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Experimental Studies of Negative Triangularity on TCV

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Recent experiments on TCV have focused on enlarging the parameter range over which measurements of turbulence and energy confinement have been made in discharges with negative triangularity (δ). Negative δ was found to improve confinement, with respect to comparable positive δ discharges, in a series of limited, L-mode discharges over a large range of conditions, notably including strongly ion driven cases in which T_e/T_i~1 in the core. Density and radiative temperature fluctuations were found to be substantially reduced for $0.5<\rho_{vol}<0.9$ in negative δ plasmas. Flux tube gyrokinetic simulations (GENE) managed to reproduce the confinement improvement only for $\rho_{vol}>0.7$, while global simulations managed to qualitatively reproduce the penetration of δ effects down to ρ_{vol}~0.5, suggesting that negative δ acts through a combination of local and non-local effects. Flux-tube, linear gyrokinetic simulations found that, in the strongly ion driven cases, the most unstable modes were a mix of positive and negative frequencies, suggesting negative δ has stabilizing effects also when turbulence is non-purely TEM dominated. Another series of simulations, using the EPED-CH model, focused on predicting the performance of a negative δ tokamak with H-mode edge pedestal. Negative δ was found to cause a reduction of pedestal height and width and, consequently, smaller edge localised mode, in agreement with past experimental measurements. Together, these observations point towards the fact that the beneficial effects of negative δ are consistent over a large range of plasma conditions. New experiments will aim to establish discharges with very strong electron and ion heating in both limited and diverted geometry while at the same time exploring the effect of triangularity balance (the ratio of upper to lower triangularity) and other shaping effects. During these new experiments it has been observed that the improved confinement with negative triangularity persists even when $T_i > T_e$. In addition, new experiments have achieved the ITER baseline β_N (≈ 1.7) in unoptimized, neutral beam heated discharges. The earlier results will be described in detail while the new experiments will be presented.