1E53

Characteristics and Features of Electromagnetic Microtubulence with Kinetic Electrons[1]

S.E. Parker and Y. Chen
University of Colorado, Boulder, CO 80309

W.M. Nevins and B.I. Cohen
Lawrence Livermore National Laboratory, Livermore, CA 94551

A new algorithm has been developed that can simulate electromagnetic tokamak microturbulence with experimental values of plasma β and drift-kinetic electrons using gyrokinetic δf particle-in-cell (PIC) simulation methods.[2] PIC methods of this type have the computational advantage of resolving particle-wave resonance effects using only a three-dimensional spatial grid. This allows for high velocity space resolution in local flux-tube simulation domains to ensure numerical convergence with respect to all five phase space dimensions and time. The simulation is massively-parallel and includes electron-ion collisions. Here, electromagnetic, kinetic electron simulation results are analyzed and compared with both adiabatic electron and electrostatic kinetic electron results. Spectral analysis shows that the residual zonal flow is less stationary in electromagnetic turbulence thereby leading to small transient bursts in energy flux. In addition, a plausible explanation is given for why gyrokinetic turbulence simulations produce energy fluxes that are much too high for typical H-mode parameters. Tokamaks operate in such a way to avoid the ballooning limit while maximizing β. This puts such plasmas in a "pocket" of good confinement where ion-temperature-gradient driven turbulence is reduced due to finite-β stabilization.

---

[1]work supported by the US Department of Energy SciDAC Plasma Microturbulence Project

[2]Y. Chen and S.E. Parker, submitted to J. Comput. Phys. 2002.