Project Details

ROSES ID: NNH14ZDA001N
Selection Year: 2014
Program Element: Physics of the Inner Heliosphere

Topic: Physics-based methods to predict connectivity of SEP sources to points in the inner heliosphere, tested by location, timing, and longitudinal separation of SEPs

Project Title:
The Transport of Electromagnetic Energy from the Upper Convection-Zone to Outer Corona

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Summary:
To maximize the scientific return from revolutionary new in-situ measurements of the solar corona to be provided by NASA's Solar Probe Plus mission, we propose a focused modeling effort to characterize the transport of electromagnetic energy from the upper convection-zone to the outer corona. Our goals are to (1) self-consistently model the introduction of magnetic energy through footpoint motions and reconnection arising from turbulent granular convection at the Sun's visible surface; and (2) understand how the network of embedded bipolar flux regions, through pseudo-streamers and the main helmet streamer belt, modulates this flow of energy.

We will perform a series of large-scale numerical simulations using a recently-updated version of the radiative-magnetohydrodynamic code RADMHD2S to: (1) Characterize the wave spectra and time series of magnetic field and plasma fluctuations at 5-10Rs in a unipolar open-field region --- one that represents the open field within a coronal hole, and the source of the fast solar wind; (2) Introduce a relatively large-scale bipolar flux system embedded in a unipolar open field to characterize the effects of the closed field region on the transport of material and energy flux, and quantify how the wave spectra and temporal evolution of magnetic field and plasma fluctuations reflect this larger coronal structure; and (3) Extend these simulations to the size of a coronal pseudo-streamer, then to the size of the helmet streamer belt.

This research will, for the first time, allow for a calculation of the energy input and spectrum from an ab-initio, first-principles numerical simulation, rather than making ad-hoc assumptions about how the solar convection zone affects open-field regions. In addition, the construction of synthetic time series of field and plasma quantities, will allow for a comparison to future measurements taken by Solar Probe Plus.

Publication References:

Summary: no summary

Reference:
Fisher, G. H.; Abbett, W. P.; Bercik, D. J.; Kazachenko, M. D.; Lynch, B. J.; Welsch, B. T.; Hoeksema, J. T.; Hayashi, K.; Liu, Y.; Norton, A. A.; Dalda, A. Sainz; Sun, X.; DeRosa, M. L.; Cheung, M. C. M.; (2015), The Coronal Global Evolutionary Model: Using HMI Vector Magnetogram and Doppler Data to Model the Buildup of Free Magnetic Energy in the Solar Corona, Space Weather, Volume 13, Issue 6, pp. 369-373, doi: 10.1002/2015SW001191