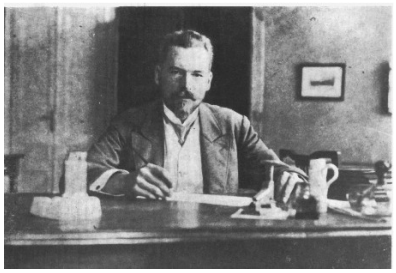

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Random walks in correlated diffusivity landscapes

Thursday, September 28, 2023 10:45 AM (40 minutes)

Diffusion of particles in random, correlated diffusivity landscapes can serve as one of the models leading to the so-called Brownian yet non-Gaussian diffusion. Under the corresponding choice of parameters, the model leads to the mean squared displacement of particles growing linearly in time, with the probability density function (PDF) of displacements changing its shape from a double-sided exponential (Laplace) at short times to a Gaussian at long ones [1]. The art of convergence to a Gaussian is, however, unusual: under the rescaling implied by the Central Limit Theorem, the central peak of the initially two-sided exponential PDF doesn't smoothen and lower but stays high while getting narrower [2]. This kind of behavior is not reproduced by the mean field theories of the phenomenon like continuous time random walks (CTRW) or diffusing diffusivity models. We discuss this kind of unusual behavior, and show that it is caused by strong correlations between spatial and temporal aspects of the motion, and cannot be reproduced by correlated CTRW schemes neglecting spatiotemporal correlations even if full temporal memory is included. Therefore, observation of the persistent central peak in the PDF could indeed serve as a clear hint onto strong, correlated spatial disorder in the system.

1. E.B. Postnikov, A. Chechkin, I.M. Sokolov, Brownian yet non-Gaussian diffusion in heterogeneous media: from superstatistics to homogenization, New Journal of Physics **22** (6), 063046 (2020)
2. A. Pacheco-Pozo, I.M. Sokolov, Convergence to a Gaussian by narrowing of central peak in Brownian yet non-Gaussian diffusion in disordered environments, Physical Review Letters **127**, 120601 (2021)

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