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

# Seminar

## Semantic Unmixing of Fluorescence Microscopy Data using Deep Learning

## Ashesh

### TU Dresden, Germany

Fluorescence microscopy is limited by optics, fluorophore chemistry, and photon exposure, forcing trade-offs in speed, resolution, and depth. In this talk, I will discuss my PhD research that addresses these challenges. Several deep-learning-based computational multiplexing techniques will be discussed which enhances imaging of multiple cellular structures within a single fluorescent channel, enabling faster imaging with less photon exposure. More concretely, I focus on unmixing superimposed structures—such as Nucleus and Tubulin—into separate images. One approach employs a Hierarchical Variational Autoencoder (H-VAE) inspired architecture, allowing sampling of diverse, plausible predictions from a trained posterior. Additionally, I present methods for uncertainty quantification and calibration to improve reliability. To handle cases where one structure dominates in the superimposed image, we leverage the inductive bias of flow-matching techniques and develop an image-unmixing framework using InDI. These advances aim to push the boundaries of fluorescence microscopy through computational innovation.

***Tuesday, Aug 12th 2025***

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

***Seminar Hall, TIFRH***