Stretched Exponential Relaxation of Weakly-Confined Brownian Particles

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Stretched-exponential relaxation is a widely observed phenomenon found in ordered ferromagnets as well as glassy systems. One modeling approach connects this behavior to a droplet dynamics described by an effective Langevin equation for the droplet radius with an $r^{2/3}$ potential. Here, we study a Brownian particle under the influence of a general confining, albeit weak, potential field that grows with distance as a sublinear power law. We find that for this memoryless model, observables display stretched-exponential relaxation. The probability density function of the system is studied using a rate-function ansatz. We obtain analytically the stretched-exponential exponent along with an anomalous power-law scaling of length with time. The rate function exhibits a point of nonanalyticity, indicating a dynamical phase transition. In particular, the rate function is double valued both to the left and right of this point, leading to four different rate functions, depending on the choice of initial conditions and symmetry