Flow shear turbulence suppression in GBS simulations of a RFX-mod diverted plasma in the presence of voltage biasing

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The **E**×**B** flow shear is believed to play a key role in suppressing plasma turbulence in the edge of magnetic confinement fusion devices, also enabling the transition to a high-confinement (H-mode) regime [1]. A direct method to generate **E**×**B** flow shear consists in biasing the tokamak plasma boundary region. Past RFX-mod tokamak experiments have shown that the H-mode can be routinely and robustly achieved at low power by inducing edge flow shear by means of a biasing electrode inserted into the plasma edge of a diverted magnetic configuration, providing further and direct evidence of the impact of flow shear on edge turbulent transport [2].

In this work, three-dimensional GBS [3] turbulence simulations of a RFX-mod diverted plasma are performed at various reference density values and in the presence of a biasing electrode, which has been recently implemented in GBS. The simulations show a strong suppression of turbulent transport caused by the flow shear generated by the biasing electrode, leading to the formation of an edge transport barrier with a pedestal-like structure, which agrees qualitatively and quantitatively with RFX-mod experiments. Significant flow shear turbulence suppression is also observed at high density near the crossing of the density limit. By building on the results of GBS simulations at high density, the theoretical scaling law of the maximum achievable edge density derived in Ref. [4] is extended to account for the effects of flow shear turbulence suppression. The improved scaling law predicts that the maximum achievable edge density in RFX-mod could be increased by a factor of two by generating a moderate flow shear with the biasing electrode, thus calling for future RFX-mod2 experiments with the aim of validated the prediction of the theoretical model.

References

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