Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Independent Investigation

Project Title:
Statistical Study of Stochastic, Chorus-driven Electron Acceleration During Geomagnetically Disturbed Periods

PI Name: J. Menietti
PI Email: jdm@space.physics.uiowa.edu
Affiliation: The University of Iowa
Project Member(s):
-

Summary:
It has been previously shown [e.g., Tsurutani and Smith, 1974; Anderson and Maeda, 1977] that the injection of substorm electrons leads to the excitation of intense whistler mode chorus emissions in the vicinity of the geomagnetic equator outside of the plasmasphere. These waves, in turn, can accelerate the electrons in the Earth's outer radiation belt to relativistic (MeV) energies [Summers and Ma, [1998]; Meredith et al., 2003a] causing radiation damage to Earth-orbiting spacecraft, communication systems, and possibly even to humans. An important question to be resolved is the free energy source of chorus. It is generally believed that chorus is generated by a nonlinear process based on the electron cyclotron resonance of whistler-mode waves with energetic electrons in the outer radiation belt (e.g., Helliwell [1967]; Tsurutani and Smith [1974]; Nunn et al. [1997]). It is known that a two-temperature anisotropic Maxwellian particle distribution can be unstable to the whistler mode. Trakhtengerts [1999] has suggested that a ''stepped'' phase space distribution may trigger chorus as suggested by the recently discovered discrete, nonlinear fine sub-packet structures seen in the wideband waveforms and spectrograms [e.g., Santokik et al., 2003; 2004]. In this proposed study we will examine the particle and wave data for each of the chorus events observed by the Polar and Cluster satellites to date. We seek to extend the CRRES study of Meredith et al. [2003a] by examining the data from polar-orbiting spacecraft, essentially along L-shells, thus providing a latitudinal dependence of the data. We will also seek to identify the free-energy source of the chorus emissions, to distinguish between competing generation mechanisms. This study provides an in-depth look at processes that are critical to the safety and operational functionality of Earth-orbiting spacecraft, communications systems, and conceivably to humans in orbit in the future. It is thus of particular interest to the Living With a Star Program sponsored by NASA. In accordance with NASA science objectives all of these studies directly attempt to enhance the scientific return of the Polar and Cluster missions, by studying the dynamical plasma and plasma wave processes operating in and near the plasmasphere of Earth. These efforts include data analysis and modeling studies relevant to the interpretation of the mission data. Goal I. OSS theme: Sun-Earth Connection; Science Objective: Understand the origins and societal impacts of variability in the Sun-Earth Connection; RFA: Specify and enable prediction of changes to the Earth s radiation environment, ionosphere, and upper atmosphere. Goal II. OSS theme: Sun-Earth Connection; Science Objective: Understanding the changing flow of energy and matter throughout the planetary environment; RFA: Understand the response of magnetospheres to the external and internal drivers.

Publication References:

no references