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Constraints on Mechanisms for Longitudinal Spreading of Impulsive SEPs from Multispacecraft Observations of Scatter-free Events

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Impulsive solar energetic particle (ISEP) events are understood to involve particle acceleration in relatively compact regions of the solar corona where reconnection causes the release of magnetic energy and produces both turbulence and larger scale motions that can interact with and accelerate charged particles. In many cases the longitudinal spread of ISEPs observed at 1 AU is relatively narrow and possibly consistent with a point source of acceleration. However, several ISEP events observed with the two STEREO spacecraft and near-Earth instruments have had exceptionally wide longitudinal spreads, sometimes significantly greater than 90 degrees. It has been suggested that this spreading could be caused by interplanetary scattering in conjunction with co-rotation of the interplanetary field. There exists a subset of ISEP events that are referred to as “scatter free” due to characteristics such as velocity dispersion, strong particle anisotropy, and/or flux dropouts observed at 1 AU. We report on scatter-free events observed by both of the STEREOs in 2014 when the spacecraft were separated by 38 degrees. Producing such a large spread in the absence of significant interplanetary scattering requires a process other than cross-field diffusion for the longitudinal transport and suggests that the spreading could have its origin in the solar corona. We will discuss the observations and candidate explanations for the spreading and will point out the relevance of these results to measurements that will be made close to the Sun by the Solar Probe Plus and Solar Orbiter missions, which are now under development.

Collaboration

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Primary author: WIEDENBECK, M. (JPL/Caltech)

Co-authors: KLASSEN, A. (Univ. Kiel); COHEN, C. (Caltech); MASON, G. (JHU/APL); NITTA, N. (LM-SAL); LIEWER, P. (JPL/Caltech); LESKE, R. (Caltech)

Presenter: WIEDENBECK, M. (JPL/Caltech)

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