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Gauge-free gyrokinetic theory[1] JOSHUA BURBY, Courant Institute, ALAIN BRIZARD, Saint Michael's College — Test-particle gyrocenter equations of motion play an essential role in the diagnosis of turbulent strongly-magnetized plasmas, and are playing an increasingly-important role in the formulation of kinetic-gyrokinetic hybrid models. Previous gyrocenter models required the knowledge of the perturbed electromagnetic potentials, which are not directly observable quantities (since they are gauge-dependent). A new gauge-free formulation of gyrocenter motion is presented, which enables gyrocenter trajectories to be determined using only measured values of the directly-observable electromagnetic field. Our gauge-free gyrokinetic theory is general enough to allow for gyroradius-scale fluctuations in both the electric and magnetic field. In addition, we provide gauge-free expressions for the charge and current densities produced by a distribution of gyrocenters, which explicitly include guiding-center and gyrocenter polarization and magnetization effects.

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