Project Details

ROSES ID: NRA-02-OSS-01
Selection Year: 2003
Program Element: Independent Investigation: LWS

Project Title:
Microphysics of Plasma Processes Dissipating Inertial Alfven Waves

PI Name: Nagendra Singh
PI Email: singh@ece.uah.edu
Affiliation: University of Alabama in Huntsville
Project Member(s):
- Wells, B. Earl ; COI; University of Alabama in Huntsville
- Seaquist, Valerie ; Authorizing Official; University of Alabama Huntsville

Summary:
It is now commonly believed that Inertial Alfven waves (IAWs) with short transverse scale lengths play a crucial role in transporting electromagnetic (EM) energy from the outer magnetosphere to the topside auroral ionosphere. However, the mechanisms for the dissipation of this energy remain largely illusive. Very intense IAWs have been measured by Freja and FAST satellites and have been called solitary kinetic Alfven waves (SAWs). The SAWs are typically characterized by (1) intense transverse electric and magnetic fields obeying the linear Alfven wave relation (LAWR); (2) intense field-aligned currents; (3) relatively large parallel electric fields, greatly exceeding the parallel field given by the LAWR; (4) transversely energized ions and bursts of parallel energized electrons; and (5) intimately co-located intense density depletions. These observations reveal that the SAWs are a product of nonlinearly evolved wave structures. A quantitative understanding of their dissipation requires an in-depth understanding of the wave-driven nonlinear processes. In view of the great significance of Alfvenic wave energy in the energetics of the M-I coupling along the high-latitude magnetic field lines, we have proposed to study the dissipative processes for the inertial Alfven waves. The study will be facilitated by parallel PIC codes. Among the dissipative processes to be studied include (i) instabilities (ion-acoustic, ion-cyclotron, Buneman, etc.) driven by the Alfven wave parallel current, (ii) interplay between the wave current and the density depletions naturally occurring as a part of the ambient plasma turbulence, forming a large number of weak double layers, (iii) cavitation by large amplitude waves, (iv) interplay between the wave current and the wave-generated cavities forming strong double layers and thereby generating burst of energetic electrons and ions, and (v) establish the link between Alfven waves and the ubiquitously present electron holes in space plasmas. A better understanding of the dissipative processes will lead to a quantitative determination of dissipation rate of Alfven waves. Since the Alfvenic wave energy is a major component of the energy budget in Sun-Earth connection, such rates are crucially important for physics-based rigorous space- weather modeling, which is an important element of the LWS program.

Publication References:

Summary: ''

Reference: Singh, Nagendra UAL-H - Microphysics of Plasma Processes Dissipating Inertial Alfven Waves