Abstract Submitted
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A quadrature- and matrix-free discretization of the multi-species, non-relativistic, Vlasov-Maxwell system of equations[1] JAMES JUNO, University of Maryland, College Park, AMMAR HAKIM, Princeton Plasma Physics Lab, JASON TENBARGE, Princeton University, MARC SWISDAK, University of Maryland, College Park, VALENTIN SKOUTNEV, Princeton University, WILLIAM DORLAND, University of Maryland, College Park — We present a novel algorithm for the numerical solution of the multi-species, non-relativistic, Vlasov-Maxwell system of equations which uses high order discontinuous Galerkin finite elements to discretize the system on a phase space grid. The resulting numerical method is robust and retains a number of important properties of the continuous system, such as conservation of mass and energy. In addition, we will discuss a number of discoveries concerning the computational implementation of the algorithm which bring the cost of directly discretizing the Vlasov-Maxwell system down tremendously. We devote a portion of the presentation to the central motivation of developing a continuum discretization of the Vlasov-Maxwell system: a clean, noise-free representation of the distribution function and electromagnetic fields. We discuss a set of recent results (Skoutnev et al. ApJ Letters 2019) which disagree with particle-in-cell simulations with the same parameters and initial conditions, and demonstrate the role particle noise plays in the disagreement. We thus argue for the utility of the continuum approach, which despite its challenges and expense compared to the particle-in-cell method, nonetheless provides a complementary tool for addressing kinetic problems in plasma physics.

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