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Discontinuous Galerkin schemes for a class of Hamiltonian evolution equations with applications to gyrokinetic edge turbulence problems[1]

AMMAR HAKIM, GREGORY HAMMETT, Princeton Plasma Physics Laboratory, ERIC SHI, IAN ABEL, Princeton University — We present a new gyrokinetic code, Gkeyll, for use in edge plasma simulations. The code implements novel energy conserving discontinuous Galerkin schemes, applicable to a general class of Hamiltonian equations. The inclusion of magnetic fluctuations with kinetic electrons has been challenging for many gyrokinetic algorithms in the past, requiring special treatment to reduce the Ampere cancellation problem. An important feature of this work is that we have developed novel versions of DG that can handle gyrokinetic magnetic fluctuations in an efficient way while preserving the energy invariant. To illustrate our improved algorithm, we show that Gkeyll reproduces the Alfven wave dispersion relation even at very low $k_\perp \rho_s$ in an efficient way with just the normal time step needed to resolve the electron dynamics. Initial results will be shown for a 1D axisymmetric problem and a higher dimensional turbulent problem with a simple geometry, to illustrate the applications of this approach for fusion problems.

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