Seed Population Pre-Conditioning and Acceleration Observed by Parker Solar Probe

Jonathan Niehof, Nathan Schwadron, and the PSP/IS☉IS team

1 University of New Hampshire, Institute for the Study of Earth, Oceans, and Space, Space Science Center, Durham, United States of America (jonathan.niehof@unh.edu)
2 Department of Astrophysical Sciences, Princeton University, Princeton, NJ, 08544, USA

A full list of authors appears at the end of the abstract

A series of solar energetic particle (SEP) events were observed at Parker Solar Probe (PSP) by the Integrated Science Investigation of the Sun (IS☉IS) during the period from April 18, 2019 through April 24, 2019. The PSP spacecraft was located near 0.48 au from the Sun on Parker spiral field lines that projected out to 1 au within ∼25° of near Earth spacecraft. These SEP events, though small compared to historically large SEP events, were amongst the largest observed thus far in the PSP mission and provide critical information about the space environment inside 1 au during SEP events. During this period the Sun released multiple coronal mass ejections (CMEs). One of these CMEs observed was initiated on April 20, 2019 at 01:25 UTC, and the interplanetary CME (ICME) propagated out and passed over the PSP spacecraft. Observations by the Electromagnetic Fields Investigation (FIELDS) show that the magnetic field structure was mostly radial throughout the passage of the compression region and the plasma that followed, indicating that PSP did not directly observe a flux rope internal to the ICME, consistent with the location of PSP on the flank of the ICME. Analysis using relativistic electrons observed near Earth by the Electron, Proton and Alpha Monitor (EPAM) on the Advanced Composition Explorer (ACE) demonstrates the presence of flare-accelerated seed populations during the events observed. The energy spectrum of the IS☉IS observed seed population below 1 MeV is consistent with the superposition of acceleration processes near the limit of plasma stability. IS☉IS observations reveal the compression and acceleration of seed populations during the passage of the ICME, which is likely a key part of the pre-acceleration process that occurs close to the Sun and pre-conditions the energetic particle acceleration process.
