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ABSTRACT

This thesis is concerned with the propagation of waves in magneto-plasmas and the manner in which these waves interact with the charged particles which constitute the plasma.

An investigation of the torsional Alfven wave in a shock produced Hydrogen plasma was carried out with the view of increasing the wave frequency up to the ion-cyclotron frequency. This study showed that if the torsional wave was to be propagated at frequencies up to the ion-cyclotron frequency, a low density (10^{13} electrons/cm^3) plasma was required to keep the cut-off frequency for the compressional waves above the ion-cyclotron frequency.

A plasma formed by a low power (< 200 watts) R.F. oscillator is described and is found to be in the right density and temperature range for studying ion-cyclotron waves.

A transverse R.F. magnetic field applied across the plasma diameter couples into a m = 1 standing helicon wave which transfers energy to the plasma electrons. A theoretical model which includes the effects of radial density non-uniformity, electron inertia and plasma resistivity due to electron-atom collisions is shown to be inadequate in explaining the dispersion and attenuation of the helicon wave. A simple model for attenuation in a cylindrical plasma due to the collisionless Cherenkov mechanism, although predicting an attenuation an order of magnitude greater than the collisional attenuation is still two orders of magnitude lower than that found by fitting the experimental wave fields to the wave fields predicted by the linear helicon theory.

It is qualitatively shown that the high attenuation can be accounted for by postulating the existence of a high-energy group of electrons moving in the azimuthal direction. These electrons are trapped in the magnetic field of the wave and acquire sufficient energy to ionize the neutral gas atoms.

The resulting plasma can be used for wave studies and the investigation of the collisionless Cherenkov and Doppler shifted cyclotron resonance mechanisms.