

Special Issue

From Symmetry to Fluctuations: Topics and Advances in Statistical Mechanics and Probability Theory

Message from the Guest Editor

This Special Issue aims to consolidate leading developments at the interface of statistical mechanics and probability theory, unified under the central theme of symmetry and fluctuation. These two foundational concepts play a pivotal role in our understanding of complex systems, ranging from microscopic particle ensembles to macroscopic emergent behavior, and they continue to inspire rich mathematical structures and physical insights. The issue will highlight how symmetry principles, such as invariance under transformations, conservation laws, and group actions, shape the behavior of stochastic systems and determine equilibrium and dynamical properties. Equally central are typical and rare fluctuations, which encode the probabilistic structure of these systems and offer a powerful lens for understanding phenomena far from equilibrium. We invite you to contribute to reflecting on the fluctuation to symmetry interplay in statistical mechanics and probability theory, from rigorous theoretical analysis to innovative applications, including but not limited to the following:

Guest Editor

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About the Journal

Message from the Editor-in-Chief

Symmetry is ultimately the most important concept in natural sciences. It is not surprising then that very basic and fundamental research achievements are related to symmetry. For instance, the Nobel Prize in Physics 1979 (Glashow, Salam, Weinberg) was received for a unified symmetry description of electromagnetic and weak interactions, while the Nobel Prize in Physics 2008 (Nambu, Kobayashi, Maskawa) was received for the discovery of the mechanism of spontaneous breaking of symmetry, including CP symmetry. Our journal is named *Symmetry* and it manifests its fundamental role in nature.

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