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

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WEARABLE, LIGHTWEIGHT AND FLEXIBLE IONIZING RADIATION DOSIMETERS FOR REAL-TIME CREW PERSONAL MONITORING

Abstract

The knowledge of the radiation dose received by crew members is essential to plan long missions (Mars) and long-term stays in space stations (ISS, Lunar Gateway, Mars) and to reduce the biological risks due to excessive radiation exposure. The IRIS project "large area, wearable Ionizing RadiatIon dosimeterS for real-time crew personal monitoring", funded by ASI in the VUS3:4ISSEXPLORATION programme, foresees the implementation of crew personal dosimeters apt to be worn 24/7 and to monitor in real-time radiation impinging from 360 (low operation power, ultrathin, large-area and versatile geometries, e.g. arm bands, large patches). IRIS dosimeters are composed of a wearable electronic readout and of detachable and replaceable active sensor patches IRIS sensor patches are easily substituted to grant replacement in case of malfunction and are based on innovative semiconductors (organic and perovskites) that are in thin film form (200nm-1 micron thick). This grants lightweight and flexibility for crew member wearability comfort and allows to send multiple IRIS sensor patches dramatically reducing the payload with respect to any presently available personal active dosimeter. The active semiconductor thin films are deposited by solution with simple ink-jet printing processes, foreseeing the ease of fabrication/duplication of the IRIS sensor patches with 2D/3D printers even directly in a space station or basis. IRIS dosimeters have been ground-verified to detect both protons (major component of space radiation fields) but also X-gamma rays and electrons. The project therefore includes a Monte Carlo study with radiation transport codes, to characterize the expected radiation environment inside the ISS and, more specifically, to verify the

extent of photon and electron production as by-products of fragmentation processes for ions interacting with space station/ship shielding.