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LATITUDE SURVEY INVESTIGATION OF GALACTIC COSMIC RAY SOLAR MODULATION DURING 1994–2007

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The Galactic cosmic ray spectrum exhibits subtle variations over the 22 yr solar magnetic cycle in addition to the
more dramatic variations over the 11 yr sunspot cycle. Neutron monitors are large ground-based detectors that
provide accurate measurements of variations in the cosmic ray flux at the top of the atmosphere above the detector.
At any given location the magnetic field of the Earth excludes particles below a well-defined rigidity (momentum
per unit charge) known as the cutoff rigidity, which can be accurately calculated using detailed models of the
geomagnetic field. By carrying a neutron monitor to different locations, e.g., on a ship, the Earth itself serves as
a magnet spectrometer. By repeating such latitude surveys with identical equipment, a sensitive measurement of
changes in the spectrum can be made. In this work, we analyze data from the 1994 through 2007 series of latitude
surveys conducted by the Bartol Research Institute, the University of Tasmania, and the Australian Antarctic
Division. We confirm the curious "crossover"in spectra measured near solar minima during epochs of opposite
solar magnetic polarity, and show that it is directly related to a sudden change in the spectral behavior of solar
modulation at the time of the polarity reversal, as revealed from contemporaneous variations in the survey data
and a fixed station. We suggest that the spectral change and crossover result from the interaction of effects due to
gradient/curvature drifts with a systematic change in the interplanetary diffusion coefficient caused by turbulent
magnetic helicity. Supported in part by the Thailand Research Fund, the US National Science Foundation (OPP-0838839, PLR-124593, and predecessors), and the Australian Antarctic Division.

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