ICTS Fluid Dynamics Seminar

Title : Cellular Slingshots and Hidden Comet-tails in the Oceans

Speaker : Rahul Chajwa (Stanford University, USA)

Date : Wednesday, 1 May 2024

Time : 2:30 PM (IST)

Abstract : The gravity-driven downward flux of carbon in our oceans in the form of *marine snow*, commonly referred to as a biological pump, directly regulates our climate, and the vertical migration of plankton adds further richness to this phenomenon. In this talk, I will share [1] an inflation-induced motility mechanism in plankton that allows single cells to vertically migrate distances ~105 times their own size in the absence of swimming and advective transport. We find that a dynamic buoyancy during the cell cycle via rapid inflation contributes a singular perturbation to migration dynamics. We show that treating gravity as selection pressure in the evolution of phytoplankton leads to critical bounds on cytoplasm and vacuole densities in non-motile plankton. [2] Sedimentation of *marine snow* presents a notoriously difficult fluid-structure interaction problem. We conduct a highly resolved PIV of *marine snow* at sea, which presents detailed fluid-structure dynamics, revealing an invisible comet-tail like morphology composed of mucus. We construct a minimal model of Stokesian sedimentation and viscoelastic distortions of mucus to understand the sinking speeds and tail lengths of *marine snow* and find that these hitherto unknown invisible degrees of freedom significantly impede carbon sequestration.

Ref.
[1] A. Larson*, **R. Chajwa***, H. Li, M. Prakash, *Inflation induced motility for long-distance vertical migration*, bioRxiv 2022.08.19.504465 (2022)
[2] **R. Chajwa**, E. Flaum, K.D. Bidle, B.V. Mooy, M. Prakash, *Hidden Comet-Tails of Marine Snow Impede Ocean-based Carbon Sequestration*, arXiv:2310.01982 [physics.ao-ph] (2023)

Venue : Chern Lecture Hall

Zoom Link: https://icts-res-in.zoom.us/j/91099687605?pwd=cnZqeFArUnY3aGhCeUdiMzZUaXhEUT09

Meeting ID: 910 9968 7605
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