Properties of ion temperature gradient mode in tokamak plasmas with inverted density profiles

Huarong Du[1], Zhengxiong Wang[2], Yuhong Xu[1]

[1]*Institute of Fusion Science, School of Physical Science and Technology, Southwest Jiaotong University, Chengdu 610031, China*

[2] *Key Laboratory of Materials Modification by Beams of the Ministry of Education, School of Physics and Optoelectronic Engineering, Dalian University of Technology, Dalian 116024, China*

The ion temperature gradient (ITG) mode in tokamak plasmas with inverted density profiles are numerically investigated with the gyrokinetic integral eigenmode equation. From comprehensive local parametric scans, we obtain stability diagrams for ITG mode and trapped electron mode (TEM) in terms of density and temperature gradient scale lengths [1]. In addition, deviations are found on the ITG threshold from an early analytic theory in sheared slab geometry with the adiabatic electron response [2]. Results show that, for the inverted density profile, there exists a normalized threshold temperature gradient above which the ITG mode and TEM are either separately or simultaneously unstable [3]. Besides, the trapped electrons are observed to stabilize the ITG mode with typical scale length $k_\perp \rho_i >> 1$, which is different from the conventional ITG mode in the long wavelength region. The critical ion temperature gradient R/L_{Tic} of the ITG mode for negative R/L_n ($L_n = -n/\nabla n$) is somewhat higher (lower) than that for positive R/L_n in the moderate (steep) density gradient region. Moreover, the effects of different physics elements (such as safety factor, temperature ratio, magnetic shear, and toroidicity) have also been studied.

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