Everlasting impact of inital perturbations on first-passage times of non-Markovian random walks

Persistence, defined as the probability that a fluctuating signal has not reached a threshold up to a given observation time, plays a crucial role in the theory of random processes. It quantifies the kinetics of processes as varied as phase ordering, reaction diffusion or interface relaxation dynamics. The fact that persistence can decay algebraically with time with non trivial exponents has triggered a number of experimental and theoretical studies. However, general analytical methods to calculate persistence exponents cannot be applied to the ubiquitous case of non-Markovian systems relaxing transiently after an imposed initial perturbation. Here, we introduce a theoretical framework that enables the non perturbative determination of persistence exponents of d-dimensional Gaussian non-Markovian processes with general non stationary dynamics relaxing to a steady state after an initial perturbation. Two prototypical classes of situations are analyzed: either the system is subjected to a temperature quench at initial time, or its past trajectory is assumed to have been observed and thus known. Altogether, our results reveal and quantify, on the basis of Gaussian processes, the deep impact of initial perturbations on first-passage statistics of non-Markovian processes.