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Spectral method for the solution of the Vlasov equation based on Hermite polynomials BEN BERGEN, GIAN LUCA DELZANNO, J. DAVID MOULTON, BHUVANA SRINIVASAN, LANL, ENRICO CAMPOREALE, CWI

— We present a spectral method for the solution of the Vlasov equation for a collisionless plasma by means of an expansion of the distribution function in Hermite polynomials, which leads to a system of partial differential equations for the coefficients of the expansion. With a spectral (Fourier) technique for the spatial discretization and a fully-implicit time integrator, the numerical scheme can achieve exact mass, momentum and energy conservation. In the one-dimensional electrostatic limit, comparisons with a Particle-In-Cell (PIC) method on standard test cases show that the Hermite method can be much more accurate and faster than PIC [1]. We also discuss our further development of this method, which includes a finite element spatial discretization, the extension of the method to multi-dimensions and to the fully electromagnetic case and the use of preconditioning techniques to speed-up the convergence of the inner iterations of the Newton-Krylov method used to solve the discrete non-linear system.

[1] E. Camporeale, G.L. Delzanno, B. Bergen, J.D. Moulton, “On the velocity space discretization for the Vlasov-Poisson system: comparison between Hermite spectral and Particle-in-Cell methods. Part 2: fully-implicit scheme,” under review (2014).

Gian Luca Delzanno
LANL

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