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Relativistic Vlasov-Poision Solver with Ponderomotive Driver

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Introducing a minimal numerical framework capable of simulating intense laser-plasma kinetic interactions. The Vlasov-Maxwell Hamiltonian system is naturally constrained to simulate driving-laser ponderomotive effects on electron and ion kinetics along the direction of laser propagation, without discarding the impact of the relativistic transverse momentum on longitudinal dynamics. Structural conditioning at the Poisson Bracket level is necessary to maintain compatibility with variational discretization and proves key to avoid breaking critical invariants associated to phase-space advection. Implementation of this scheme through composed finite-difference integrators qualifies our model as both time-implicit and Eulerian. We apply this solver to demonstrate relativistic dispersion and laser-driven particle trapping. The techniques we outline are highly extensible.

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