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Measurement of the neutron travel time distribution inside a neutron monitor

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Using a setup for testing a prototype for a satellite-borne cosmic-ray ion detector, we have operated a stack of scintillator and silicon detectors on top of the Princess Sirindhorn Neutron Monitor (PSNM), an 18-counter NM64 detector at 2560-m altitude at Doi Inthanon, Thailand. Monte Carlo simulations have indicated that about 15% of the neutron counts by PSNM are due to interactions (mostly in the lead producer) of GeV-range protons among the atmospheric secondary particles from cosmic ray showers, which can be detected by the scintillator and silicon detectors. Detection of incoming charged particles associated with neutron counts in the NM64 allows a measurement of the travel time distribution of such neutrons as they scatter and propagate through the NM64, processes that are nearly the same whether the interaction was initiated by an energetic proton (for 15% of the count rate) or neutron (for 80% of the count rate). This travel time distribution underlies the time delay distribution between successive neutron counts, from which we can determine the leader fraction (inverse multiplicity), which has been used to monitor Galactic cosmic ray spectral variations over ~1-40 GV. In the present experiment we have measured both the coincidence rate of incident charged shower particles with neutron counts in the NM64 and the neutron travel time distribution. We utilize these measurements to validate Monte Carlo simulations of atmospheric secondary particle detection by the NM64 and the resulting yield functions used to interpret the count rate and the leader fraction.

Keywords

neutron monitor, Monte Carlo simulation, leader fraction, spectral variation

Collaboration

other Collaboration

Subcategory

Experimental Results

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