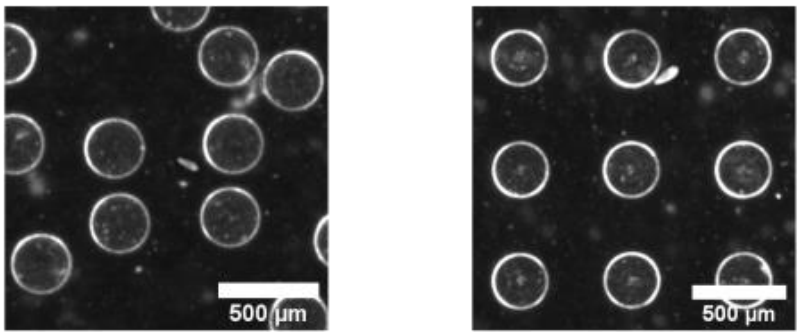

Mechanosensitive swimmers in crowded environments

Paramecium is a large unicellular eukaryote organism (100 – 300 µm long) that swims in fresh water by beating its cilia. It feeds on bacteria that it locates by chemotaxis and changes its swimming direction when the chemical concentration associated with the presence of bacteria decreases. It also exhibits mechanosensitive behaviors as it can detect and avoid obstacles in its path with the so-called "avoiding reaction": when it hits an obstacle, it usually swims backwards for a short time, then swims forward in a new direction. This characteristic motion, that can also occur spontaneously, induces a diffusive-like motion of *Paramecium* at long time scales.

The biophysical basis of the avoiding reaction has only been described qualitatively. The reaction is triggered by action potentials that are produced by voltage-gated ion channels and whose initiation in the case of mechanical contacts, results from the opening of mechanosensitive ion channels. The avoiding reaction has however neither been measured precisely in a free environment nor characterized in ecologically relevant crowded environments. It is unclear how its properties depend on the geometric/mechanical features of the obstacles, as well as on the swimming characteristics of the *Paramecium* (velocity, incidence angle) and the spatial distribution of the mechanosensitive channels. More generally, the role of *Paramecium* mechanosensitivity on its long times swimming behavior in crowded environments has not been studied.

For this Master 2 internship, we propose to address these questions by developing behavioral experiments of *Paramecium Tetraurelia* (wild types and mutants) swimming in micro-engineered environments with different types of obstacles (*see* Figure). Dedicated tools to track the motion of *Paramecium* (trajectory/orientation) in 2D but also in 3D, with high temporal and spatial resolutions, will be developed. These will allow to measure precisely the characteristics of the avoiding reaction, relate them to the geometrical/mechanical properties of the obstacles and, eventually, to the long times swimming behavior of *Paramecium*.

These experiments will be done at Laboratoire Jean Perrin under the supervision of A. Prevost and L.-L. Pontani. They will involve regular interactions with R. Brette of the Institut de la Vision, with whom we collaborate closely within the framework of a project funded by the ANR (project MECHAMO).

This internship could be followed by a PhD thesis.

- ***Location***

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