Mimicking heterogeneous diffusion with time dependent random diffusivity

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A considerable number of systems have recently been reported in which Brownian yet non-Gaussian dynamics was observed. These are processes characterised by a linear growth in time of the mean squared displacement, yet the probability density function of the particle displacement is distinctly non-Gaussian, and often of exponential (Laplace) shape. This behaviour has been interpreted as resulting from diffusion in inhomogeneous environments and mathematically represented through a variable, stochastic diffusion coefficient. Indeed different models describing a fluctuating diffusivity have been studied. In particular, we propose the very generic class of the generalised Gamma distribution for the random diffusion coefficient. I will present two models for the particle spreading in such random diffusivity settings. The first belongs to the class of generalised grey Brownian motion while the second follows from the idea of diffusing diffusivities. The two processes exhibit significant characteristics which reproduce experimental results from different biological and physical systems. Finally, addressing the first passage problem for the two models, I will emphasize that even when the non-Gaussian character appears for certain regimes only and in the tails of the distributions (thus with low probability), it may be essential for those systems in which rare events dominate triggered actions.