Galerkin GX Vlasov-Maxwell system

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A variety of "gyroaveraged" kinetic plasma models are structurally very similar, even though they describe different physical processes. I will show that drift kinetics, gyro kinetics, and Vlasov-Maxwell theory are all particular examples of a much more general theory that I call GX Vlasov-Maxwell theory. The GX Vlasov-Maxwell system is an infinite-dimensional Hamiltonian system. Starting from the GX Vlasov-Maxwell system, I will derive a finite-dimensional version of the theory called Galerikin GX Vlasov-Maxwell theory. By representing the electromagnetic field using finite element exterior calculus, and replacing the one-particle distribution function with the Klimontovich distribution, the partial differential-integral equation that comprises the GX Vlasov-Maxwell system will be replaced with a finite dimensional ordinary differential equation. The conserved Hamiltonian and Poisson bracket for this system will be presented. While infinite-dimensional Hamiltonian systems do not possess (functional) Liouville measures, finite dimensional approximations of these systems do. The expression for Galerkin GX Vlasov-Maxwell theory's Liouville volume will be presented.