Particle Transport in Co-rotating Interaction Region (CIR)

During solar minimum, energetic particles up to a few to 10's MeV are often observed with CIRs. In the Fisk & Lee (1980) model, these energetic particles that are observed at 1AU are accelerated in the CIR reverse shock at 3~5AU and then transport back to 1AU, yielding a clear modulation effect. However, there were observations showing that in many CIR events, there were clear signs of local acceleration near 1 AU. We examine one such event, the February 08, 2008 CIR event in this work. This event was observed by both Advanced Composition Explorer (ACE) and Solar Terrestrial Relations Observatory (STEREO) spacecraft. A reverse shock was observed by STEREO-B (1 AU) but not ACE (0.98 AU), suggesting that the CIR shock was formed at a heliocentric distance very close to 1 AU. Using STEREO-B observations and assuming the CIR structure does not vary significantly in the co-rotating frame, we can estimate the shock location for both STEREO-B and ACE observations at later times. Further assuming the accelerated particle spectral shape at shock does not vary with shock location, we calculate the particle differential intensities observed by STEREO-B and ACE at different times using the focused transport equation. Energetic particles are traced in two frames: the instantaneous co-rotating frame (inertial frame) and the instantaneous solar wind frame. In the co-rotating frame, particle energy and magnetic moment is conserved and in the solar wind frame, the solar wind MHD turbulence leads to pitch angle diffusion, modeled by a Gaussian process. From the simulation, we obtain particle differential intensities and spectra. Reasonable comparison between simulations and observations by both STEREO-B and ACE can be obtained, provided that the shock can accelerate particles more efficiently at a larger distance.

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Light Refreshments Served

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