LadHyX Seminar – June 18, 10:45

Cecile Cottin-Bizonne (Institut Lumière Matière, Lyon 1)

A journey in the dynamics of active particles: dense Janus colloids and Marangoni surfers

Abstract

The behavior of self-propelled particles, that are intrinsically out of equilibrium, is rather fascinating and opens new questions. In a first part I will focus on our experimental study of the dynamics of active colloids in crowded conditions. Our system is a monolayer of micronsize gold-platinum Janus particles in water. Upon addition of hydrogen peroxide, the colloids become self-propelled due to the different chemical gradient on both sides. If at low density they behave as perfect hot gas, at intermediate densities we have observed and characterized a new collective phenomenon: the formation of clusters. In the dense regime, we notice an unexpected behavior as the activity level rises up. Ergodic supercooled states always relax faster with self-propulsion. By contrast we observe a dramatic slowdown of relaxation of nonergodic states when particles become weakly self-propelled. As we increase further activity, the relaxation speeds up until it exceeds the passive situation. This unexpected nonmonotonic behavior cannot be described by a simple increase in temperature.

In a second part I will present our studies on the dynamics of interfacial swimmers, self-propelled objects lying between two fluid phases, and more precisely the spontaneous motion of camphor particles at a liquid-gas interface. Marangoni swimmers present complex problems starting with the simplest question of their swimming properties when symmetry breaking arises spontaneously rather than being encoded in the particle properties. I will discuss recent investigations we have conducted on the dynamics of lonely camphor swimmer as well as on the original collective dynamics emerging from the interactions between many swimmers: a collection of Marangoni surfers exhibits multi-scale dynamics matching with the canonical Kolmogorov description of inertial turbulence.