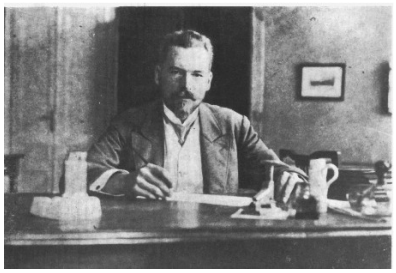

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Combination of two types of disorder in lattice random walk

Tuesday, September 26, 2023 4:45 PM (1 minute)

Often the motion in complex systems is subdiffusive. Meaning, instead of a linear dependence on time, the mean square displacement (MSD) grows as $\sim t^{\alpha}$ where $0 < \alpha < 1$. This can be attributed to long waiting times that cause a significant slowdown from the classical description of Brownian motion. But a slow down of the MSD can also arise from repeated collisions with obstacles in the media causing persistent memory and correlations in the system. For the first time the moments of displacement are found in a system with a quenched disorder of obstacles combined with a heavy tailed distribution ($\sim \tau^{-1-}$) of waiting times causing subdiffusion. Our mathematical description consists of a biased tracer particle being pulled by an external force, hopping on a two-dimensional lattice where a fraction of the sites are inaccessible and act as a reflective obstacle. We present a new method to find the moments of the system in discrete time, i.e amount of steps N, and use subordination to include the heavy tailed waiting times and transition to continuous time. Correlations in time where the temporal disorder is quenched is also studied. Our analytical results fit perfectly to numerical simulations in the limit of low obstacle density and arbitrarily strong driving force.

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