Hamiltonian gyrokinetic Vlasov-Maxwell system
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Objectives
- Develop an infinite-dimensional Hamiltonian formalism for gyrokinetic Vlasov-Maxwell system, that is most suitable for massively parallel supercomputers

Accomplishments

We have found a new formulation of collisionless electromagnetic gyrokinetic theory with three novel features:

- Manifestly gauge invariant
- Hyperbolic in nature
- Can be cast as an infinite-dimensional noncanonical Hamiltonian system.

By leveraging the model's Hamiltonian form, we have

- Derived an energy principle for electromagnetic gyrokinetic equilibria.
- Constructed the first rigorous proof that a gyrokinetic thermal equilibrium in a uniform background is stable.

Impact

- Growing need for reduced data motion and increased efficiency-to-solution in algorithms deployed on modern massively-parallel super computers.

- These new gyrokinetic equations offer an attractive alternative basis for large-scale gyrokinetic simulations.

- Due to the hyperbolic nature of the new formalism, all dynamical variables in the theory can be advanced on a parallel computer in a manner that requires only nearest-neighbor, i.e. local, communication.