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Energy Conserving Forms of Discontinuous Galerkin Algorithms, and Sparse Grid Methods[1] AMMAR HAKIM, GREG HAMMETT, Princeton Plasma Physics Laboratory, ERIC SHI, Princeton University — A hybrid discontinuous/continuous Galerkin scheme for gyrokinetic equations is presented. Discretizing the Poisson bracket form of the equations, along with a careful choice of basis functions allows conserving the total (particle+field) energy exactly, even with upwinding to reduce artificial oscillations. Straightforward use of tensor basis functions can get expensive in higher dimensions and high polynomial order. Savings might be possible by using basis sets that have fewer monomials and combining these with a version of sparse grid quadrature methods. For example, a tensor product of piecewise parabolic basis functions in 5D involves 243 basis functions per cell, but this drops to 21 basis functions if only second order monomials are needed. Enforcing continuity needed for energy conservation in configuration space might reduce the savings, but would still be a gain over Gaussian quadrature. Our version of sparse grid methods could use non-nested quadrature points as well as well as anisotropic basis. Energy conservation with use of reduced basis sets is discussed.

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