Project Details

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

Topic: Interaction Between the Magnetotail and the Inner Magnetosphere and its Impacts on the Radiation Belt Environment

Project Title:
Energy transport from tail to ring current via fast, low entropy flows

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Summary:
Recent theoretical research has indicated that it is very difficult to populate the ring current from the tail when the convection from the tail is laminar. This is because the general gradient of the flux tube entropy does not allow tail material to approach the Earth very closely. Observationally, the study of fast flows in the tail have indicated the extent that the general flow is both non-laminar and that the Earthward moving ``bursty bulk flows'' have reduced entropy from their surroundings. These features have also been called flow channels and/or bubbles. The leading edge of these bubbles have a quick rise in magnetic field strength and velocity. There is a decrease in density behind the leading edge and, generally, a continuing increase in velocity.

This proposal seeks to probe through the use of computer simulation, how the tail dynamics, through the formation and propagation of bubbles, affects the inner magnetosphere. We can break this research down into four distinct, but related, questions:

1. How do bubbles form and how do they propagate? How do the plasma properties evolve as the bubble propagates toward the inner magnetosphere?

2. How is the bubble plasma processed into the ring current?

3. What is the effect of the ionosphere on the whole process?

4. What is the back reaction of the ring current upon the tail?

The computational tools will be based upon a coupled model combining a very high resolution global MHD code (LFM) and a ring current model incorporating the appropriate drift physics (RCM). Four different approaches to answering the science questions will be used. One will be to study isolated depleted flux tubes. Another will be global simulations using idealized solar wind conditions. Another will be to use realistic solar wind drivers. Finally, we will modify the plasma conditions entering the RCM domain to see how important the mesoscale structure of the tail convection is to ring current formation.

Proposed Contribution to the Focus Team Effort:

The proposed research is directly relevant to Focused Science Topic (b), the ``interaction between the magnetotail and the inner magnetosphere and the impact of that interaction on the radiation belt environment''. The research will contribute to the focus team efforts both by providing global models to aid in analysis of observational studies and characterizing the physical processes that lead to the formation of the ring current. The project metrics will assess progress in (1.) completion of simulations of idealized cases and event studies and (2.) in understanding how plasma is energized and transported from the tail to the inner magnetosphere.

Publication References:

no references