Impact of the plasma $\beta$ and magnetic topology on the nature of plasma edge turbulence

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Experimental measurements of fluctuation levels on typical fusion devices reveal that magnetic perturbations are typically much smaller than electrostatic perturbations. However, as even small magnetic fluctuations ($\approx 10^{-4}$) can locally modify the topology of the magnetic surfaces, they can thus play an important role with respect to the transport properties of the plasma. The nature of turbulence at plasma edge is not totally clear, even if drift-wave turbulence is assumed to be dominant [2]. The resistive ballooning instability is a possible driving mechanism of the turbulence in the plasma edge region [1]. Indeed, recent works related to the characterization of the L-H transition revealed that resistive ballooning modes are plausible candidates for the origin of edge turbulence [3]. Key ingredients for the destabilization of resistive ballooning modes appear to be the values of the safety parameter and the collisionality at the edge[3].

In the present work, the nature of edge turbulence is investigated through numerical simulations in toroidal geometry using realistic plasma edge parameters in high collisionality regimes. These simulations focus on the effects of plasma $\beta$ parameter and magnetic topology on the nature of plasma edge turbulence. More precisely, we investigate the possible transition from resistive ballooning modes to drift-waves driven turbulence. Presented results have been performed with EMEDGE3D [4], a three dimensional global code which calculates the evolution of the pressure, the electrostatic potential and self-consistent electromagnetic fluctuations at plasma edge. To ensure accuracy of the results concerning the electromagnetic effects, the EMEDGE3D results have been in a first part benchmarked with other fluid simulations of plasma edge.

References