Institut de Biologie Structurale
UMR 5075 CEA- CNRS – Univ. Grenoble-Alpes
Microbial Metabolism team

A postdoc and two PhD student positions are available to snapshot native (metallo)enzymes in action from the anaerobic microbial dark matter

These positions (a 2-year postdoc with possible extension and 2 PhD student positions) are available **to investigate the enzymatic chemistry orchestrated in the microbial anaerobic carbon cycling**. These offers are part of the ERC Project "EnLightEn," which is devoted to understanding the **molecular basis of methanogenesis and methanotrophy** in **non-isolated anaerobic archaea.** The positions will be hosted in the newly established Microbial Metabolism team, with a preferred starting date of late summer 2026.

The archaeal realm harbours anaerobic methane producers and methane degraders, respectively called **methanogens and anaerobic methanotrophs**, that **impact our planet and modern society**. These strict anaerobes are key actors in the carbon one-unit cycle (CO_2 <-> CH_4), nourish ecosystems, and perform the final step of organic matter degradation. They remain **largely uncharacterised and uncultured, yet harbour a concealed enzymatic chemistry that** cannot be tackled via classic omics. The EnLightEn project investigates non-isolated archaea, which belong to the "microbial dark matter", by **exploiting native biomass or enrichments rather than artificial recombinant systems**. The landscape of enzymes involved in carbon-processing to retrieve cellular energy is characterized through an **anaerobic purification and characterization pipeline**, ensuring that enzymes are bound to physiological partners and equipped with native (metallo)cofactors. This unconventional approach, which **circumvents the microbial isolation barrier**, proved successful by deciphering the first and last steps of the ethane-oxidation process from an anaerobic microbial enrichment, thereby breaking the accepted metabolic model of archaeal alkanotrophy. Each successful candidate will **join our effort to pioneer environmental biochemistry** by investigating catabolic enzymes from microbial enrichments cultivated in flasks or bioreactors, as well as from environmental samples. EnLightEn will **open a field to characterise the functional dark matter**, offering an unprecedented view of the **molecular tricks used by the microbial world**.

The **ERC MicroMet team,** led by Dr. Tristan Wagner (https://www.ibs.fr/en/research/assembly-dynamics-and-reactivity/extremophiles-and-large-molecular-assemblies-group-b-franzetti/microbial-metabolism/), has long-standing expertise in methanogenic and alkanotrophic archaea, with the rare capability of going from their culture to the structural description of their native metalloenzymes. For this purpose, the freshly built laboratory is equipped with five anaerobic glove boxes containing state-of-the-art equipment for the extraction, purification, crystallization, and characterization of O_2-sensitive enzymes. Internal collaboration at the Institute for Structural Biology (IBS) and within the scientific network will enable candidates to access advanced experimental tools for characterizing these native enzymes.

The team hosted by the Extremophiles and Large Molecular Assemblies Group (ELMA) benefits from the infrastructure gathered at the **IBS** (https://www.ibs.fr/) and the expertise of neighbouring groups in structural biology, biophysics, and biochemistry. **Grenoble** is a prominent university city in France, hosting over 58,000 students from over 70 countries. Thanks to a leading

university, various state-owned research organizations, top-tier international scientific facilities like the ESRF synchrotron and ILL neutron facilities, and significant high-tech industries, it boasts a globally recognized research community. This diversity creates a vibrant atmosphere, buzzing with activity day and night. Additionally, Grenoble is renowned for its exceptional location in the French Alps, with major ski resorts reachable in under an hour, along with breathtaking natural sites to explore in other seasons.

The ideal postdoc candidate must hold a PhD in **protein biochemistry and have a solid background in structural biology**, including the purification of native enzymes, their crystallization, X-ray crystallography data collection, structural analyses, and enzyme functional assay. Candidates with experience in anaerobic handling, from microbial production to the crystallization/characterization of O_2-sensitive proteins, are strongly encouraged to apply and will be treated as a priority. Cultivation of anaerobic microbes and skills in cryo-electron microscopy are welcomed but not mandatory. Interest in metalloenzymes, extremozymes, and the reaction mechanisms involved in microbial metabolism is fundamental to bloom at maximum potential in the laboratory.

The profile of the 1st PhD student candidate is that of a **microbiologist** with a strong motivation to delve into protein biochemistry and structural biology and to understand the fundamental enzymatic mechanisms underlying metabolism. The candidate must hold a master's degree in microbiology and preferably have experience in environmental microbiology (e.g., microbial sampling). Students with skills and solid knowledge in anaerobic microbiology (e.g., anaerobic microbial cultivation, assays, metabolisms, genome mining…) will be prioritized. Experience in native protein purification, biochemistry, and structural biology is welcome.

The open position for the 2nd PhD student candidate targets a **protein biochemist with a background in chemistry** and a strong interest in exploring Life´s catalysts. The candidate must hold a master's degree in biochemistry and preferably have experience purifying native proteins, setting up enzymatic assays, and protein biophysical/biochemical characterization. Applicants with skills in anaerobic handling (e.g., anaerobic protein purification, assays…), analyses of enzymatic reaction mechanisms, and structural biology will be prioritized.

Given the nature of the European project, the candidates must be scientists who are highly motivated, open-minded, and possess a strong commitment to scientific rigor. In addition, the candidate must have excellent English communication skills, enabling smooth interaction with the team, as well as the ability to write scientific articles. Following the commitments made by the CEA, this position is open to everyone.

To apply, please use the following link and attach a detailed resume, a summary of your past research activities, a letter describing how you would fit the requested profile, and contacts for reference letters before the 30th of April 2026:

PostDoc position:

https://www.emploi.cea.fr/Pages/Offre/detailoffre.aspx?idOffre=39870&idOrigine=502&LCID=2057&offerReference=2026-39870

PhD student with expertise in microbiology:

https://www.emploi.cea.fr/Pages/Offre/detailoffre.aspx?idOffre=39863&idOrigine=502&LCID=2057&offerReference=2026-39863

PhD student with expertise in biochemistry/chemistry:

https://www.emploi.cea.fr/Pages/Offre/detailoffre.aspx?idOffre=39871&idOrigine=502&LCID=2057&offerReference=2026-39871

Selected publication.

Müller M-C, et al. Atomic resolution structures of key enzyme MCR in anaerobic methanotrophy reveal novel and extensive post-translational modifications. Nat. Comm. *2025*. doi: 10.1038/s41467-025-63387-1.

Wagner T, Toffin L, Borrel G. Chapter 5 “Methanogenic Archaea” from Biology of Archaea, Volume 1: Discovery, Evolution and Diversity of Archaea. Wiley. *2025*. doi: 10.1002/9781394351848.ch5.

Lemaire ON, and Wagner T. An all-in-one CO_2 capture and transformation: lessons from formylmethanofuran dehydrogenases. Account of Chemical Research. *2024*. doi: 10.1021/acs.accounts.4c00623.

Lemaire ON, Wegener G, Wagner T. F_{420} reduction as a cellular driver for anaerobic ethanotrophy. Nat. Commun. *2024*. doi: 10.1038/s41467-024-53338-7.

Hahn CJ, Lemaire ON, Kahnt J, Engilberge S, Wegener G, Wagner T. Crystal structure of a key enzyme for anaerobic ethane activation. Science. *2021*. doi: 10.1126/science.abg1765.