28 Second order gyrokinetic Vlasov-Maxwell model: comparing numerical simulations and theory

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The main idea of Gyrokinetic dynamical reduction consists in systematic removing of fastest scale of motion (the gyro motion) from plasma's dynamics, resulting in a considerable model simplification and gain of computing time.

Gyrokinetic Vlasov-Maxwell system is broadly implemented in nowadays numerical experiments for modeling strongly magnetised plasma (both laboratory and astrophysical). Different versions of reduced set of equations exist depending on the construction of the Gyrokinetic reduction procedure and approximations assumed while their derivation. The purpose of that communication is to sketch a systematic derivation of the second order self-consistent set of Vlasov-Maxwell equations from the modern variational formulation of the Gyrokinetic theory [1] and to compare it with those recently implemented in Particle-in-Cell codes NEMORB and EUTERPE [2]. In the same time, field theory formulation of reduced plasma dynamics provides an opportunity to systematically derive corresponding energy conservation law. The result of that explicit derivation is compared to the energy conservation diagnostics currently implemented in both codes.

This work subscribes into the context of codes verification project currently run in IPP Max Planck in collaboration with others European institutions.

References

1. A.J.Brizard, T.S.Hahm, Foundations of nonlinear gyrokinetic theory, *Phys. Mod. Phys*, **79** , (2007).
2. A.Bottino, E.Sonnendrucker, Monte-Carlo particle-in-cell methods for the simulation of the Vlasov-Poisson-Ampère gyrokinetic equations, *J. Plasma Phys.* in press (2015).