

# Exploring Heliospheric Conditions on Diurnal Variability of Galactic Cosmic Rays: A Current Perspective

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**Abstract:** *The diurnal variability of cosmic rays remains an attractive phenomenon with important implications for our understanding of cosmic ray transport and modulation. This study examines the current understanding of the diurnal variability of cosmic rays, focusing on the influence of solar activity, interplanetary magnetic field (IMF), and solar wind speed on the observed diurnal anisotropy patterns. An attempt is made to identify some key open questions and future research directions, with an emphasis on fully uncovering the current anomalies in both the amplitude and phase of diurnal anisotropy and estimating their future implications. Examination of data from four neutron monitors from 1986 to 2022 revealed a significant decrease in the amplitude and phase of diurnal anisotropy within the transition period of solar cycles 24/25. This reduction in diurnal cosmic ray modulation deviates from the patterns observed in prior solar cycles. Our findings explore the interplay between heliospheric conditions and cosmic ray transport and provide insight into the evolving nature of solar modulation and its impact on galactic cosmic ray behavior near Earth. This research contributes to the enhancement of the models of space weather and cosmic ray forecasting.*

**Keywords:** Diurnal anisotropy, Interplanetary magnetic field, Solar poloidal magnetic field, and Polarity reversal