MATROSHKA ASTRORAD RADIATION EXPERIMENT (MARE) ON THE ORION EM-1 FLIGHT: HOW TO TACKLE THE HAZARD OF RADIATION FOR EXPLORATION MISSIONS

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NASA's Human Research Program has organized and summarized five classifications of hazards for long duration human exploration missions beyond Low Earth Orbit (LEO). These five hazards are 1) radiation, 2) isolation, 3) distance, 4) gravity fields and 5) the hostile/close environment inside the spacecraft. Leaving LEO and traveling in free space will expose the astronauts to a much harsher radiation environment than currently on board the International Space Station (ISS). The relevant radiation risks for these upcoming exploration missions, to the Moon, near Earth Asteroids and in the end to Mars need to be identified and dealt with to enable safe and secure human exploration. Within this context Orion, being NASA´s next generation spacecraft designed for human exploration of the solar systems will be the home of the next generation of astronauts. The upcoming Orion Exploration Mission 1 (EM-1), being an unmanned test flight scheduled for 2020 venturing beyond LEO and into cislunar space offers the unique opportunity to house a variety of secondary research payloads to tackle the problem of radiation and radiation protection. One of these payloads is the Matroshka AstroRad Radiation Experiment (MARE), a science payload proposed by the German Aerospace Center (DLR) and the Israel Space Agency (ISA) and approved by NASA and manifested for flight aboard EM-1 in 2017. MARE will consist of two anthropomorphic female phantoms (torsos), named Helga and Zohar, located inside the Orion cabin at seat positions 3 and 4. Each of the phantoms will be equipped with a variety of active and passive radiation detectors to determine the skin and organ doses during this first flight beyond LEO since almost 50 years. In addition one of the phantoms (Zohar) will be equipped with a novel radiation protection vest (AstroRad) developed in cooperation between StemRad Ltd, Israel and Lockheed Martin. An ergonomic evaluation of AstroRad is planned onboard ISS as early as 2019. With this flight configuration Helga will act as the reference phantom while the protection properties of the AstroRad vest will be tested with Zohar. MARE is designed to provide a comprehensive picture of the radiation environment beyond Earth orbit specific to the Orion vehicle and internal to human body analogs. This data set will inform about expected exposures, enable better planning by validating the operational toolsets used to predict crew radiation exposure risk on future Orion missions, and evaluate a potential countermeasure. MARE leverages the expertise and international collaboration heritage of the ISS Matroshka experiments, and expands it further by adding the mitigation component of the AstroRad shield. MARE represents a demonstration of science research opportunities aboard NASA's next generation space exploration vehicle. The presentation will provide an overview of the current status of the experiment hardware design, presenting the first data on the special developed new active radiation detectors included in MARE and provide insights in the international team working together to ensure safe human travels for exploration missions.