Collisional and Electromagnetic Simulations with the Global Gyrokinetic δf Particle-in-Cell 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] and a solver for electromagnetic perturbations [3]. Results from global simulations of electrostatic 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 [4], are emphasized. Electrostatic simulations where the neoclassical driving term is artificially suppressed in the gyrokinetic equation are also discussed. Numerical issues are addressed as well through a coarse graining procedure [5] applied on the weights, which is shown to have a positive effect on the numerical noise level. Furthermore, a new numerical scheme for the δf approach is presented, switching between a canonical Maxwellian background and a local Maxwellian background for carrying out the collisionless and the collisional dynamics respectively [2]. Finally, the ion heat diffusivity predicted by simulations in an ITG-dominated regime is studied for different β values [6] and compared with the adiabatic electron model at $\beta = 0$.

References

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