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Temporal Correlation between Positive-Charged Cosmic Ray Flux and Solar Polar Field Variation: Insights from Delayed Modulation Analysis

We present an analysis of the time-dependent modulation of galactic cosmic rays near Earth, with a focus on the cosmic proton flux and polar field. Using data from the Alpha Magnetic Spectrometer (AMS) and the Wilcox Solar Observatory, we identify a significant time-lagged relationship between the observation of two missions. Our model incorporates a weighted magnetic field parameter to address the hemispheric asymmetry in solar magnetic fields and captures the temporal evolution of cosmic-ray proton spectra in relation to solar activity. We find a time lag of approximately 10 months, varying with cosmic ray rigidity. At 1 GV, the time lag is 360 days, while it is 300 days above 3 GV. A potential mechanism is proposed to explain the observed time-lagged relationship and its dependence on cosmic ray rigidity.

This offers predictive insights into cosmic ray modulation within the heliosphere. These results enhance the accuracy of space weather forecasting models, with significant implications for the safety of space missions and aviation.

Collaboration(s)

Author: Dr FENG, Jie (Shenzhen Campus of Sun Yat-Sen University (CN))

Presenter: Dr FENG, Jie (Shenzhen Campus of Sun Yat-Sen University (CN))

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