

EGU23-15283, updated on 26 Apr 2024

<https://doi.org/10.5194/egusphere-egu23-15283>

EGU General Assembly 2023

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Using non-thermal electron distributions to probe the inner heliosphere

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The electrons in the solar wind exhibit non-thermal velocity distribution functions. Observed non-thermal features of the electron distribution in the inner heliosphere include the field-aligned strahl, the suprathermal halo, the sunward deficit, and temperature anisotropy. These features are the result of a complex interplay between global expansion effects and local interactions between the particles and the electromagnetic fields. Global effects create, for example, the strahl via the mirror force in the decreasing magnetic field and the sunward deficit via reflections in the interplanetary electric field. Local wave-particle interactions such as instabilities change the shape of these features and thus the overall properties and moments of the electron distribution.

We discuss the science opportunities that the high-resolution data of Solar Orbiter's SWA/EAS sensor open up for unprecedented studies of the causes and effects of non-thermal electron distributions in the context of the expansion of the solar wind in the inner heliosphere. We focus, in particular, on the interplay between expansion effects and instabilities related to the electron strahl and the sunward deficit.