Anomalies, Rare Events and Brownian Motion

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In his celebrated 1905 paper, Albert Einstein proposed for the first time a statistical interpretation of Robert Brown's *innocent* observation based on the corpuscular constitution of matter. His theory suggested that the long time motion of a Brownian particle is diffusive whereas the probability distribution of the particle displacements is Gaussian. For more than one hundred years these predictions were systematically validated in real systems and the coexistence between Diffusivity and Gaussianity became a paradigm. However, recent experiments on mesoscopic particle systems have claimed the existence of a time regime where diffusion is not accompanied by a purely Gaussian distribution of displacements. In this talk I will discuss these recent observations as well as those minimal stochastic models proposed to rationalize the new intriguing experimental phenomenology. Using molecular dynamics simulations I will further discuss the emergence of the hypothetical diffusive yet non-Gaussian regime in glass and gel forming-liquids. I will conclude my talk by exploring the connection between non-Gaussian dynamics and system topology.

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