amplitude and phase velocity for spherical ion-beam modes that, we have derived using the fluid equations. The dependence of the wave phase velocity on the ion-beam speed indicates that the waves found were hemispherical ion-beam modes.


3A6

Kinetic Theory of Ion-Cyclotron Wave Using Energy Conserving BGK Collision Operator

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In this paper we investigate the kinetic ion-cyclotron instability in the presence of an external d.c. drift. The electron-ion collisions are assumed to be the dominant collisions. We use energy conserving BGK collision operator to solve the kinetic equations for both electrons and ions to obtain the expressions for distribution function of both the species which vary as the wave. These expressions of the distribution functions are further used to obtain the expression of various quantities i.e. nsi, mi, Te, Ti, ue and ui (u being the a.c. drift of particles). The set of equations thus obtained along with the continuity equations for the two species are solved to obtain the general dispersion relation. The dispersion relation is then solved to obtain the expressions for real as well as imaginary part (growth rate) of the wave frequency in the various limits of the collisional parameter kl i.e.

(i) \( \frac{Cs}{Ce} < 1 \),
(ii) \( \frac{Cs}{Ce} < kl < 1 \)
(iii) \( kl > 1 \), (iv) \( kl > \frac{Ce}{Cs} > 1 \)

The results of our theory are compared with those of earlier workers.

3B1-2-INQUIRED PAPER

Plasma Motion Into a Transverse Magnetic Field and Plasma,* F. J. VESSEL, A. FISHER, N. ROSTOKER, and J. SONG, Physics Department, University of California, Irvine, California 92717—in spite of its fundamental significance for plasma physics the diffusion of a plasma beam into a transverse magnetic field and magnetized plasma is an unsolved problem. Major issues which remain include rapid diffusion of the magnetic field in vacuum and in the presence of a background plasma.

In a transverse magnetic field a tenuous beam follows a curved Lorentzian trajectory. In contrast a collisionless dense beam propagates undeflected by collective plasma processes including diamagnetic flux exclusion and the ExB drift. Early plasma gun experiments confirmed this behavior in a range of stream magnetization states ranging from fully magnetized to perfect diamagnetism. In recent laboratory and space experiments the magnetic field has been observed to diffuse much more rapidly than classically predicted. This fast diffusion occurs even in the limit of high beta (ratio of plasma beam-to-magnetic field energy) and small ion gyroradii (beam radius-to-ion gyroradius >1) where diamagnetic flux exclusion is normally expected.

In space experiments the mechanism for rapid diffusion has been attributed to a lower hybrid drift instability. However, in laboratory experiments the instability growth time is too long to account for the observations. Solving the nonlinear magnetic diffusion equation gives a conductivity substantially reduced from its classical value by the square of the plasma collisionality parameter, \( \zeta \). The resulting diffusion timescale is more consistent with experimental observations. Rapid diffusion is also observed for high beta beam propagation in a magnetized plasma. By varying the background plasma density we can increase the perpendicular conductivity to a value which prevents polarized ExB propagation. The measured limits for complete shorting agree with a dynamic calculation of the beam polarization and shorting timescales and has resulted in an analytic expression for the ratio of beam to plasma density.

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3B3

Strong Steering of Intense Electron Beams in Circular Accelerators with Transverse Wire Arrays

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Theory [1,2] and experiments [3,4] have shown that transverse foils or meshes are effective for focusing high-intensity electron beams (>10 kA). Recent experiments [5] have verified that wall forces can steer beams in