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P2.1029 Towards understanding the relative role of divertor geometry and magnetic topology on detachment

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Plasma detachment needs to be achieved in ITER and future devices such as DEMO to dissipate most of the power in the Scrape-Off-Layer (SOL) and to reduce the particle flux reaching the divertor targets. To enhance our capability to improve current, and design future tokamaks, we must improve our understanding of the relative effect on detachment of physical (baffles, strike point angle) and magnetic geometry (conventional vs alternative topologies). For example, it is predicted by analytic calculations and modeling that the detachment threshold is reduced with increasing total flux expansion [1] [2] [3] (i.e. low Bt/high Rt at the target); how is that effect modified by varying the angle between the divertor leg and the target or the baffling? In this SOLPS-ITER modeling study of density-ramp discharges for TCV and MAST-U, the magnetic topologies are varied from a conventional divertor to the placement of the strike point at progressively larger Rt; divertor baffling and poloidal strike point angle are varied as well. From those scans we abstract out the sensitivity of the upstream density detachment threshold and window to variations of total flux expansion and neutral trapping. In the TCV equilibria that are considered in this study, total flux expansion is expected to lead to a ratio of detachment thresholds of low-Rt to large-Rt equilibria, Rthres, of 1.32. Instead, both recent TCV experiments [4] and modelling lead to a Rthres of 0.81. The SOLPS-ITER modelling demonstrates that the low value of Rthres is due to enhanced neutral trapping in the low-Rt configuration compared to that in the high-Rt configuration, an effect similar to that observed in DIII-D [3]. By making magnetic and physical divertor configuration changes in the modeling we much more closely equalize the neutral trapping as a function of Rt and we manage to get Rthres back to the predicted scaling. In MAST-U, the difference of neutral trapping between configurations is less important because of the divertor design providing strong baffling.

[1] B. Lipschultz, et al., Nucl. Fusion 56 (2016) 056007
[2] D. Moulton, et al., PPCF, 59 (2017) 065011
[3] T.W. Petrie, et al., Nucl. Fusion 53 (2013) 113024
[4] C. Theiler, et al., Nucl. Fusion 57 (2017) 072008

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