Bioenergetics in the green microalga *Chlamydomonas reinhardtii*: maturation of proteins with iron-sulfur centers and hydrogen production in organelles

Workplace: NANCY (France) - LIEGE (Belgium)

Scientific supervisors: Profs. Claire Remacle & Nicolas Rouhier

Type of Contract: PhD Student contract / Thesis offer, Lorraine Université d'Excellence (LUE) funding

Contract Period: 36 months

Start date of the thesis: September/October 2024

Proportion of work: Full time

Remuneration: 2100 € gross monthly

Doctoral School: SIReNa (link)

Work context
This PhD proposal is part of a 4-year International Research Partnership (IRP) and will be in co-tutelle between two laboratories, the team "Stress response and redox regulation" of the UMR 1136 Tree-Microbe Interactions (link) and the laboratory of "Genetics and Physiology of Microalgae" from University of Liège (link).

Description of the thesis topic:

The IRP project is divided into two transversal and connected research axes briefly described below. The applicant will have to position him/herself in one of these axes.
Photosynthetic and respiratory complexes are central to cellular bioenergetics and most of them contain metals and in particular iron-sulfur (Fe-S) clusters which are essential, although it is not known precisely when the cofactors are inserted and by which mechanism(s) and maturation/assembly factor(s). The first research axis aims at unravelling how Fe-S clusters are exchanged and selectively inserted into the photosynthetic and respiratory complexes by performing the functional analysis of specific chloroplastic and mitochondrial maturation factors from *Chlamydomonas reinhardtii*, in particular those involved in the final transfer of Fe-S cluster to recipient proteins (Przybyla-Toscano et al., 2021).
The second axis is oriented towards the metabolic engineering of hydrogen production in Chlamydomonas organelles. One of the particularities of *C. reinhardtii* compared with terrestrial plants is the existence of a highly developed anoxic metabolism. It involves several Fe-S enzymes, including iron-iron hydrogenases that bind an atypical Fe-S cluster (called cluster H) catalyzing the formation of hydrogen. The aim of this project is to understand which maturation factors are responsible for Fe-S cluster insertion in the proteins of the anoxic metabolism using state-of-the-art biochemical and functional approaches. This will provide the bases for manipulating the levels of hydrogen production in several subcellular compartments using a synthetic biology approach.

Main technical approaches:
- Molecular biology (modular cloning)

- Expression and purification of recombinant proteins
- Biochemical and structural characterization
- Functional analyses in *Chlamydomonas reinhardtii*
- Synthetic biology approaches
- Cell biology and physiology of microalgae

Application requirements:
The applicant should hold a Master degree (or equivalent) in Biology or another relevant subject such as Biochemistry. Applications of students finishing their Master degree in 2024 will also be analyzed. Good language skills in English will be considered as an asset.
Application should contain a detailed CV, a brief summary of previous research projects, and the names and contact details of 2 scientists/teachers that have offered to act as references, with a clear indication of their relationship with the applicant. Deadline for application is April 10, 2024.

Contacts:
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Reference:
Przybyla-Toscano J, Couturier J, Remacle C, Rouhier N (2021). Occurrence, Evolution and Specificities of Iron-Sulfur Proteins and Maturation Factors in Chloroplasts from Algae. Int J Mol Sci 20;22(6):3175. doi: 10.3390/ijms22063175.