The role of slab-ETG modes in determining the structure of JET-ILW pedestals with varying levels of power and fuelling

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Recent gyrokinetic simulations have shown that turbulent heat transport is a major component governing the dynamics of JET ITER-like wall (ILW) pedestals [1]. JET-ILW consists of a tungsten divertor and beryllium chamber, and ITER-relevant baseline plasmas have been limited to lower pedestal top temperatures than their JET-C (carbon-wall) counterparts. Increased input power is necessary to recover the pedestal height, while increased gas puffing is needed to prevent tungsten contamination [2, 3]. Understanding and decoupling the effects of increased power and increased gas fuelling on inter-ELM turbulent transport is an important step towards understanding the nature of the JET-ILW H-mode pedestal [4, 5, 6]. We present the results of local GENE gyrokinetic calculations from a series of JET-ILW type I ELMy H-modes discharges operating with similar experimental inputs but at different levels of power and gas fuelling.

We observe that, around the nominal normalised temperature (ω_{T_e}) and density gradients (ω_{n_e}), the variation in the peak growth rate of slab-ETG modes becomes more stiff when increasing ω_{T_e} above the nominal value. We also find that there is no change in stiffness when increasing $\eta_e = \frac{\omega_{T_e}}{\omega_{n_e}}$ above the nominal value via decreases in ω_{n_e} only. In the nine JET-ILW pulses we examine linearly, the dominant slab-ETG modes have an increased parallel wave number $k_{\|}$ [7] when ω_{T_e} is increased above the nominal value. We show that these modes with large $k_{\|}$ define a boundary in $(\omega_{n_e}, \omega_{T_e})$ parameter space to which the experimental gradients in the steep gradient region are pinned. We demonstrate this effect nonlinearly for two of our nine pulses, showing that the level of slab-ETG heat transport Q_e is limited by ω_{T_e} as opposed to η_e.

References

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