Master 2 "Systèmes Complexes, Optique, Lasers (SCOL)": Research Training 2022-2023
Master 2 "Matter Molecules and their Environment(MME)": Research Training 2022-2023

Appel à sujet de stage recherche / Call for research training subject

Laboratory: PhLAM

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Topic: Complex Systems, Optics and photonics

X Master 2 SCOL	□ Master 2 MME (GP-SCP)
X Option Complex Systems (GP-IKS)	□ Option Condensed Matter
	□ Option Condensed Matter/Pharma
	□ Option Dilute Matter and Spectroscopy
	□ Option Atmospheric Sciences
	□ Option Modeling at the molecular & atomic scales

Master 2:

Nonlinear dynamics and instabilities of relativistic electron beams in free-electron lasers

Free-Electron Lasers (FELs) are currently the brightest lightsources in the short wavelength range emitting very intense and ultra-short pulses in the extreme ultraviolet (EUV) and X-ray domain. The properties of the emitted radiation are strongly related to the properties of the relativistic electron bunches being the amplifying medium required for FEL radiation emission.
Theses electron bunches are complex systems with a rich and complex dynamics still difficult to control. As other systems in nonlinear dynamics, these relativistic electron bunches suffer from spatio-temporal instabilities that can degrade the FEL performances. An important research topic in this field relates to the study, the understanding and the handling of these instabilities, theoretically/numerically as well as experimentally. The Master internship will be focused on the numerical study of the complex behaviors in free-electron lasers, in particular in the FERMI FEL in Italy (https://www.elettra.trieste.it/lightsources/fermi.html).
The internship will involve the use of existing codes for the integration and / or analysis of the dynamics of electron bunches, as well as the development of original codes depending on the progress of the project. Prerequisite skills in programming are required, as well as good adaptability to advanced computer tools (use of Python and C / C ++, Linux). The calculations will be performed on the PhLAM cluster (high-performance computer). The numerical results will be compared to experimental results obtained on the FERMI FEL.

Key words: free-electron lasers, linear accelerator, microbunching instability