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Shear-dynamo and the excitation of kink modes

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In recent years, more and more tokamak experiment device found an ELM (edge localized modes) - free H model state—QH mode (Quiescent H mode).[1] In standard QH mode scenarios, there often appears a coherent edge harmonic oscillation (EHO), which is thought to be a saturated kink-peeling mode excited by strong E×B shear flow.[2] The typical feature of EHO shows that the magnetic fluctuations increase and have dominant frequencies. However, the fundamental physics remain unknown. In astrophysics, there also exist periodic phenomenon of magnetic field and magnetic field generation from shear-dynamo process, which has similar characteristics to EHO.[3]

We use the phase dynamics[4,5] to investigate the excitation of low n kink modes and shear-dynamo process in the presence of edge E×B shear flow. The results shows that the shearing location and strength are crucial for determining the stability, which is through influencing the Reynold stress and the Maxwell stress. When the E×B shear flow is located on the most unstable region, both the Reynold stress and the Maxwell stress are positive, thus, they result in larger growth rate. Meanwhile, the magnetic perturbations are amplified by the flow shear, which strongly demonstrate that it is a shear dynamo process. When the E×B shear flow is located near the separatrix, the Reynold stress plus Maxwell stress is negative in the most unstable region, thus they result in smaller growth rate. We also found that the cross phase (between electrostatic potential perturbation and magnetic vector potential perturbation) could help us understand how the E×B shear flow influence the Reynold stress and the Maxwell stress, which determines different edge states selection.

References

[1] A. W. Leonard, Phys. Plasmas 21, 90501 (2014).
[2] F. Rincon, arXiv, physics.plasm-ph:1903.07829, (2019).
[3] J. A. Wesson, Nucl. Fusion 18, 87 (1978).
[4] Z. B. Guo, P. H. Diamond, Phys. Rev. Lett, 114, 1 (2015).
[5] Y. Zhang, et al, Phys. Plasmas 26, 052508 (2019).