Final Progress Report

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Kinetic Plasma Processes Occurring in the Outer Plasmasphere

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Submitted by
Gordon R. Wilson

Physics Department, and
Center for Space Plasma and Aeronomic Research
EB-136M
The University of Alabama in Huntsville
Huntsville, Alabama 35899

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Data Analysis

Although we have made a great deal of progress during the year of this project the work is not finished. We are however continuing the data analysis and modeling work under other contracts that we have. One area of data analysis work that was begun under this contract and will continue this summer is the fitting of the perpendicular velocity distributions of equatorially trapped ions with a Kappa function. There are thirteen events in this study as mentioned in the previous report. This type of characterization of the trapped ions will be very useful for comparison with velocity distributions produced by the model. A second area of data analysis, which is piggy backing on work being done by Giles Carpenter and Chappell [*Carpenter et al.*, 1991], is to study data from consecutive passes when DE 1's apogee was near the magnetic equator and the spacecraft was often skimming along nearly the same L shell. In 1982 three such periods occurred in May, June, and July. For these consecutive events we have Kp histories, density measurements from a number of sources (Whistler data, DE SFR, ISEE SFR) and consecutive samples of ion pitch angle distributions along field lines. It is clear from this data how the pitch angle distributions evolve during a flux tube refilling event. Figure 1 shows histogram plots for the occurrence probability of certain densities for a give pitch angle distribution type. The isotropic or rammed distributions are typical for flux tubes with high densities while bi-directional field-aligned and trapped often occur when the density is lower. When bi-directional field-aligned and trapped distributions are seen together the densities are typically very low.

Modeling Work

Our modeling of the flow of plasma along closed field lines is following two basic tracks. The first is a study of the basic refilling process without the effect of wave-particle heating near the equator or the effect of large or abrupt field-aligned electric potential drops. This model includes the effects of Coulomb self-collisions and collisions with the O^+ ions in the topside ionosphere. The production of H^+ ions in the topside ionosphere by the charge exchange reaction ($O^+ + H \rightleftharpoons H^+ + O$) is also included as the principle means for generation of H^+. The inclusion of the topside ionospheric processes was facilitated by our recent work on the topside transition region [*Wilson*, 1992]. Preliminary results from this work without the topside processes recently appeared in JGR [*Wilson et al.*, 1992]. We are currently working with the full model, comparing its results with the DE 1 data supplied to us by B. L. Giles.

The second track is a study of the effects of wave produced pitch-angle scattering and perpendicular heating occurring near the magnetic equator, in connection with the development of large potential drops that result from electron heating and the development

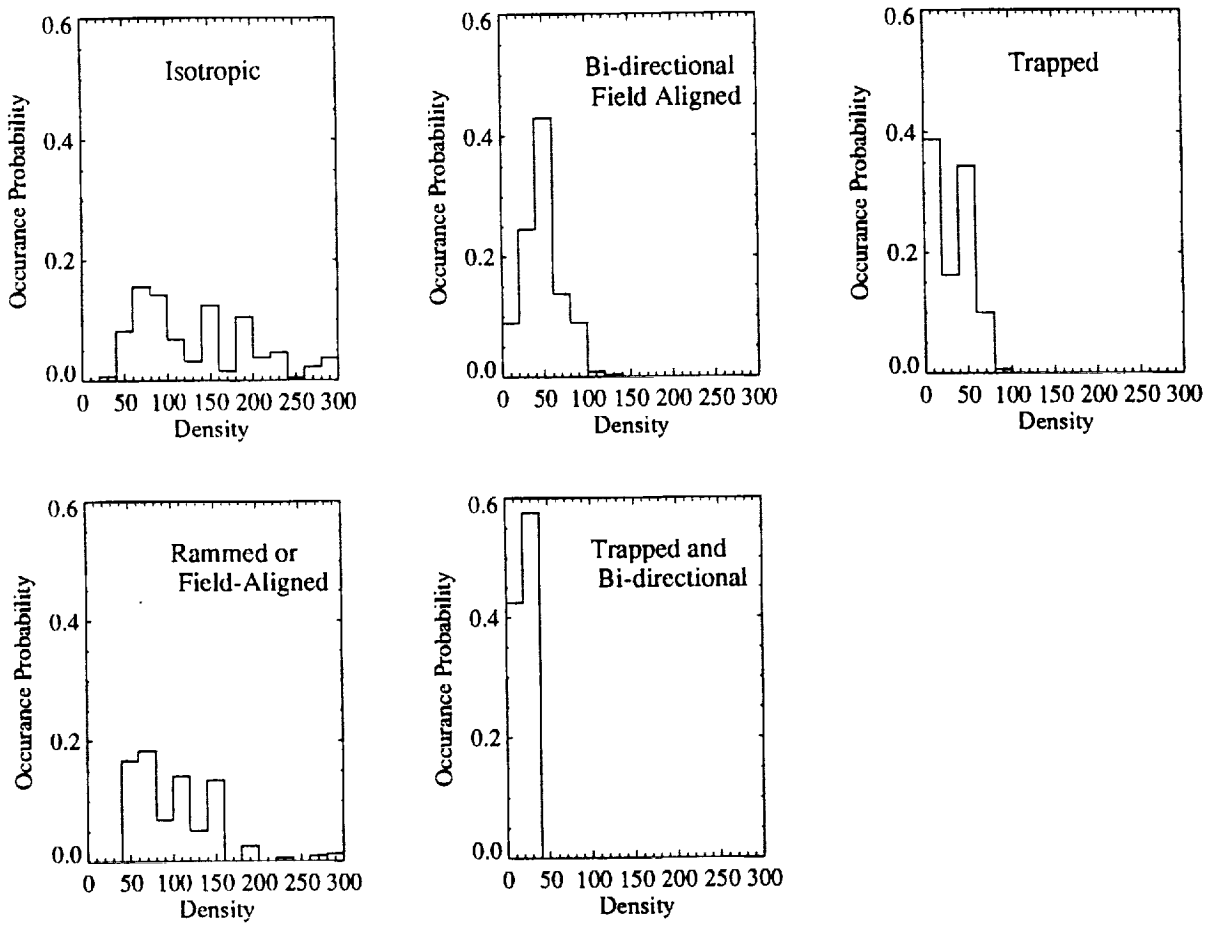

Fig. 1 Occurrence probability histograms for the densities that occur when a given type of ion pitch angle distribution is observed. The density values come from PWI upper hybrid data. The isotropic and rammed or field-aligned distributions are essentially the same and correspond to ions with little or no field-aligned flow velocity and a parallel to perpendicular temperature ratio of about 1. The bi-directional field-aligned distributions are two counterstreaming field-aligned beams with small perpendicular temperatures. The trapped distributions are characterized by large values of $T_\perp/T_\parallel$ and are always located around the magnetic equator.

of density gradients. Because of the greater uncertainty of the proper value for parameters that are used in this work, it has proceeded through various parametric studies. The first results from this work appeared in late 1991 [*Lin et al.*, 1991], while more recent results appeared in February 1992 [*Lin et al.*, 1992]. The results in *Lin et al.* [1992] show latitudinal structures, with bi-directional field-aligned flows and trapped distributions, which are very similar to those seen in the data.

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