LA-UR- 04-1428

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Submitted to: 35th COSPAR Scientific Assembly
Paris, France
July 18-25, 2004

ALFVÉN-CYCLOTRON FLUCTUATIONS: LINEAR VLASOV THEORY

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Linear Vlasov dispersion theory for a homogeneous, isotropic, collisionless, electron-proton plasma is used to examine the damping of Alfvén-cyclotron fluctuations. Fluctuations of sufficiently long wavelength are essentially undamped, but as $k_{\parallel}$, the wavevector component parallel to the background magnetic field $\mathbf{B}_o$, reaches a characteristic dissipation value k_d, the protons become cyclotron resonant and damping begins abruptly. For proton cyclotron damping, $k_d c/\omega_p \sim 1$ for $10^{-3} \lesssim \beta_p \lesssim 10^{-1}$ where $\beta_p \equiv 8\pi n_p k_B T_p / B_o^2$ and ω_p/c is the proton inertial length. At $k_{\parallel} < k_d$, $m_e/m_p < \beta_e$ and $\beta_p \lesssim 0.10$, the electron Landau resonance becomes the primary contributor to fluctuation dissipation, yielding a damping rate which scales as $\omega_r \sqrt{\beta_e}(k_{\perp} c/\omega_p)^2$ where ω_r is the real frequency and $k_{\perp}$ is the wavevector component perpendicular to $\mathbf{B}_o$. Over $0.10 < \beta_p \lesssim 10$ the proton Landau resonance dominates damping of these waves, although no simple analytic expression for this damping rate has been found. Analytic expressions for proton cyclotron and electron Landau damping are used in a simple model of magnetic turbulent transport to calculate the dissipation range magnetic power spectra which may result from these two types of wave-particle interactions.