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Nuclear Physics Applications in Astronaut Radiation Protection

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National space agencies and commercial companies continue to develop plans for long-term space missions outside the protection of the Earth's magnetosphere. An important concern for astronauts participating in these missions are the health effects from galactic cosmic rays (GCR). The GCR consist of protons, helium, and heavy ions with energy spectrum peaking at a few hundred MeV/nucleon, however with more than 50% of the heavy ion fluence inside tissues from ions with energies from 1000 to 10,000 MeV/nucleon. Secondary radiation including neutrons, protons, mesons and electrons increase in importance with shielding depth and can dominate astronaut risks for large shielding amounts (>50 g/cm2). We review nuclear absorption, fragmentation and particle production cross section data and the models used in GCR transport codes and risk assessment models. Recent data from the RAD experiment on the Mars surface and comparisons to models are described. NASA has implemented new radiation quality factors based on track structure concepts developed by the author (1-4). Also ancillary requirements using 95% confidence levels in risk projections
are used by NASA (1-4). Using state-of-the-art models of cancer risks, the impacts of cross section uncertainties and overall risk projection uncertainties are discussed.
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