Project Details

ROSES ID: NNH11ZDA001N
Selection Year: 2012
Program Element: Focused Science Topic

Topic: Interaction Between the Magnetotail and the Inner Magnetosphere and the Impact of that Interaction on the Radiation Belt Environment

Project Title:

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Summary:

The primary objective of our proposed project is to achieve quantitative understanding of plasma-sheet/ring-current coupling, with an extended simulation domain covering the magnetic field transition region between 6.6 and 12 RE. Our current understanding of this region is much less advanced than of the main ring current region inside 6.6 RE and this project particularly focuses on that poorly understood, but crucial, region and its effects on the main ring current. The central theme of our proposed study is that bubbles (i.e., reduced entropy flux tubes) play a critical role in the earthward transport of plasmasheet plasma and the structure of the ring current.

This proposal is targeted at the LWS focus science Topic: (b) Interaction between the magnetotail and the inner magnetosphere and the impact of that interaction on the radiation belt environment and, as is noted in the LWS TR&T amendment: Therefore, understanding how plasma is energized and transported inward to the inner magnetosphere is one of the missing links in our ability to predict near-Earth space weather. In addition, our proposed work addresses all 3 goals: Improvement in our understanding of plasma transport process; Development of detailed descriptions of the nonlinear interaction between low-energy plasma transport, the ring current and its impact on the outer radiation belt; Continued improvement of coupled numerical models of the inner and outer magnetosphere.

To accomplish our objective, we propose using the RCM-E with global MHD/RCM, utilizing the RCM-E s capabilities for high resolution and low numerical diffusion in the inner magnetosphere, but employing a coupled MHD/RCM code to represent the effect of solar-wind/magnetosphere coupling, including a time-variable standoff distance. We will also add to the RCM-E the capability for controlled dissipative violation of the adiabatic drift condition on closed field lines, a process that plays a key role in some substorm models. This research project is designed to make optimal use of RBSP and THEMIS data. Simulation results will be extensively compared with observations ranging from RBSP, THEMIS and geosynchronous spacecraft in the near-equatorial magnetosphere to magnetic fields, auroral emissions, and ionospheric electric fields measured from the ground. Moderate and major magnetic storms will be simulated, including at least one steady magnetospheric convection event and one sawtooth event. An entropy analysis will be performed for each event, to determine quantitatively what part of the simulated storm-time ring current comes from bubbles and what part comes from acceleration of previously trapped particles and from convection outside bubbles. The model should produce the best available quantitative calculation of storm-time electric and magnetic field configurations on time scales of minutes to hours, and it can also provide magnetic fields and high-L and low-energy boundary conditions for radiation belt models.

Publication References:

no references