Effect of negative central shear on infernal-kink instability in negative-triangularity plasmas

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The dominant operation for most present tokamak devices is to operation in H-mode, due to good confinement performance and higher operating parameters [1]. However, it still presents a multitude of challenges, including the strong interaction between the plasma and plasma facing components (PFCs); the inherent conflict between the damage limit of PFCs and the threshold for the transition between L-mode and H-mode and so on.

Recent experimental results on DIII-D [2] and TCV [3][4][5], featuring negative triangularity shapes (neg-D), present a promising approach to address the aforementioned challenges. However, further study is still required to understand the instabilities of MHD modes in these neg-D configuration plasmas.

Therefore, in this work, a systematic numerical investigation is carried out to understand magnetohydrodynamic (MHD) stability of the ideal infernal-kink instability in tokamak plasmas with negative central shear for the equilibrium safety factor in neg-D shaping. The negative central shear is motivated by the desired to form the internal transport barrier in the neg-D configuration, which is known to have difficulty to form the edge transport barrier. We generally found that the infernal-kink mode is more unstable in neg-D plasmas as compared to the positive D-shaped (pos-D), due to less favorable average magnetic curvature near the radial location of the minimum safety factor, as compared to the pos-D configuration. On the other hand, we also study on the effect of this negative central shear on the instability of the infernal-kink modes in neg-D configuration.

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