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

Seminar

Surprises in Driven Stokesian Suspensions

Rahul Chajwa

Stanford University, CA

The inertia-less dynamics (Re=0) of particles suspended in a fluid is ubiquitous in both the natural and industrial worlds. When particles with internal degrees of freedom (shape or activity) are driven, the coupling between these degrees and fluid flow can yield rich dynamical behaviour. In this talk, I will share: [1]An array of coins settling under gravity exhibits wave-like modes, overturning the iconic Crowley instability, with effective Hamiltonian dynamics mimicking those of a lattice of masses and springs. The non-normal nature of the dynamical matrix leads to algebraic growth of perturbations even in the linearly stable regime, presenting an unconventional route to instability.[2] For a dilute suspension of self-propelled particles (SPP) in externally driven flows, yet another type of effective inertia gives rise to a singularly high concentration of SPP, namely caustics, at intermediate levels of activity. This effect is likely consequential for sexual reproduction of plankton in the ocean.[3] Marine snow presents a complex fluid-structure interaction problem that is at the heart of ocean-based carbon sequestration and the ongoing climate crisis. Micro-hydrodynamic measurements done at sea reveal invisible comet-shaped halo around sinking marine snow, the presence of which could significantly impede carbon flux in the ocean. This study promotes the value of doing clean table-top soft-matter experiments in noisy field settings.

References:

[1] R. Chajwa, N. Menon, S. Ramaswamy, R. Govindarajan, https://doi.org/10.1103/PhysRevX.10.041016 (2020).
[2] R. Chajwa, Rajarshi, S. Ramaswamy, R. Govindarajan https://doi.org/10.48550/arXiv.2310.01829 (2023).
[3] R. Chajwa, E. Flaum, K.D. Bidle, B.V. Mooy, M. Prakash https://doi.org/10.48550/arXiv.2310.01982 (2023).

Thursday, Apr 25th 2024

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

Auditorium, TIFR-H