8th Asia-Pacific Conference on Plasma Physics, 3-8 Nov, 2024 at Malacca

Impact of shaping and self-regulation processes in Trapped Electron Mode turbulence

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Trapped Electron Modes (TEM) are responsible for electron heat and particle transport in toroidal magnetic configurations for fusion. This work addresses two specific features of TEM turbulence. One is their sensitivity to the shape of magnetic surfaces, in particular negative triangularity. A reduced model for Trapped Electron Mode stability has been developed, which incorporates basic effects of magnetic surface shaping, in particular elongation and triangularity. It turns out that a simple explanation based on a change of interchange drive due to shaping contradicts observations of improved confinement with negative triangularity [1,2]. Other effects like finite orbit width effects (FOW) and/or mode ballooning must be invoked (see Figs 1, 2) [3].

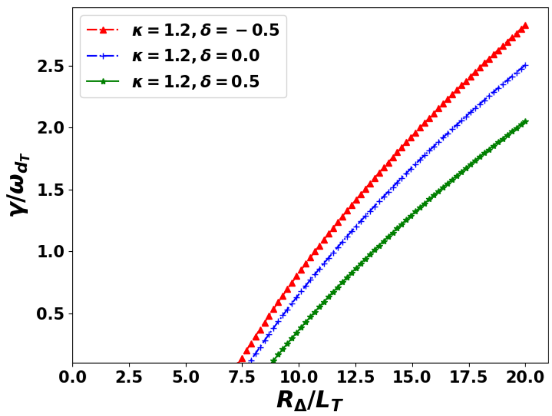

Fig. 1: Growth rate vs temperature gradient R/L_T for a triangularity scan δ= -0.5, 0.0, and 0.5 at fixed elongation κ=1.2. FOW and ballooning mode effects not included.

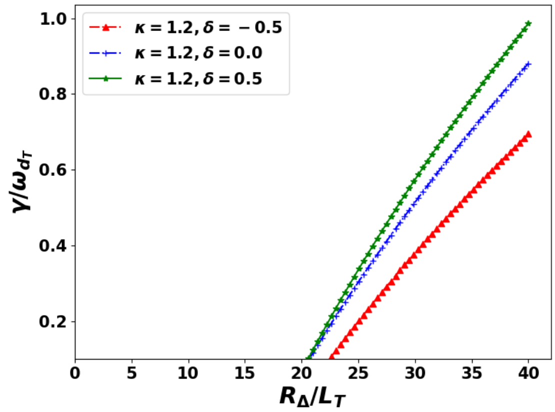

Fig. 2: Growth rate vs temperature gradient R/L_T for a triangularity scan δ= -0.5, 0.0, and 0.5 at fixed elongation κ=1.2. FOW and ballooning mode effects are included.

Second, it has been argued that TEMs primarily driven by electron temperature gradient are weakly sensitive to zonal flows. Self-regulation seems rather ruled by density zonal fields, which can be seen as fluctuations of the mean density gradient. An explanation based on turbulent transport matrix and negative off-diagonal diffusion coefficients will be proposed and commented.

References

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