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The Role of Interplanetary Shocks for Accelerating MeV Electrons

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One source of solar energetic particle (SEP) events are shocks that are driven by fast Coronal Mass Ejections (CMEs). These can accelerate SEPs up to relativistic energies and are attributed to the largest SEP events. Even though the exact role of shocks for accelerating SEP electrons is still under debate, new studies suggest that CME-driven shocks can efficiently accelerate electrons to MeV energies in the vicinity of the Sun.

In this ongoing study, we present STEREO spacecraft observations of potential electron Energetic Storm Particle (ESP) events, characterized by intensity time series that peak at the time of the associated CME-driven shock crossing. We study near-relativistic and relativistic electrons during strong IP shocks between 2007 and 2018, to answer if the shock can actually keep accelerating electrons up to 1 AU distance. We use both, the Solar Electron and Proton Telescope (SEPT) and the High Energy Telescope (HET).

We focus especially on the MeV electron measurements and study if these are real or if the increases during the shock crossing are caused by strong proton contamination in the instrument. Therefore, we investigate the time profiles of the SEP events from the beginning until the crossing of the CME-associated shock and perform a correlation analysis of electron and proton intensities. We also investigate the in-situ plasma and magnetic field measurements at the spacecraft and analyze the energy spectrum of upstream regions of the shocks to shed light on the shock acceleration mechanism.