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Bifurcation of coherent vortex flow in a magnetic island through nonlinear parity instability

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The topology of the vortex flow associated with the magnetic island plays a significant role in modulating the turbulent transport near the magnetic island. In this work, self-consistent nonlinear simulations of multi-scale interactions among large scale tearing mode (TM), vortex flow, and small scale ion temperature-gradient (ITG) mode are numerically investigated based on the five-field Landau-fluid model. We found that the coherent vortex flow in a magnetic island has different parities in the nonlinear saturated state, and this can be described by a theoretical framework---nonlinear parity instability. In the ITG stable case, the structure of the vortex flow bifurcates from tearing parity to twisting parity, which is characterized by modulational parity instability, modeled by a four-wave nonlinear coupling process. In the ITG unstable case, the vortex flow stays in tearing parity without parity bifurcation, and the energy is transferred from the twisting parity modes to the tearing parity modes. The impact of the parity instability on the magnetic island width is discussed as well. More details will be presented in this conference.

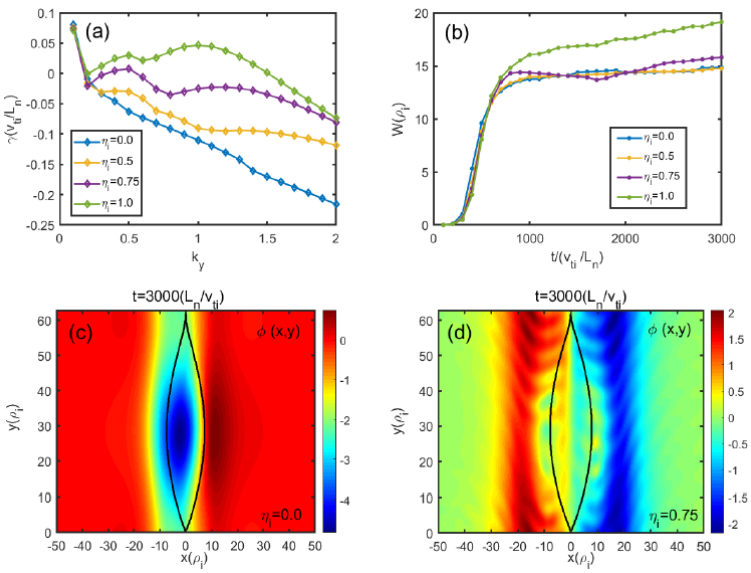

Figure. (a) Normalized linear growth rate spectrum versus k_y for different η_i. (b) Time history of the corresponding magnetic island width. (c) and (d) are snapshots of the perturbed electrostatic potential$\phi(x,y)$ with $\eta_i = 0.0$ and $\eta_i = 0.75$, respectively. The black solid line represents the magnetic island separatrix.

References
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