Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Focused Science Topic

Topic: To determine the solar origins of the plasma and magnetic flux observed in an Interplanetary Coronal Mass Ejection.

Project Title:
Dynamics and Topology of Coronal Mass Ejections

PI Name: C DeVore
PI Email: devore@lcp.nrl.navy.mil
Affiliation: Naval Research Laboratory
Project Member(s):
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Summary:
The Naval Research Laboratory proposes to apply physically robust theories of coronal mass ejection (CME) initiation and state-of-the-art numerical simulation techniques to understand the dynamics and magnetic topology of solar CMEs and their interplanetary counterparts (ICMEs). Previously, we have shown in spherically axisymmetric geometry that fast CMEs can be initiated by the onset of magnetic ~breakout reconnection in multipolar coronal topologies. The ejecta exhibit the three-part density structure characteristic of many CMEs, and evolve into a force-free flux rope typical of the magnetic cloud subclass of ICMEs. We now propose to build upon these successes and to extend our understanding of breakout CMEs and ICMEs to more realistic, fully three-dimensional field configurations. Our research plan is to develop and analyze simulated breakout eruptions initially in global 3D topologies, and later in more concentrated and localized active-region topologies. Throughout these studies addressing CME initiation, we also will analyze the resultant model ICMEs for their plasma and magnetic signatures, and compare them with those observed. The initiation of CMEs in the corona, and the structure and connectivity of ICMEs in interplanetary space, are linked through the vital roles played by the dynamics of magnetic reconnection and the topology of the magnetic field. Our research effort seeks to develop new understanding of these important aspects of the CME/ICME connection.

Publication References:

Summary: no summary

Reference: Lynch, B. J., Antiochos, S. K., DeVore, C. R., Luhmann, J. G., & Zurbuchen, T. H. 2008, Topological evolution of a fast magnetic breakout CME in three dimensions, ApJ, 683, 1192

Summary: no summary

Reference: Antiochos, S. K.; DeVore, C. R.; Karpen, J. T.; Miki?, Z.; (2007), Structure and Dynamics of the Sun's Open Magnetic Field, The Astrophysical Journal, Volume 671, Issue 1, pp. 936-946, doi: 10.1086/522489