Master 2 “Photonics, Complex and Quantum Systems (PhoCQS)”: Research Training 2023-2024

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Topic: Accelerator Physics

Numerical investigation on advanced compact accelerators

Particle accelerators are devices of primary importance in a large range of applications as fundamental physics as medical. Electron is the easiest particle to produce and manipulate, resulting in unequaled energy over cost ratio. However, there is an urgent and growing need to reduce the footprint of accelerators in order to lower their cost and environmental impact.

In the last decade, new accelerating techniques such as laser-plasma acceleration (LPA), have made significant progress. However, despite acceleration over extremely short distance, the electron beam properties of these new sources remain a bottleneck for direct application of the LPA.

The Master’s internship will study a new vision of accelerators staging, which would permit a strong reduction of the footprint of the infrastructures while maintaining good electron beam properties. We propose to study numerically a hybrid accelerator system that combines different accelerating period especially new acceleration techniques such as dielectric waveguide accelerator and laser-plasma acceleration. The internship will be part of the international project TWAC (https://twac.ijclab.in2p3.fr/en/twac/) and will focus on the accelerator complex of IJCLab (Orsay).

The internship will imply the development of original codes as well as the use of existing codes for the integration and/or analysis of the electron beam dynamics. A preset level in program writing is required as well as a good capability to adapt to advanced computing tools (use of C/C++, Python and Linux environment). Depending on the complexity of the simulations, access to the parallel cluster of PhLAM will be possible.

Key words: accelerator physics, relativistic electron beam dynamics, compact accelerators