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Time-Delay Measurements from Antarctic Neutron Monitor Stations Indicate Weak Spectral Changes during 27-day Variations

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Using neutron time-delay data from neutron monitors (NMs), we can extract the leader fraction, L, of neutron counts that do not follow a previous neutron count in the same counter tube due to the cosmic ray shower. L is the inverse of the neutron multiplicity and serves as a proxy of the cosmic ray spectral index over the rigidity range of the NM response function. We have outfitted several Antarctic NMs with special electronics to collect neutron time delay distributions. We present a comparative analysis of L during two time periods: 1) during December 2015 to January 2017, for NMs at South Pole (SP), McMurdo (MC), and Jang Bogo (JB), and 2) during February 2020 to February 2021, for NMs at SP, JB, and Mawson (MA). To first order L varies in concert with the count rate C, reflecting unrolling of the Galactic cosmic ray (GCR) spectrum as part of solar modulation during the declining phase of solar cycle 24 and during solar minimum. However, during 27-day variations in C due to high-speed solar wind streams (HSSs) and corotating interaction regions (CIRs), L usually had a very weak variation. We found that both C and L are higher correlation with the solar wind speed than magnetic field magnitude but much weaker in L. Moreover, the wavelet analysis show that C are mostly see two significance signals with periodicity of 27-day and 13-day similar to solar wind speed. L observed 27-day period but no visible periodicity at half of the solar rotation period. So, the spectral variation show only 27-day period but not a harmonic.

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