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Measuring the Relative Biological Effectiveness of High Energy Neutrons in Space

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The primary radiation environment in space consists of a complex mixture of charged particles with a broad range of energies originating from our Sun and from outside of our solar system. Neutrons with energies of up to several TeV are produced through the interactions of this primary cosmic radiation with matter, such as that in spacecraft shielding, and in the atmospheres and regoliths of moons and planets. Current radiation health risk models developed within the context of future space exploration involve considerable uncertainties surrounding our knowledge of the biological effects of neutron radiation at relevant energies, doses, dose-rates, biological systems and endpoints. In particular, there is a severe lack of experimental data for neutron energies above 20 MeV. The fast neutron beam facility at iThemba LABS is capable of producing quasi-monoenergetic neutron beams in the range of 30-200 MeV. We report on a project to assess the feasibility of, and implement the preparation required for utilising this facility for the undertaking of meaningful measurements of the neutron Relative Biological Effectiveness (RBE) under conditions relevant to space travel. Such measurements require reliable neutron beam metrology and detailed computational simulations of the experimental setup for both the neutron and reference irradiations, along with appropriate radiobiological analyses.

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