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Effect of Shaping on Fluctuations in TEM Dominated TCV Plasmas

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The unique versatility of the Tokamak à Configuration Variable (TCV) has been exploited to investigate the effects of extreme shaping on confinement. Recent experiments have focused, in particular, on the influence of negative triangularity (δ) on turbulent fluctuations. Measurements obtained using the Correlation Electron Cyclotron Emission (CECE) and the Tangential Phase Contrast Imaging (TPCI) diagnostics of TCV allowed the study of electron temperature and density fluctuations in inner wall limited, L-mode discharges. Fluctuation levels in both quantities have been found to reduce in plasmas with negative δ with respect to positive δ. This is consistent with earlier observation of confinement improvement [1]. In particular, these studies included discharges in which the auxiliary heating power applied to positive δ discharges has been increased, with respect to negative δ ones, in such a way to obtain comparable density and temperature profiles in the two different plasma shapes. The improvement in transport has been observed also deep in the core where the triangularity of the local flux surfaces approaches zero. This is thought to be due to the existence of a non-stiff region at the edge of TCV plasmas, where local parameters can influence confinement all across the plasma profile [2]; however, our findings show that the fluctuation amplitude itself is also reduced in the core. Other beneficial effects of negative δ include: reduction of the radial correlation length, decrease of the decorrelation time and increase in the threshold electron temperature gradient for the onset of turbulence [3, 4]. Effective collisionality ($\nu_{eff} = 0.1 \cdot Z_{eff}\, n_e/T_e^2$) has been observed to have a stabilizing effect on the measured fluctuations, stronger in positive δ discharges. Local and global gyrokinetic simulations, performed with the GENE code, have shown consistent results and identified trapped electron modes as the dominant source of instability for these discharges [5]. For the first time on TCV, NBI heated negative δ plasmas have been studied to investigate the effects of a transition between TEM and ITG dominated regimes. Even in plasmas with strong ion heating, negative δ discharges show reduced fluctuations amplitude. Gyrokinetic simulations are ongoing to gain better insight on the underlying changes in turbulence characteristics.

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