Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

Supervisor(s):
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Host laboratory:
IBS, DYNAMOP group
https://www.ibs.fr/spip.php?lang=en

Title of the M2 research internship:
Serial crystallography: from protein microcrystallization to sample delivery

Project summary:
The advent of a new generation of X-ray sources called X-ray free electron lasers (XFEL) paved the way in the last decade to new possibilities for structural biology. An approach called serial femtosecond crystallography (SFX) has been developed, where µm-sized protein crystals are intercepted by the bright and short (fs) XFEL pulses. The interaction of an X-ray pulse with a microcrystal produces a diffraction pattern just before the microcrystal is destroyed. A large number of such diffraction-before-destruction events produces a dataset which is used to obtain the protein structure. One of the crucial aspects of SFX experiments is the capability of producing a stable thin jet of microcrystals at a reasonably low flow-rate.
The experimental approaches for serial protein crystallography developed at XFELs have been also recently re-adapted at several synchrotrons like the ESRF in Grenoble.
An injection system for serial crystallography applications has been recently set up at IBS for testing microcrystal injection in preparation of XFEL or synchrotron based experiments. The apparatus is equipped with a a high-speed camera to perform measurements of the jet speed, an essential parameter for realizing time-resolved experiments at high repetition rate. A microscopy station at high resolution for microcrystal morphology characterization will complete soon (April 2022) the IBS facility for serial crystallography. A collaboration between the IBS and the ESRF synchrotron has been also established for supporting the operation of the new ID29 beamline at ESRF dedicated to serial protein crystallography.
The M2 research internship will consist in defining the conditions for protein microcrystallization, producing microcrystals and testing their injection.

Keywords:
structural biology, protein dynamics, serial crystallography

Relevant publications of the team:
Simple and efficient system for photoconverting light-sensitive proteins in serial crystallography experiments. J. Appl. Crystallogr. 50, 932–939 (2017).

Chromophore twisting in the excited state of a photoswitchable fluorescent protein captured by time-resolved serial femtosecond crystallography. Nature Chem. 10, 31–37 (2018).

Light-induced structural changes in a full-length cyanobacterial phytochrome probed by time-resolved X-ray scattering. Commun Biol 2, 1 (2019).

Photoswitching mechanism of a fluorescent protein revealed by time-resolved crystallography and transient absorption spectroscopy, Nature Comms. 11, 1-11 (2020).

Mechanism and dynamics of fatty acid photodecarboxylase. Science 372, eabd5687 (2021).