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Study the relationship between Galactic Cosmic Rays' 27 day recurrent variation and Corotating Interaction Region

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The development of advanced space-based cosmic ray observation experiments (such as AMS, PAMELA, and DAMPE) have provided precise data, offering new opportunities for the study of cosmic ray solar modulation. During 2007-2008, as the period of longest-live coronal holes and corresponding variation in all heliospheric characteristics, the pronounced 27-day wave in the GCR intensity had been observed by PAMELA. In 2016, the AMS experiment observed significant 27-day periodic variations of cosmic ray protons, helium nuclei, and electrons. To investigate the theoretical mechanism and deepen our understanding of this 27-day periodic variations, we employed a magnetohydrodynamic (MHD) numerical model to simulate the solar wind environment containing corotating interaction regions (CIRs). We then coupled this model with a cosmic ray propagation model. Using this coupled framework, we simulated the modulation processes of protons, helium nuclei and electrons with different rigidities under the influence of CIRs. The simulation results reveal that: Protons, helium and electrons are affected by CIRs, with their fluxes decreasing and then recovering. The modulation strength of CIRs on cosmic rays, is decreasing as rigidity increases. At higher rigidities, this modulation can be approximated by a power-law shape. The manner in which protons and helium-4 responds to the presence of a CIR is similar, while electrons behaves differently, indicating a clear charge-sign dependent effect as well.

Collaboration(s)

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