Fine Structure Zonal Flow Excitation by Beta-induced Alfvén Eigenmode

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Beta-induced Alfvén eigenmode (BAE) [1, 2] excited inside the kinetic thermal ion induced shear Alfvén continuum gap, is characterized with a frequency in the ion acoustic frequency regime, and mode structure highly localized around mode rational surfaces. BAE is of particular importance to Tokamak confinement in that it can be driven unstable by thermal as well as energetic particles, leading to transport and confinement degradation.

In this work, nonlinear excitation of low-frequency zonal structure (LFZS) by BAE is investigated using nonlinear gyrokinetic theory. It is found that, electrostatic zonal flow (ZF), rather than electromagnetic zonal current, is preferentially excited by finite amplitude BAE [3, 4]. In addition to the well-known and common meso-scale radial envelope structure, ZF is also found to exhibit fine radial structure, due to the localization of BAE with respect to mode rational surfaces. Specifically, the zonal electric field has an even mode structure at the rational surface where radial envelope peaks, consistent with numerical simulation [4].

References

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