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

Webinar

Fluctuations and Defect Interactions in Athermal Crystals

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We analyze the fluctuations in particle positions and inter-particle forces in disordered crystals composed of jammed soft particles in the limit of weak disorder. We demonstrate that such athermal systems are fundamentally different from their thermal counterparts, characterized by constrained fluctuations of forces perpendicular to the original lattice directions. We develop a perturbation expansion about the crystalline ordered state, which we use to derive exact results to linear order. We show that constrained fluctuations result as a consequence of local force balance conditions, and are characterized by non-Gaussian distributions which we derive exactly. We analytically predict several properties of such systems, including the scaling of the average coordination with polydispersity and packing fraction, which we verify with numerical simulations using soft disks with one-sided harmonic interactions.

We also focus on the nature of defects in the athermal crystalline system. We theoretically predict the strain fields and the change in forces produced by a single defect in a crystalline arrangement. We use this to predict the excess energy in the system associated with this defect. Finally, we use the principle of superposition at linear order to predict the interaction energy between defects placed at different locations in the system.

Monday, Jul 27th 2020

4:00 PM