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A Novel Multi-Dimensional Vlasov-Fokker-Planck Code for Modeling Electron Transport in High Energy Density Plasmas[1]

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The unexpected macroscopic behaviour of laser-irradiated plasmas is often attributable to complex kinetic phenomena that depend on the detailed structure of the electron distribution function. For example, the non-local transport of electrons can have a dramatic effect on the temperature and pressure profile of inertial confinement fusion targets. To explore the kinetic physics of high energy density plasmas we have developed the parallel relativistic 2D3P Vlasov-Fokker-Planck code OSHUN [1] that incorporates a spherical harmonic expansion of the electron distribution function. The expansion is truncated such that the necessary resolution in momentum space is retained for a given problem. Finite collisionality results in rapid decay of the high-order harmonics, thereby providing a natural truncation mechanism for the expansion. The code has both implicit and fully explicit electromagnetic field-solvers and employs a rigorous "linearized" Fokker-Planck collision operator. OSHUN has been benchmarked against well-known problems, in the highly kinetic limit to model collisionless relativistic instabilities, and in the hydrodynamic limit to recover transport coefficients. We will demonstrate the applicability and limitations of the code by discussing a number of studies we have recently undertaken with relevance to shock ignition and the national ignition facility.

[1] M. Tzoufras, A. R. Bell, P. A. Norreys, F. S. Tsung, "*A Vlasov-Fokker-Planck code for high energy density physics*," J. Comp. Phys. 230, 17, 6475-6494 (2011)

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