Motivations

• Negative triangularity configuration has a larger wall-plasma interface in the bad curvature region.
• Negative triangularity equilibrium has a larger Shafranov shift.

Experimental observations

Experiments: NTT has lower turbulent transport level:

DIII-D

TCV

M. E. Austin, APS-DPP, 2017

Y. Camenen, Nucl. Fus. 2007

Background

• The negative triangularity tokamak (NTT) is a possible solution for the divertor heating load issue due to ELMs. But, its stability remains to be fully assessed.
• TCV and DIII-D experiments constantly show that the transport level in the negative triangularity discharges is substantially lower than the positive triangularity discharges, although it is generally believed that the negative triangularity case is more unstable for low n MHD modes.

Equilibrium

Use the VMEC code to extrapolate the g-file from the DIII-D experiments

Conformal wall is used in the investigation

Fig. 1. Cross sections of positive (a) and negative (b) triangularity equilibria for DIII-D derivative configurations.

Fig. 2. Plasma beta and safety factor profiles versus poloidal magnetic flux $\chi$ for DIII-D derivative configuration with triangularity $\delta = 0.40$ (red) and $-0.40$ (blue) shown respectively.

Abstract

• The rotation effects on RWMs in the negative triangularity tokamak are investigated in comparison with the positive triangularity case.
• Use the DIII-D-negative-triangularity-experiment-like equilibria.
• We found that, although the negative triangularity case is less stable for $n = 1$ MHD, the rotation stabilization effects on RWMs are more effective in the negative triangularity configuration than in the positive triangularity one.

Stability

Use the AEGIS MHD stability code

$n = 1$ modes: NTT is less stable than PTT

Fig. 3. The critical wall position $b$ normalized by the minor radius at midplane versus the beta normal $\beta_n$ for three different triangularity case: $\delta = +0.40$ (red), $0.00$ (black), and $-0.40$ (blue).

Rotation effects

Typical eigenmode with rotation

• RWM growthrate vs wall position with the rotation freq. as parameter

Stability diagrams: the stability region is broader in NTT

Conclusions

• We previously found that NTT is more stable than PTT for intermediate n MHD modes although NTT is believed to be less stable for $n=1$ modes than PTT.
• We found in this work that, although the negative triangularity case is less stable for $n = 1$ MHD modes, the rotation stabilization effects on RWMs are more effective in the negative triangularity configuration than in the positive triangularity one.

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