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Radiation Fields, Effects and Risks in Human Space Missions (5)

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DOSE-EFFECTS MODELS FOR SPACE RADIOBIOLOGY: AN OVERVIEW ON DOSE-EFFECT RELATIONSHIP

Abstract

Space radiobiology is an interdisciplinary science that examines the biological effects of ionising radiation on humans involved in aerospace missions. The dose-effect models(DEM) are one of the relevant topics of space radiobiology. Their knowledge is crucial for optimising radioprotection strategies (e.g., spaceship and lunar space station-shielding and Moon or Mars village design), the risk assessment of the health hazard related to human space exploration, and reducing damages induced to astronauts from galactic cosmic radiation. Dose-effect relationships describe the observed damages to normal tissues or cancer induction during and after space flights.

DEM are developed for the various dose ranges and radiation qualities characterising the actual and the forecast space missions (International Space Station (ISS) and solar system exploration).

Based on a Pubmed search including last 20 years peer-review published papers reporting the collected dose-effect relationships after space missions or in ground simulations, we identified seven significant dose-effect relationships(e.g., eye flashes, cataract, central nervous systems, cardiovascular disease, cancer, chromosomal aberrations, and biomarkers).

For each considered effect, the absorbed dose thresholds and the uncertainties/limitations of the developed relationships are summarised and discussed.

The current knowledge on this topic can benefit from further in vitro and in vivo radiobiological studies, an accurate characterisation of the quality of space radiation, and the numerous experimental dose-effects data derived from the experience in the clinical use of ionising radiation for diagnostic or treatments with doses similar to those foreseen for the future space missions.

The growing number of pooled studies could improve the prediction ability of dose-effect relationships for space exposure and reduce their uncertainty level. Novel research in the field is of paramount importance to minimise damages to astronauts from cosmic radiation before Beyond Low Earth Orbit exploration in the next future.

In this paper, we will present the state of the art of knowledge in the fields and some possible hints and examples of potential synergies between different research areas to improve it