INTERNSHIP PROPOSAL

Laboratory name: Physique et Mécanique des Milieux Hétérogènes (PMMH)
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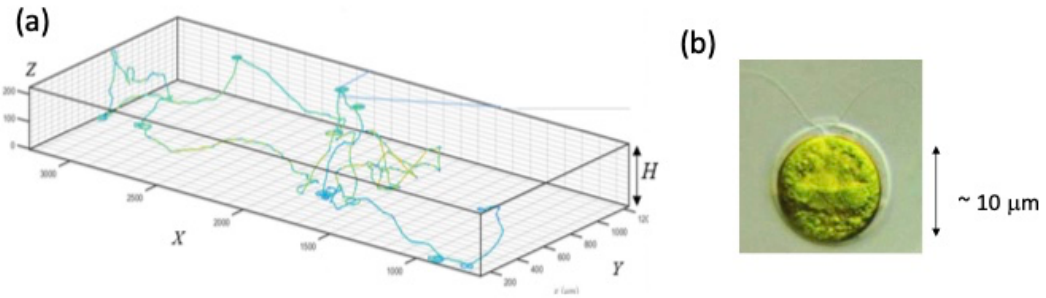
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR

Micro-algae swimming under confinement

Eukaryotic micro-swimmers, such as micro-algae, often propel themselves using flagella that allow them to move in a breaststroke-like motion. In natural environments, e.g. in the soil or in an aquatic foam, their motion is however confined between boundaries, which consist in liquid-solid or liquid-air interfaces [1]. In this internship, we will explore the change in the swimming behaviour of the biflagellate microalgae *Chlamydomonas reinhardtii* from a 3D swimming to a motion in a confined controlled environment. The 3D swimming is usually described as an alternance of ballistic trajectories and random reorientations leading to a diffusive exploration of the space at long times. Using a Lagrangian 3D trajectory tracking technique that has been developed in the PMMH laboratory to track fluorescent objects such as colloids or bacteria over very long timescales [2, 3], we will investigate in detail the trajectory of microswimmers in confined environments, i.e. in a cuvette with a controllable thickness. By measuring observables such as the swimmer instantaneous velocity and long-time diffusion coefficient, we aim to evidence the characteristic length under which the swimmer is confined. We will also be able to analyze the swimming behaviour close to the surface and away from the surface. The original setup will allow to test different boundary conditions. This experimental internship will involve setting up protocols for observing the micro-organism's 3D trajectory, and following it in order to analyze its trajectories. The internship may be continued as a thesis. Although a great deal of emphasis will be placed on experiments, there will also be opportunities for rationalization of results and modelling.



(a) 3D trajectory of a bacteria confined between two parallel plates, and measured using the PMMH 3D Lagrangian microscope. From [3]. (b) Unicellular eukaryotic bi-flagellated alga Chlamydomonas reinhardtii.

References

[1] Q. Roveillo, J. Dervaux, Y. Wang, F. Rouyer, D. Zanchi, L. Seuront and F. Elias, Trapping of swimming microalgae in foam, J. R. Soc. Interface, 117: 20200077 (2020).
[2] T. Darnige, N. Figueroa-Morales, P. Bohec, A. Lindner and E. Clément, Lagrangian 3D tracking of fluorescent microscopic objects in motion, Review of Scientific Instruments, 88, 055106 (2017).
[3] R. Baillou, M. Pedrosa Garcõa-Moreno, Q. Guigue, S. Meinier, T. Darnige, G. Junot, F. Peruani and E. Clément, Exploring space under confinement: a quantitative view on bacteria contamination, preprint.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/NO Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO