Collisional Electrostatic Simulations of Turbulence with the Global Gyrokinetic Code ORB5

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Global gyrokinetic simulations provide a powerful tool for studying microturbulence underlying the anomalous transport in tokamak plasmas. The δf Particle-In-Cell (PIC) code ORB5 [1] has been recently upgraded with linearized collision operators [2]. Results from global simulations of electrostatic Ion-Temperature-Gradent (ITG) turbulence with a linearized ion-ion collision operator are presented, featuring heat sources maintaining constant temperature gradients, both above the non-linear stability threshold as well as below, in the so-called Dimits shift region above the linear stability threshold. The effects of a finite collisionality on the turbulent transport level, through its action on zonal flows [3], are emphasized. Global simulations of electrostatic Trapped-Electron-Modes (TEM) microturbulence, carried out by considering kinetic trapped electrons, show how collisions, both electron-ion and electron-electron, damp the growth rate of the modes in the linear phase and how they affect the turbulent transport level. True MHD equilibria based on the CYCLONE case [4] are used for studying TEM, pointing out the effects of plasma shaping on the turbulence development. Finally, a coarse graining procedure [5] applied on the weights is shown to have a positive effect on the numerical noise level.

References