

Local and non-local Gyro-Fluid Simulation of ITG and ETG turbulence and the statistical properties

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The turbulent-zonal flow system due to micro-scale electron and meso-scale ion temperature gradient mode turbulence is studied based on our gyro-fluid model in order to understand various prominent structure formations in magnetically confinement plasma. Here, we investigate the possible mechanism regulating the zonal flow and resultant turbulent dynamics from various view points, i.e. secondary and higher order instabilities and saturation mechanism, control of zonal flow instability including enhancement and diminishment, electromagnetic effect, toroidal coupling effect due to Stringer-Winsor term and GAM, non-local and/or global effect, etc. Specifically, it is found that the electromagnetic effect plays an important role for the zonal flow and resultant transport dynamics in ETG turbulence. The coupling between zonal mode and poloidal pressure anisotropy through Stringer-Winsor term is found to lead to a new energy transfer channel that regulates the zonal flow level. We also study the turbulent dynamics by introducing statistical approaches such as fractal dimension and probability distribution function. A significant dimensionality lowering and coherent transport characteristics are obtained for the transport dominated by zonal flows.

Reference

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