



Dependence of Energetic Storm Particle Heavy Ion Peak Intensities and Spectra on CME Source Longitude and Speed

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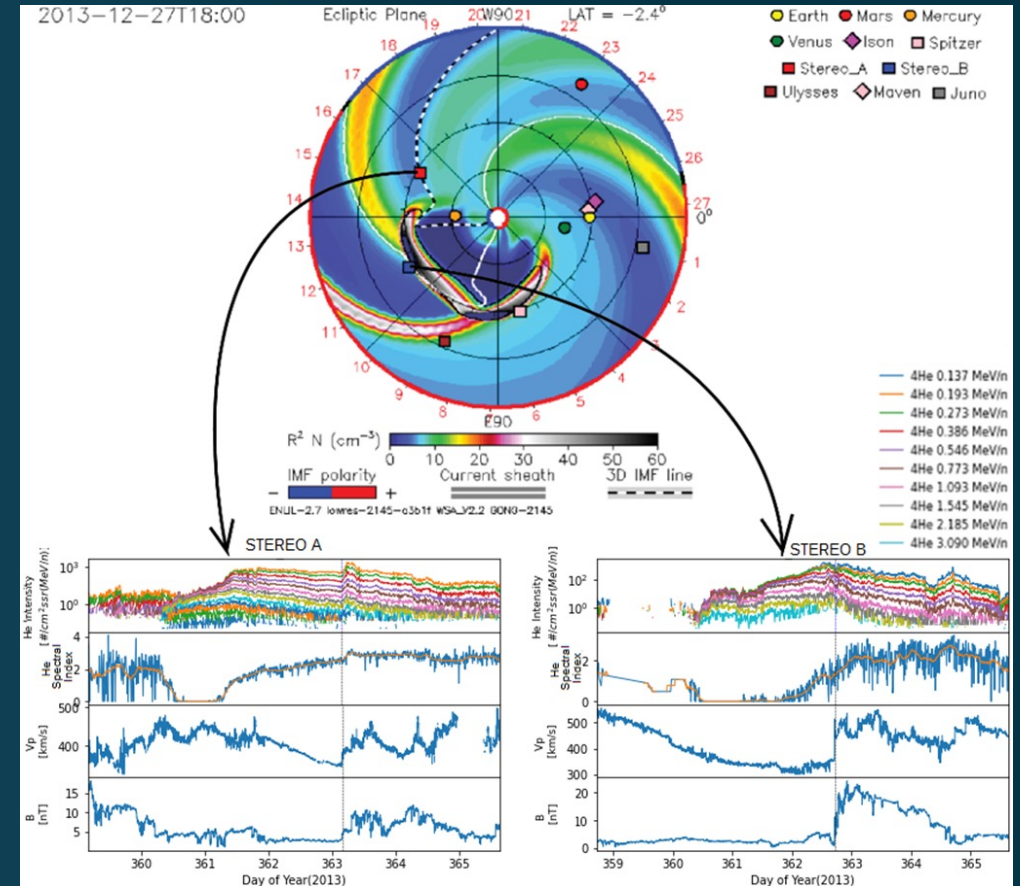


Background



- Energetic storm particle (ESP) events are enhancements of energetic particles (ions and electrons) observed during the passage of an interplanetary (IP) shock, and are associated with Coronal Mass Ejections (CMEs) or interactions between fast and slow solar wind streams.
- Heavy ion in energetic storm particle (ESP) events at CME shocks provide unique insight into the ESP source(s) and acceleration process(es), including the roles of seed particles from flares and/or previous CMEs
- Understanding what factors affect the production of ESPs will help us better understand the energetic particles, a significant Space Weather hazard to spacecraft and astronauts, especially those beyond Earth orbit.
- STEREO has provided the possibility of observing ESPs at multiple locations along the shock, allowing tests of their spatial dependences inferred from single point measurements

Right: Top – WSE-ENLIL simulation looking down on the solar system showing one CME on 2013-12-27 and the locations of STEREO A and B, and ACE. Simulation from the Community Coordinated Modeling Center (CCMC) Bottom - STEREO in-situ observations showing energetic Helium intensity and spectral index, solar wind speed and magnetic fields. (credit Santa Fe Dueñas et al.)





Analysis

- In this paper, the investigators examined the dependence of ESP heavy ion peak intensities and spectra with the longitude relative to the CME source region and with CME speed, for events observed in Solar Cycle 24 at STEREO-A, STEREO-B, and/or ACE
- CME speeds near the Sun are obtained from estimates reported in the Space Weather Database of Notifications, Knowledge, and Information (DONKI) at the Community Coordinated Modeling Center (CCMC)

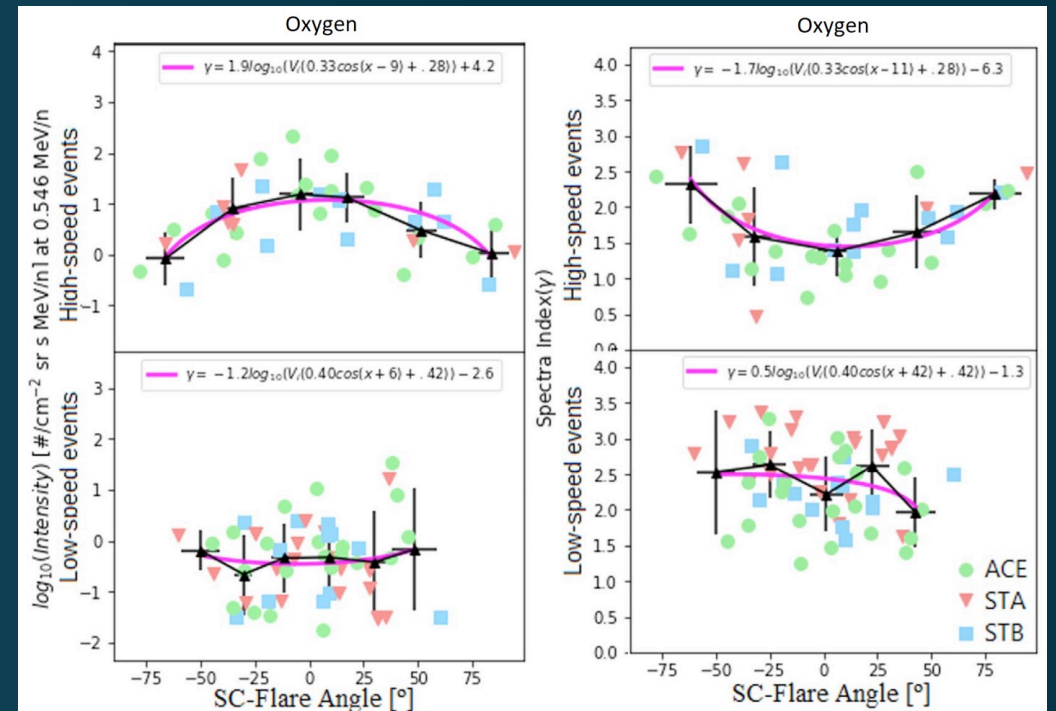




Findings & Impacts



- Intensities of ESP events correlate with CME transit speed.
- ESP events associated with fast CMEs (top panels to the right) showed larger heavy ion peak intensities near the nose of the shock (Space Craft (SC)-Flare Angle = 0°) compared to the flanks while their spectral index was smaller near the nose and larger at the flanks. These results can account for some of the variability observed in ESP heavy ion properties at 1 AU
- The study enhances our understanding of the variability of these particles, which in turn helps us better understand variations in space weather. This sort of study will ultimately guide space weather prediction efforts.



Above: Comparison of ESP events associated with fast CMEs (top) vs. slow CMEs (bottom).
Credit: Santa Fe Dueñas et al. (2022)



Publication Information



“Dependence of Energetic Storm Particle Heavy Ion Peak Intensities and Spectra on Source CME Longitude and Speed”

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