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

Seminar

Droplet Growth in Clouds: Roles of Non-Continuum Hydrodynamics and Electrostatic Interactions

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Rain formation in clouds begins with the collision and coalescence of small droplets. These processes govern the evolution of the droplet size distribution (DSD) and the onset of precipitation. In contemporary weather and climate models, these processes are represented through parameterizations that often rely on simplified assumptions and empirical formulas that fail to capture the complex interplay among turbulence, gravity, hydrodynamic, and non-hydrodynamic interactions among droplets, leading to significant uncertainties in predicting DSD evolution. Cloud–climate interactions inherently involve multiscale, multiphysics, and multiphase processes. This complexity underscores the necessity for a comprehensive understanding of cloud microphysics, with the objective of developing physically consistent parameterizations of droplet-level processes. Improving the collision parameterizations directly impacts the accuracy of cloud microphysics schemes used in large-scale models. The collision rate between droplets is strongly influenced by background turbulence, gravity, and hydrodynamic and non-hydrodynamic interactions. In this talk, I will present a systematic study of near-field mechanisms governing droplet collision dynamics. In particular, I will discuss the role of non-continuum lubrication interactions, which become important when the inter-droplet gap thickness is less than the mean free path of air, and electrostatic interactions arising from droplet surface charges and electric fields within clouds. The findings of this study provide valuable physical insights into the collision dynamics of droplets under the influence of background laminar flows or gravitational settling, with direct implications for improving collision parameterizations in cloud microphysics schemes.

Tuesday, Jun 23rd 2026

11:30 Hrs (Tea / Coffee 11:15 Hrs)

Seminar Hall, TIFRH