Project Details

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Project Title:
Numerical Modeling of the Evolution of CME Shocks in a Realistic Lower Corona and their Radio and Energetic Particles Signatures

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Summary:
This proposal will address two important questions for Living with a Star motivated by recent CME-related solar energetic particle (SEP) and radio observations: (1) Can strong CME-driven shocks form in the lower corona (~3 solar radii) and accelerate particles to the GeV/nucleon energies observed in some ground level CME-related events? and (2) Can some CMEs drive multiple coronal shocks, as suggested by radio observations, because of the strong variations in the magnetosonic speed in the lower corona? While it is general accepted that the largest energetic particle events are created by CME-driven shocks in interplanetary space, the relative importance of CME-driven shocks versus flare-related processes in creating energetic particles low in the corona is not understood and is an area of active research. To answer these questions, we will use the state-of-the-art 3D MHD BATS-R-US code to model CME-driven shocks in the lower corona. This code is the most suitable for this task because its adaptive grid capability will allow sufficient resolution near the Sun to follow the CME and shock evolution. The CME will be modeled as a buoyant flux rope lying under a closed field region. The MHD code will first be used to create realistic background corona using observed photospheric fields for boundary conditions so that results from the model can be compared to SEP and radio observations from specific CME events. We will validate the background corona by computing the magnetic field topology and solar wind from the Sun to 1 AU and comparing results from the model with in situ solar wind observations from ACE. This will be the first 3D MHD study focused on understanding the formation and evolution of CME-driven shocks in the lower corona and their role in SEP creation. In keeping with the goals of the LWS TR&T program, this research will increase our scientific understanding of the basic physical processes underlying the Sun-Earth connection. The team assembled, consisting of scientists from JPL, the University of Michigan, GSFC and the University of Florence, has the necessary numerical, analytic and observational experience needed for the proposed work.

Publication References:

Summary: ''

Reference: Merav Opher / GMU-Alfvén Profile in the Lower Corona: Implications for Shock Formation