Department Seminar
4:00pm, April 2, 2026
Girish Kulkarni (TIFR Mumbai)
Towards understanding the epoch of reionization out to the cosmic dawn

Venue: AB1 Conference Room

Abstract: Work on understanding the epoch of reionization has been galvanized in recent years by a series of observational and theoretical breakthroughs. These include the recognition that spatial structure in the Lyman-α forest retains signatures of reionization history, the discovery of galaxies and quasars deep in the reionization era by JWST, and renewed efforts to detect the redshifted 21-cm signal from cosmic dawn and the epoch of reionization. In this talk, I will present a series of results from my group that address the goal of understanding the evolving ionization state of the Universe, from cosmic dawn to the final stages of reionization. This includes new simulations of reionization, updated measurements of the mean free path of ionizing photons, improved constraints on the neutral hydrogen fraction from quasar damping wings, and interpretations of AGNs and LAEs discovered by JWST. I will describe our ongoing attempts to directly detect the neutral parts of the IGM for the first time using the 21-cm forest, and discuss the implications of JWST data for quasar growth during this era. Deeper into the reionization epoch, I will present new approaches to charting reionization using LAEs. Closer to cosmic dawn, I will highlight new radiative transfer models of Lyman-α coupling and a model-agnostic framework for combining JWST and 21-cm observations, including results from REACH. I will conclude by reviewing where we are and outlining key challenges ahead.

About the Speaker: Girish Kulkarni is an astrophysicist and Associate Professor at the Tata Institute of Fundamental Research in Mumbai. He works on the first billion years of cosmic history, when the first galaxies formed, the intergalactic medium became reionised, and the earliest supermassive black holes began to grow. His research combines physics, astronomy, and high-performance computing, and engages with data and questions connected to major international facilities and experiments, including JWST, the VLT, REACH, the Square Kilometre Array, and LSST at the Rubin Observatory. He received his PhD from the Harish-Chandra Research Institute under the supervision of Jasjeet Singh Bagla, and has previously held positions in Cambridge and Heidelberg.