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Do thermal fluctuations stabilize an extensible buckling rod?

DESHPREET BEDI, XIAOMING MAO, Univ of Michigan - Ann Arbor — The classical problem of a rod buckling under a compressive force, "Euler buckling," has long been studied and solved in physics; however, the classical theory of Euler buckling does not take into account thermal fluctuations. At small enough scales, entropic effects become significant, and a more intricate analysis incorporating thermal fluctuations is needed, for instance, in the study of biopolymers and nanotubes. In this talk, we discuss buckling of an extensible, semi-flexible rod embedded in two and three dimensions. We systematically examine the problem both analytically, using a momentum-space renormalization group procedure, and numerically, using Monte Carlo simulations, to determine the topology of the phase diagram containing the unbuckled and buckled states. In two dimensions, for instance, we determine that thermal fluctuations tend to stabilize the straight-rod state over the buckled state and that this stabilization increases with temperature. We also analyze the mechanical response of the rod in order to study the differing scaling regimes of the system.

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