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Title:	A Study of Persistence in Different Non-Equilibrium Systems
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Abstract:	Considerable interest has been generated recently in understanding the statistics of first passage events in spatially extended non-equilibrium systems. A persistence probability $P(t)$, is defined as the probability that the position of the step edge at a point along a fluctuating step does not return to its initial value (at time $t = 0$) over time t is found in these studies to decay in time as a power-law, $P(t)$ □ $t^{-\theta}$, for large t, where θ is the so- called persistence exponent. Similar power-law behavior of the persistence probability has also been found in experiments for other physical processes. The persistence proba- bility has been obtained both analytically and numerically for a large class of stochastic processes, Markovian as well as non-Markovian. For single particle systems such as the Brownian motion, which is also Markovian in nature, the persistence probability is easy to calculate since the stationary correlator of such a process decays exponentially at all times. For many body systems where the field φ has a space dependence, the calculation of the zero crossing probability becomes complicated. In the first part (Chapter 2 and Chapter 3) of the thesis, we investigate the persis- tence probability $p(t)$ of the position of a Brownian particle with shape asymmetry in two dimensions. We explicitly consider two cases diffusion of a free particle and that of a harmonically trapped particle. The latter is particularly relevant in experiments that use trapping and tracking techniques to measure the displacements. We provide analytical expressions of $p(t)$ for both the scenarios and show that in the absence of shape asymmetry, the results reduce to the case of an isotropic particle. The analytical expressions of $p(t)$ are further validated against a numerical simulation of the underly- ing overdamped dynamics. We also illustrate that $p(t)$ can be a measure to determine the shape asymmetry of a colloid and the translational and rotational diffusivities can be estimated from the measured persistence probability. The advantage of this method is that it does not require the tracking of the orientation of the particle. In the second part of the work Chapter 4, we have studied the persistence of the active asymmetric rigid Brownian particle in two dimensions. Nowadays self-propelled systems are an interesting topic of research. Active matter systems are any systems either of biological or artificial origin where the individual components can take up energy from their environment and use it to move automatically. The energy they con- sume helps them to perform the task of self-movement. These types of systems form patterns and exhibit several interesting properties. We have studied the persistence of such active asymmetric free particle and that in a harmonic trap. We have calculated 5the analytical expressions of the persistence and thereafter validated those analytical expressions with numerical simulations. In the third part of the work Chapter 5, we study the persistence probability $p(t)$ of stochastic models of surface growth that are restricted by finite system size. Surface growth is an important stochastic phenomenon that is found in a large class of phys- ical systems ranging from a few nanometers to a few micrometers. That is why this process is of so much interest to study its persistence for finite-size lattice. We look at two specific models of surface growth - the linear Edwards-Wilkinson(EW) model and the non-linear Kardar-Parisi-Zhang(KPZ) model. In this chapter, we have analytically studied the persistence of the finite-size system.
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