Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire d'Optique et Biosciences
CNRS identification code: UMR 7645
Internship director'surname: Manuel JOFFRE
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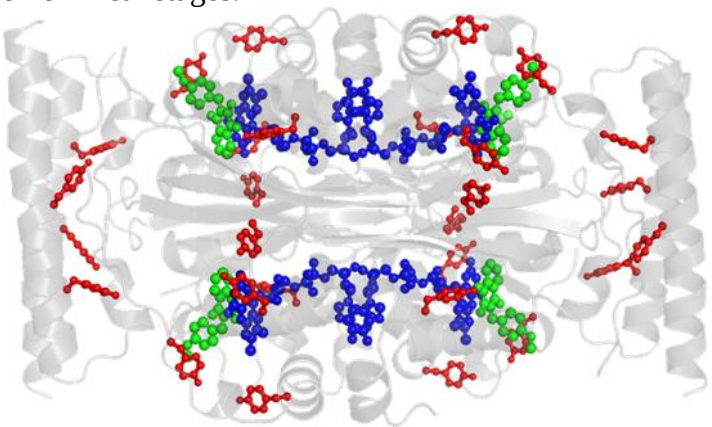
Internship location: LOB, Ecole Polytechnique, Palaiseau

Thesis possibility after internship: YES
Funding already obtained for a PhD: NO (funding conditioned to graduate-school application)

Mid-infrared femtosecond spectroscopy in flavoenzymes

Laboratoire d'Optique et Biosciences benefits from a cross-disciplinary environment where physicists and biologists work together in order to address relevant issues in biology through the development of new optical methods, based for example on femtosecond lasers and nonlinear optics. In this context, the host team is more particularly developing femtosecond spectroscopy in the mid-infrared (mid-IR) and visible spectral domains in order to control and probe biomolecules such as hemoproteins [1-3]. The available experimental setup consists of a 1-kHz femtosecond mid-IR pulses source, relying on an amplified Titanium:Sapphire laser system pumping two nonlinear stages.



The internship project will deal with mid-infrared femtosecond pump-probe spectroscopy in thymidylate synthase ThyX. This essential flavoenzyme, whose 3D structure is shown above, is present only in bacteria and thus constitutes a promising antimicrobial target [4]. In collaboration with LOB biologists, unnatural amino acids will be incorporated at specific sites of the protein so that relevant local information on structure fluctuation can be extracted from the experimental data. Continuation towards a PhD will take place in the framework of the MIRTHYX project (ANR-19-CE30-0001), in collaboration with Institut d'Optique Graduate School and Amplitude Lasers.

[1] C. Falvo, L. Daniault, T. Vieille, V. Kemlin, J.-C. Lambry, C. Meier, M.H. Vos, A. Bonvalet, M. Joffre, J. Phys. Chem. Lett. **6**, 2216-2222 (2015).
[2] V. Kemlin, A. Bonvalet, L. Daniault, M. Joffre, J. Phys. Chem. Lett. **7**, 3377-3382 (2016).
[3] J.A. De La Paz, A. Bonvalet, M. Joffre, Opt. Express **27**, 4140 (2019)
[4] H. Myllykallio, G. Lipowski, D. Leduc, J. Filee, P. Forterre, U. Liebl, Science **297**, 105 (2002).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	YES
Quantum Physics:	YES	Theoretical Physics:	NO