INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Ondes et Matière d'Aquitaine (LOMA)
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Internship location: Université de Bordeaux, Talence

Thesis possibility after internship: NO
Funding: YES

Swimming cells under light

Photosynthetic micro-organisms contribute for half of dioxygen production, consume carbon dioxide, and are promising regarding biofuel production. Our lab aims to develop a quantitative approach describing the energetic state of these micro-organisms exploring their environment, a crucial aspect to better understand their motility behaviour. To tackle this problem, we use the motile micro-algae Chlamydomonas reinhardtii, a model unicellular organism, per-forming photosynthesis (light-to-chemical energy conversion) and phototaxis (cell reorientation along the light direction). Two projects are available.

The first one is about coupling photosynthesis and motility. In microalgae like C. reinhardtii, phototaxis is widely hypothesised to optimise photosynthesis, yet a direct quantitative link between photosynthetic activity and motility remains elusive. During this internship, the student will perform real-time tracking of photosynthetic parameters at the single-cell level, using Pulse Amplitude Modulation (PAM) fluorometry, which measures chlorophyll autofluorescence. Chlorophyll autofluorescence will be recorded dynamically, with a temporal resolution of few seconds, while cells move between different light conditions in confined environments.

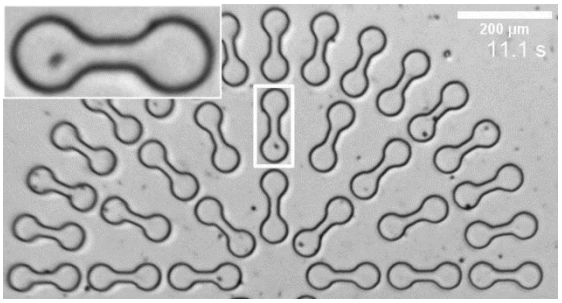

Figure 1: Confined swimming cells.

The second project investigates how C. reinhardtii dynamically regulate their motility under spatially dispersed light wavelengths. Light is a key, yet variable, resource for microalgae, affected by natural fluctuations (e.g., seasonal changes, cloud cover) and artificial factors in controlled environments (e.g., self-shading, mixing). While previous studies have explored cell response to monochromatic light, this project uniquely addresses microalgal motility under dispersed light fields, revealing how phytoplankton regulate movement in response to natural-like light variability. A white light will be collimated and passed through a high-quality dispersive prism to create a continuous wavelength gradient. We aim to characterize the spatial and temporal evolution of local cell density, potentially revealing wavelength-dependent behavioral patterns.

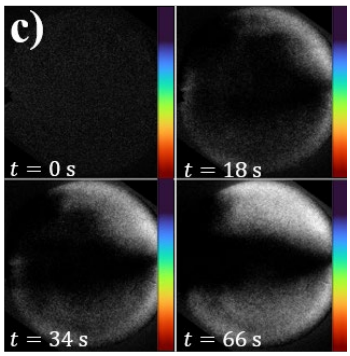

Figure 2: Preliminary results showing C. reinhardtii population swimming in a Petri dish. Light propagates from left to right, dispersed through a prism, with approximate wavelength locations indicated in each panel.

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

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