Plasma elongation and magnetic shear effects in nonlinear simulations of ITG-zonal flow turbulence

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Drift waves turbulence is a key issue in understanding the anomalous transport observed in magnetic confinement fusion experiments. Drift waves turbulence is known to self-organize to form axisymmetric band-like shear flows, commonly referred to as zonal flows. Since zonal flows are generated by nonlinear energy transfer from drift waves, they naturally act to regulate and partially suppress turbulence. In toroidal systems, zonal flows show an oscillatory behavior due to coupling with poloidally asymmetric pressure perturbations. These oscillations are called geodesic acoustic modes (GAMs), the coupling coming trough the geodesic curvature. GAM oscillations affect the turbulent transport because the oscillatory zonal flows are less effective in suppressing the turbulence than stationary ones. This is the reason for the growing interest in the investigation of the mutual interactions of drift wave turbulence, zonal flow and GAMs.

We address this problem with the help of electrostatic global nonlinear gyrokinetic simulation. In particular we focus on the study of ion temperature gradient (ITGs) turbulence in realistic tokamak magnetohydrodynamic equilibria. We show results on the effects of the plasma elongation on the GAM amplitude and frequency. The zonal flow oscillatory behaviour is known to depend on the value of the safety factor q. Reversed shear magnetic configurations are investigated. The transport in the region around the minimun-q surface, a critical issue for understanding the internal transport barrier (ITB) formation, is examined in detail focusing on the role of the zero shear point.