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Competition Behavior between Drift Instability and Flute Instability in Bounded Linear ECR Plasma

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The nonlinear self-regulation mechanism of the drift wave turbulence has been subject to attentions in order to clarify the structural formation of the plasma turbulence. The drift wave instability has been extensively studied in linear magnetized plasmas in different plasma parameter regimes, including weakly ionized, fully ionized, collisionless and collision plasmas [1]. In the magnetic confinement hot plasmas, there has been considerable interest in the coexistence and the competition between the dissipative instability (such as the collisional drift wave instability) and the reactive instability (such as the flute wave instability) recently. In this paper, we investigate the interaction of drift wave and flute wave instabilities using the bounded linear Electron Cyclotron Resonance (ECR) plasma device.

It is found that the drift wave [(m, n) = (4, 1)] and flute wave [(m, n) = (2, 0)] instabilities coexist in the range of the filling gas pressure 1.0×10^{-3} Torr < $P_{(\mathrm{Ar})}$ < 1.6×10^{-3} Torr [2]. Here, m and n are the azimuthal and axial mode number. The nonlinear interaction between these two instabilities is identified by the bicoherence analysis, which provides a direct measurement of the nonlinear coupling. Moreover, it is observed that the drift wave interacts nonlinearly with the higher harmonics and the background broadband turbulence. By comparing the envelope of these two instabilities, it is found that there are the time windows of the drift wave growth accompanied with the decay of the flute wave and vice versa. In order to show this interaction between the two waves in the radial direction, we install the multi electrodes radial array: the ring probe consists of 8 electrodes, which can measure the radial structure at the same time.

References

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