Proposal for an internship

Diffusion and clustering of passive particles in a bath of micro-algae

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Micro-organisms, such as bacteria or micro-algae, are an essential part of the life cycle on Earth. Those small life forms are able to move by themselves around their environment, for instance by swimming, in order to reach the optimal conditions for their survival. Depending on the bacterial or algal species, they can look for food, oxygen or even light [1,2].

We want to use such micro-swimmers to help deliver precisely specific drugs at a target location, for example in the human organism. In order to do so, we need to understand their interaction with their environment: what happens for the small passive particles naturally present around the micro-organisms, for instance in the sea or in the soil? Do they follow the micro-swimmers in their surviving quest, are they ejected the other way or even dispersed all around?

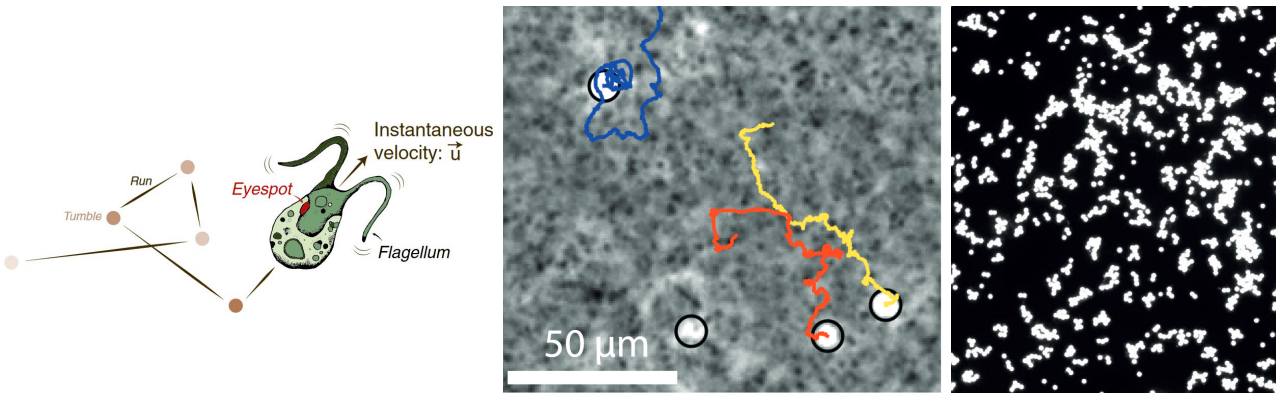

Figure 1: (Left) Sketch of a *Chlamydomonas reinhardtii* from Ramamonjy *et al.* [1]. (Center) Diffusive motion of passive beads of 5 µm diameter in a bath of swimming bacteria, from Bouvard *et al.* [3]. (Right) Unexpected agglomeration of passive beads of 25 µm diameter in a bath of swimming bacteria, from Bouvard *et al.* [3].

This internship will consist of studying experimentally the motion of passive micrometric beads immersed in a suspension of micro-algae. First, the student will learn how to grow micro-algae *Chlamydomonas reinhardtii*, and will study their swimming behaviour under a microscope. Afterwards, he/she will observe what happens when passive beads are added to the algal suspension, analyse those observations and adapt the experimental protocol (*e.g.* by varying the concentration and size of beads, the concentration of algae etc.) to prevent beads agglomeration or direct them at a targeted location.

[1] Ramamonjy, A., Dervaux, J., & Brunet, P. (2022). Nonlinear phototaxis and instabilities in suspensions of light-seeking algae. *Physical Review Letters*, 128(25), 258101.
[2] Raina, J. B., Fernandez, V., Lambert, B., Stocker, R., & Seymour, J. R. (2019). The role of microbial motility and chemotaxis in symbiosis. *Nature Reviews Microbiology*, 17(5), 284-294.
[3] Bouvard, J., Moisy, F. & Auradou, H. Ostwald-like ripening in the two-dimensional clustering of passive particles induced by swimming bacteria. *Submitted*.