Investigation on β dependence of transport in experimental conditions of ASDEX Upgrade β scans using linear gyrokinetic simulations

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Dedicated β scan experiments have been performed in ASDEX Upgrade in H-mode plasmas with type-I ELMs between $\beta_N = [1.4 - 2.2]$ [1]. Global analysis of these β scans exhibits an unfavourable β scaling as $B\tau_{th} \propto \beta^{-0.9}$. This degradation is confirmed by the local transport analysis which shows an increase of the thermal heat diffusivity with increasing β as $\chi_{eff}/B \propto \beta^{0.65}$. To compare these results with theoretical predictions, we investigated the β dependence of micro-instabilities present in the core of ASDEX Upgrade β scaling discharges by means of the gyrokinetic code GS2. To compute β scans, we used both $s - \alpha$ and Miller equilibrium and experimental values for temperature and density gradient lengths. In this paper, we will present the β scaling of the linear growth rate of the most instable modes associated with different equilibra and sets of parameters. Depending on the equilibrium parameters, in the β range of ASDEX Upgrade experiments, micro-tearing modes or Ion Temperature Gradient modes (ITG) may appear as the most unstable modes. However micro-tearing are not expected to lead to a strong energy transport and ITG mode are stabilized with increasing β. On the contrary, Kinetic Ballooning Modes (KBM) should dramatically degrade the confinement and are supposed to become unstable [2] for β values comparable to those found in the high β discharges of the experimental ASDEX Upgrade β scan. For this reason, we focused our study on the onset of the KBM branch. We analyzed their stability taking into account all equilibrium and shape parameters such as Shafranov shift, triangularity and elongation.

References

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