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INTRODUCTION
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Special Collection:
Solar Wind: Origin, Acceleration, and Outflow

Introduction to Multidisciplinary Special Collection: Solar Wind: Origin, Acceleration, and Outflow

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Abstract On the occasion of the 50 years since the launch of Helios 1 and Helios 2, we proposed a special collection related to the solar wind, its origin, evolution, and space weather related effects. In addition to old missions like ULYSSES that explored the solar wind outside the ecliptic plane, recent missions like the Parker Solar Probe (PSP) and Solar Orbiter (SolO), as well as established ones such as the Solar Dynamics Observatory (SDO) and the Solar Terrestrial Relations Observatories (STEREOs), offer extensive new measurements that help to refine existing knowledge of slow and fast solar wind in the heliosphere and the development of new models. This collection addressed different solar wind topics, which included but were not limited to the mechanisms of solar wind acceleration and outflow, dynamics of stream interaction, the configuration of the magnetic field and plasma topology at the source surface and within the inner heliosphere.

Key Points:

- Preface to the special collection Solar Wind
- Characterization of the solar corona as a source of solar wind
- Importance of the core, halo and Strahl electrons in the solar wind acceleration

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Solar corona as source of the solar wind: As solar wind depends on the conditions in the corona, observations at low radial distances are crucial to determine the most important acceleration processes. Innovative results have shown that proton - specific entropy variability ceases its evolution on open magnetic fields as solar plasma becomes collisionless. Consequently, proton specific entropy, charge states, and elemental abundance ratios constrain the role of interchange reconnection in the corona. Using observations from Ulysses, periodic density structures were identified in the fast solar wind from polar coronal holes, demonstrating a global source. Periodic density structures formed in the low solar corona have many aspects dependent on the magnetic field configuration at the solar source location. Comparisons between models and observations enable prediction improvements. The stationary solar wind model WSA-ENLIL predicts Stream Interaction Regions (SIR) that arrive earlier and last longer compared to in situ measurements made by Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft. SIR speed is well predicted by WSA-ENLIL, while density and magnetic field magnitude are smaller than in situ measurements from MAVEN. In situ magnetic compression ratios measured at MAVEN are, on average, smaller than those predicted by WSA-ENLIL.

Importance of core, halo and Strahl electrons: PSP observations at very low distances from the Sun provide new information about the presence of suprathermal electrons with Kappa distributions in the solar corona that play a key role in the formation and acceleration of the solar wind. Observed electron core and halo populations in the solar wind are correlated by kinetic parameters, temperature anisotropy and plasma beta. Thresholds of temperature anisotropy instabilities can be significantly reduced under the mutual core-halo effects. Comparisons with observations prove the constraining role of self-generated instabilities for the low-energy core and the suprathermal halo. Suprathermal electrons with Kappa distributions (KDs) in the solar corona play a key role in the formation and acceleration of the solar wind. Semi-analytic kinetic models built for the large-distance solar wind by assuming electrons with regularized KDs at the exobase emphasize the importance of the increased presence of suprathermal electrons. Parker Solar Probe also enables us to study the whistlers. By reconstructing whistler wave polarization using PSP measurements for heliocentric distances of 10.75–101 Rs, it was shown that whistlers are mostly quasi-parallel, with 87% having a propagation angle under 25, and exhibit rapid amplitude decay with increasing angle. Sunward waves have a high frequency and interact via less efficient resonances with strahl electrons.

Conflict of Interest

The author declares no conflicts of interest relevant to this study.

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Availability Statement

There are no data used in this paper.

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