Project Details

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Topic: Origins, Acceleration and Evolution of the Solar Wind

Project Title:
The Spatial, Temporal, and Charge-State Variability of the Solar Wind

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Summary:
The solar wind expands outward from the solar corona and fills the heliosphere. It is the medium by which solar-driven space weather phenomena transmit their effects to Earth and the surrounding space environment. Fundamental questions remain about the wind's origin and acceleration, its connection to smaller-scale dynamical phenomena close to the Sun, and the partitioning of the wind into fast and slow streams. Specific examples include:

1) Are topological changes to the magnetic field (e.g. interchange reconnection) in the corona essential for explaining heliospheric solar wind properties?
2) Are density fluctuations related to such processes, and if so, what determines their observed time period?
3) What coronal processes are required to explain ionization charge states in the heliosphere?

To address these questions, we propose to use a magnetohydrodynamic (MHD) model of the solar corona and heliosphere developed at PSI to model specific time periods. The model incorporates the time-dependent evolution of the magnetic field in response to photospheric motions, a wave-turbulence-driven (WTD) description of corona heating, Alfv n wave acceleration of the solar wind, and modeling of ionization charge states. It will be supplemented with comprehensive topological analysis of the magnetic field that identifies different types of magnetic reconnection. Specifically, we will:

* Model the solar wind, in conjunction with the charge states, as it evolves in response to the magnetic field evolution on the solar surface, and compare our results with remote observations and in-situ measurements.
* Utilize an advanced technique for identifying topological changes (i.e., interchange reconnection) in the magnetic field and unravel their role in producing plasma properties.
* Determine whether density fluctuations are also a consequence of the topological evolution of the Sun s magnetic field.
* Connect in situ measurements of the solar wind with the topology of the coronal magnetic field, and provide our results to the LWS team and the larger scientific community.

Our proposed investigation, which aims at furthering our understanding of the solar wind by connecting topological properties with in-situ measurements, density fluctuations, charge states, and the formation of the wind itself, is relevant to FST #2: Origins, Acceleration and Evolution of the Solar Wind. It contains modern theoretical (topological analysis), numerical modeling (MHD), and observational analysis (charge states) elements. We will quantitatively compare our results with remote observations from NASA missions such as SDO, SOHO, and STEREO, and in situ measurements from ACE, PSP, and STEREO. Our project will provide tools for linking these in situ measurements with the remote observations..

Publication References:

no references