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

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COMFORT AND HUMAN FACTORS ASTRO RAD RADIATION GARMENT EVALUATION
(CHARGE) ON THE ISS

Abstract

The AstroRad flight hardware for the Comfort and Human factors AstroRad Radiation Garment Evaluation (CHARGE) was delivered to the International Space Station (ISS) via the Cygnus NG-12 began testing on the ISS in November 2020. This abstract will discuss the preliminary results from CHARGE, including modifications to improve comfort and usability of the vest for use in the deep space environment. This abstract will provide a status on the Matroshka AstroRad Radiation Experiment (MARE) on the Artemis I mission. MARE is currently going through the payload integration process to prepare for the Artemis I launch scheduled for this year.

The AstroRad is personal protective equipment for astronauts, designed to mitigate the radiation threats which astronauts are exposed to in deep space missions to the Moon and Mars where unpredictable Solar Particle Events (SPE) could potentially deliver high radiation doses in just a few hours and potentially lead to acute effects and increased radiation-induced cancer probability (i.e., stochastic effects). The AstroRad is designed to reduce the probability of Radiation Exposure as well as diminishing long-term, adverse health effects. It was developed as part of a collaboration between StemRad and Lockheed Martin and provides selective shielding protection to radiation sensitive organs, tissues and stem cell concentrations. Selective shielding is achieved through variable thickness shielding which three-dimensionally complements the body's self-shielding.

The Comfort and Human factors AstroRad Radiation Garment Evaluation (CHARGE) ensures that this personal protective equipment will be reasonable to deploy for operations. Four crew members total were planned to perform the evaluations. Test subjects could be male or female. A smaller vest size was developed so the study could include a broad range of female test subjects. The astronauts wore the AstroRad vest in microgravity for variable durations during nominal ISS activities such as maintenance, sleep, meals, packing/unpacking and exercise. They assessed ergonomics, range of motion, comfort and general user experience. Surveys were used to record crew feedback which served as the primary data source. Video footage recorded during assessments also served as a quantified data source depicting range of motion angles. This experiment was facilitated by the ISS National Laboratory.

The CHARGE experiment complements the Matroshka AstroRad Radiation Experiment (MARE) on the Artemis-1 mission, which will characterize the radiation environment beyond low Earth orbit in the Orion module. The AstroRad RD team will apply the data and feedback from both experiments to define operational use-cases and improve garment ergonomics and function, which will optimize the AstroRad. This will allow the AstroRad to become a key enabler of future deep space exploration missions by improving the safety of astronauts.