In-situ monitoring of the regulation of photosynthesis in microalgae using in-cell real-time NMR.

Keywords
in-cell NMR, photosynthesis regulation, redox transition, Calvin Benson Basham cycle, structural NMR, diffusion ordered NMR spectroscopy.

Summary
The assimilation of CO₂ by photosynthetic organisms thanks to the Calvin-Benson-Bassham (CBB) cycle is a key process of the carbon cycle in the biosphere and a prerequisite for the synthesis of biomolecules by these organisms. New lessons emerge from this ancient process and recent genetic studies that are re-assessing the classic redox regulation⁴. The applicant will monitor in-situ and in real-time the relative population of the reduced and oxidised states of known redox mediators including NADP/NADPH or GSSG/GSH on model micro-algae upon light-to-dark and dark-to-light transitions using NMR. Also, the redox transition of a well-known regulatory protein, CP12, will be investigated directly in the chloroplast. Different means will be employed to introduce NMR visible ¹⁵N-labelled CP12 in NMR invisible chloroplast⁶. Besides, the effect of molecular crowding will be monitored using diffusion-ordered NMR spectroscopy⁸. Despite the recent development and renewed interest for in-cell structural biology⁷ and real-time in-cell metabolomic⁹, this approach has not yet been applied to photosynthetic cells using NMR.

The success of this approach will rely on the close collaboration between a group specialised in biochemistry: micro-algae culture, protein production and purification, enzymatic regulation⁹,¹⁰ (BIP2), and a group specialised in NMR methods development for the identification and characterisation of biomolecules in complex solution (BioSciences)¹¹,¹². The applicant will have an easy access to NMR spectrometers: 600MHz liquid, 600MHz with a cryo-probe, 400MHz HR-MAS, and to algal-culture and biochemistry laboratories.

References:

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Locations
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Doctoral school
Life and Health Sciences (ED 62), Aix-Marseille université (https://ecole-doctorale-62.univ-amu.fr/)

Expected profile of the candidate
The candidate should have a strong background in biochemistry and knowledge of NMR.