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Cyclotron Resonances in a Non-Neutral Multispecies Ion Plasma[1]

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Shifts of cyclotron mode frequencies away from the single particle Ω_c are observed to be proportional to the $E \times B$ rotation frequency in non-neutral ion plasmas. These cylindrical ion plasmas consist of $Mg24^+$, $Mg25^+$, and $Mg26^+$, with H_3O^+, O_2^+ and H_2^+ impurities. Laser cooling of the majority species, $Mg24^+$, enables temperature control over the range $10^{-5} < T < 1$.eV, as well as determination of cyclotron mode frequencies from launched wave absorption. At moderately low temperatures, the $m = 1$ and $m = 2$ cyclotron frequency shifts are well described by cold fluid theory for an equilibrium square profile.[2] However, at $T < 10^{-3}$ eV centrifugal mass separation can cause order unity changes in these shifts. For $T \geq 1$ eV, the observed frequency shifts are reduced substantially. Prior high temperature experiments[1] saw majority species shifts consistent with cold fluid theory, and theoretically unexplained minority species shifts $\Delta f \sim 2 f_{\mathrm{Dio}}$. Comparisons will be made with nascent theory to determine the effects of temperature and profile shape on these cyclotron modes.

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[2]E. Sarid, F. Anderegg and C.F. Driscoll, Phys. Plasmas **2**, 2895 (1995).

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