STAGE DE M2 / THÈSE - année 2018-2019

Laboratoire : Matière et Systèmes Complexes (MSC)

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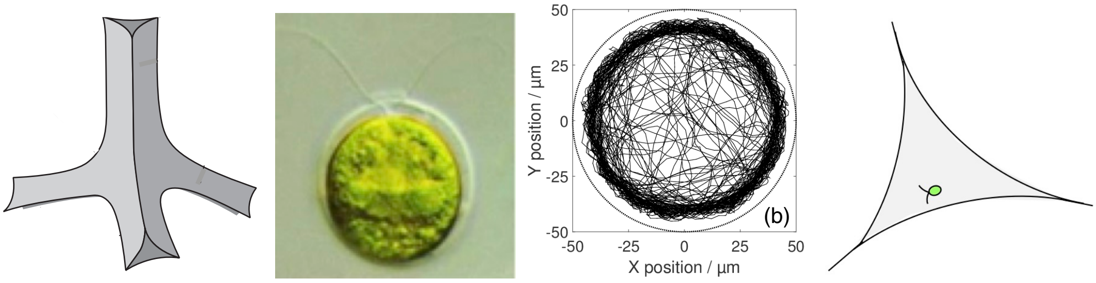
Swimming in a foam channel

How do micro-organisms (bacteria, micro-algae, worms, …) move in confined environments? This situation is pertinent in natural conditions where micro-organisms must move in crowded and complex environments like porous media (soils, sediments, aquatic foams). Recent experiments in our group suggest than liquid foams act as a filter, retaining motile planktonic cells, while the non-motile cells can flow through the foam [1]. Our hypothesis is that in the geometry of a foam channel (Fig 1a), the swimmer might spend more time in the corners, which could lead to the trapping of the microswimmer by confinement while the channel shrinks.

This internship aims to shed light on those results by observing locally the motion of the microswimmer inside a foam channel. The bi-flagellate algae *Chlamydomonas rheinardtii* (Fig. 1b) will be placed in microfluidic chambers under a microscope. Previous studies have shown that in a confined concave geometry, the alga swims in preference close to the boundary (Fig. 1c), with a probability density depending on the curvature of the chamber [2]. The purpose of this internship is to measure the probability density of the swimming alga in a convex chamber (Fig. 1d) that mimics the cross-section of a foam channel with a prescribed curvature. This internship subject will provide to the student the opportunity to become familiar with experimental techniques such as phase contrast microscopy, the design of microfluidics wells, algal culture and particle tracking. This problematic comes from the question of quantifying the trapping of plankton in marine ultra-stable foams. The internship can be pursued by a PhD on this topic.



(a) (b) (c) (d)

Figure 1: (a) Geometry of the internal liquid channels of a foam. (b) Micro-algae Chlamydomonas reinhardtii (diameter : 5 to 10 μm); the flagellae are visible. (c) Single trajectory of a C. rheinardtii algae in circular confinement. From [2]. (d) Sketch of the cross-section of a foam liquid channel with a bi-flagellated microswimmer (in green).

[1] Q. Roveillo, ongoing PhD thesis
[2] T. Ostapenko, et al., Physical Review Letters 120, 068002 (2018).