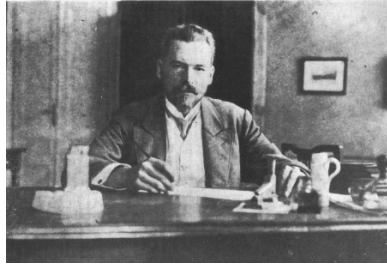


# 36th M. Smoluchowski Symposium on Statistical Physics: Soft Matter, Information Processing and Nonequilibrium Fluctuations



Contribution ID: 75

Type: **Invited Talk**

## Heterogeneity, long-range correlations, and ageing in diffusion

*Sunday, 24 September 2023 16:00 (40 minutes)*

Brownian motion is one of the most fundamental processes in non-equilibrium statistical physics. High resolution data from single particle tracking and supercomputing across the scales demonstrate deviations from the simple law of Brownian motion. I will introduce the concept of “doubly-stochastic” processes for the modelling of transport in heterogeneous systems, before turning to “anomalous diffusion” processes, characterised by a power-law form of the mean-squared displacement. For such processes non-ergodic and ageing behaviours are frequently observed.

Special emphasis will be put on stochastic processes driven by Gaussian yet power-law correlated noise, such as Mandelbrot’s fractional Brownian motion (FBM), which represents a quite ubiquitous effective description of the dynamics in a range of complex systems, e.g., for the motion of tracers in viscoelastic environments, in “rough” financial data, or for the persistent motion of animals. FBM is an ergodic yet strongly non-Markovian process, with often surprising behaviour. In this talk I will briefly introduce these processes and demonstrate that in strong confinement their probability density may assume non-Boltzmann, multimodal stationary shapes, while in soft external potentials no steady state exists. An application of this effect to the modelling of brain fibre densities is discussed. For the heterogeneous case doubly-stochastic versions of FBM are introduced as well as generalisations for deterministically changing environments.

Finally I will introduce data assimilation methods for time series data and present the Anomalous Diffusion community challenge.

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**Session Classification:** Session 1