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Executive Summary

Determination of Yield Functions of Neutron Counters at the South Pole from Monte-Carlo Simulation

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Neutron monitors (NM64) are ground-based cosmic ray detectors that measure the flux of primary cosmic rays at the GeV-energy range by counting (primarily) secondary neutrons in atmospheric cascades. They have a lead producer to generate evaporation neutrons that are moderated before being detected in a $^{10}BF_3$ or ^{3}He gas-filled proportional counter. By omitting the lead, a so-called "bare detector" responds to lower energy particles on average and can be used in concurrence within NM64 to estimate the primary cosmic rays' energy spectrum. This research uses Monte-Carlo FLUKA simulation to refine our understanding of two types of bare neutron detector and three NM64 units located inside and outside, respectively, of the Amundsen-Scott station at the South Pole. One bare design uses paraffin and wood to moderate high-energy neutrons, and another bare design has no moderator. All bares are mounted together in a single assembly. The bares and NM64 all use ^{3}He gas-filled proportional counters. In our previous work, the energy-dependent effective area (yield function) of the paraffin-moderated bares was directly determined from a ship-borne latitude survey in 2009 - 2010. The influence of the container and the environment on the ship significantly affects the measured yield function. In this work, we compare our preliminary simulated yield function of the actual configuration at the South Pole with the experimental yield function derived by measurement in the latitude survey at sea level in 2009-2010 [Nuntiyakul et al.,2020]. The determination of the yield function of the 3NM64 located outside the Amundsen-Scott South Pole station is a work in progress. We will continue our effort to improve the precision and accuracy of the simulation to better determine the spectral index of the Solar Energetic Particle during Ground Level Enhancement using South Pole neutron monitor data.

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