Year 2022 – 2023 Internship (Master 2)

Name of host organization : LP3 (Lasers Plasmas et Procédés Photoniques) laboratory, Marseille
Mail address **:** www.lp3.fr/

Title: Development of a time-resolved X-ray diffraction facility: Probe condensed matter with ultrafast X-ray pulses.

Name of the supervisor: Raphaël Clady / Ferré Amélie
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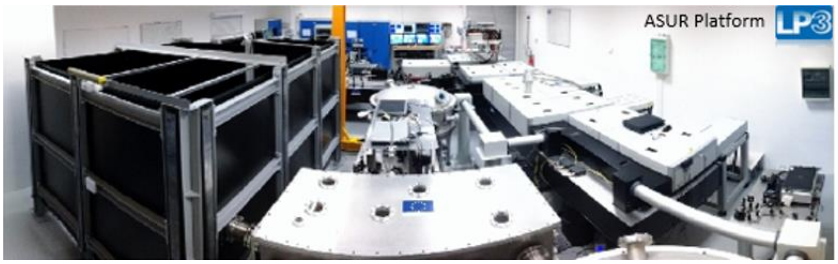
Summary of the subject:
Recently new X-ray sources of very short pulse duration (< 1 ps = 10^{-12}s) appeared thanks to the fast technological progress of advanced high-peak power laser sources. The emergence of these new sources opens new horizons for ultrafast science and x-ray science. The current and potential applications are numerous and varied (solid-state physics and surface, plasma physics, biology, health, etc.). These "hard" plasma laser X-ray sources (> 4 keV) are generated by the interaction of an intense laser pulse ($I_{las} > 10^{16}$ W/cm^2) with a solid [1].
The main objective of this internship is to study and identify the operating conditions to perform ultra-short time resolved (< 1ps) X-ray diffraction experiments using this table-top X-ray source. The student will be involved in implementing the X-ray diffraction setup in a pump-and-probe configuration on a sample (as Germanium, GaAs…). To solving the challenge, several issues will have to be explored by the student as choice of diffraction sample/ (wavelength, energy, size) pump beam/ signal to noise ratio…



To perform the experimental work, the student will benefit from the outstanding facilities of the platform ASUR (Applications of Ultra-Fast Laser sources: https://lp3.fr/les-plateformes/asur/) located on the campus of Luminy in Marseille. In the context of his/her experimental developments, the student will also develop user interface and code in Python to control the motion different elements (diffraction sample, pump delay line) synchronized with laser shots.

Additional information:
* Keywords: X ray source, X-ray diffraction, laser-matter interaction, laser, ultrafast phenomena
* Required skills: physic of solid/ optic/photonic/ python/Matlab
* Begin/End dates (min 7 weeks for Internship): First semester 2023. Possible extension with Thesis

Internship subject will carry on the following research field: generation and applications [2] of hard X-ray radiation source. Possibility to apply for PhD position.

[1] Y. Azamoum, R. Clady, A. Ferré, M. Gambari, O. Utéza, and M. Sentis, "High photon flux Kα Mo x-ray source driven by a multi-terawatt femtosecond laser at 100 Hz," Opt. Lett. 43, 3574-3577 (2018).
[2] Gambari, M., Clady, R., Stolidi, A. *et al.* "Exploring phase contrast imaging with a laser-based K_α x-ray source up to relativistic laser intensity". *Sci Rep* **10,** 6766 (2020).