Laboratoire d'Optique et Biosciences
CNRS-INSERM-Ecole Polytechnique-IPParis
91128 Palaiseau, France

Post-doc position available:

Contract duration: 12 months with possibility of extension
Salary: From 2992,93 and 4204,22 €/month gross salary depending on experience.
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Manuel Joffre, manuel.joffre@polytechnique.edu

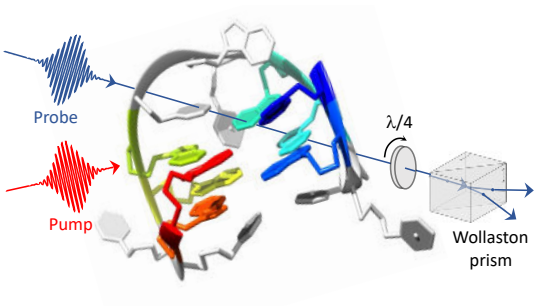
Probing multiscale chirality changes in biomolecules from femtoseconds to milliseconds with Arbitrary Detuning ASynchronous OPtical Sampling

Context :

Conformational dynamics of biomolecules are intimately linked to their function. However, monitoring of these intrinsically multiscale dynamics remains an experimental challenge. To this end, ultrafast pump-probe spectroscopy offers a tool of choice to follow these dynamics in real time with a "virtually" unlimited temporal resolution. In this context, this research project proposes the development of an experiment combining both structural sensitivity and high temporal resolution thanks to the unique pump-probe methods developed at LOB for multiscale detection (ADASOPS) and time resolved circular dichroism (TRCD). This experimental setup will allow to follow the structural changes of biomolecules with an extended observation window ranging from a few hundred femtoseconds to milliseconds.

Research program :

Circular dichroism, which is the difference in the absorption of a chiral sample between left and right-handed circularly polarized light, is a popular tool for determining the secondary structure of biomolecules at equilibrium. However, the transposition of such measurements to the time domain (TRCD) on a "pump-probe" set-up remains delicate because it generally requires the introduction of a modulation of the probe polarization combined with the detection of very small signal variations with very long acquisition times (>>1h). In order to avoid these tedious detection procedures and to improve the measurement S/N ratio, we have developed a detection method without polarization modulation allowing access to the TRCD signals with a single laser shot and very short acquisition times (<10 min).



The first part of this project will consist in combining this new TRCD detection with the ADASOPS (Arbitrary Detuning ASynchronous OPtical Sampling) method developed at LOB to enlarge the time window of our pump-probe set-up from femtoseconds to milliseconds. ADASOPS, which uses two independent femtosecond lasers for the pump and probe pulses will allow to cover a time window of more than 10 orders of magnitude. The use of a high repetition rate femtosecond Ytterbium laser source for the probe will improve the S/N ratio of TRCD measurements and allow to reach accuracies of the order of ~1µOD. The second part of this project will use this new setup to study the conformational dynamics of two hemoproteins, the bacterial CO transcription regulator, CooA, and the human NO receptor, guanylate cyclase, as well as those of G-quadruplex (G4) DNA structures known to play an important role in cellular regulation.

portail.polytechnique.edu/lob/fr/protein-and-dna-folding-dynamics-probed-time-resolved-circular-dichroism

Environment :

LOB is an interdisciplinary laboratory where physicists and biologists work on common topics. The project will take place in the "Internal dynamics of biomolecules" group which has a recognized expertise in the development of ultrafast optical spectroscopy methods for the study of biological processes. This research work is part of the ChirASASOPS project funded by the French ANR, started in October 2022. It will be supervised by Pascale Changenet and Manuel Joffre (CNRS researchers).

Application :

We are looking for a motivated candidate to develop this experimental project at the interface of physics and biology. The candidate will have a PhD with an experience in ultrafast spectroscopy and nonlinear optics. Basic knowledge in optical spectroscopy (absorption, fluorescence, circular dichroism) and computer science (Python) will be an additional asset.
Applicants should send at pascale.changenet-barret@polytechnique.edu and manuel.joffre@polytechnique.edu:

- a detailed CV,
- a 1-page cover letter,
- the names and contact details of two referees