Project Details

ROSES ID: NNH05ZDA001N
Selection Year: 2006
Program Element: Focused Science Topic

Topic: Shock acceleration of solar energetic particles by interplanetary CMEs

Project Title:
An Analytical Theory of Diffusive Shock Acceleration for Gradual SEP Events

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Summary:
The goal of this project is to develop an analytical theory for the shock acceleration of solar energetic particles (SEPs) at an evolving coronal/interplanetary shock. The theory should provide an effective framework for understanding the essential behavior of the large "gradual" SEP events which contribute to the most severe storms in space. Although the theory will be idealized in many ways in order to be amenable to analytical techniques, it will include the essential features which control the morphology of these events: shock acceleration by shock drift and the first-order Fermi process, wave excitation upstream of the shock by the energetic protons, diffusive transport of the ions in the turbulent sheath upstream of the shock, ion escape from the sheath by magnetic focusing, and injection from both solar wind and suprathermal/energetic ion seed populations. The theory will improve on previous analytical (and numerical) work in important ways, both in calculating the excited wave intensity and generalizing the injected populations. The theory will predict wave intensities, and particle energy spectra and anisotropy for all ion species, as functions of distance upstream of the shock. In particular the spectra of the escaping ions (which satisfy the "streaming limit") will be determined. The project will be critical to the success of Focused Science Topic (a) since it will provide analytical predictions which (i) can be compared with the detailed current and future observations of several spacecraft including ACE, STEREO, and Wind, and (ii) can be incorporated into numerical schemes which can be applied to more complex and realistic geometries and time variations.

Publication References:

no references