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Electron Strahl properties in the solar wind: Helios, Cluster and Ulysses Observations

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The observations show that the solar wind electrons can be typically represented by three different populations. The main part is composed of the thermal core electrons representing 95% of the total electron density. The left 5% represent the suprathermal non-Maxwellian halo, distributed in all directions of the velocity space and the strahl. This last component is mostly aligned in the direction parallel to the interplanetary magnetic field and largely moving away from the Sun. Even thought the strahl component only represents a few percents of the total number density, it plays an important role regarding the solar wind plasma properties. For instance it is responsible for the main part of the electron heat flux and it can also create electron temperature anistropies which can give rise to plasma instabilities. We present a statistical study of the strahl population from analysis of measured electron velocity distribution functions. The strahl is fitted with analytical models and its resulting characteristics are compared with other electron properties in order to study their possible correlations. Our data set comprises measurements from three missions, namely HELIOS I, HELIOS II, CLUSTER II and ULYSSES, and covers the radial distance from the Sun from 0.3 AU up to almost 4 AU. It is thus possible to examine also the radial evolution of the strahl properties.