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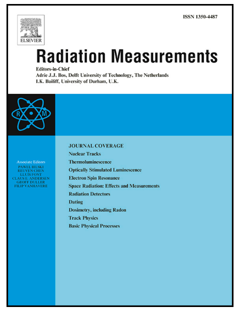

Particle accelerator-based simulation of the radiation environment on board spacecraft for manned interplanetary missions

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PARTICLE ACCELERATOR-BASED SIMULATION OF THE RADIATION ENVIRONMENT ON BOARD SPACECRAFT FOR MANNED INTERPLANETARY MISSIONS

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Abstract

The high-energy accelerator-based simulation of both Galactic Cosmic Rays (GCR) and secondary radiation, to which astronauts will be exposed within a spacecraft in deep space, is a very relevant task for the purposes of space radiobiology. In this work, a method of simulating continuous proton, neutron, and $\pi^{\pm}$-meson spectra within the habitable module of a spacecraft is described. The methods are based on a linear combination of the energy spectra of particles emitted at various angles from three different targets bombarded by a high-energy proton beam. The consecutive irradiation of targets makes it possible to create in a certain volume near the beam a summary field that is similar in characteristics to the nucleon field inside the habitable module exposed to GCR averaged over solar activity.

Keywords:

Space radiobiology
Galactic cosmic rays
Particle accelerator
Astronaut exposure

INTRODUCTION

Radiobiological research in recent years has identified the radiation exposure risk as one of the stopping factor for long-duration manned interplanetary missions. As of today, a large amount of experimental data on the damaging effects of high-energy heavy charged (HZE) particles at the cellular and organism levels has been accumulated. The risks related to space radiation exposure during long-term missions can have two main components: the late (after the mission) risk of cancer or cardiovascular disease and acute (during the mission) ergonomic risks due to cognitive function disorders. There is also an acute risk associated with rare and powerful solar proton events, but it is hardly predictable and manageable.

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