Space Missions (5)

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CHARGE AND MARE RADIATION PROTECTIVE EQUIPMENT EVALUATIONS UPDATES

Abstract

The AstroRad, developed by StemRad and Lockheed Martin, is a wearable vest that is designed to provide radiation protection to crew during unpredictable solar particle events (SPE). SPE are especially threatening to crew beyond Low Earth Orbit (LEO). The AstroRad is being tested on two missions– The Comfort and Human factors AstroRad Radiation Garment Evaluation (CHARGE) on ISS and the Matroshka AstroRad Radiation Experiment (MARE) on the Orion Artemis I mission. The AstroRad flight hardware for CHARGE was delivered to the International Space Station (ISS) via the Cygnus NG-12 resupply mission in Nov. 2019. The ISS National Laboratory aids ISS integration for CHARGE. During CHARGE, multiple crew members will wear a single, adjustable AstroRad on ISS for variable durations while doing nominal tasks. Ease of donning/doffing the equipment, ergonomics, range of motion, comfort and general user experience will all be assessed. Stowage options for the vest when not in use and during launch will also be explored. AstroRad uses passive shielding in an efficient manner by maximizing the solid angle of coverage and optimizes protection factors for specific radiosensitive organs, tissues and stem cell concentrations with a proprietary selective shielding strategy. This feature has the potential of reducing the probability of radiation exposure induced death in spacecraft as well as diminishing long-term, adverse health effects and for the Orion Spacecraft, provides an additional layer of protection for the crew, beyond the protections that are designed into the vehicle. Selective tissue protection is achieved through variable thickness shielding, augmenting self-shielding of human body. On the Orion Artemis I flight, the MARE payload, a trinational collaboration between NASA, the Israel Space Agency (ISA) and the German Aerospace Center (DLR), will take radiation measurements during the approximately 1-month flight in lunar orbit. MARE will characterize the radiation environment beyond LEO in the Orion module. MARE will also quantify AstroRad protection factors for both Galactic Cosmic Radiation (GCR) and Van Allen Belt transit – serving as an analog for an intense SPE. Since crew radiation exposure should be As Low As Reasonably Achievable (ALARA) – a guiding principle in radiation protection, the AstroRad must provide crew protection and not impede crew activities. Preliminary CHARGE results and MARE design/integration updates will be presented at IAC 2020. AstroRad designers will apply both CHARGE and MARE feedback to improve ergonomics, function, and radiation protection factors for future exploration missions. Data from both experiments will aid in defining operational use-cases.