Postdoctoral Research Associate Position

Investigating the connection between photosynthetic and respiratory electron flows in cyanobacteria

A postdoctoral position is now open in the **Photosynthesis & Environment team** at the Bioscience and Biotechnology Institute of Aix-Marseille (https://www.cite-des-energies.fr/en/home-biam/search/pe/), under the supervision of **Dr Stefania Viola**.

Full time. Competitive salary to be determined depending on relevant experience.
Initial appointment 1 year with possibility of extension, starting date from **3rd January 2024**.
Location: Cité des Énergies, CEA Cadarache, 13115 St Paul lez Durance, France

Project description

In oxygenic photosynthesis, Linear Electron Flow (LEF) between photosystem II (PSII) and photosystem I (PSI) leads to the reduction of $NADP^+$ to NADPH and to the generation of the trans-thylakoid proton motive force (pmf) used to produce ATP. Additionally, Cyclic Electron Flow (CEF) around PSI generates pmf, and thus ATP, but no NADPH. The regulation of the alternative electron flows is proposed to adjust the ratio between the ATP and NADPH produced to meet the requirements for CO_2 fixation.

Cyanobacteria are the only organisms where the photosynthetic electron transport chain is connected and shares components with the respiratory one, which is also located in the thylakoids[1]. In cyanobacteria, "mixed" photosynthetic and respiratory electron flows can thus occur during illumination, in addition to LEF and CEF. In particular, respiratory complexes can use electrons coming from PSI and PSII to generate extra pmf, and therefore ATP, to sustain CO_2 fixation.

The main aim of the project is to investigate how the connection between photosynthetic and respiratory electron flows contributes to optimising the efficiency of light energy conversion and of CO_2 fixation in the model cyanobacteria *Synechocystis* sp. PCC 6803 (*Synechocystis*) and *Synechococcus elongatus* PCC 7942 (*S. elongatus*). The second aim is to investigate how the regulation of the alternative electron flows depends on the molecular architecture of the electron transport chain, and more specifically on i) the relative amounts of the complexes, and ii) their lateral distribution in the thylakoids[2], with the possible formation of functional microdomains[3] and/or supercomplexes.

Key Responsibilities and Duties

We are looking for a postdoctoral researcher with experience in molecular biology, biochemistry and in the study of the photosynthetic activity who will:

- Generate mutants and culture strains of *Synechocystis* and *S. elongtaus*.
- Use chlorophyll fluorescence and time-resolved optical spectroscopy to investigate the photosynthetic activity *in vivo* in the generated strains. In particular, use ElectroChromic Shift (ECS) to quantify the photosynthetic electron transport rates and kinetics[4,5,6].
- Use gas exchange to measure the rates of CO_2 fixation and of O_2 evolution and consumption.
- Use biochemical techniques and *in vivo* time-resolved optical spectroscopy to quantify the relative amounts of the electron transport chain components.
- Use confocal fluorescence microscopy to investigate the distribution and co-localisation of the electron transport chain components in the thylakoids.
- Analyse and interpret data, and write papers to report experimental findings.

- Participate in conducting relevant collaborative projects and communicate with collaborators.
- Attend relevant conferences and present findings in oral or poster form.
- Participate in advising and training other postdocs, PhDs, and students.

Person Specification

Essential Knowledge, Skills and Experience

1. A PhD or equivalent experience in a relevant research area (plant biochemistry, physiology, biophysics or similar).
2. Experience in microbiology, molecular biology, genetic manipulation of photosynthetic organisms, biochemistry.
3. Solid knowledge of photosynthesis.

Desirable – Knowledge, Skills, Experience and qualifications

1. Experience of research in regulation of photosynthesis, including use of gas exchange, chlorophyll fluorescence and time-resolved optical spectroscopy.
2. Previous experience in working with cyanobacteria is not required but welcome.

Application procedure

Please submit your application or make enquiries to Dr Stefania Viola (**stefania.viola@cea.fr**).
Your application should include the following documents:

- Curriculum vitae, incl. educational qualifications, experience, skills and a list of publications
- Motivation letter, incl. a brief summary of past and current research accomplishments
- 2-3 reference letters and contact of referees

Relevant literature

1. D. J. Lea-Smith, P. Bombelli, R. Vasudevan, et al., Photosynthetic, respiratory and extracellular electron transport pathways in cyanobacteria. BBA - Bioenerg. 1857, 247–255 (2016) DOI:10.1016/j.bbabio.2015.10.007.
2. L. N. Liu, S. J. Bryan, F. Huang, et al., Control of electron transport routes through redox-regulated redistribution of respiratory complexes. PNAS 109, 11431–11436 (2012) DOI:10.1073/pnas.1120960109.
3. A. Strašková, G. Steinbach, G. Konert, et al., Pigment-protein complexes are organized into stable microdomains in cyanobacterial thylakoids. BBA - Bioenerg. 1860 (2019) DOI:10.1016/j.bbabio.2019.07.008.
4. B. Bailleul, P. Cardol, C. Breyton, et al., Electrochromism: A useful probe to study algal photosynthesis. Photosynth. Res. 106, 179–189 (2010) DOI:10.1007/s11120-010-9579-z.
5. S. Viola, B. Bailleul, J. Yu, et al., Probing the electric field across thylakoid membranes in cyanobacteria. PNAS 116, 21900–21906 (2019) DOI:10.1073/pnas.1913099116.
6. S. Viola, J. Sellés, B. Bailleul, et al., In vivo electron donation from plastocyanin and cytochrome c_6 to PSI in *Synechocystis* sp. PCC6803. BBA - Bioenerg. 1862 (2021). DOI: 10.1016/j.bbabio.2021.148449.