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:
What is the origin and life-cycle of transient and long-lived open solar magnetic fields?

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Summary:
Goals and Objectives: Open solar magnetic field primarily consists of long-lived, large open field regions (coronal holes, or CHs) and transient open fields related to solar eruptions (dimming regions). Although these phenomena are well observed, the origin and life-cycle of open magnetic field on the Sun is still highly debated. Open magnetic field may be created during large solar eruptions as magnetic field lines are dragged out into the heliosphere. This open field is briefly observed as a dimming region. Meanwhile, large open magnetic field regions (CHs) form in the quiet Sun and gradually disintegrate, with the cause of the formation and disappearance unclear. It has been suggested that decaying active regions (ARs) may provide a hotbed for CH emergence, but it may or may not be the sole source. Our goal is to investigate the different ways open magnetic field emerges in the Sun: through eruptive processes and gradual accumulation. We will determine its evolution over the solar cycle: is open flux recycled, i.e. concentrated at the poles during solar minimum and redistributed in the quiet Sun afterward, or created by opening closed field near ARs and/or during eruptive events. Methodology: We will carry out our investigation using automated CH and dimming detection algorithms that have already been developed by the PI. These algorithms allow us to determine the properties of CHs and dimmings (area, polarity, location, photospheric magnetic field strength, duration of existence, N/S asymmetry). The algorithms have been developed to be compatible with different satellites and instruments (SDO/AIA, STEREO/EUVI, SOHO/EIT, Hinode/XRT). A CH catalogue (1996-present) has already been created by the PI, and a dimming catalogue is currently being populated. Our dimming tracking algorithm will be further developed to allow for the automated identification of dimmings, allowing us to process the large amount of data available. Our CH and dimming databases have been created using SOHO/EIT and SDO/AIA. We will also use STEREO/EUVI detections to create 360 degree maps of open field regions for the available period and compare them with available PFSS models of the Sun to establish the differences between the observational and theoretical models of open fields. This will be beneficial to CME modeling and forecasting purposes. We have also developed tools to link the observed open field regions with solar wind signatures using ACE data, which will allow us to study the complete Sun-Earth connection and assist improving the accuracy of existing forecasting models. Relevance to the Solar Orbiter/Solar Probe Plus missions: Our proposed research will directly advance our understanding of the connection between coronal and heliospheric structures. Specifically, we will study the connection between short/long lived open magnetic fields (dimmings/CHs) and the corresponding solar wind structures using multiple instruments. Our tools have been thoroughly tested and used in the community (e.g. NOAA/SWPC, Heliophysics Feature Catalogue), making their adaption to Solar Orbiter/Solar Probe Plus straightforward and reliable.

Publication References:

Summary: no summary

Reference: Krista, Larisza D.; Reinard, Alysha A.; (2016), Statistical Study of Solar Dimmings Using CoDiT, The Astrophysical Journal, Volume 839, Issue 1, article id. 50, 7 pp, doi: 10.3847/1538-4357/aa6626