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Radiation Fields, Effects and Risks in Human Space Missions (4)

Author: Mr. Scott Freese
Space Policy Institute, George Washington University, United States

Dr. Kris Lehnhardt
School of Medicine and Health Sciences, George Washington University, United States

THE IMPACT OF RADIATION ON HUMAN HEALTH DURING SPACEFLIGHT BEYOND LOW EARTH ORBIT

Abstract

Since the beginning of human space exploration, many features of the novel space environment have caused physical ailments to the human explorers. Some of these issues are truly unique to living in space. For example, the long-term health effects of living and working in a microgravity environment can be experienced nowhere else than in an orbiting spacecraft. Other issues, such as radiation exposure, are of significant concern space but are also present in certain terrestrial environments. Despite some of the similarities with terrestrial radiation, space radiation is rarely encountered in a typical Earth environment. In fact, there are only a few locations in the world where space radiation can even be produced for research purposes (e.g. radiobiology). Although many long-term studies on the health effects of terrestrial radiation have been performed, such as those following the survivors of the atomic bomb attacks on Hiroshima and Nagasaki, there remain significant uncertainties as to whether or not Earth-based radiation can even be used as a model for space-based radiation. Some of this uncertainty rests with the limited, human-applicable radiation data acquired in space environments beyond Low Earth Orbit. Recent publications documenting radiation measurements from NASA's Mars Science Laboratory (MSL) have significantly added to the understanding of expected total radiation exposure doses during a human Mars Mission. Likewise, data from the CRaTER instrument on board NASA's Lunar Reconnaissance Orbiter (LRO) have provided new knowledge on the impacts of space radiation, and also the effectiveness of various shielding techniques. Despite the uncertainties regarding total space mission radiation doses and the use of Earth-based radiation as a model, it is known that there are unquestionable health risks associated with long-term exposure to space radiation. This paper will discuss those risks, the differences between terrestrial and space radiation, recent knowledge developments regarding space radiation, and also potential countermeasures for protecting future human spaceflight explorers.