The effect of triangularity on plasma turbulence and transport in tokamaks

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The effects of plasma shaping, in particular of the triangularity δ, on plasma turbulence in terms of relative density and temperature fluctuations, have been studied in the Tokamak à Configuration Variable (TCV) using the Tangential Phase Contrast Imaging (TPCI) [1] and the Correlation Electron Cyclotron Emission (CECE) [2] diagnostics, respectively. It has been found that for inner wall limited L-mode plasmas, negative triangularity leads to a substantial reduction of turbulence amplitude, as well as of the decorrelation time and radial correlation length, consistent with the beneficial effect on energy confinement. Crucially, this reduction extends deepin the core, where the *local* triangularity becomes vanishingly small. Additionally, the electron temperature profile of negative triangularity plasmas features a narrower and less stiff core region [3], as well as a higher value of critical electron temperature gradient for the onset of turbulence. A stabilizing effect of effective collisionality $\nu_{\text{eff}} = 0.1 n_{\text{e}} Z_{\text{eff}} / T_{\text{e}}^2$ on TEM-type turbulence was also observed. The increase of turbulence amplitude with decreasing ν_{eff} is slower with negative triangularity, while the triangularity effect vanishes at high ν_{eff}. These observations are consistent with previous experimental results on the triangularity effect on electron heat transport [4], as well as with global gyrokinetic GENE simulation results [5]. It is also observed that the GAM frequency and wavenumber increases with the triangularity. Experiments are ongoing on the effects of varying electron to ion temperature ratio in plasmas with positive and negative triangularity to investigate the transition between TEM and ITG dominated turbulence regimes.

References

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