# Stability of Double Tearing Mode in the Presence of Shear Flows

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The reversed magnetic shear (RMS) configuration is beneficial for improving confinement performance due to the stabilization of the pressure driven instabilities. However such configuration can produce double current sheets so that a very violent MHD instability, referred as to the double tearing mode (DTM) associated with the fast magnetic reconnection, can be excited.[1] On the other hand, shear flows are generated in tokomak plasmas, which plays a key role in stabilizing various micro-instabilities and also macro-scale MHD fluctuations, including the kink/tearing modes and the DTM.
The DTM is characterized by both symmetric (eigen function with odd radial symmetry) and antisymmetric (eigen function with even radial symmetry) islands, which shows two eigen mode states. These can coexist and the even mode is always more unstable than the odd one. In this work, the evolution of the DTM in the presence of antisymmetric shear flow is numerically simulated based on a reduced MHD model in slab geometry by using both initial-value and eigen-value methods to understand the stabilization mechanism of the shear flow. It is observed that a critical shear flow exists for the island distortion/rotations and oscillatory growth of the fluctuation energy, similar to those in [2]. Weak shear flow below the critical value stabilizes DTM with antisymmetric island and destabilizes the symmetric DTM through distorting the eigen structure of the magnetic fluctuation. This process is characterized by a phase angle, $\theta$, of the eigen-function of the magnetic flux, which is monotonously changing across two islands. When the distortion makes two eigen modes have the same structures as the shear flow increases, an oscillating growth of fluctuation energy appears. It is identified that this oscillatory growth results from the superposition of the two linearly-independent eigen-modes propagating in opposed directions due to the antisymmetric flows. The Alfven resonance occurs at one of double current sheets to widen the singular layer, thus preventing the formation of magnetic island.[3] More particularly speaking, the Alfven resonance appears at different side of the neutral plane for two opposite propagating eigen-modes. 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.

[1] J. Miho, Y. Kishimoto, J.Q.Li, Phys. Rev. Lett. 107, 195001(2011)
[2] T. Voslion et al., Phys. Plasmas 18, 062302 (2011)
[3] Z.X. Wang, L. Wei et al., Phys. Plasmas 18, 050701 (2011)