Title: Measurement of secondary neutron spectra induced by 480 MeV proton and 430 MeV/u ^{4}He beams with a thick aluminum target.

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Abstract

Knowledge of the characteristics of secondary neutrons produced by the interaction of GCRs with spacecraft shielding materials during long deep space travel is becoming increasingly important for predicting and mitigating astronauts' biological risks. Hadron accelerators for medical application are well suited to reproduce the conditions found in deep space in terms of ion species production and energy. The objectives of this work were to measure the secondary neutron spectra produced by proton and helium ion beams hitting an aluminum target with energies that would be found during minimal solar activity and to validate and compare physical models of Monte Carlo simulations. Neutron spectra were measured with the extended-range Bonner sphere system NEMUS at two positions, 0° and 90° relative to the direction of the primary ion beam. The experimental setup consisted of a 480 MeV proton and a 430 MeV/u ^{4}He beam, colliding with a 30 x 30 x 63.5 cm^{3} aluminum target. The experimental neutron spectra were analyzed using the MAXED unfolding code and compared to Monte Carlo simulations. The results show deviations in terms of the shape of the neutron energy distributions and integral quantities of fluence and ambient dose equivalent.

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