Project Details

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Project Title:
Solar Wind from Pseudostreamers and their Immediate Environment: Observations and Modeling

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Summary:
Beyond the very large-scale relationship of fast solar wind streams to coronal holes, the connection between coronal structures and their solar wind counterparts remains largely mysterious. The traditional view states that slow solar wind arises from the boundaries of coronal holes due to the larger expansion factor. It is hard in this explanation to understand why the slow wind occupies so much space in the heliosphere. Pseudostreamers are multipolar features which develop into fields that are unipolar at greater heights. There is debate as to the speed and nature of the wind from pseudostreamers: it could be fast, slow, or in between. And, in general, they
might form a network of slow wind which may or may not connect in the heliosphere to slow wind coming from around the heliospheric current sheet.

Different types of pseudostreamers exist, with a complex inner structure which depends on the number of polarities embedded in the closed regions below. In addition pseudostreamers may also harbor filament channels, often occurring in pairs (twin filament channels). In the latter case, the strongly sheared field of the channel magnetic structures and the skew of the coronal arcade above the channels dictate the way the coronal field expands in the neighborhood of pseudostreamers. We will calculate the expansion factor along the PFSS extrapolated magnetic field lines to investigate relationship between pseudostreamers and wind speed, study how the resulting wind type depends on the global coronal environment, including the height of the pseudostreamer null point, the presence or absence of filament channels, and therefore the expansion of the coronal magnetic field in the neighborhood of the pseudostreamer spine. We will follow formation and evolution of the low-latitude coronal hole from decaying active regions in which pseudostreamers are embedded, study coronal cells and filaments topology at the pseudostreamer bases to determine the direction of the tangential fields and currents in the pseudostreamer bases. We will study the composition and fluctuation of the solar wind from pseudostreamers during the whole period of their evolution from formation to dissipation.

We will also carry out numerical models of the solar wind along field lines chosen from potential field source-surface calculations extrapolated from HMI and MDI magnetograms to better understand the sources of slow and fast solar wind for the Solar Probe Plus mission. The magnetic field extrapolated potentially to 2.5 Solar radii will be used as a skeleton along which both stationary and time-dependent 1D solar wind models will be calculated to understand the solar wind structure in the inner heliosphere. The transverse pressure structure will then be iteratively adjusted (inside 2.5 solar radii) to develop a semi-empirical three dimensional model of the corona and inner solar wind.

Finally, we will also perform local simulations of field point motions in model pseudostreamers to see the type and speed of outflow generated locally by reconnection at the pseudostreamer fan/spine surface. Reconnection at the location occurs due to the accumulation of magnetic stresses from field line stressing due to the random motions at the photosphere. This would release particles from the confined plasma below the pseudostreamer into the solar wind via jets of plasma adding to the solar wind naturally flowing along the open field regions adjacent to the spine.

Publication References:

no references