Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Annealing and Memory Effects in Active and Passive Amorphous Solids

Rishabh Sharma

TIFR, Hyderabad

Glasses are dense, disordered, and inherently far-from-equilibrium objects. When some constituents can move independently using internal energy reserves or external energy inputs, time-reversal symmetry is further broken, giving rise to systems colloquially known as active glasses. These serve as excellent model systems for biological tissues and cells, where dense packing and motility coexist. Due to their strong history dependence and a plethora of metastable states, glasses can “remember” deformations, making them highly trainable.

My research employs large-scale molecular dynamics simulations to investigate how activity regulates glassiness and introduces improved protocols for memory encoding in both externally and internally driven glasses.

In the seminar, I will first discuss how activity can anneal glasses and highlight the similarities between active glasses and ordinary glasses under cyclic shear. I will demonstrate how active drive imprints itself on the structure of the annealed glass and introduce novel methods to encode “directionally-agnostic” memories in externally driven amorphous solids. I will further highlight the challenges of encoding memory in thermodynamically large systems and explain why memory encoding at the nanoscale is intrinsically advantageous. Finally, I will briefly discuss how active glasses can self-regulate rigidity and examine mechanisms behind early onset of failure under realistic loadings, with implications for better failure prediction and improved material design.

Thursday, May 15th 2025

12:00 Hrs (Tea / Coffee 11:45 Hrs)

Auditorium, TIFRH