

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 : Sylvain Engilberge

E-Mail Address : sylvain.engilberge@ibs.fr

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:

Synchrotron Group and ELMA group

Title of the M2 research internship:

Time-resolved functional oscillation crystallography of oxygen-sensitive CO₂-fixing oxidoreductases

Project summary:

We will use **Time-Resolved Functional Oscillation Crystallography (TR-FOX)**, a novel method developed in the Synchrotron Group [1], to **capture catalytic intermediates** and protein motions using single crystal at room temperature. The enzymatic reaction is triggered by injecting nanoliter droplets of substrate during oscillation X-ray data collection with a time resolution from hundreds of milliseconds to minutes.

Our target will be the **oxygen-sensitive 2-oxoacid:ferredoxin oxidoreductase (OGOR)**, directly isolated from a hyperthermophilic archaeon that generates methane and fixes N₂ (a methanogen coming from a deep-sea volcano) [2]. Because of its **extremely slow activity at room temperature**, OGOR represents a perfect model to challenge TR-FOX capabilities, with the ultimate goal of visualizing the choreography of the iron-sulfur cluster-containing enzyme over the catalytic course of CO₂ capture [3].

In this internship, you will master the art of **native anaerobic protein purification, crystallization, and enzymatic characterization**. You will benefit from our preliminary data showing a bound intermediate to optimize the trapping conditions for TR-FOX and **collect X-ray data at the ESRF beamline BM07**, followed by **structure determination** and analysis. The internship will include strong **instrumentation development** to enable room-temperature X-ray diffraction under anaerobic conditions.

Keywords:

Anaerobic enzymes; iron–sulfur clusters; catalysis; time-resolved crystallography, extremophiles

Relevant publications of the team:

1. Martel *et al.* Capturing enzymatic dynamics and catalysis using time-resolved functional oscillation crystallography (manuscript under finalization).
2. Maslać *et al.* Molecular basis of N₂ fixation in a hyperthermophilic archaeon. BioRxiv. doi: 10.1101/2025.10.10.681579
3. Yin *et al.* Conformational dynamics of a multienzyme complex in anaerobic carbon fixation. Science. 2025. doi: 10.1126/science.adr96