Diagnostic of the suprathermal electrons strahl scattering mechanism with Parker Solar Probe and Solar Orbiter data

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Résumé

The solar wind shows different electrons populations, namely, the core, a thermalized isotropic component, and the suprathermals, at energies larger than a few kT, which exhibit non-gaussian energy tails. The latter is divided among an isotropic halo and the strahl population which we can describe as an excess of electrons aligned with the magnetic field line direction.

For this study, we aim at characterizing the strahl electrons distributions and their radial evolution in the close neighborhood of the Sun. For this purpose we study their pitch angle width (PAW) and look for correlations between this quantity and other local plasma or magnetic field parameters. Using the data from Parker Solar Probe and Solar Orbiter missions, respectively the Solar Probe ANalyzers (SPAN-electron and SPAN-ion) and the Solar Wind Analyser (SWA) for the electrostatic analysers and the so called magnetometers (respectively FIELDS-MAG and MAG).

We explore the repartition of the SPAW in a parameter space including distance to the Sun, plasma moments (n, T, v, ...) and magnetic fluctuations properties (alfvenicity, intensity of fluctuations, etc.).

First, we show that Coulomb collisions are the main scattering process closer than 35 solar radii, a region where the SPAW decreases with distance to the Sun - this is a first unambiguous and quantitative observation of the effect of coulomb collisions on suprathermals.

Further away from the Sun, we identify two solar wind type of streams : one in which SPAW are very small, and one characterized by large SPAW. The characteristics of magnetic fluctuations and background plasma properties in these two type of streams are identified, and we discuss the possible reasons of the existence of these low and high scattering regimes.

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