LadHyX Seminar – February 12th, 10:45

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Granular suspensions in complex environments

Granular suspensions, i.e., suspensions composed of particles of micron size and larger, are ubiquitous in both natural and industrial contexts. Despite the apparent complexity arising from the large number of constituent particles, such systems often display a surprisingly simple, Newtonian-like rheological behavior when their bulk properties are probed. This picture, however, breaks down in non-bulk situations, where confinement, boundary conditions, or the nature of the surrounding medium can strongly affect suspension flows. In this talk, I will present two examples of granular suspensions in complex environments.

In the first case, complexity arises from boundary conditions and confinement of the particulate phase. I will focus on the Rayleigh–Taylor instability of a thin granular suspension film hanging from a ceiling. Under gravity, the free capillary interface destabilizes, but the presence of particles introduces a new intrinsic length scale into the problem, which can constrain the classical instability modes. I will show that as the particle size increases, the classical destabilization is replaced by new regimes that were previously predicted for extremely thin films of simple liquids, but had not been observed experimentally.

In the second part of the talk, I will consider a different type of complex environment, in which the suspending Newtonian fluid is replaced by a shear-thickening fluid. Such fluids can undergo a transition from a fluid-like to a solid-like state under sufficiently large stresses. I will show that the interaction between the granular phase and the shear-thickening matrix leads to unexpected rheological behavior, revealing a complex interplay between the different phases and length scales at play.