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

Seminar

Emerging paradigms in the lateral and transverse organisation in biological membrane and their functional implications: Connecting the dots with biomolecular simulations

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In the first part of my talk, I will provide a pedagogical timeline of the evolving paradigm in our understanding of membrane structure since the earliest work of Overton and Myers. I shall then briefly discuss a new framework developed in our group that uses non-affine displacement metric to faithfully capture the extent of local membrane order in simulated heterogeneous bilayers. My main discussion will be on recent results from our laboratory where we investigated spatial and temporal organisation on microseconds trajectories of liquid-ordered bilayer systems at all-atom resolution. Interestingly, the lateral organisation exhibits noticeable heterogeneity despite its liquid-ordered nature (JCP2025, https://doi.org/10.1063/5.0250190). Our analysis reveals soft channels within the tightly packed membrane reminiscent of the classical two-component Kob-Andersen glass-forming models. Hence, we characterised them using classical glass physics markers for dynamic heterogeneities such as overlap, four-point susceptibility, van Hove and intermediate scattering functions to quantify the multiple time scales underlying the ordered lipid dynamics. Our analyses suggest that highly ordered membrane systems (lipid nanodomains, rafts) may exhibit glass-like dynamics with highly fluid channels within them that facilitate anomalous molecular encounters for biological functions. Time permitting, I shall also discuss an emerging (and exciting) paradigm where "oligomeric lipid motifs" or "lipid nanodomains" are posited as functional building blocks. I will try to argue that simulations and theory, when integrated with experimental data, can be used to robustly address biologically pertinent questions such as "Why are there so many lipids?" or "Is there a lipid code?" (CoSB2025, https://doi.org/10.1016/j.sbi.2025.103128).

Tuesday, Sep 23rd 2025

14:30 Hrs (Tea / Coffee 14:15 Hrs)

Auditorium, TIFRH