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Gyrokinetic Simulations of Microturbulence in DIII-D pedestal

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Present understanding of ELM triggering mechanism is mostly based on the peeling-ballooning theory (PBT) often providing sufficiently good pedestal prediction. While PBT is rather empirical, the more comprehensive kinetic description is still required.
In this work we present recent gyrokinetic simulations aimed to identify electromagnetic microinstabilities in the H-mode pedestal region of DIII-D tokamak (discharge #131997 at 3011 ms) using global gyrokinetic code GTC. It was found that dominant instability at the top of the pedestal is the ion temperature gradient mode (ITG). In the middle of a pedestal the kinetic ballooning mode (KBM) becomes the most unstable for the intermediate range of toroidal mode number n~20. For shorter wavelengths the dominant instability is TEM. We have demonstrated the ITG-KBM transition at the pedestal top and TEM-KBM transition in the steep pressure gradient region as plasma pressure increases.
One possibility to control drastic ELM activity during H-mode operation is applying resonant magnetic perturbations (RMP) however the detailed mechanism of RMP effect is not completely clear.
In our studies we address the direct effect of modified magnetic equilibrium geometry on microturbulence in DIII-D pedestal. By fixing the profiles, and excluding magnetic stochasticity effects, we examine the effect of various strength RMP on KBM stability, and turbulent transport. We have observed the increase of KBM growth rate when RMP is applied; however this change is only detectable for artificially amplified RMP strength. The direct effect of RMP geometry perturbation on zonal flow generation and turbulent transport is found to be insignificant.

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