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A Simulation Study of the Response of the Princess Sirindhorn Neutron Monitor and Bare Counters to Solar Neutrons

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The Sun can occasionally accelerate particles to become solar energetic particles, some of which may collide with the Earth's atmosphere and produce secondary air showers that ground-based neutron monitors can detect. This work investigates the Princess Sirindhorn Neutron Monitor (PSNM) response to solar neutrons originating from solar activity such as solar flares and coronal mass ejections. The PSNM, located at an altitude of 2560 m near the equator with a high geomagnetic cutoff rigidity of 16.7 GV, is particularly suited for this study as it can potentially detect lower-energy (sub-GeV) solar neutrons against a background of higher-energy charged cosmic rays because neutrons are not affected by the geomagnetic field. Furthermore, since the start of operations in 2007,PSNM has deployed bare counters without surrounding lead or polyethylene. These bare counters are more sensitive to low-energy atmospheric neutrons and may be used to distinguish showers from solar neutrons versus those from Galactic cosmic-ray ions. This research employs Monte Carlo simulations to model the interactions of solar neutrons with the Earth's atmosphere and the response of PSNM to solar neutrons. We simulate neutron showers across a range of energies at different zenith angles. This study provides useful insights into the capabilities of neutron monitors, together with bare counters, for solar physics research and contributes to advancing our understanding of solar neutron detection. This research was supported by Thailand's National Science and Technology Development Agency (NSTDA) and the National Research Council of Thailand (NRCT) under the High Potential Research Team Grant Program (N42A650868).

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