A coupling approach to the kinetic Langevin equation

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The (kinetic) Langevin equation is an SDE with degenerate noise that describes the motion of a particle in a force field subject to damping and random collisions. It is also closely related to Hamiltonian Monte Carlo methods. An important open question is, why in certain cases kinetic Langevin diffusions seem to approach equilibrium faster than overdamped Langevin diffusions.
So far, convergence to equilibrium for kinetic Langevin diffusions has almost exclusively been studied by analytic techniques. In this talk, I present a new probabilistic approach that is based on a specific combination of reflection and synchronuous coupling of two solutions of the Langevin equation. The approach yields contractions in a particular Wasserstein distance, and it provides rather precise bounds for convergence to equilibrium at the borderline between the overdamped and the underdamped regime.