Project Details

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Selection Year: 2017
Program Element: Focused Science Topic

Topic: Toward a Systems Approach to Energetic Particle Acceleration and Transport on the Sun and in the Heliosphere

Project Title:
Understanding the Genesis of Coronal Mass Ejections and Shocks via multi-viewpoint EUV and coronagraph analysis

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Summary:
This proposal addresses the Focused Science Topic: "Toward a Systems Approach to Energetic Particle acceleration and Transport on the Sun and in the Heliosphere" via the analysis of multi-view, high cadence EUV and White Light observations of the formation of CMEs and shocks in the solar corona. The study includes CMEs with and without SEPs integrating tightly with the final FST team.

Goals

Our goals are a focused subset of the overarching FST goals. Namely, we aim to develop a detailed observational understanding of the properties of the source regions of SEPs and to understand the relative roles of flares and CMEs in producing SEPs as well as the underlying mechanisms. Depending on the direction of the broader FST team we could also contribute in identifying the mechanisms by which impulsive or gradual SEP events of large angular extent occur.

Objectives

Our starting hypothesis, based on our early 3D reconstructions of EUV CMEs with STEREO/SECCHI and SDO/AIA, is that some CMEs undergo a fast (~1000 km/s), short-lived (
To test this hypothesis, we undertake a thorough analysis of multi-view EUV and coronagraph observations of CME and shock/wave formation for SEP-associated events to address the following science questions:

- What is the 3D kinematic profile of the nascent CME? More specifically, do SEP-associated CMEs undergo a hyper-inflation phase during their formation?

- What are the 3D properties (kinematic and dynamic) of the CME and its associated wave from the low corona to 15 Rs?

- Can these properties account for the existence (or absence) of SEPs in a given event?

Methodology

We leverage existing analysis tools developed by our team and highly relevant to this problem. Namely, we use the 3D shock/CME reconstruction and wavelet-enhancement algorithms developed for the SECCHI analysis, and the Coronal Analysis of Shocks and Waves (CASHeW) framework developed for AIA analysis. Our approach comprises the following broad tasks:

- Use the CASHeW list of CME events (http://helio.cfa.harvard.edu/cashew/) to select a subsect of 20-30 CME-SEP events with good observational coverage in SECCHI+AIA.

- Select another set of ~10 events with similar EUV signatures but without (or possibly weak) SEP signatures to use as control group.

- Perform 3D reconstructions of the CME and wave in the EUV (2) across the shock below 15 Rs. Establish whether the hyper-inflation phase exists and whether it correlates with SEPs. Establish an empirical relationship between CME/shock kinematics and SEP production.

Publication References:

no references