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Sharp interface limits in the study of rare events

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Abstract

Thermal or stochastic effects are prevalent in physical, chemical, and biological systems. Particularly in small systems, noise can overpower the deterministic dynamics and lead to "rare events" that would never be seen in the absence of noise. One example is the thermally-driven switching of the magnetization in small memory elements.

Wentzell–Freidlin large deviation theory analyzes rare driven events (e.g. their probability and "most likely pathway") by way of an action functional. First developed in the ODE setting, the theory generalizes naturally to systems with spatial dependence. We discuss the Allen–Cahn action functional and its sharp interface limit, including the issue of interfaces with nontrivial multiplicity.

Includes joint work with *Bob Kohn*, *Felix Otto*, *Yoshihiro Tonegawa*, and *Eric Vanden–Eijnden*.