PHENIICS doctoral school **PhD thesis subject proposal 2017**

Laboratory/research team

Laboratoire Leprince-Ringuet, École polytechnique / GALOP

Title

High performance numerical simulation of leptons laser wakefield acceleration

Overview of the research:

Laser wakefield acceleration (LWFA) consists in accelerating charged particles by trapping them in a plasma wave generated by an ultra intense laser. Spectacular progresses have been made during the last 15 years and this method will probably be the technology used in the next generation of particles accelerators because of its unparalleled accelerating fields magnitude. The LWFA experimental program on the "Centre Interdisciplinaire pour la Lumière Extrême" (CILEX) will explore new acceleration schemes and physics parameters.
Its success heavily depends on the support of an appropriate numerical simulation tool. This is why a large consortium gathering plasma physicists, astrophysicists and high performance computing (HPC) experts decided in 2013 to co-develop a dedicated, open source, massively parralel simulation code for plasma physics: SMILEI. The student will participate to both the effort of improving SMILEI and the achievement of CILEX objectives, being an intermediate between the two projects.

Thesis project

The M2 internship objective will be to implement the quasi-cylindrical geometry in SMILEI and run the first SMILEI LWFA simulations for CILEX.

The PhD student research will have two axis. The physics part of the thesis will be dedicated to discussing with CILEX experimentalists, running simulations, analyzing and communicating the results to the community. The multi-stage LWFA of electrons will be at the center of the work but exploratory work, such as positron acceleration, will also be considered.

The numerical part of the thesis aims at designing and implementing a spectral solver for the quasi-cylindrical geometry in order to improve the accuracy of the simulations. It will have to be included into the massively parallel and dynamically load balanced structure of SMILEI.

Local team

The student will be hosted at the Laboratoire Leprince-Ringuet (LLR) in the GALOP team ideally located to interact with CILEX teams and facilities as well as HPC experts.
The team has a strong expertise in developing and using various PIC codes, as well as in plasma physics and particularly in LWFA. It has a leadership role in SMILEI's development team and is leading the long focal experimental room at CILEX.
The student will also benefit from support of our partners: Maison de la Simulation, LULI and the Lawrence Berkeley National Lab.

Master and doctoral school

M2 in Plasma Physics, Numerical Simulations, Numerical Analysis, Applied Mathematics, or High Energy Physics will be considered.

PHENIICS doctoral school – Université Paris-Saclay

Contact

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SMILEI : www.maisondelasimulation.fr/smilei
CILEX : http://cilexsaclay.fr/Phocea/Vie_des_labos/Ast/index.php