Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Students' Annual Seminar

Unconventional deformation structures in confined membranes under stretching

Debankur Das

Two dimensional elastic networks when stretched, deform plastically by producing 'pleats'; system spanning linear structures with width comparable to the lattice spacing, where the network overlaps on itself. When a similar elastic membrane is confined within rigid walls and allowed to have out of plane fluctuations, similar unconventional deformation modes appear upon stretching. Within these structures, which we call "ripplocations", the height field becomes multivalued. These distinct structures are separated by large free energy barriers from a phase with only smooth ripples that are always present at non-zero temperatures. To understand these structures and their interrelation, we introduce an external field that couples to local non-affine fluctuations measured from the flat reference. Using sequential umbrella sampling Monte Carlo involving sophisticated non Boltzmann sampling, we obtain conditions under which ripplocations are formed. We obtain a finite temperature phase diagram in the strain-field plane. We also describe experimental signatures such as typical stress strain curves for membranes by which transitions from rippled to ripplocated membranes may be probed. We extend our study to understand the deformation of a honeycomb lattice and obtain the relevant phase diagram in the strain-field plane.

Monday, Feb 17th 2020

12:00 PM (Tea/Coffee at 11:45 AM)

Seminar Hall, TIFR-H