Project Details

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

Topic: To relate solar-energetic particles to their origin at the sun and inner heliosphere.

Project Title:
Particle Acceleration in Reconnecting Current Sheets in Solar Flares

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Summary:
A large fraction of solar flare energy is released in the form of nonthermal particles. This proposal requests funding for a three-year program of theoretical research on particle acceleration in flares and coronal mass ejections (CMEs). The modeling of particle acceleration by the direct electric field at magnetic reconnection sites in the solar corona and its observational consequences at the Earth is the focus of the proposed work. The major goal is to relate the observed properties of the high-energy particles and radiation to the properties of an evolving magnetic field in solar active regions. This is a necessary step for the prediction of solar energetic particle events and, more generally, for the development of quantitative useful models of space weather. The proposed work is strongly motivated by new observations, primarily by the Ramaty High Energy Solar Spectroscopic Imager (RHESSI) that provided important information on the location, flux, and spectra of flare X-rays and gamma-rays, as well as the evolution of flare loops. The effects of the geometry of the coronal magnetic field on the process of particle acceleration will be investigated using an exact global solution for three-dimensional magnetic reconnection. The model for particle acceleration will be extended to include the effects of the Hall current at the reconnection site and a realistic time-dependent model for the magnetic field structure associated with an erupting filament or CME. The theoretical predictions will be compared with RHESSI data in order to relate the observed properties of solar energetic particles to the underlying process of magnetic energy release. Observational effects to be analyzed will include the correlation between the separation of flare loop footpoints and the total hard X-ray flux, the shape of hard X-ray light curves during the flare impulsive phase, and the soft-hard-soft pattern in the evolution of the flare hard X-ray spectra. A combination of numerical analysis and analytical modeling will provide testable quantitative predictions that can be effectively used for the interpretation of observations. The proposed work will provide a framework for modeling and predicting the active phenomena associated with solar energetic particles.

Publication References:

no references