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COUNTERMEASURES TO RADIATION FOR AN IN-SPACE HUMAN TRANSPORTATION VEHICLE TO MARS

Abstract

A vehicle for transporting humans to Mars is the next step on the Global Exploration Roadmap (GER) for the International Space Exploration Coordination Group (ISECG), with the view for a platform to allow human exploration of the Martian surface. As a means of helping humans reach Mars in a comfortable manner, a Mars Cycler has been investigated allowing for a larger station with greater radiation shielding. Despite the time to reach Martian orbit being greater for a cycler system, the increase in shielding can help reduce the crew's exposure to the radiation environment. This reduction in the total radiation dose received by the crew and the spacecraft is essential for protecting the health of the crew as well as any electronics on board.

In order for a human mission to Mars to succeed, the health hazards associated with the expedition must be carefully studied and handled. As demonstrated in NASA's Human Research Program and in ISECG Global Exploration Roadmap Critical Technology Needs, space radiation from Galactic Cosmic Rays (GCRs) and Solar Particle Events (SPEs) is one of the most dangerous variables, associated to a variety of human health hazards. The effects of prolonged exposure to radiation differ greatly with the total dose received by the subject. Acute side effects include a reduction in white blood cell count meaning astronauts will be more susceptible to illnesses. The more severe side effects can include radiation sickness, carrying its own symptoms such as damaged nerve cells, seizures and death.

In this study, the total radiation dose distribution that will be encountered by a human is estimated using Monte Carlo simulation in a Geant4 environment and appropriate shielding is proposed. The shielding design is estimated to decrease the radiation by ten-fold to that of current state-of-the-art technology.

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