

ION BEAM DRIVEN ION CYCLOTRON WAVE INSTABILITIES IN MAGNETIZED PLASMA CONTAINING HEAVY NEGATIVE IONS

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ABSTRACT

An ion beam propagating through magnetized plasma cylinder containing K^+ positive ions, electrons and $C_7F_{14}^-$ heavy negative ions drives electrostatic ion-cyclotron waves to instability via Cerenkov interaction. Two EIC wave modes, K^+ and $C_7F_{14}^-$ are present. The frequencies and growth rates of both the unstable light positive ion and heavy negative ion modes increase, with the relative density of heavy negative ions $\varepsilon(=n_{C_7F_{14}^-}/n_{K^+})$, where $n_{C_7F_{14}^-}$ and n_{K^+} are the equilibrium densities of perfluoromethylcyclohexane and potassium ions, respectively). The heavy negative ions present in magnetized plasma have a significant effect on the excitation of light positive ion instabilities. The frequencies of both the unstable modes, K^+ and $C_7F_{14}^-$ increase, with the increase in magnetic field. In the present case, the growth rates of both the unstable modes scales as the one-third power of the beam current. The real frequency of both the unstable modes increases as almost the square root of the beam energy. These theoretical studies may be important in the interpretation of the plasma wave properties in space plasmas containing appreciable population of heavy negative ions, such as in the ionosphere of Titan and Earth's ionosphere.

KEYWORDS: Ion-Cyclotron Waves, Growth Rates, Cerenkov Interaction and Real Frequency