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Divertor Detachment In Negative-Triangularity Configurations In The TCV Tokamak

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Experimental observations on TCV [1] and DIII-D [2] have shown that negative triangularity L-Mode discharges can exhibit H-mode grade confinement, opening the possibility for high confinement reactors that side-step the challenges associated with H-mode such as ELMs, narrow scrape-off layer widths, and density control. To ensure safe power exhaust that protects the plasma facing components, partially or fully detached divertor operation will still, however, be required. This work, therefore, investigates detachment of TCV ohmic L-Mode negative triangularity (NT) configurations and compares them to similar positive triangularity (PT) cases. Detachment is generally found harder to attain in NT, where sufficient cooling (< 5eV) of the outer target is not achieved in core density ramps and, with N2 seeding, only at the cost of confinement degradation. While changes in connection length and divertor shape were initially thought responsible, experiments with matched poloidal outer leg length and effective connection length, or matched divertor geometry, still show an increased difficulty in reaching detachment for NT, seen by reduced outer target cooling and no clear movement of the CIII front towards the X-point. Discharges with matched divertor geometry but changes of the top triangularity indicate a generally lower divertor neutral pressure in NT plasmas, associated with a lower D2 flux required to achieve a similar core density ramp, hinting at a difference in particle confinement. This contribution will also explore the role of lambdaq, previously measured to be smaller in L-Mode NT than in L-Mode PT [3]. Overall, this study indicates that, while NT represents a promising solution towards ELM-free, high confinement scenarios, the core-edge integration remains challenging.

[1] Y. Camenen et al, Nucl. Fusion 47 510 (2007)
[2] M.E. Austin et al, Phys. Rev. Lett. 122, 115001 (2019).
[3] M. Faitsch et al, Plasma Phys. Control. Fusion 60 045010 (2018).

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