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Spectral methods for multiscale plasma-physics simulations GIAN LUCA DELZANNO, GIANMARCO MANZINI, Los Alamos National Laboratory, JURIS VENCELS, STEFANO MARKIDIS, KTH, VADIM ROYTERSHTEYN, Space Science Institute — In this talk, we present the *SpectralPlasmaSolver* (SPS) simulation method for the numerical approximation of the Vlasov-Maxwell equations. SPS either uses spectral methods both in physical and velocity space or combines spectral methods for the velocity space and a Discontinuous Galerkin (DG) discretization in space. The spectral methods are based on generalized Hermite's functions or Legendre polynomials, thus resulting in a time-dependent hyperbolic system for the spectral coefficients. The DG method is applied to numerically solve this system after a characteristic decomposition that properly ensures the upwinding in the scheme. This numerical approach can be seen as a generalization of the method of moment expansion and makes it possible to incorporate microscopic kinetic effects in a macroscale fluid-like behavior. The numerical approximation error for a given computational cost and the computational costs for a prescribed accuracy are orders of magnitude less than those provided by the standard PIC method. Moreover, conservation of physical quantities like mass, momentum, and energy can be proved theoretically. Finally, numerical examples are shown to prove the effectiveness of the approach.

Gian Luca Delzanno
Los Alamos National Laboratory

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