

# Investigating Cosmic Ray Variation with Semi-Leaded Neutron Monitors and Polar Surveys

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This study presents notable progress in cosmic ray research through both semi-leaded (Changvan) and standard neutron monitor configurations, focusing on the Changvan latitude surveys (2018–2024) and altitude comparisons with the Princess Sirindhorn Neutron Monitor (PSNM). Our findings confirm the spectral crossover pattern in cosmic ray modulation, revealing rigidity-dependent phenomena—drifts at lower rigidities and helicity-driven diffusion at higher rigidities—and highlight the leader fraction as a key spectral indicator that clarifies structural influences on detector responses. Preliminary results from the 2023 Antarctic and 2024 Arctic voyages, conducted in collaboration with the Korea Polar Research Institute (KOPRI), further explain Galactic cosmic ray spectra and solar modulation. By improving our understanding of cosmic ray dynamics, this integrated approach ultimately enhances space weather forecasting and helps mitigate the potential impacts of cosmic rays on technology and human activities.

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