A study of auroral electron acceleration by Alfvén waves in the LAPD

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Alfvén wave-particle interactions are believed to contribute to the acceleration of auroral electrons. Experiments in the Large Plasma Device (LAPD) at UCLA have been performed with the goal of providing the first direct measurement of these wave-particle interactions. Inertial Alfvén waves were produced in the LAPD while simultaneously measuring the suprathermal tails of the electron distribution function using resonant whistler mode wave absorption. During a burst of inertial Alfvén waves, the measured portion of the distribution function oscillates at the Alfvén wave frequency. The phase space response of the electrons is well-described by a solution to the linearized Boltzmann equation. Experiments have been repeated using electrostatic and inductive Alfvén wave antennas. The oscillation of the distribution function is described by a purely Alfvénic model when the Alfvén wave is produced by the inductive antenna. However, when the electrostatic antenna is used, measured oscillations of the distribution function are described by a model combining Alfvénic and non-Alfvénic effects.

Ongoing work is assessing the nonlinear interaction between Alfvén waves and electrons including the resonant acceleration of electrons. Two approaches are being used to study nonlinear effects. First, oscillations of the distribution function at harmonics of the Alfvén wave frequency have been identified in the data and indicate nonlinear wave-particle interactions. Second, the field-particle correlation technique is used to show the secular transfer of energy between the Alfvén wave fields and electrons. Results of this analysis indicate collisions alter the resonant signature of the field-particle correlation. Implications for resonant Alfvénic electron acceleration in the LAPD are considered.