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Potential formulation of the dispersion relation for a cold, magnetized plasma ROBERT JOHNSON, Alphawave Research — The derivation of the dispersion relation for a cold plasma in a constant background magnetic field is reexamined in terms of the potential formulation of electrodynamics. Under the usual approximations for a neutral plasma neglecting ion flow and thermal stress, the linearized equation of motion for the electron flow describes only the electron cyclotron resonance when the ion contribution to the material response is included through the friction term. Only by addressing the nonlinear coupling of the perturbed electron flow to the perturbed potential can a more interesting solution be found. The coupling of the flow to its potential leads to resonance in the electron fluid whose frequency depends upon the inclination of the propagation vector from the direction of the background field. The plane wave solution for general propagation vector is determined for several cases of interest and compared to the helicon relation as commonly described in the literature. The presence of an electromagnetic oscillation in an otherwise uniform plasma induces a rotation of the magnetization vector away from the axis of the background field.

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