

**ICTS**

INTERNATIONAL
CENTRE *for*
THEORETICAL
SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS Thesis Defense Seminar

Title : From microscopics to hydrodynamics

Speaker : Sahil Kumar Singh (ICTS-TIFR, Bengaluru)

Date : Tuesday, 02 September 2025

Time : 2:00 PM (IST)

Abstract : The macroscopic properties of many-particle systems are usually governed by phenomenological laws, such as thermodynamics and hydrodynamics, which differ notably from their underlying microscopic dynamics. These macroscopic laws are usually not rigorously derived from first principles. In this thesis, we investigate whether predictions from these phenomenological laws can be validated through microscopic simulations in both non-integrable and integrable systems. In the first part, we focus on non-integrable systems, comparing the predictions of molecular dynamics with those of hydrodynamics for a blast wave initial condition (in which a shock or discontinuity forms). We thus test hydrodynamic predictions under conditions that challenge its assumptions of slow field variation. We identify two regions with distinct space-time scaling: one dominated by dissipative terms and the other by Euler terms. In the second part, we study an interacting integrable system whose hydrodynamic equations exhibit non-zero dissipation, driving it toward a Generalized Gibbs Ensemble (GGE). Interestingly, we identify certain initial conditions that do not go to GGE, while other conditions do. For both cases, we find good agreement between hydrodynamic predictions and molecular dynamics simulations, demonstrating the applicability of hydrodynamic theory in these integrable settings..

Venue : Feynman Lecture Hall

Zoom link: <https://icts-res-in.zoom.us/j/94585821893?pwd=NsurRORd5f9QKl2QYzRv4SvuPbQQOb.1>

Meeting ID: 945 8582 1893

Passcode: 040440