Paper ID: 36665
student

Key Technology of Space Exploration (8)
Key Technology of Space Exploration (1)

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SPACE EXPLORATION: THE NEED FOR BETTER RADIATION DETECTORS

Abstract

During their ventures beyond the protection of Earth's atmosphere and magnetosphere, astronauts on exploration missions will be subjected to myriad health risks. Elevated radiation levels are a serious health concern—especially when traveling beyond the realms of Earth's magnetosphere. Astronauts living and working on the International Space Station (ISS) receive doses that are substantially higher than those of the average population, but within the limits that apply to radiation workers on the ground. In missions to the Moon, Mars, or other destinations beyond low Earth orbit, doses will be significantly higher. Beyond measuring astronauts' exposures, acquiring detailed knowledge about the radiation environment is crucial to the development of more effective shielding methods.

On the ISS, radiation levels are monitored by a suite of sensors: wearable dosimeters to measure crew exposure, area monitors to measure the radiation dose at fixed locations, and particle telescopes to determine the composition and energy spectrum of radiation. The data of these sensors must be combined to arrive at a meaningful model of the radiation environment. However, the accuracy of this model is constrained by the limited capabilities of currently available sensors—e.g. small fields of views, limited energy ranges, and almost no real-time capabilities.

To acquire the desired level of real-time knowledge about the composition, directionality, and spectrum of radiation, the development of new and innovative detectors is required. These sensors should ideally be able to determine the species, energy, and direction of individual radiation particles with omnidirectional acceptance. They should also be small, light-weight, and energy-efficient to facilitate deployment on deep-space spacecraft. We present the limitations of current radiation detectors and the desired capabilities of a new class of sensors, as well as candidate technologies that promise to offer these capabilities.