

Master Internship in Soft Matter Physics

Chemotaxis of Coral-Symbiont Microalgae Under Climate Change: A Microfluidics Approach

Institut de Physique de Nice, MIMIC Team

Our team, in collaboration with marine biologists at Symbiose Marine lab (SYMAR) studies the symbiosis between a sea Anemone (Cnidaria) and a microalgae (Dinoflagellate). This mutualistic association is a keystone element sustaining coral-reef ecosystems. The establishment of this intracellular endosymbiosis relies on two sequential steps: attraction and recognition between partners. In this project, we focus on characterizing the chemotactic activity of the microalgae toward their host, and on assessing how climate change affects this process.

Two Master's students will be recruited to work together throughout the internship: one physicist at INPHYNI and one biologist at SYMAR. Each student will broaden their field of expertise through complementary experiments conducted in both laboratories. The biology-side student will notably isolate and characterize the chemoattractant molecules released by the anemone, while the physics-side student will focus on the microfluidic and quantitative motility analysis of the microalgae. The project is funded by IdEx Université Côte d'Azur (Complexity and Diversity of Living Systems).

Physics Internship Focus: Investigation of Microalgal Swimming and Chemotaxis

The MIMIC team has long-standing expertise in microfluidics for studying the collective and individual movement of microswimmers [1–5]. A microfluidic device already designed in the lab will be used to generate gradients of chemoattractants isolated by our biologist partners, and the swimming behavior of the microalgae will be observed in real time by microscopy. Trajectory analysis will go beyond simply confirming attraction. Using specific observables such as velocity distribution, trajectory curvature, and frequency of directional changes, we aim to provide a detailed, quantitative characterization of the chemotactic response, and to compare this response under control versus climate-stress conditions (e.g., algae acclimated at elevated temperature and/or reduced pH).

Building on our previous work on microswimmers [2–5], the student will lead the fabrication of the experimental set-up in the clean room at INPHYNI. He/she will image the algae in the absence and presence of a chemical gradient. Combining time-lapse microscopy with image analysis using TrackMate and custom Python pipeline, the student will extract kinetic parameters describing algal motility and characterize how these parameters shift under simulated climate-change conditions.

Benefits of the Internship

- Interdisciplinary research at the interface of physics, marine biology, and data science, in direct collaboration with a biologist counterpart at SYMAR.
- Hands-on training in microfluidic device fabrication (clean-room work) and quantitative trajectory analysis.
- Contribution to research with direct relevance to coral-reef conservation in the context of climate change.
- Possibility of continuing toward a PhD (unsecured funding)

References

- [1] <https://inphyni.univ-cotedazur.fr/sites/mimic/recherche/micro-nageurs-phytopathogenes>
[2] Galiana et al., (2019) Interface 16(157) 20190367, 10.1098/rsif.2019.0367
[3] Cohen et al. (2025) Phys. Rev. E. <https://journals.aps.org/pre/abstract/10.1103/PhysRevE.111.024411>
[4] Lupatelli et al. (2023) Computational and Structural Biotechnology **21** 5640
[5] Tran et al. (2022) eLife <https://elifesciences.org/articles/71227>.

For any information please contact: philippe.thomen@univ-cotedazur.fr