The composition of ETG turbulence in JET-ILW pedestals

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Here we assess the impact of electron temperature gradient (ETG) driven turbulence in JET-ILW by performing GENE gyrokinetic [1] in the pedestal region of multiple type I ELMy H-mode discharges [2]. Previous work using local GENE simulations has shown that ETG driven turbulence produces a significant amount of heat flux in four discharges that comprise a power and gas scan [3]. Focussing on the high power discharges, it was found that the Gyro-Bohm normalised heat flux Q_e/Q_{GBe} (using the temperature gradient scale length in the normalisation) increases rapidly with the parameter $\eta_e = \omega_{T_e}/\omega_{n_e}$ (the ratio of the normalised temperature gradient ω_{T_e} to the normalised density gradient ω_{n_e}). Here we extend this work by probing the nature of the turbulence in each discharge.

To assess the relative contribution of both toroidally driven (TETG) and slab driven (sETG) ETG turbulence, we artificially suppress the toroidal drifts in a selection of simulations, thereby eliminating the toroidal resonance necessary for the existence of TETG instability. Upon turning off the magnetic drifts, the low gas (LG) variation in Q_e/Q_{GBe} remains unchanged, confirming that the ETG turbulence in the LG pulse is purely slab-like at this flux-surface. For the high gas (HG) pulse, turning off the magnetic drifts changes things in two notable ways: i) the total heat flux is drastically reduced and ii) the now purely sETG turbulence has a variation of Q_e/Q_{GBe} with η_e much more similar to the LG pulse. Note that artificially removing the toroidal resonance means the impact of nonlinear interaction between TETG and sETG modes at different length scales are neglected in our study [4]. Future reactors such as STEP and DEMO will consist of metal walls, meaning two distinct turbulence regimes associated with short wavelength ETG modes in the steep temperature gradient region will be present. By elucidating the nature of these turbulence regimes, we open up the possibility of tuning the turbulent transport in the pedestal, and therefore the global confinement, based on their response to actuators.

References

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