

## Project Details

**ROSES ID:** NNH05ZDA001N

**Selection Year:** 2006

**Program Element:** Independent Investigation

**Topic:** Shock acceleration of solar energetic particles by interplanetary CMEs

**Project Title:**

Modeling The 3D Density Structure and White-Light Appearance of CME Events

**PI Name:** Ward Manchester

**PI Email:** chipm@umich.edu

**Affiliation:** University of Michigan

**Project Member(s):**

- Vourlidas, Angelos ; Co-I; JHU/APL
- Roussev, Ilia Iankov; Collaborator; University of Hawaii

**Summary:**

We propose to examine the propagation of solar eruptive events to 1 AU

in a realistic heliosphere using a global magnetohydrodynamic (MHD) model.

The main focus of this study will be the evolution of the 3D density

structure of the CME and how it relates to Thomson-scattered white

light images. The University of Michigan's BATSRUS code will be used to

perform the proposed simulations. CME initiation will follow from

both flux ropes and (Gibson & Low, 1998) and imposed shearing motions.

Our earlier simulations have produced many important results. We have

shown that the mass of fast CMEs increases by as much as a factor of

four as they propagate to Earth because of plasma swept up by the

CME-driven shock. We have also shown that line-of-sight measurements

of CME mass may significantly underestimate the mass swept up by a

CME if a dense spherical shell encases a low density cavity. Expansion

of the CME flux rope has also been shown to cause the dense core to

evolve to a density depletion. These results have been published in a

series of papers: Manchester et al. (2004a, 2004b) Lugaz, Manchester

and Gombosi (2005). This proposal seeks funds to significantly

advance this research in 4 ways: (1) incorporate a more realistic

MHD model of the inner heliosphere based on solar magnetograms,

(2) investigate the pre-eruption conditions at the Sun based on

magnetic data for chosen active regions and use this data to direct

CME initiation, (3) comparing the CME synthetic white light images

with LASCO observations near the Sun and images obtained near 1 AU

with STEREO. We will examine the 3D model density structure of CME disturbances and line-of-sight images to determine what may be accurately inferred about the density, velocity and energy of CMEs from single and stereoscopic views. Understanding the CME morphology will allow us to separate the shock from the driver and will lead to more accurate measurements of the physical parameters such as the compression ratio, speed, mass, and location. In the case of shocks, the compression ratio and speed are necessary inputs in models of particle acceleration. Understanding how the various CME structures evolve through the heliosphere will enhance the scientific return from the numerous in-situ instruments. It will also help us investigate what causes some CME to be geoeffective. Obtaining realistic CME models throughout the heliosphere will greatly enhance the return from the SECCHI observations by (1) providing examples of how certain CME structures (shock, flux rope) will look at different heliocentric distances and perspectives, and (2) act as a controlled data set upon which to test the fidelity of the 3D reconstruction algorithms.

## **Publication References:**

no references