A New Eigenvalue Solver for Electrostatic Drift-Wave Instabilities in Tokamaks

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Abstract:
For the electrostatic drift wave (DW) instabilities in tokamaks, many local eigenvalue codes (e.g., *HD-7* [1] and *FULL* [2]) have been developed in the ballooning space by using the ballooning mode transformation. By using the translational invariance[3], we developed a new local electrostatic gyrokinetic eigenvalue code, ESR, in the Fourier transformed space for the drift-wave modes (ITG, TEM, ETG) based on the Vlasov-Poisson description. As an application [4], this code is applied to analyze the linear stability analysis of the electrostatic drift wave in the electron thermal internal transport barrier in EAST. Moreover, for the passing particles, the $v_{||}$ modulation along the unperturbed particle orbit due to the mirror effect is included; for the trapped particles, the orbit-averaged gyrokinetic equation is solved analytically, including finite banana-width effects. The toroidal coupling between adjacent poloidal harmonics from both the $k_{||}v_{||}$ term and the ω_d term and the trapped ion contribution will be discussed.

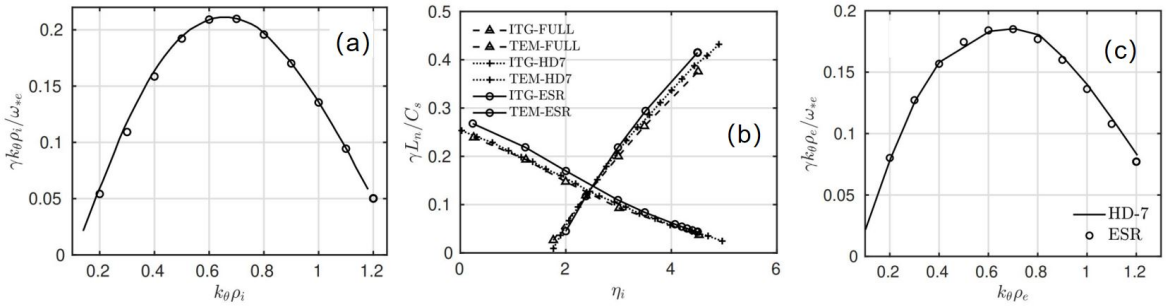

Fig. 1. The benchmark results[4] of the linear (a) ITG , (b) TEM and (c) ETG mode.

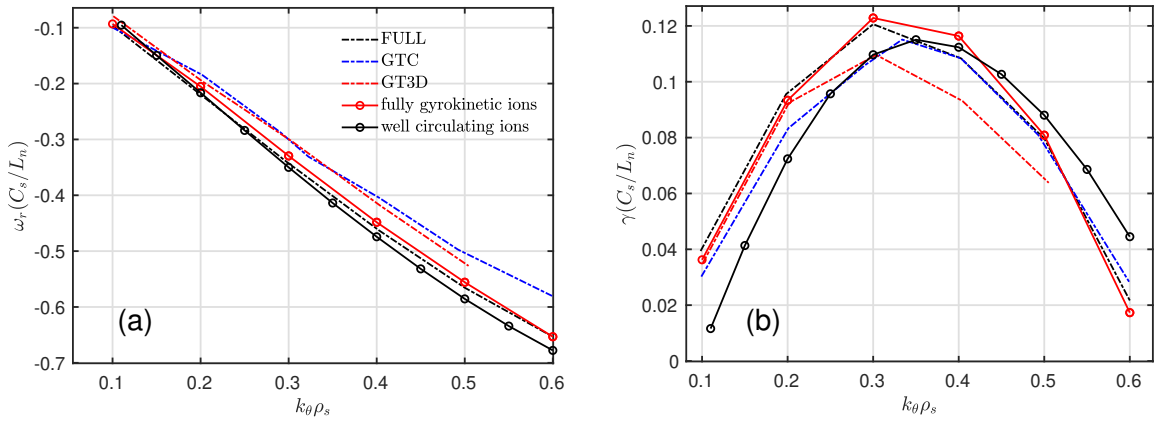

Fig. 2. The ITG linear (b) growth rate and (a) real frequency spectra with adiabatic electron response. The GTC, GT3D, and FULL data are taken from Ref. 5.

[1]J. Dong, W. Horton, and J. Kim, Phys. Fluids B 4, 1867–1876 (1992).

[2]G. Rewoldt, W. Tang, and M. Chance, Phys. Fluids 25, 480–490 (1982).

[3]F. Zonca and L. Chen, Phys. Fluids B. 5, 3668–3690 (1993).

[4]J. Wang, Y. Qiu, and S. Wang, Phys. Plasmas. 31 (2024).

[5]G. Rewoldt, Z. Lin, and Y. Idomura, Comput. Phys. Commun. 177, 775–780(2007).