Exposure and Shielding from Radiation on Mars

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ABSTRACT

Space radiation is one of the multitude of factors that may deter space missions given the high uncertainty of the risk of radiation-induced morbidity and the lack of simple countermeasures to reduce the exposure. This paper examines the challenges of space radiation and the options for shielding materials in support of the human exploration of Mars.

(Keywords: radiation assurance, ionizing radiation, space biology, radiation shielding, interplanetary exploration, human space flight).

INTRODUCTION

Radiation assurance is an essential component of space explorers, such as those that journey to the moon or Mars. It is an aspect of space voyage safety that is carefully monitored during missions. Radiation assurance, among various evaluations are meant to be performed with cutting edge technology during take-off from Earth.

Existing evaluations and arrangements are plotted using the Langley inestimable beam transport code and the nucleon transport code. They are used to calculate the amount or radiation during space transportation and reduce the impact of galactic astronomical beams and sun-oriented proton flares. This is done through various protecting media. Data that identifies with the radiation portion on the different Martian surfaces was investigated and is proposed as intensive protecting alternatives.

CURRENT RESEARCH

Space radiation is one of the multitude of factors that may deter space missions given (i) the high uncertainty on the risk of radiation-induced morbidity and (ii) lack of simple countermeasures to particularly reduce the exposure, a major concern of safety on board [1].

The Curiosity rover which forms part of the Mars Science Laboratory spacecraft, reports measurements of the energetic particle radiation environment confirming the very high likelihood of radiation hazard for astronauts on future trips to Mars [2]. "The dose equivalent for even the shortest round-trip with current propulsion systems and comparable shielding is particularly found to mostly be 0.66 ± 0.12 Sievert", demonstrating the intensity of radiation hazards for astronauts. Many of these high-risk regions have been mapped using existing instruments, such as the Mars Global Surveyor on NASA's Mars 2000 Odyssey spacecraft (Figure 1).

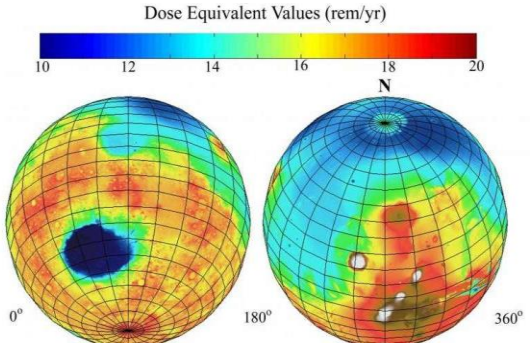

Figure 1: Estimated Radiation Dosage on Mars in its Cosmic Ray Environment according to Dose Equivalent Values in rem/year.
Source: NASA Jet Propulsion Laboratory [6].

To reduce exposure, shielding is the most basic and fairly common physical countermeasure to protect against radiation [3-4]. However, based on the new information and measurements of the level of radiation from the Mars Science Laboratory, the current provisions are found to provide very poor radiation protection.

Even with sufficient radiation protection, these types of ionizing radiations have the potential to create health-related problems during space travel. Based on terrestrial research, the primary concern is related to the increased risk of cancer induction in the long term. There is still a high degree of uncertainty with these predictions as the experiments have not been conducted in space.

Proposed Avenues

Some protecting ideas particularly are proposed with the spotlight on the adequacy of the material sorts, and strategies for mass protecting (using attractive and electromagnetic field avoidance techniques). Research has demonstrated that specific light-weight materials with relatively low nuclear weight offer an elevated amount of ionic protection than those of much heavier metals. Some related research has demonstrated that attractive protecting needs to be adequate for security against radiation.

Enhancing transport to Mars is another area of study, which has gained much traction. Our group has previously described a novel ionic wind-based propulsion system for transport, which makes use of electrostatic airflow in space and has been engineered to reduce the risk of radiation [5].

Martian surface residence must carefully consider radiation protecting also. Mars can offer some degree of radiation insurance from the nearness of a, though, feeble attractive field alongside a carbon dioxide environment, to provide some protection from the harmful rays.

As an augmentation of *in-situ* resource use, it is suggested that future missions may need to "utilize the land" given the absence of innovation to ship all the vital residence necessities from Earth. One such model is utilizing the Martian regolith-based home strategies for fluctuating sorts and thicknesses to secure the occupants.

RESEARCH SUPPORT

This research is supported by the Antarctic Institute of Canada and the Government of Canada CSJ Grant.

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SUGGESTED CITATION

Zhou, G., P.A. Johnson, J.C. Johnson, S. Zirnov, I. Oboh, D. Santhosh, and A.A. Mardon. 2020. “Exposure and Shielding from Radiation on Mars”. *Pacific Journal of Science and Technology*. 21(2):144-145.

Pacific Journal of Science and Technology