Statistical Mechanics and Shape Transitions in Microscopic Plates

By
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Host: Assoc. Prof. Massimo Pica Ciamarra

Abstract

Unlike macroscopic multistable mechanical systems such as snap bracelets or elastic shells that must be physically manipulated into various conformations, microscopic systems can undergo spontaneous conformation switching between multistable states due to thermal fluctuations. Here we investigate the statistical mechanics of shape transitions in small elastic elliptical plates and shells driven by noise. By assuming that the effects of edges are small, which we justify exactly for plates and shells with a lenticular section, we decompose the shapes into a few geometric modes whose dynamics are easy to follow. We use Monte Carlo simulations to characterize the shape transitions between conformation minima as a function of noise strength, and corroborate our results using a Fokker-Planck formalism to study the stationary distribution and the mean first passage time problem. Our results are applicable to objects such as such as graphene flakes or protein β-sheets, where fluctuations, geometry and finite size effects are important.

Short Biography

Yong Ee Hou graduated from Stanford University in 2003 with a BSc in Physics, BSc in Mathematics and MSc in Statistics. In 2012, he obtained a Ph.D in Physics from the Harvard University, working in the research group of Prof. L. Mahadevan From 2012-2013, he worked as a postdoctoral researcher at Applied Mathematics department at Harvard University. His research interests lies in soft condensed matter, particularly at the intersection of mathematics, elasticity and statistical physics.