

The 23 July 2012 SEP event numerical simulation with multi-spacecraft observation data

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23 July 2012, multiple-spacecraft, namely STEREO-A, STEREO-B, and ACE, observed an extremely powerful, superfast interplanetary coronal mass ejection (ICME) together with the ICME-driven shock and associated solar energetic particles (SEPs). We analyze the relationship between the propagation of the shock and the SEP flux with the Parker spiral magnetic field model. Moreover, we simulate the SEP event by numerically solving the three-dimensional focused transport equation of SEPs considering the shock as the moving source of energetic particles. We use the same diffusion model format for the simulations of protons and electrons but with different parameters for simplicity. The simulation results can qualitatively explain the important features of the SEP flux observed by the multiple spacecraft simultaneously. Additionally, the numerical results for both energetic protons and electrons approximately agree with multi-spacecraft observations.

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