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AUTHOR: Gor'kov, V. P.

TITLE: The dispersion relation for the ordinary wave with consideration of the wave magnetic field

PERIODICAL: Moscow. Universitet. Vestnik. Seriya III. Fizika, astronomiya, no. 6, 1962, 28-31

TEXT: When waves are propagated in a uniform unbounded plasma placed in a field $\vec{H}_0$, the frequency ω and the propagation constant k are interrelated by a dispersion relation resulting from the Maxwell equations and from the kinetic equation. In general, the electron distribution is assumed to be Maxwellian. This paper starts with an arbitrary electron distribution $f_0(v,u)$ where v is the transverse component, u is the longitudinal component of the electron velocity with reference to $\vec{H}_0$. In the general dispersion relation for the ordinary wave propagating transversely to $\vec{H}_0$, the term accounting for the effect of the magnetic field vanishes when the

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velocity distribution is isotropic: $f_0(v,u) = f_0(v^2 + u^2)$. In this case, the dispersion relation is

$$G(k,\omega) = k^2 - \frac{\omega^2}{c^2} - \frac{\omega\omega_0^2}{\omega_H c^2} 2\pi \int_0^{+\infty}\int_{-\infty}^{+\infty} f_0 \times$$

$$\times \sum_{n=-\infty}^{+\infty} \frac{I_n^2\left(\frac{kv}{\omega_H}\right)}{n - \frac{\omega}{\omega_H}} v\,dv\,du = 0. \qquad (2)$$

$\omega_H = \frac{eH_0}{mc}$ is the Larmor frequency, $\omega_0 = \sqrt{\frac{4\pi Ne^2}{m}}$ is the plasma frequency of the electrons, ϑ is the polar angle in velocity space ($z \parallel \vec{H}_0$, ϑ counted from the x-axis), $I_n(kv/\omega_H)$ are Bessel functions. By means of the principle of the argument (Cauchy integral theorem in the theory of

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functions) it is shown that $G(k,\omega)$ for any given real k has no complex solutions $\omega(k)$ and that a real solution exists in every interval $(n\omega_H, (n+1)\omega_H)$, where n is a natural number. This holds true also for a non-isotropic distribution if $f_0(v,u)$ is a monotonically decreasing function with respect to the variable v. If this restriction upon f_0 is not fulfilled, then it is not possible to make any general statements as to the kind of solutions, owing to the method used here.

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