19aFA-2 Stability mechanism of double tearing mode (DTM) in the presence of sheared flows (II)

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To understand the underlying stabilization mechanism of the shear flow on the double tearing mode (DTM), we have simulated the DTM evolution in the presence of anti-symmetric shear flow in slab geometry based on both initial-value and eigen-value methods. It was observed that a critical shear flow exists for the island distortion/rotations and oscillatory growth of the fluctuation energy[1,2]. It was identified that this oscillatory growth results from the superposition of the two linearly-independently eigen-modes propagating in opposed directions due to the asymmetrical flows [1].

In this work, the eigenmode characteristics of the DTM are further analyzed with emphasis of the stabilization mechanism. In the case without flow, the eigen-functions of magnetic flux of two eigen-states are characterized by radial symmetry with even or odd parity. More particularly speaking, they have only real part, giving rise to regular island structures. However, the anti-symmetric shear flow can distort the symmetry to deform the regular islands so that the two eigen-states may be stabilized or destabilized. This process is characterized by a phase angle, θ, of the eigen-function of the flux, which is monotonously changing across two islands. Above the critical flow, an Alfven resonance occurs at one of double current sheets to widen the singular layer, thus preventing the formation of magnetic island. Meanwhile, two new resonant layers appear, possibly enhancing the DTM instability. The competition of such processes may result in complex dependence of the DTM instability on the shear flow. Furthermore, the eigenmode characteristics of the Kelvin-Helmholtz instability are also discussed with strong shear flow.

[1] Mao Aohua et al., Japan Physical Society, 2012 spring meeting, 24aYG-7, 2012-3-24

[2] T. Voslion et al., Phys. Plasmas 18, 062302 (2011).