

Vlasov-Poisson-Fokker-Planck equation in the adiabatic asymptotics

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The main concern of this article is the study of a nonlinear Vlasov-Poisson-Fokker-Planck equation describing the electron dynamics in a thermonuclear fusion plasma, in the regime of a small electron-to-ion mass ratio ($\epsilon \ll 1$). The first part of this work focuses on the rigorous $\epsilon \rightarrow 0$ asymptotic study, based on hypocoercive techniques, permitting to understand the transition from the kinetic level to the macroscopic, adiabatic electron level. The second part introduces a Hilbert-Fourier spectral method enabling to treat without too much numerical effort the above mentioned electron transition. This scheme has in particular the nice property of being Asymptotic Preserving in the sense that ϵ -independent meshes can be chosen, without degrading the accuracy. Some numerical tests are finally performed validating on one hand the scheme and underscoring on the other hand the mathematical results.

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