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

Seminar

Complex fluids with mobile and deformable interfaces

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Complex fluid interfaces where interface mobility and deformations coexist, departs fundamentally from the rigid interface counterpart. The richness of this scenario engages physicists, biologists, and engineers, pointing to their value in both fundamental research and practical applications. I will demonstrate this through two examples of complex interfaces in my talk.

In the first part, I will discuss physics of disperse systems using jammed emulsions. Emulsion, foams or jammed systems in general are usually described by phenomenological law which assumes yield stress and power law behaviour. This simple assumption breaks down for ultra monodisperse emulsions. Here, the flow is possibly governed by, collective behaviour, and long-range order of the system. I will present some of our recent experiments. Key questions include modes of stress relaxation in jammed crystalline soft system and the relevant length and time scales. In the second part, I will move to multiphase continuum system and share how magnetic confinement can result in a stable, deformable, and mobile liquid-liquid interface. We have here coupled non-linear hydrodynamics between fluid magnetic pressure, viscous forces, and the Laplace pressure. Experimentally this has realised nearly shear-less flow, arbitrary deformable interface, instability control, and remarkably improvement in biomaterial transport.

These complex fluids scenarios not only reveal novel flow conditions but also provides opportunities for broad applications in biomimetic and smart materials, drug delivery and microfluidics, surface engineering and wetting phenomena, hyperuniform surfaces and sensor applications, cosmetics, and porous media transport. Such wide range of application motivates us to study this unique class of complex fluids, which covers the interplay between hydrodynamic forces, interfacial mechanics, and collective phenomena for fundamental and applied research.

Friday, Sep 19th 2025

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

Auditorium, TIFRH