

LA-UR- 04-1428

Approved for public release;
distribution is unlimited.

Title: ALFVEN-CYCLOTRON FLUCTUATIONS: LINEAR VLASOV
THEORY

Author(s): S. Peter Gary, LANL, ISR-1
Joseph E. Borovsky, LANL, ISR-1

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



Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the U.S. Department of Energy under contract W-7405-ENG-36. By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

ALFVÉN-CYCLOTRON FLUCTUATIONS: LINEAR VLASOV THEORY

S. Peter Gary and Joseph E. Borovsky

Los Alamos National Laboratory, Los Alamos, NM, USA

pgary@lanl.gov/Fax: 505-665-7395

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}_0 , 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 $\beta_p \equiv 8\pi n_p k_B T_p / B_0^2$ 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}_0 . 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.