Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Independent Investigation

Project Title:
Topological Studies of Photospheric, Coronal, and Interplanetary Magnetic Fields

PI Name: Richard Canfield
PI Email: atn@g.ucla.edu
Affiliation: Montana State University
Summary:
The overall goal of this research is to understand why certain coronal magnetic field topologies erupt to produce interplanetary magnetic clouds. We determine the topology of coronal magnetic fields from photospheric vector magnetograms to address this goal. Recent results strongly point to reconnection of active regions with their surroundings as a basic physical process in such eruptions. We focus on eruptions that involve active regions because they represent a major fraction of the most geoeffective events. We will enlarge our present preliminary database of eruptive events for which we have unambiguous solar and interplanetary associations. The unique nature of our database is that it enables: (1) determination of the topological parameters of coronal active region magnetic fields derived from nonlinear force-free coronal magnetic field reconstructions based directly on observed photospheric vector magnetograms of active regions; (2) values of the topological parameters of magnetic clouds created in eruptions associated with the same active regions. It is well known that magnetic helicity is well conserved in magnetic reconnection in the solar corona. We therefore propose to apply helicity conservation and the concepts of self and mutual helicity to the coronal magnetic field reconstructions to better understand the role of coronal topology in the genesis of magnetic clouds. Our present understanding of the tendency of any given coronal magnetic field topology to erupt is inadequate for predictive purposes. The magnetic field topology connecting the photosphere to the corona is a specific research topic of high current interest to the LWS TR\&T program. The proposed research promotes training of graduate and undergraduate students with expertise on this topic, and is an archetype for the first LWS mission, the Solar Dynamics Observatory. We expect that the proposed research will yield improved physical understanding and a better physics-based ability to predict space weather.

Publication References:

no references