Project Details

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Program Element: Focused Science Topic

Topic: Shock acceleration of solar energetic particles by interplanetary CMEs

Project Title:
Search for Shocks Ahead of LASCO CMEs

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Summary:
We propose a research plan designed to contribute to the first of the Focused Science targets identified in the LWS TR&T program:

Shock acceleration of solar energetic particles by interplanetary Coronal Mass Ejections

We will attack a fundamental component of this problem; namely, the formation and evolution of CME-induced shocks using a combination of observations, MHD models and analysis tools. Our goal is to provide a clear understanding of the shock structure in white light coronagraph images. Our objectives are: (1) to establish whether CME-driven shocks are detectable in white light coronagraph images, (2) to derive methods to reliably identify these shocks, and (3) to provide tools for extracting the physical parameters of the shock for inputs to particle acceleration models. We will also attempt to compile metrics and/or rules for the easy identification of the shocks for operational applications. Our analysis will be based on calibrated white light images from the SOHO/LASCO C2 and C3 coronagraphs.

To achieve our objectives, we will use the high dynamic range and fidelity of calibrated LASCO images to search for faint emissions/fronts ahead of fast CMEs. We will then use two new tools, raytrace and magnetosonic speed maps, to identify and measure the physical parameters across the shocks. We will also use synthetic white light maps from recent 3D MHD models to guide us in the interpretation of the various white light features and to investigate the expected visibility/morphology of the shock under varying viewing angles

This work and its potential applications relate directly to the new vision of NASA as it applies to both human and robotic exploration. Knowledge of the shock conditions in the corona/heliosphere and in extension of the likelihood of SEP events will be crucial extending human presence across the Solar System (a National Objective) and in particular for successfully conducting Lunar and Martian manned expeditions (NASA Objectives). Our proposal relates directly to the NASA Objective of "exploring the Sun-Earth system to understand the Sun and its effects on Earth, the Solar System, and the space environmental conditions that will be experienced by human explorers, and demonstrate technologies that can improve future operational Earth observation systems". Our work also contributes to increased understanding of CME and coronal physics through the better determination of density profiles in CMEs, shocks and the extended corona, and to better models of the CME phenomenon through the validation of such codes. In that sense, our work contributes to the objectives of the Solar and Heliospheric Physics program.

Publication References:

no references