Paper ID: 19298
oral

SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (4)

Author: Dr. Ralph L. McNutt, Jr.
Johns Hopkins University Applied Physics Laboratory, United States, ralph.mcnutt@jhuapl.edu

Prof. Stanislav Barabash
Institutet för Rymdfysik (Swedish Institute for Space Physics), Sweden, stas.barabash@irf.se
Dr. Pontus Brandt
Johns Hopkins University Applied Physics Laboratory, United States, Pontus.Brandt@jhuapl.edu
Dr. Christina Cohen
California Institute of Technology, United States, cohen@srl.caltech.edu
Dr. Robert Decker
United States, Rob.Decker@jhuapl.edu
Dr. Carolyn Ernst
The John Hopkins University Applied Physics Laboratory, United States, Carolyn.Ernst@jhuapl.edu
Dr. Nicola Fox
The John Hopkins University Applied Physics Laboratory, United States, Nicola.Fox@jhuapl.edu
Dr. Yoshifumi Futaana
Institutet för Rymdfysik (Swedish Institute for Space Physics), Sweden, futaana@irf.se
Dr. Sanjoy Ghosh
The John Hopkins University Applied Physics Laboratory, United States, Ron.Ghosh@jhuapl.edu
Dr. Dennis Haggerty
The John Hopkins University Applied Physics Laboratory, United States, Dennis.Haggerty@jhuapl.edu
Dr. Dana Hurley
The John Hopkins University Applied Physics Laboratory, United States, Dana.Hurley@jhuapl.edu
Dr. David Lario
The John Hopkins University Applied Physics Laboratory, United States, david.lario@jhuapl.edu
Dr. David Lawrence
The John Hopkins University Applied Physics Laboratory, United States, David.J.Lawrence@jhuapl.edu
Dr. John Lyon
Dartmouth College, United States, John.G.Lyon@dartmouth.edu
Dr. Glenn Mason
The John Hopkins University Applied Physics Laboratory, United States, Glenn.Mason@jhuapl.edu
Mr. James McAdams
JHU Applied Physics Laboratory, United States, Jim.McAdams@jhuapl.edu
Dr. Viacheslav Merkin
The John Hopkins University Applied Physics Laboratory, United States, Viacheslav.Merkin@jhuapl.edu
Dr. Richard Mewaldt
California Institute of Technology, United States, RMewaldt@srl.caltech.edu
Dr. Christopher Paranicas
The John Hopkins University Applied Physics Laboratory, United States, Chris.Paranicas@jhuapl.edu
Dr. Thomas Prettyman
Planetary Science Institute, United States, prettyman@psi.edu
Dr. NourEddine Raouafi

The John Hopkins University Applied Physics Laboratory, United States, NourEddine.Raouafi@jhuapl.edu
Dr. Edmond Roelof
The John Hopkins University Applied Physics Laboratory, United States, Edmond.Roelof@jhuapl.edu
Dr. Mark Wiedenbeck
Jet Propulsion Laboratory - California Institute of Technology, United States, mark.e.wiedenbeck@jpl.nasa.gov
Dr. Michael Wiltberger
High Altitude Observatory, National Center for Atmospheric Research, United States, wiltbemj@ucar.edu

THE HUMAN ENERGETIC RADIATION ASSESSMENT (HERA) NETWORK

Abstract

The hazards of the space radiation environment have been known from the early days of space exploration. What are less well appreciated are the potential cumulative effects from both the space and target-induced environments on human crews. The Sun is the ultimate source of these effects whether via the modulation of galactic cosmic rays (GCRs) entering the heliosphere from interstellar space (controlling "space climate") or from the direct injection of solar energetic particles (SEPs) from the Sun itself (a factor in shorter-term "space weather"). This combination of charged particles leads to the production of secondary particles at the surfaces of solid bodies with no atmospheres, such as the Moon, near-Earth asteroids, and the moons of Mars Phobos and Deimos, while also offering the hazard of highly-charged nuclei, such as fully-ionized iron atoms, which can cause significant levels of radiation deposition in materials encountered. While understood qualitatively, the quantitative physics of the transport of GCRs, and especially SEPs, in the inner solar system remains poorly understood. The fluxes of GCRs, which vary by small amounts over the 11-year solar cycle, have been well characterized, but the inability to shield easily against these very-high-energy particles for long space voyages makes them important at potential human destinations, as the induced particle and neutron environments can either enhance or reduce the radiation dose which would be accrued otherwise in deep space. The SEPs are less energetic but exhibit more rapid variations and can provide lethal radiation doses to unprotected human crews. Hence, a robust predictive capacity is needed, combined with a system-wide alert system, along with a good knowledge of the secondary environment produced by these particles at the surfaces of airless bodies, to ensure crewed mission success on deep-space missions. The Human Energetic Radiation Assessment (HERA) network is an effort to provide an appropriate, quantitative assessment and predictive capability for energetic particle events in the region of the inner heliosphere targeted for human exploration (1 to 2 AU from the Sun). By drawing upon the GCR and SEP records available from satellites over the last several solar cycles, along with data and modeling from ongoing missions, predictive capabilities can be developed both for the purposes of providing operational and engineering requirements for human crews for long-term stays at the Moon and to near-Earth asteroids and the moons of Mars as well as for providing input to long-term space-weathering of these airless bodies.