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Langevin dynamics beyond the weak coupling limit ALEXANDER PLYUKHIN, Saint Anselm College — Many popular results of non-equilibrium statistical mechanics hold only in leading order in a small parameter λ which controls the strength of the system-environment coupling. In this approximation the equations for the first two moments $\langle v \rangle$ and $\langle v^2 \rangle$ of the Brownian particle's velocity are closed and describe exponential relaxation to thermal equilibrium. To higher orders in λ these equations are not closed but coupled to higher moments $\langle v^n \rangle$. This may result in much richer dynamics (both transient and stationary) and non-trivial ergodic properties. Generalized fluctuation-dissipation relations are derived microscopically and shown to ensure convergence to thermal equilibrium to any order in λ. One exception is the regime of superlinear diffusion, characterized by zero integral friction (vanishing integral of the memory kernel), when the generalized Langevin equation may have non-ergodic solutions that do not relax to equilibrium values. Also, for specific memory kernels the equation may have non-dissipative (non-stationary) solutions even if the integral friction is finite and diffusion is normal.

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