MICROPHASE SEPARATION OF LIVING CELLS

LABORATORY : Institut Lumière Matière

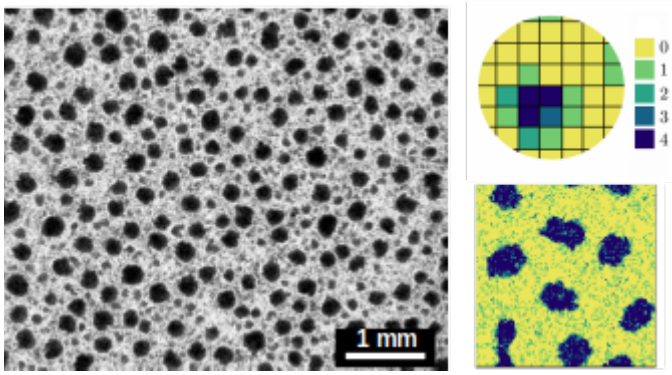
LEVEL : M2
TEAM(S) : LIQ@INT
BIOPHYSIQUE

CONTACT(S) : DETCHEVERRY François
RIEU Jean-paul

CONTACT(S) DETAILS: francois.detcheverry[at]univ-lyon1.fr / Tel. 0472431025
jean-paul.rieu[at]univ-lyon1.fr / Tel. 0472431142

KEYWORD(S) : Biophysics / Self-organization / Simulations

SCIENTIFIC CONTEXT :



Experiments (left) and simulations (right) of microphase separation

Self-organization of cells is central to biological systems and understanding the underlying mechanisms is a long-standing quest. Our recent experiments on the model organism *Dictyostelium discoideum* show that those motile cells can spontaneously self-assemble into **compact aggregates** with a characteristic size of 100 µm (Figure). The phenomenon is in fact akin to a microphase separation [1].

Microphase separation is an equilibrium phenomenon where the **formation of domains is induced by competing interactions**, usually a short-range attraction opposed by a long-range repulsion. Over the last 40 years, the phenomenon has been recognized in several physical systems, from magnetic films and superconductors to liquid crystals, colloids and copolymers. However, it has never been observed with living cells. The experiments shown in the Figure thus raise a host of questions.

MISSIONS :

The goal of the internship is to explore the microphase-separation of cells using **numerical simulations**. Our model describes each cell individually and account only for the essential ingredients: adhesion between cells, consumption of oxygen and motion toward oxygen-rich regions. The simulations so far provide an understanding of the domain size but many facets of the microphase separation deserve to be explored, from the various morphologies possible to the **dynamic properties** of the very mobile domains.

The student will exploit and expand a simulation code that is already functional. A taste for numerical techniques is desirable. No background in biology is required. The work lies at the interface of **statistical physics, biophysics and active matter.**

OUTLOOKS :

Continuation as a **PhD** is possible.

BIBLIOGRAPHY :

[1] Microphase separation of living cells. Carrère et al, *Nature Communications* (2023)

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