Influence of Divertor Geometry and Baffles on Nitrogen seeded H-mode discharges in TCV

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Steady-state, unmitigated divertor target heat loads are expected to largely exceed the material limits of plasma-facing materials in future high-power density fusion reactors such as ITER and DEMO. Assuring a safe plasma exhaust solution for a reactor remains, therefore, a challenge. L-mode detachment experiments in Alternative Divertor Geometries (ADCs) at TCV have examined the effects of increasing poloidal flux (fx), poloidal leg length, introducing additional X-points at the outer divertor, and installing a new set of baffles [1,2,3] in terms of the power exhaust capabilities. Encouraged by the results, detachment experiments in ADCs with enhanced poloidal flux expansion (going from fx~3.3 to fx~10) at the outer target were investigated in TCV in nitrogen (N_2) seeded H-mode discharges, both with and without baffles installed. The explored geometries were generated by placing an additional X-point just outside (X-divertor), and inside (X-point Target) the vacuum vessel, respectively. Surprisingly, little effect of divertor geometry and baffles on H-mode confinement was observed. In the absence of N_2, both increasing poloidal flux expansion and baffles reduced the peak inter-ELM parallel heat flux at the outer strike point ($q_{||(OSP)}$). Compared to an unbaffled single null (SN) plasma where $q_{||(OSP)} \sim 5MW/m^2$, $q_{||(OSP)}$ was reduced by a factor of ~3 in the X-divertor plasma with baffles. Similarly, in the X-point Target case, for an appropriate distance between the two X-points, $q_{||(OSP)}$ decreased ~3 times *w.r.t.* a SN plasma. N_2 seeded detachment was achieved in these H-mode plasmas both in SN and ADCs. The X-point target configuration with baffles exhibited the lowest $q_{||(OSP)}$ ($\sim 0.5MW/m^2$). In upcoming experiments, these studies will be extended to higher power H-mode scenarios, where an increasing importance of the effect of divertor geometry is expected.

Reference

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2) Reimerdes H *et al* 2017 *Nucl. Fusion* **57** 126007
3) Reimerdes H *et al* 2021 *Nucl. Fusion* **61** 02400