Fluid moments and spectral diagnostics in global gyrokinetic simulations

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The theoretical understanding of mesoscale and microscale turbulence is required for developing a predictive capability of heat, particle and momentum transport in tokamaks and stellarators. During the last years, the global particle-in-cell gyrokinetic code ORB5 [1] has been upgraded with intra- and inter-species Landau collision operators for ions and electrons [2]. In addition to this, electromagnetic perturbations have been included in the model [3] allowing for a complete self-consistent and fully kinetic treatment of finite $\beta$ effects. More recently, the code has been extended to include new 3D diagnostics, allowing for measurements of electromagnetic potentials and relevant fluid quantities (density, temperature, vorticity) as well as turbulence spectral analysis. Those diagnostics have been successfully applied to the study of electrostatic ion temperature gradient (ITG) driven turbulence, focusing in particular on the convergence properties of the different spectra and on the role of the plasma shape [4]. In this paper we apply the new 3D diagnostics to trapped electron mode (TEM) driven turbulence and to the case of ITG driven turbulence in the presence of finite $\beta$ effects.