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

Seminar

Structure-function paradigm of biomolecular condensates: a multiscale perspective

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Biomolecular condensates, formed by reversible phase separation of proteins and nucleic acids, have emerged as a ubiquitous strategy to organize cell biology. These dynamic, membrane-less compartments underlie key biological processes, including signal transduction, stress response, and transcriptional regulation, while their dysregulation is increasingly linked to neurodegeneration and cancer.

Classical thermodynamic theories of polymer physics provide a powerful framework for understanding condensate formation. However, condensates in living cells typically contain many molecular species and display rich internal organization, leading to spatially heterogeneous microenvironments. The relationship between sub-condensate structure and its respective function is not well established.

In this talk, I will discuss our recent efforts to bridge the molecular-scale biophysics to cellular-scale chemistry via condensate architecture at the mesoscale. Using tools from biophysics, systems biology and bioinformatics, we show how the “sticker–spacer” architecture of biopolymers gives rise to metastable condensates with distinct microenvironments that may be functionally useful. This perspective reveals evolutionary design principles that shape biological systems to optimize their functions across disparate scales.

Tuesday, Aug 11th 2026

16:00 Hrs (Tea / Coffee 15:45 Hrs)

Auditorium, TIFRH