Impact of density on the ion diamagnetic stabilizations of edge Peeling–Ballooning modes

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The recent DIII-D experiments [1] show that at high density an assumption of reduced diamagnetic stabilization of edge Peeling–Ballooning modes in EPED [2] is required for reasonable agreement with measurements. In this work, we present a systematic study of ion diamagnetic stabilization of edge Peeling–Ballooning modes using BOUT++ different physics models and different assumption of density profiles.

Some 3-field BOUT++ code simulations under the X-point geometry show that the large density gradient may drive instability and the ion diamagnetic stabilizations may be reduced, which is different from the 3-field results using circular equilibrium [3]. Since the 3-field model only has a limited finite Larmor radius (FLR) effect, the difference above may mean that the instability comes from the missing terms of the FLR effects or other kinetic effects. Here, the gyro-Landau-fluid (GLF) 3+1 module in BOUT++ [4], containing full FLR effects, Landau damping and toroidal resonance, is employed to study this problem. First, a series of self-consistent ITER-FEAT equilibrium models with a fixed temperature profile and different β is used to benchmark the GLF code with the local and global runs of GYRO code for ballooning modes. The large density gradient effects are then investigated in both GLF code and GYRO code for the circular case. The results show the consistent ion diamagnetic stabilization under the circular geometry. The β scan of both codes will be presented. Finally, the GLF results will be presented in X-point geometry with different assumption of density profiles.

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