

Variations in the Neutron Time Delay Distribution at the Princess Sirindhorn Neutron Monitor

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The Princess Sirindhorn Neutron Monitor (PSNM) has operated since late 2007 at the summit of Doi Inthanon, Thailand's highest mountain, in Chiang Mai province. PSNM records the flux of galactic cosmic rays (GCRs) impinging on Earth's atmosphere, as well as the GCR flux variations with time due to solar activity. PSNM has the world's highest cosmic ray vertical cutoff rigidity (momentum per charge) for a fixed station, 16.8 GV. The recorded count rate comes from the detection of nuclear disintegrations of ^{10}B in BF_3 -filled proportional counters, mostly due to interactions with neutrons evaporated from the Pb producer when hit by a cosmic-ray-generated atmospheric shower particle (usually a neutron). In addition to monitoring the count rate, the PSNM electronics can record neutron time delays (the time between one count and the next) in each counter. An analysis of time delay histograms shows an exponential tail at long times (> 1 ms) that can be interpreted in terms of chance coincidences, i.e., counts associated with independent atmospheric particles. Shorter time delays, however, are dominated by counts originating from the same interaction between a Pb nucleus and an atmospheric particle. This component contains information about the energy distribution of atmospheric shower particles and, thus, about the GCR energy spectrum as well, and its variations with time are of interest. In this work we analyze neutron time delay histograms from PSNM and derive the leader fraction L , i.e., the fraction of neutron counts not associated with a previous count in the same counter from the same nuclear interaction. We report on variations of L with time, their dependence on atmospheric depth and water vapor pressure, and show that, after correcting for these environmental effects, the remaining variations are of interplanetary origin. This represents a qualitatively new type of observation in the 60-year history of neutron monitor science.

Summary

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