Stefan
Hofmeister
Columbia Astrophysics Laboratory, Columbia University, New York, NY-10027, USA
Astrid Veronig (Kanzelhöhe Observatory for Solar and Environmental Research & Institute of Physics, University of Graz)
Stefaan Poedts (Center for Mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Celestijnenlaan 200B, 3001Leuven, Belgium; Institute of Physics, University of Maria Curie-Sk?odowska, Pl. Marii Curie-Sk?odowskiej 5, 20-031 Lublin, Poland)
Jasmina Magdalenic (Solar-Terrestrial Centre of Excellence—SIDC, Royal Observatory of Belgium)
Manuela Temmer (University of Graz, Austria)
Susanne Vennerstrom (DTU Space, Denmark)
Bojan Vrsnak (Hvar Observatory, Faculty of Geodesy, University of Zagreb, Croatia)
Evangelia Samara (Centre for mathematical Plasma Astrophysics (CmPA), Department of Mathematics, KU Leuven, Belgium)
Verena Heidrich-Meisner (University of Kiel)
Stephan Heinemann (Max Planck Institute for Solar System Research, Göttingen, Germany) Eleanna Asvestari (Department of Physics, University of Helsinki, Finland)
Oral
Since the 1970s, it is empirically known that the area of coronal holes affects the properties of high speed solar wind streams (HSSs) at Earth. However, a theoretical explanation was still missing. We derive a simple analytical model for the propagation of HSSs from the Sun to Earth, and thereby show how the area of coronal holes affect the HSS velocity, temperature, and density near Earth.
We show that the velocity plateau region of HSSs as seen at 1 AU originates from the center region of the HSS close to the Sun, whereas the velocity tail originates from the trailing boundary region. The peak velocity at Earth depends on the longitudinal width of the HSS close to the Sun. The shorter the longitudinal width of a HSSs close to the Sun, the more of its 'fastest' HSS plasma parcels have impinged into the stream interface to the preceding slow solar wind, and the smaller is the peak velocity at Earth. Further, the temperature and density of HSS plasma parcels at Earth depend on their radial expansion from the Sun to Earth. The radial expansion is determined by the velocity gradient across the HSS boundary region close to the Sun, and gives the velocity-temperature and density-temperature relationships their specific shape. Finally, we show how the number of particles of the piled-up slow solar wind in the stream interaction region depends on the velocities and densities of the HSS and preceding slow solar wind plasma.
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