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First Global Gyrokinetic Multiscale Pedestal Simulations with the GENE code

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The residual turbulent transport in the pedestal is a central component determining its structure and ultimately the accessibility of advanced confinement regimes, including H-mode or ELM-free regimes. Experimental observations of pedestal fluctuations generally focus on ion-gyroradius-scale, while fine-scale electron temperature gradient (ETG) turbulence has been shown in various numerical studies to play a significant role, see e.g. [1].

This coexistence of ion- and electron-scale fluctuations demands the consideration of the role of cross-scale coupling [2]. Due to several unique properties of pedestal turbulence, cross-scale coupling is expected to be very distinct from its core counterpart: pedestal ETG transport is typically isotropic and may be expected to be less-susceptible to ion-scale shearing and by extension, cross-scale coupling. Furthermore, the steep gradients and the rapid geometry variations in the pedestal require performing radially global runs, making simulations significantly more challenging.

To address this topic, we will discuss pedestal global multiscale simulations results, obtained with the GENE code [3], where for the first time we have resolved pedestal turbulence down to the electron scale for an experimental C-Mode discharge [4] where electrostatic ion-scale modes coexist with fine-scale ETGs.

For the case at hand, our results indicate that in spite of the absence of radially elongated streamers, the transport caused by the electron scale is significantly reduced when compared to results obtained with a scale separated approach.

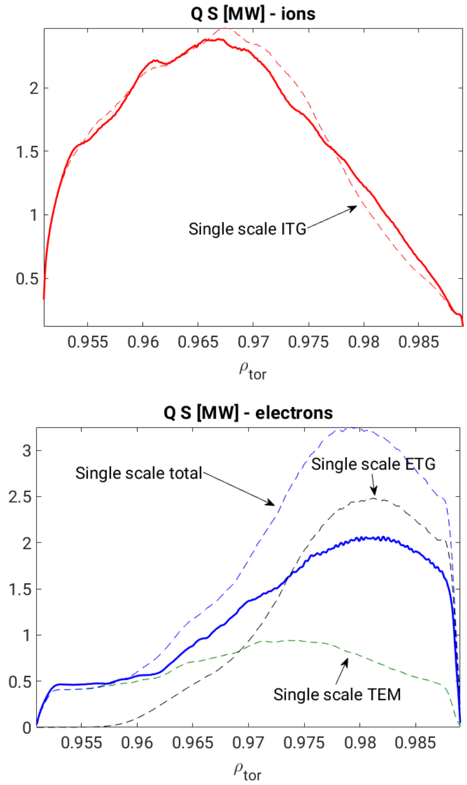

Figure 1: Comparison between single- (dashed) and multi-scale results for ion (top) and electron (bottom) heat transport across the pedestal.

Comparison and limits of local (flux-tube) approach will also be discussed.

References

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