

INTERNSHIP PROPOSAL

Institute and Group: INSTITUT DE BIOLOGIE STRUCTURALE, DYNAMOP Group.

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Research project title:

Time resolved insights into the photo-activation mechanism of the Orange Carotenoid Protein by pump-probe serial femtosecond nano-crystallography.

5 Keywords to describe the project:

Time-resolved crystallography – X-ray free electron lasers – Recombinant *in vivo* nanocrystallization – Artificial photosynthetic systems

Description of the project (aims, experimental techniques, recommended background):

The Orange Carotenoid Protein (OCP) is a two-domain photoactive protein involved in the photoprotection of *cyanobacteria*. Upon exposure to intense blue light, the carotenoid pigment undergoes a 12 Å translocation, causing a spectral shift and leading to separation of the two domains. These characteristics open the possibility to rationally engineer OCP variants suited for optogenetic applications and for the regulation of light uptake in artificial photosynthetic systems. A prerequisite is yet to understand how photoactivation proceeds in OCP. We here propose to conduct a femtosecond timescale characterization of the photoactivation mechanism of OCP, by a combination of serial femtosecond X-ray crystallography and optical spectroscopy. Proposed insights will allow identifying residues involved in photoactivation (fs-ns), dissociation into two domains (ns-ms), and reassociation into a functional OCP (ms-s).

Justification that the internship's subject fits with the general theme of GRAL:

Our projet fits the GRAL's theme to the letter, aiming at "*deciphering and integrating knowledge on the structure and dynamics*" of OCP, "*in the cellular context and both in space and time*", with view to "*open the way to major advances in health, environment and biotechnologies*".

Relevant publications of the team :

Colletier et al., 2016, *J. Phys. Chem. Lett.* 7, 882–887 (2016).

Colletier et al. *Nature*, 539, 43-47 (2016).

Coquelle et al., 2018, *Nat Chem*, 10, 31-37 (2018).