Project Details

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Selection Year: 2009
Program Element: Focused Science Topic

Topic: Integrate Non-MHD/Kinetic Effects on Magnetic Reconnection, Particle Energization, and Plasma Heating into Global Models

Project Title:
Investigation of Alfvenic Interactions in the Magnetotail and Their Relationships With the Onset of Substorms

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Summary:
The onset of magnetospheric substorm is an explosive increase of dissipation of the energy transmitted into the magnetosphere from the solar wind. The trigger of magnetospheric substorms has been suggested to be due to magnetic reconnection in the mid-magnetotail (~ 20-30 Re) or the disruption of currents in the near-tail (~10 Re). The subsequent development of the substorm is attributed to the propagation of these disturbances out from a single onset region. The models are still controversial, and often inconclusive. An alternative mechanism has been suggested that the substorm onset is a result of Alfvenic interactions in the global current system. The interaction occurs in multiple active regions throughout the tail current sheet. Compressional and shear Alfve n waves play important roles in the transport of energy through the magnetotail. Observations of occurrences and propagation of these disturbances will produce timing relationships between active regions dissimilar from that resulted from single region initiation, and have not been explored before.

We therefore propose to investigate the observational consequences of the Alfve nic interaction mechanism. The tasks include: (1) Investigate how disturbances in the various regions of the magnetotail are related to each other and to the onset of aurora intensification and the subsequent development of substorms by comparing timing relationships predicted in the Alfve nic interaction mechanism with those resulting from single region initiation. (2) Investigate the properties (phase velocity, propagation direction, intensity, etc) of the waves excited at the onset of substorms. Are the properties consistent with the expectation from the scenarios under examination? (3) Investigate how the external trigger mechanism is related to the observed signatures in the magnetotail and the aurora activity.

We will analyze data from Themis spacecraft and the Themis ground based observatory network, and from the solar wind monitor. This research will advance our understanding of the substorm onset mechanism which will lead to a physical understanding of the integral system linking the Sun and our earth environment. It will provide observational constraints on theoretical study and simulation and modeling of the substorm process. The results of this research are needed for efficient development of global modeling efforts specified in Focused Science Topics d of the LWS TR&T program.

Publication References:

Summary: no summary

Reference: Lin, Naiguo; Frey, H. U.; Mende, S. B.; Mozer, F. S.; Lysak, R. L.; Song, Y.; Angelopoulos, V.; (2009), Statistical study of substorm timing sequence, Journal of Geophysical Research, Volume 114, Issue A12, CiteID A12204, doi: 10.1029/2009JA014381