LadHyX Seminar – December 1, 10:45 – LadHyX Library

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Helical Flows and Transport Phenomena

Advances in microfabrication enable the tailoring of surfaces to achieve optimal sorting, mixing, and focusing of complex particulate suspensions in microfluidic devices. Corrugated surfaces have proved to be a powerful tool to manipulate particle motion for a variety of applications, yet the fundamental physical mechanism underlying the hydrodynamic coupling of the suspended particles and surface topography has remained elusive. In this talk, I will first discuss the hydrodynamic interactions between sedimenting spherical particles and nearby corrugated surfaces, whose corrugations are tilted with respect to gravity. Our experiments show three-dimensional, helical particle trajectories with an overall drift along the corrugations, which agree quantitatively with our analytical perturbation theory. The theoretical predictions reveal that the interaction of the disturbance flows, induced by the particle motion, with the corrugations generates locally a transverse anisotropy of the pressure field, which explains the helical dynamics and particle drift. In the second part of this talk, I will revisit the classical Taylor dispersion theory and discuss the impact of corrugated surface structures on the dispersion of tracer particles in shear flow.

[1] DL Chase*, C Kurzthaler*, HA Stone, PNAS 119 (2022)
[2] JV Roggeveen, HA Stone, C Kurzthaler, arXiv:2210.02354 (2022)