Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

To be completed and returned to the following address: helene.marche@ibs.fr or labex-gral@univ-grenoble-alpes.fr

Supervisor(s):
Name : Tristan Wagner
E-Mail Address : tristan.wagner@ibs.fr

Host laboratory:

Lab : Institut de Biologie Structurale (IBS), Univ. Grenoble Alpes /CEA/CNRS, Grenoble (France)

Host group/team:

ELMA group (Microbial Metabolism team)

Title of the M2 research internship:

EnLigthening carbon-processing enzymes from the microbial dark matter via a native approach

Project summary:

The newly built Microbial Metabolism (MicroMet) laboratory aims to understand the **molecular mechanisms underlying microbial methane generation/degradation**, which **impact Earth´s carbon cycle** and would provide blueprints for chemists to **develop green carbon-based technologies**. To reach this goal, Micromet relies on an unbiased approach in which **carbon-processing enzymes** (e.g., those involved in cellular energy acquisition) are **directly extracted from their native hosts** instead of being produced by recombinant expression. Since most of these obligate anaerobes are part of microbial dark matter (i.e., cannot be isolated), the **laboratory has the originality of cultivating and investigating microbial consortia**, and **hunting via an O_2-free pipeline the proteins of interest** harboring their natural partners [1], post-translational modifications [2,3], and metallo-cofactors [1-3].
In this project, you will learn how to **cultivate your own methane producers and methane consumers**. With our **state-of-the-art anaerobic setup**, you will **extract proteins and purify the most abundant ones through a semi-robotic pipeline**. The fractions containing enriched proteins will be **crystallized** and analysed via a suite of **biochemical and biophysical methods**. You will collect X-ray data on the obtained crystals at the ESRF to **determine the structures** of new enzymes and analyse their specificities. You will then **confirm the enzyme's function** using a dedicated enzyme assay.
In parallel, you will practice processing of X-ray data and structural analysis, using untouched X-ray datasets previously obtained from a methane-devouring consortium.
The internship represents an ideal first experience for a student who wants to master the whole pipeline from microbial cultivation to the biochemical/structural characterization of native enzymes, and wants to dive into the fascinating metabolism of Planet-changing microbes.

Keywords:

Planetary carbon-cycle, anaerobic enzymes, environmental biochemistry, archaea extremophiles.

Relevant publications of the team:

1. Lemaire ON *et al.* Ethane-oxidising archaea couple CO_2 generation to F_{420} reduction. Nature Communications 2024.
2. Müller M-C *et al*. Atomic resolution structures of the methane-activating enzyme in anaerobic methanotrophy reveal extensive post-translational modifications. Nature Communications 2025.
3. Hahn CJ *et al*. Crystal structure of a key enzyme for anaerobic ethane activation. Science. 2021.