



SORBONNE
UNIVERSITÉ



LUMINESCENCE-BASED FINGERPRINTS OF MICROALGAE - APPLICATIONS IN SENSING AND ENVIRONMENTAL MONITORING

Position. A 36 months doctoral position is available from Fall 2022 at the Chemistry Department of Ecole Normale Supérieure (ENS, Paris) and Institut de Biologie Physico-Chimique (IBPC, Paris). The project, funded by the European Innovation Council, relies on a collaboration between L. Jullien and T. Le Saux from the group «Physical and Biological Chemistry of Living Matter» at ENS with expertise in dynamic contrast fluorescence imaging,¹⁻⁵ and B. Bailleul, S. Bujalon, and F. A. Wollman from IBPC with expertise in mechanistic aspects of photosynthesis and phenotypic analysis of microalgae down to the single cell level.^{6,7} Its implementation will be performed in close collaboration with W. Hendrix, L. Özkan, and P. Van den Hof from the Control Systems Group at the Department of Electrical Engineering of Eindhoven University of Technology (TUE, Eindhoven, The Netherlands) with expertise in optimal experiment design for modulating illumination and linear/nonlinear system identification in frequency domain for categorization.⁸

Context. Cultivation of plants consumes huge resources of water for irrigation and energy for lighting. Introducing disruptive technologies is key to improve plants and enable their parsimonious cultivation. Our project overtakes these challenges by gathering an interdisciplinary consortium sharing a same radical vision: to measure and exploit the dynamics of photosynthesis regulation under natural-like light conditions for selective sensing – monitoring the plant state – and enhancing lighting efficiency in controlled environments.

In practice. At ENS and IBPC, the candidate will produce wild-type and mutants of microalgae conditioned with and without specific stress applications and acquire kinetic data from conditioned algae by using novel (multi)sinewave or randomly fluctuating illuminations, chlorophyll fluorescence, and original luminescent nanosensors with ground-breaking home-built epifluorescence microscope and acquisition protocols. Those data will be used to feed our collaborators with datasets for building fingerprints of the physiological states of microalgae by implementing comprehensive theoretical tools (system identification, dynamical systems, system control, machine learning). They will also enable the candidate to design and implement original applications in sensing and environmental monitoring in microfluidic devices.

Starting date. Flexible from 1st September 2022.

Candidate profile. Candidates should hold a Master in Biophysics or Physical Chemistry with a marked interest for acquiring and processing data for applied Biology with home-built optical instruments. A former experience in programming (MATLAB, Python,...) and in fluorescence imaging and image analysis will be appreciated.

Application. To apply, please send a detailed resume including the names of at least two referees and a brief motivation letter to the scientific coordinators of the project, Dr. Benjamin Bailleul (bailleul@ibpc.fr), Prof. Ludovic Jullien (Ludovic.Jullien@ens.psl.eu), and Dr. Thomas Le Saux (Thomas.LeSaux@ens.psl.eu).

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