

First Demonstration of a Coronal Mass Ejection with Self-Consistent Driving

*Joel Timothy Dahlin^{1,2}, Spiro K Antiochos², C Richard DeVore²

1. University Corporation for Atmospheric Research, 2. NASA Goddard Space Flight Center

Determining the mechanism that drives coronal mass ejections is one of the most important problems in all of space science. Understanding the trigger for eruption onset is essential for accurate prediction of major space weather events. Self-consistent modeling of the energy buildup and resulting magnetic field configuration is vital for distinguishing the role of ideal instabilities (e.g. the torus instability) versus reconnection (e.g. magnetic breakout) in the onset of CMEs. We present the first 3D MHD numerical simulations in a spherical system appropriate for studying CMEs, in which the initial state is a minimum energy potential field and the system is driven by small-scale motions observed for photospheric convection. This simple, self-consistent model drives large-scale energy build up through an inverse cascade of magnetic helicity injected into the corona, forming a filament channel consistent with solar observations. We show that energy buildup continues until reconnection in the overlying magnetic field destabilizes the configuration resulting in the ejection of a fast CME. We discuss the implications of this fully self-consistent eruption simulation for predicting CMEs/flares and their space weather impact.

Keywords: Coronal Mass Ejections, Eruptions, Solar Physics, Space Weather, Flares