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Poster
Fast neutrons constitute one of the most hazardous forms of space weather radiation, threatening astronauts and space assets in a variety of contexts. In addition to primary fast neutrons (e.g., from solar flares), secondary fast neutrons can be produced by interactions between high-energy charged particles (e.g., GCRs and SEPs) and the shielding that is intended to protect astronauts from radiation. It has been found that albedo neutrons on the surface of the Moon contribute up to 23% of the total radiation on the lunar surface. Of this population, models suggest that 80% of the total radiation dose comes from neutrons in the energy range between~1-300 MeV. Fully characterizing albedo neutrons is also highlighted as a key gap area in NASA's Space Weather Science and Observation Gap Analysis (2021) and in the recommendations from the Space Weather Advisory Group (SWAG). Albedo neutrons also radiate from the Earth's atmosphere contributing to single event upsets in avionics (Leray2007; Ziegler 1998) and a significant radiation dose to flight crews, particularly important because there is growing evidence of higher cancer rates among flight attendants (McNeeley et al 2018; Dyer 2002). We emphasize that space weather modeling and forecasting has high priority in the recently released Heliophysics 2024 Decadal Survey. The High-energy Lunar Orbiting and On-surface Neutron Spectrometer (Hi-LOONS) is designed to measure fast neutrons (~0.5- to >400 MeV). It is based on its predecessor, an imaging neutron spectrometer, LOONS. Hi-LOONS is a unique configuration, replacing arrays of large monolithic scintillators found in LOONS, with two segmented layers along the instrument axis in Hi-LOONS. Hi-LOONS is a low SWaP instrument (10x10x30-cm3,~10 kg, < 20W) suitable for compact platforms within the aviation industry and future Moon to Mars opportunities where safeguarding astronauts is critical. We discuss the development of LOONS for upcoming Artemis opportunities and Hi-LOONS for future space weather applications.

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