Azimuthal ULF Wave Structure and Radial Transport of Charged Particles

A Thesis Proposal

Presented By
Ashar F. Ali

Thesis Advisor
Dr. Scot Elkington

The Van Allen radiation belts contain highly energetic particles which interact with a variety of plasma and MHD waves. Waves with frequencies in the ULF range are understood to play an important role in loss and acceleration of energetic particles. There is still much to be understood about the interaction between charged particles and ULF waves and how they influence particle diffusion. Considering the geometry of the geomagnetic field, charged particles trapped in the inner magnetosphere undergo three distinct types of periodic motions with an adiabatic invariant associated with each type of motion. The evolution of the phase space density of charged particles in the magnetosphere in the coordinate space of the three adiabatic invariants is modeled by the Fokker-Planck equation. If we assume that the first two adiabatic invariants are conserved while the third invariant is violated then the general Fokker-Planck equation reduces to a radial diffusion equation with the radial diffusion coefficient quantifying the rate of radial diffusion of charged particles including contributions from perturbation in both the magnetic and the electric fields. This proposal proffers to investigate two unanswered questions about ULF wave driven radial transport. First, **how important are the fluctuations in the magnetic field compared with the fluctuations in the electric field in driving radial diffusion?** It has been generally accepted that magnetic field perturbations are dominant over electric field perturbations but several recently published studies suggest otherwise. Second, **how does ULF wave power distribution in azimuth affect radial diffusion?** Analytic treatments of the diffusion coefficients generally assume uniform distribution of power in azimuth but in situ measurements suggest otherwise. In this proposal we present specific steps and tools needed to investigate these questions as they are crucial to our understanding of the particle dynamics in the magnetosphere.

Department of Applied Mathematics

Laboratory of Atmospheric and Space Physics

University of Colorado at Boulder

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