INTERNSHIP and PhD   PROPOSAL

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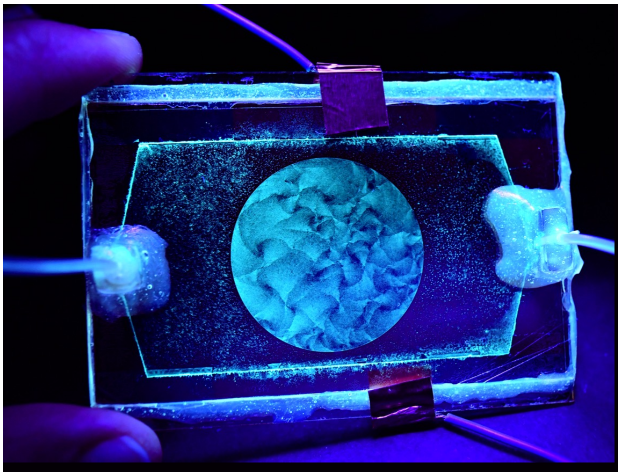
Internship location: ENS de Lyon
Thesis possibility after internship: YES
Funding: YES   If YES, which type of funding: ERC

Three-dimensional active fluids and crystals

The goal of our work will be to elucidate the phase behaviour of the first realisation of three dimensional synthetic active fluids and solids.

Active-matter physics emerged from the endeavor to describe the collective dynamics of interacting biological entities, ranging from cell colonies to bird flocks. The captivating dynamics of these systems prompted physicists to create materials composed of man-made active units, driven independently far from equilibrium. This pursuit ignited a surge in experiments, simulations, and theories during the 2010s, and within less than a decade, all the essential components of the soft matter toolbox became effectively motorized. However, up until this point, all realizations of synthetic active matter have been limited to two-dimensional model systems.



The emergence of collective motion in a population of millions of active colloids results in the formation of an active fluid that can spontaneously flow in a circular chamber. A. Cahrdac and D. Bartolo.

`Our objective is to elevate the status of synthetic active matter from aesthetic 2D model experiments to genuine 3D solid and liquid materials capable of emergent flows and deformations. We will characterize and explain the spatiotemporal structure of active crystals and liquids. We will then investigate the transition between these two states of matter, where the macroscopic structure is intricately linked to the motorization of microscopic active units.
To gain a better idea of our research approach and the concepts and tools we employ, you can review our recent work on colloidal active matter:

Jorge, Poncet et al, under review Nature Physics Active hydraulics laws from frustration principles (2023)

Chardac et al Physical Review X Topology driven ordering of flocking matter (2021)