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Resetting dynamics and random search in heterogeneous media

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Theoretical investigation of diffusion in heterogeneous media (such as materials with impurities, defects, fractal and random heterogeneous structures and combs, crowded environments, etc.) currently receives a considerable interest. The corresponding heterogeneous diffusion process often becomes anomalous due to the geometric constraints, random potential effects or variations of the local diffusion coefficients in the heterogeneous media. We will present results for the first passage and first hitting times for different random search processes in such complex environment. Introduction of a stochastic resetting in the corresponding heterogeneous diffusion process leads to a non-trivial transition of the system to a nonequilibrium stationary state. We will quantify the transition to the stationary state in terms of a large deviation function, which defines the separation of the region in which relaxation to the nonequilibrium stationary state has been achieved from the region in which the system is still in a transient state. We will also show that the heterogeneous diffusion process might be closely related to the turbulent diffusion represented by the inhomogeneous advection-diffusion equation, and the (generalized) geometric Brownian motion used to model stock prices.

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