Master 2 Internship position in soft matter physics

Interactions of zoospore microswimmers with solid walls.

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The microswimmer we study in our team in collaboration with plant biologists of INRAE at Sophia Antipolis is a plant pathogen named *Phytophthora parasitica*. *Phytophthora* genus causes plant diseases, known under the name of mildew and infects lot of plant varieties. It is then a major threat in agriculture with billions of dollars lost each year. To infect plants, the pathogens use their chemotactic properties that allow them to orient themself in response to chemical signals. In previous works, we studied the collective movement of these microswimmers in a chemical gradient [1], directly around living plant root [2], with other telluric species [3]; we also described the physics of swimming of this microorganism in a liquid medium without physical or chemical constraints [4]. The form of the pathogen able to swim is called zoospore. Zoospores swim mainly in a straight line (‘run’). These run phases are interspersed with changes of direction known as “tumble”. Their tumble mechanism which is represented on figure 1, is complex and very different from other microswimmers. Indeed, to change of direction, zoospores stop the beating of their posterior flagellum. The anterior one decreases his frequency and increases its amplitude very much. Then, it turns and goes. This complex turning mechanism presents the advantage to allow the zoospores to actively and quickly achieve a new direction.

In this internship, we aim to study how swimming mechanisms are affected by obstacles (walls of a channel for example). In a previous study, we observed that, near walls, the mean velocity of zoospores decreases. In addition, zoospores can bounce on the wall or swim along it. With microscopic rapid imaging, we observed their behaviors near walls and showed that when zoospores touch the solid wall, it triggers their tumbling. If they succeed to change direction, they bounce on the wall, otherwise they swim along it.
To understand those different behaviors, we want to study in more details the origin of this tumble near wall and more precisely the effect of surface elasticity and roughness on the tumbling.

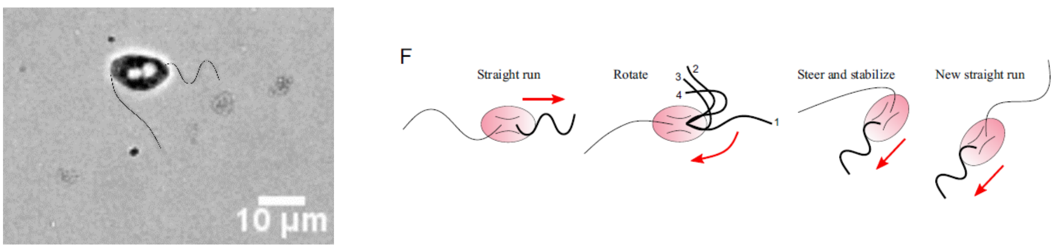

Figure 1. Zoospore tumbling. Scheme from [4]

[1] Galiana et al., (2019) Interface 16(157) 20190367, 10.1098/rsif.2019.0367
[2] Cohen et al. bioRxiv, 2023.06. 21.545863.
[3] Lupatelli et al. (2023) Computational and Structural Biotechnology **21** 5640
[4] Tran et al. (2022) eLife https://elifesciences.org/articles/71227.

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