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Executive Summary

Validation of Monte Carlo Yield Function of a Semi-Leaded Neutron Monitor using Latitude Survey Data in 2019 and 2020

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A neutron monitor (NM) is a ground- (or sea-) based detector of the flux of cosmic ray particles in space. The high-energy cosmic rays in the GeV primary range interact in the upper atmosphere, producing a cascade of subatomic particles, some of which reach Earth's surface. A neutron monitor is mostly sensitive to the neutron component of the atmospheric cascade. These neutrons can then be detected by induced nuclear fission of ^{10}B in a $^{10}BF_3$ gas proportional counter. The Changvan neutron monitor is a portable neutron monitor assembled in Thailand and housed in a standard insulated shipping container to conduct long-term research in polar regions. There are three proportional counters housed in the insulated shipping container, but the central counter lacks the lead producer. We performed a Monte Carlo Simulation for the yield function of the Changvan monitor to primary particles. We validated our preliminary yield function by comparing count rates from simulation with actual data. We found that the maximum difference of the unleaded/leaded count rate ratio between simulation and experimental data was less than 8%. This leads to a promising yield function that can be used to determine the spectral index of relativistic solar ions with a single detector. At present, we cannot draw any conclusions regarding the obtained simulation result based on the Hobart atmosphere only. While conducting the actual experiment, the ship traveled through different atmospheres. In future work, we plan to modify some of the surrounding structures that affect the center unleaded tube more than the leaded tube and change the atmospheres corresponding to the actual observations.

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