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MARS MISSION RADIATION SAFETY ASSURANCE

Abstract

Radiation safety assurance of Mars mission crew remains one of the key issues defining not only the concept, but in some cases the possibility of the long-term Mars mission in principle. Significant radiation exposure of astronauts during their interplanetary flight and on the Mars surface is unavoidable. Mission designers are in charge of ensuring the acceptable space radiation exposure limits for the crew in hard restrictions of the available resources for radiation shielding development. The concepts of radiation safety assurance based in highest possible utilization of the natural Martian resources are advantageous in these conditions, especially in the case when their application do not require the use of complex technological and industrial equipment. In this context we have to pay attention to the water ice, with a fairly high degree of confidence found under the Martian surface. Water ice has a number of apparent advantages that allow considering it as a promising material for development of space radiation shielding of a habitant for human settlement on the Mars. Among the main ones should be referred: - high content of hydrogen which is the best material for shielding the high-energy particles of galactic and solar cosmic rays; - the relative simplicity of technological process to build water ice structures in the Martian environment; - water ice transparency for the visible sunlight, and shielding ultraviolet part of the solar spectrum. The paper presents the results of estimations of effective doses behind the various thickness shielding made of water ice for space radiations penetrating through the Martian atmosphere. The calculations simulating transport of space radiations through shielding materials taking into account all the possible physical mechanisms of nuclear and electromagnetic interactions with matter were conducted with the help of GEANT4 code. The requirements on thickness of water ice shielding ensuring radiation safety of the Mars mission crew in accordance with the actual radiation exposure limits are developed as a result of the calculations.