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# Negative Triangularity Effects on Tokamak MHD Stability

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Recently, discharges with negative triangularity were created in the DIII-D tokamak. These discharges exhibited the H-mode-level confinement features with L-mode-like edge behavior without ELMs (M.E. Austin et al., Bull. Am. Phys. Soc. vol. 62 (2017)). This led us to extensively examine the MHD stability of negative triangularity tokamaks. Using the numerically reconstructed experimental equilibrium, our computation confirmed the stability of the beta normal of 2.6 achieved in DIII-D experiments against low-n MHD kink modes. In parameter variations outside the experimental values, we surprisingly found that the negative triangularity configuration can actually achieve even higher beta normal than the positive triangularity case in certain cases. We used the VMEC equilibrium code to construct the equilibria, with the bootstrap current included from the Sauter formula. The stability was investigated using the AEGIS code, supplemented by the DCON code. Indeed, our calculations show that the negative triangularity configuration with low bootstrap current fraction and usual equilibrium profiles is usually not good for MHD stability. However, we found that the negative triangularity configuration leads to a lower safety factor value especially near the edge. That motivates us to reduce the Ohmic current and increase bootstrap current fraction. Surprisingly, it is found that some higher bootstrap fraction, high poloidal beta, negative triangularity cases can have much higher beta normal limit than 4 Li, while the positive triangularity case is limited by 4 Li as usual. We found that the negative triangularity favors the peak pressure profiles; while the positive triangularity the broad pressure profiles. This leads us to conclude that the negative triangularity tokamak can be more attractive than the positive triangularity case for steady-state confinement in the advanced tokamak scenario from the point of view of low n MHD stability.

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