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

Internal Webinar

Stochastic dynamics of subcellular structures

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The regulation of size and number of subcellular structures is critical for cellular organisation and function. Cytoskeletal filaments, such as microtubules and actin filaments, exhibit size regulation influenced by limited resources of building blocks and different biochemical processes. Further, cytoskeletons interact with various motors and proteins in vivo that may promote growth or disassembly. Using coarse-grained models, we demonstrated that nucleotide hydrolysis, a non-equilibrium process, drives bimodal length distributions and bistable length toggling, promoting length diversity. Positive feedback in microtubule growth and hydrolysis leads to non-unimodal length distributions for multiple filament systems, highlighting collective effects in shared subunit pools. For organelles, we developed a model of biogenesis incorporating bursty synthesis, revealing its role in amplifying noise and broadening the parameter space for bimodal organelle number distributions. These findings suggest bursty events significantly contribute to variability in organelle abundance.

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14:30 Hrs