M2 Internship / PhD Proposal

Laboratory: Matière et Systèmes Complexes (MSC), UMR CNRS 7057
Internship director's surname: J.-B. FOURNIER and F. VAN WIJLAND
E-mail: jean-baptiste.fournier@u-paris.fr, frederic.van-wijland@u-paris.fr
Web page: See Google Scholar
Funding: Ecole Doctorale's contract

Active matter, chemotaxis and organization

When the motion of active particles couples to the local density of a diffusive agent, its individual motion is obviously affected, but new collective phenomena also show up.

The internship/PhD will consist in using statistical physics methods (namely a combination of stochastic calculus, Langevin and mean-field description for the density and ordering fields, numerical simulations) to describe:

- how an updated description of the injection of activity leads to the emergence of the concept of active Brownian particle;
- how activity couples to the collective density modes;
- how effective interactions between particles build up.

Once a description in terms of equations for continuous fields, with or without noise, is achieved, this paves the way for the exploration of macroscopic organization (patterns, localized dynamical structures, etc.) and the characterization of the nonequilibrium features of the system.

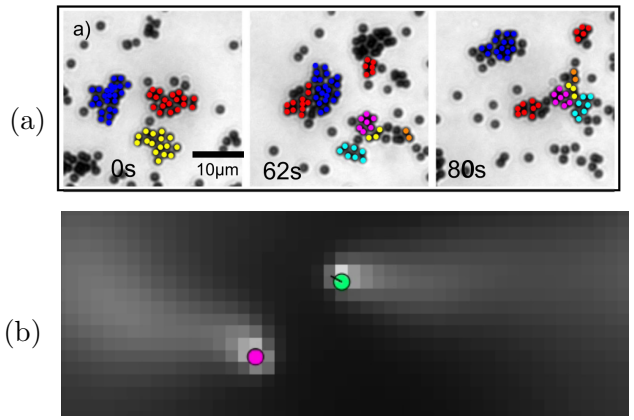

Figure 1: (a) Experimental dynamical cluster of chemotactic active particles [Bocquet et al., Phys. Rev. Lett. 108, 268303 (2012)]. (b) Stochastic numerical simulation with emergent active motion.

[1] Phoretic Active Matter, R. Golestanian, arXiv:1909.03747v3 [cond-mat.soft] (2019)
[2] Dynamic Clustering in Active Colloidal Suspensions with Chemical Signaling, I. Theurkauff et al., PRL 108, 268303 (2012)
[3] Dynamic Clustering and Chemotactic Collapse of Self-Phoretic Active Particles, O. Pohl et al., PRL 112, 238303 (2014)