Master's degree in Biology – Chemistry-Biology Department

Master 2 internship project
Year 2025-2026

Laboratory/Institute: Institut Néel / IBS **Director:** Laurence Magaud / Winfried Weissenhorn
Team: Nano Optics and Forces / PBRC **Head of the team:** Benjamin Pigeau / Ina Attrée

Scientists in charge of the project: Jochen Fick (CRHC) / Eric Faudry (DR) **HDR: yes x no ☐**

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Program of the Master's degree in Biology:

x Microbiology, Infectious Diseases and Immunology ☐ Biochemistry & Structure
☐ Physiology, Epigenetics, Differentiation, Cancer ☐ Neurosciences and Neurobiology

Title of the project: Using advanced optical fiber tweezers to investigate the motility of bacteria from the *Pseudomonas* genus

Objectives (up to 3 lines):

Studying the specific swimming features of trapped monotrichous *Pseudomonas* bacteria using dedicated optical microscope systems with integrated optical fiber tweezers, allowing long-term observations.

Abstract (up to 10 lines):

In order to explore their environment the polarly flagellated bacteria of the *Pseudomonas* genus have developed a characteristic swimming pattern named run-wrap-reverse, which consists in a sudden stop of the flagellum rotation, its wrapping around the bacteria body and the flagellum rotation in the opposite direction. Deciphering trajectories, flagellum and cell-body movements is challenging, in particular for these fast-swimming bacteria. In this context, optical fiber tweezers allow trapping a single bacterium in a defined observation volume, thus allowing long-term study of swimming during and after cell division. Moreover, staining the bacteria flagella gives detailed information about its rotation and their capacity to propel the bacteria.

The interdisciplinary internship will be be co-supervised by J. Fick, physicist working in optical trapping and E. Faudry, biologist working on *Pseudomonas* bacteria.

Methods (up to 3 lines):

Bacteriology, flagella labeling, bright field / fluorescence microscopy, optical trapping, bacteria tracking, data treatment / modeling

Up to 3 relevant publications of the team:

- E. Faudry and J. Fick, Optical trapping with nanostructured optical fibers and motility analysis of Pseudomonas aeruginosa, Eur. Biophys. J. 2025, in press, doi:10.1007/s00249-025-01775-7
- Fresnel lens optical fiber tweezers to evaluate the vitality of single algae cells, A. Asadollahbaki, A. Kumar, M. Heymann, H. Giessen, and J. Fick, Opt. Lett. 2022, doi:10.1364/OL.447683.
- S. Pont, M. Janet-Maitre, E. Faudry, F. Cretin, and I. Attrée. Molecular Mechanisms Involved in *Pseudomonas aeruginosa* Bacteremia.. Adv Exp Med Biol. 2022, doi: 10.1007/978-3-031-08491-1_12.

Requested domains of expertise (up to 5 keywords):

Microscopy, bacteria culture, basic programming (R or Python)