Abstract Submitted
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Variational Formulation of Particle Algorithms for Kinetic E&M Plasma Simulations[1] ALEXANDER STAMM, BRADLEY SHADWICK, Department of Physics and Astronomy, University of Nebraska-Lincoln, EVSTATI EVSTATIEV, FAR-TECH Inc. — A rigorous variational method was used to derive a self-consistent set of equations of motion from a discretized Lagrangian to study kinetic plasmas. Discretization of the Lagrangian was performed by reduction of the phase-space distribution function to a collection of finite-sized macro-particles of arbitrary shape and discretization of field quantities onto a spatial grid. The equations of motion were then obtained by demanding the action be stationary [1]. This approach may be used in both lab frame and moving window coordinates, which improve computational efficiency when modeling laser-plasma interactions. The primary advantage of the variational approach is preservation of Lagrangian symmetries, which in our case leads to energy conservation and avoids difficulties with grid heating. Additionally, this approach decouples particle size from grid spacing and relaxes restrictions on particle shape, leading to a decrease in numerical noise. The variational approach also guarantees consistent ordering and is amiable to higher order methods in both space and time. Simulations conducted with the new equations of motion demonstrate the desired energy conservation and a decrease in numerical noise.

[1] E. G. Evstatiev and B. A. Shadwick J. Comput. Phys 245, 376 (2013).

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