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:
Understanding the Dynamics of the Radiation Belts

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Summary:
The goal of the proposed work is to determine if changes in particle drifts and the open closed boundary control whether the outer radiation belt flux is depleted or enhanced. More specifically, we propose to test the following hypotheses: 1) The outer electron radiation belt will be depleted due to direct transport out the magnetopause and enhanced outward radial diffusion if the open/closed boundary of radiation belt electrons intersects the magnetopause and 2) The outer electron radiation belt will be enhanced only when the last closed drift orbit of seed electrons is inside the magnetopause, allowing those electrons access to the inner magnetosphere from the tail. We do this using a four step method. First, we create a dataset of phase space density at fixed invariants with error estimates for the GOES and POES proton and electron data to determine how often decreases are just adiabatic. Next, we calculate proton and electron drift orbits in TS05 field with the Volland-Stern electric field model to find which particle energies and pitch angles should be lost to the magnetopause and compare to the GOES data set. Then, we use observed PSD radial gradients and ULF wave measurements from multiple GOES and POES satellites to determine whether outward radial diffusion and direct magnetopause loss can explain decreases. Lastly, we identify storms with small, medium and large PSD enhancements in the GOES dataset. We calculate the width of the forbidden region by tracing particles in the TS05 model with a Volland-Stern electric field and use a superposed epoch analysis to determine whether the width of the forbidden region dictates whether the radiation belts are enhanced. Ultimately, the impact of the proposed work is that it will clarify and possibly alter our understanding of both radiation belt loss and acceleration processes leading to more realistic modeling and predictive power for anticipating events with societal impacts. Additionally, the work will provide a new dataset of PSD as a function of the adiabatic invariants that can be used to complement the upcoming RBSP mission as well as future NASA missions.

Publication References:

Summary: no summary

Reference: Hartley, D. P.; Denton, M. H.; Green, J. C.; Onsager, T. G.; Rodriguez, J. V.; Singer, H. J.; (2013), Case studies of the impact of high-speed solar wind streams on the electron radiation belt at geosynchronous orbit: Flux, magnetic field, and phase space density, Journal of Geophysical Research: Space Physics, Volume 118, Issue 11, pp. 6964-6979, doi: 10.1002/2013JA018923