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Multi-spacecraft observations of near-relativistic electron events at different radial distances

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With the launch of Solar Orbiter (SolO) on Feb. 10th 2020, a new era of multi-spacecraft solar energetic particles (SEP) observations has started. The unique orbit of the mission allows the observation of SEP events close to the Sun (<0.28 au), which can occasionally be compared to corresponding observations made by other spacecraft at 1au. Such multi-spacecraft observations of the same event at different radial distances provide an excellent opportunity to study the radial evolution of SEP events.

In this study, we identify SEP events for which SolO and either Wind or STEREO-A had a small longitudinal separation (<15°) between their magnetic foot-points at the Sun. For all SEP events that satisfy our selection criteria we determine the onset times and rise times as well as peak fluxes and peak values of the first-order anisotropy for electrons in the energy range from 50−85 keV. We compare the event parameters observed at the different spacecraft regarding their radial changes. In our sample we find strong event-to-event variations in the radial dependency of all derived event parameters. For the majority of events, the peak flux and the maximum value of the first-order anisotropy decrease with increasing radial distance to the Sun, while the rise time increases with radial distance in the majority of events. The derived onset delays observed between two spacecraft were found to be too long to be explained by ideal Parker spirals in multiple events.

We present an overview of the most interesting observations and discuss the wide variability in the radial dependency of the event parameters analysed in this study.