Short wavelength ion temperature gradient mode in tokamak plasmas with hollow density profile

Huarong Du,¹,a) J. Q. Dong,²,³ and Z. X. Wang⁴,b)

¹School of Physics Science and Technology, Southwest Jiaotong University, Chengdu 610031, People’s Republic of China

²Southwestern Institute of Physics, Chengdu 610041, People’s Republic of China

³Institute for Fusion Theory and Simulation, Zhejiang University, Hangzhou 310027, People’s Republic of China

⁴Key Laboratory of Materials Modification by Beams of the Ministry of Education, School of Physics, Dalian University of Technology, Dalian 116024, People’s Republic of China

The short wavelength ion temperature gradient (SWITG) driven instability in tokamak plasmas with hollow density profiles is numerically investigated by using the gyrokinetic integral eigenmode equation. It is found that for the hollow density profile (negative $R/L_n$), there exists a critical ion temperature gradient $R/L_{tic}$ above which the SWITG mode is unstable, and that $R/L_{tic}$ for negative $R/L_n$ is somewhat higher (lower) than that for positive $R/L_n$ in the moderate (steep) density gradient region. In addition, the effect of temperature ratio on the SWITG mode has been investigated, indicating the SWITG mode is harder to be excited in hot ion plasmas than that in hot electron ones. Besides, two critical $R/L_{ti}$ (positive and negative) exist in hot electron plasmas. In particular, it is found that non-adiabatic electron response can stabilize the SWITG mode, which is different from the conventional long wavelength ITG mode. Moreover, when the nonadiabatic electron is considered, the eigenfunctions have broad structures along the magnetic field line and have oscillatory tails with a periodicity about $\pi$.

E-mail: a) hrdu@swjtu.edu.cn
          b) zxwang@dlut.edu.cn