

Focus on Brownian Motion and Diffusion in the 21st Century

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Abstract

Without doubt, the problem of Brownian motion has played a guiding role in the development for both the foundations of thermodynamics and the dynamical aspects of statistical physics. The development of the phenomenon of Brownian motion based on the molecular-kinetic theory of heat provides a link between the microscopic dynamics and the macroscopic phenomena such as diffusion and fluctuation phenomena. It has also provided a first link between the macroscopic response and the equilibrium fluctuation characteristics via an early form of the ubiquitous fluctuation-dissipation theorem: the Einstein relation that relates the mobility to the diffusion strength.

The topic of Brownian motion has likewise inspired many scientists to deploy a consistent treatment of phenomena far from thermal equilibrium via such concepts as the Fokker–Planck or master equation descriptions of noisy nonlinear dynamics in such diverse areas as soft matter physics, surface science, solid state physics and chemical kinetics. In recent years this theme has also increasingly impacted upon the life sciences and even extends to areas such as cosmology, astrophysics and econophysics.

This celebratory Focus Issue in *New Journal of Physics* is not only timely but also circumstantiates that this research topic is very much alive and indeed multifaceted. As Guest Editors we share the confident belief that the contributions by leading practitioners from a diverse range of backgrounds will together provide a fair and accurate snapshot of the current state of this rich and interdisciplinary research field. Last but not least, we hope that this issue will stimulate readers into pursuing research of their own in the exciting areas represented.

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