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High-Order, Conservative Discontinuous Galerkin Algorithms for (Gyro) Kinetic Simulations of Edge Plasmas[1] AMMAR HAKIM, GREGORY HAMMETT, Princeton Plasma Physics Laboratory — We explore algorithms developed recently for the solution of a class of problems expressible as Hamiltonian equation coupled to elliptic field equation. Examples include 2D incompressible flow, Vlasov-Poisson and the gyrokinetic equations. Such systems admit two quadratic invariants, energy and a second quantity, known by various names (e.g., enstrophy or entropy) in different contexts. The algorithm uses a continuous finite-element scheme for the elliptic equation and a DG scheme for the Hamiltonian dynamics. With a proper choice of basis functions and numerical flux function both energy and enstrophy are conserved. Even with a choice of a diffusive, but more stable, upwind flux the scheme is shown to conserve energy, in addition to being enstrophy stable. For the Vlasov equation coupled to a quasi-neutrality condition or a Poisson equation, the total energy is conserved. The high-order accuracy of the finite-element representation, with a hyper-collision operator to handle recurrence, results in an accurate and efficient scheme. We show results from passive advection, nonlinear vortex merger (incompressible 2D hydrodynamics) and several 1D Vlasov-Poisson problems, including electron plasma oscillations and ion acoustic waves with quasineutrality used to determine fields.

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