§24. Gyrokinetic Study of Electron Temperature Gradient Instability in Plasmas with Slightly Hollow Density Profiles

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Currently, it is widely accepted that linear and nonlinear ion temperature gradient(ITG) instability theories and simulations are enough to explain the ion transport anomaly qualitatively. It has been shown that the ion thermal diffusivity reduces to neoclassical level in advanced tokamak plasmas with internal transport barriers(ITB's).This transport reduction is explained by the model based on the $E\times B$ suppression effects on the ITG instabilities. Recent experiments seem to indicate, however, that the electron thermal diffusivity is often still anomalous even in discharges with an ITB. These findings support the hypothesis that ,within an ITB, ITG turbulence is suppressed by $E\times B$ shear flow, whereas electron temperature gradient(ETG) driven turbulence controls electron thermal transport. As a result, ETG instability and related anomalous electron thermal transport become a hot topic and received research attentions in recent years.

On the other hand, in the Conpact Helical System(CHS) experiment, the correlation between the transport barrier formation, fluctuation reduction and structural change of radial electric field profile at the barrier location was clearly demonstrated. It should noted that the density profiles have a flat or slightly hollow shape in these discharges. Stimulated by the experimental observations and aimed at the understanding of the anomalous electron transport, the ETG driven instability is studied with gyrokinetic theory in the present work.

Gyrokinetic theory is employed for ions and electrons. The finite Larmor radius effects of electrons and ions are taken into account. Finite beta effects are neglected and electrostatic perturbations are only considered. An $E\times B$ velocity shear effects in the y-direction for electrons and ions are considered. A typical result for the mixing length estimated normalized anomalous transport coefficient versus $\hat{v}_E'$ is plotted in Fig.1 for an unstable mode. This result shows the enhancement of normalized transport due to the $\hat{v}_E'$ in some range of the value of $\hat{v}_E'$.

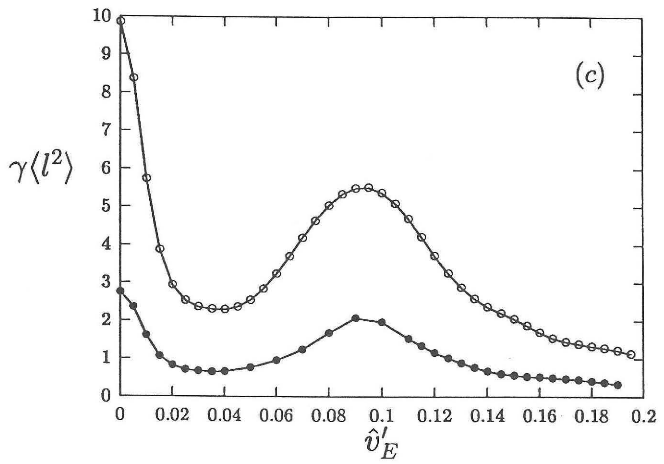

Fig.1 Mixing length estimated normalized transport versus $\hat{v}_E'$