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Monte Carlo Simulations of Multiple-secondary Cosmic Ray Detection by Neutron Detectors in Mawson Station, Antarctica

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Neutron monitors (NMs) are basic instruments to measure Galactic cosmic ray variations in the range of ˜ 1 to 50 GeV. The upgraded electronics at a few NM stations enable the analysis of the relative time delays and relative positions of multiple secondary particles produced by the same primary particle in Earth's atmosphere. In this work, we performed atmospheric Monte Carlo Simulations using FLUKA Then, we illuminated the simulated detector by using rectangular beams and recorded the counts produced by all secondaries from the same primary cosmic ray. We calculated the cross-counter multiplicity and cross-counter "leader fraction"for different counter separations, which helps provide more insight into atmospheric showers for cosmic rays in this energy range. We compared model results with real count rate and absolute timing data from the NM and bare neutron counters at Mawson Station. With this technique, we can distinguish the contributions of single secondaries and multiple secondaries to the cross-counter multiplicity. We gratefully acknowledge the logistical support provided by Australia's Antarctic Program for operating the Mawson neutron monitor. This research was also supported by a Postgraduate Scholarship from the Mahidol University Faculty of Graduate Studies, by Thailand's Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation (OPS MHESI, Grant No. RGNS 65-181), by Thailand's National Science and Technology Development Agency (NSTDA) and National Research Council of Thailand (NRCT) under the High-Potential Research Team Grant Program (N42A650868), and from the NSRF via the Program Management Unit for Human Resources & Institutional Development, Research and Innovation (B39G670013).

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