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Analytic study on localized wave modes driven by relativistic ion cyclotron in nonuniform magnetic field[1] TSUNG-HUA TSAI, KUAN-REN CHEN, National Cheng Kung University, Tainan, Taiwan, LIU CHEN, University of California, Irvine, CA. — A systematic perturbation theory is developed to study in-depth the localized ion cyclotron modes observed in our simulation. The parabolic magnetic field profile studied in the theory is an approximation of the magnetic field at the minimum of the sinusoidal profile considered in the simulation. The theory is based on an absolute instability condition and the assumption of local homogeneity. It reveals the mechanism for driving the localized modes by fusion-produced alpha particles. The analytical results indicate that the localized modes are corresponding to the eigenmodes excited by the relativistic alpha-driven ion cyclotron instabilities at a specific eigen-frequency. The frequency, growth rate and spatial profile of the wave modes obtained from the analytical theory are in a good agreement with the simulation results. Moreover, both our analytical and simulation results show that the wave modes can exist at where the wave eigen-frequency is lower than the local harmonic cyclotron frequency; even this violates the resonance condition required for the relativistic cyclotron instabilities as generally believed.

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