Turbulence in edge tokamak plasma and interaction with magnetic X-point configuration in 3D fluid simulations

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Turbulence in the edge plasma of a tokamak fusion device is a key actor in the determination of the confinement properties. The physics of the transition from Low to High confinement mode is not fully understood, but seems to be linked to the plasma shape. The 3D fluid turbulence code TOKAM3X is used here to evaluate the effect of a diverted configuration on turbulence in the edge plasma, in a isothermal framework. The presence of the X-point is found, locally, to affect both the shape of turbulent structures and the amplitude of the fluctuations, in qualitative agreement with recent experimental observations. In particular, fluctuations are strongly damped in the vicinity of the X-point, both in open and closed flux surfaces. Globally, a mild transport barrier spontaneously forms near the separatrix, differently from simulations in limiter configuration. The effect of turbulence-driven Reynolds stress on the formation of the barrier is found to be weak by dedicated simulations, while turbulence damping around the X-point seems to globally reduce turbulent transport on the whole flux surface. Although the L-H transition dynamics is not retrieved, the magnetic shear around the X-point could be a crucial element in the formation of the edge transport barriers

Références

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