Geophysical Research Abstracts
Vol. 21, EGU2019-16531, 2019
EGU General Assembly 2019

The role of Coulomb collisions in the solar wind acceleration region: Kinetic simulations

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The solar wind is, being a weakly collisional plasma, difficult to completely capture by commonly used fluid or kinetic numerical models. To be able to reproduce suprathermal, non-maxwellian velocity distribution functions so commonly observed for the solar wind electrons, we have to apply a fully kinetic approach, usually computationally highly demanding. Aiming to reduce the complexity of the model capable of well reproducing the observed solar wind parameters, we use a fully kinetic model of radially expanding solar wind taking into account binary collisions between the particles (Landi & Pantellini, 2001, A&A 372:686). With it we are able to study the importance of Coulomb collisions in shaping the velocity distributions in the solar wind, but are in turn neglecting any wave particle interactions. The model has been already used to study the evolution of the electron velocity distribution functions and macro quantities in the expanding solar wind between 0.3 to 3 au (Landi et al., 2012, ApJ 760:143; Landi et al., 2014, ApJL 790:L12). Besides these works, Zouganelis et al., (2005, ApJL 626:L117) used the same model to quantify the importance of the presence of suprathermal electrons within the solar corona on the maximal reached solar wind velocity.

As a continuation of the above studies we simulate acceleration region up to 35 R_{Sun}, the distance reached during the first two perihelions of the new solar mission the Parker Solar Probe. We explore how important is the role of expansion and collisions compared to the role of initial conditions in producing a complex electron velocity distribution functions observed further from the Sun.