LadHyX Seminar – August 25, 10:45, – LadHyX Library

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Reactive suspensions: modeling and large scale simulations

Active matter span many scales, sweeping from a large flock of birds to tiny swimmers in suspensions of sperm cells or bacteria colonies. Recently, synthetic micron particles have been developed to study and mimic their natural counterparts and to explore engineering applications like microsurgery or water purification. These suspensions of artificial phoretic particles can form coherent structures due to dual hydro-chemical interactions between the individual swimmers leading to the emergence of rich dynamics. Given the scale of the particles, the problem is governed by the Laplace and Stokes equations coupled by the boundary conditions on the particles' surface.
The computational modeling of such systems remains particularly challenging given the coupled nature of the chemical and the hydrodynamical problems but mainly because of the rapid increase in the required computational resources for large ensembles of particles. During this presentation, I will present a new framework based on the core ideas of the Force Coupling Method, which is able to handle both the chemical diffusion and Stokes flow problems for many particles (called Diffusiophoretic Force Coupling Method). This method was implemented in an efficient parallel solver to model the collective motion of diffusiophoretic suspensions formed with Janus particles. I will show the most recurrent patterns in our simulations and rationalize how the particles' individual properties and interactions explain the emerging structures in the suspensions.