Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 10/11/2016

Responsable du stage / *internship supervisor*:

Nom / *name*:	CORDE	Prénom / *first name* :	Sébastien
Tél :	+33 1 69 31 97 10	Courriel / *mail*:	sebastien.corde@polytechnique.edu

Nom du Laboratoire / *laboratory name*: Laboratoire d'Optique Appliquée (LOA)

Code d'identification : UMR 7639 Organisme : Ecole polytechnique, ENSTA ParisTech, CNRS

Site Internet / *web site*: http://loa.ensta-paristech.fr/

Adresse / *address:* Centre de l'Yvette de l'ENSTA ParisTech, Chemin de la Hunière, 91120 Palaiseau

Lieu du stage / *internship place*: Laboratoire d'Optique Appliquée (LOA)

Titre du stage / *internship title*:

Modeling plasma accelerators and application to the acceleration of positrons

Résumé / *summary*

To unlock the mysteries of the subatomic world and to study matter's fundamental components and the forces between them, physicists use particle colliders to smash highly energetic particle beams into one another. But as we push the particle energy of these colliders even higher, conventional accelerator techniques are attaining their limits and new concepts are emerging. The use of an ionized gas —or plasma— circumvents the most significant barrier of conventional techniques by increasing the energy gained per unit length by several orders of magnitude. While plasma accelerators made considerable progress to manage to accelerate electrons, research on the acceleration of the electron antimatter counterpart, the positron, has only recently yielded results [1]. This research is however extremely important as it is mandatory to accelerate both electrons and positrons to apply plasma accelerators to particle colliders. One strategy being studied in the research field of plasma accelerators consists in using a particle beam (typically made of electrons or positrons), « the driver », to excite a high-amplitude plasma wave [2], that can then be used to accelerate the main particle beam [3]. One of the key advantages of this strategy is the good energy efficiency [3], which makes it more appropriate for high energy physics applications, where energy efficiency is critical.

While the recent experimental results [1] have attracted a lot of attention and have opened new opportunities, theoretical and numerical studies are now necessary to tackle some of the most important remaining challenges in our field of research. During the internship, the student will work at LOA to develop and implement a numerical Particle-In-Cell code that can simulate and model the interaction between the particle beams and the plasma. The work will aim at addressing, both theoretically and numerically, how we can accelerate positrons while preserving the beam quality, in different regimes of plasma wave excitation. During the PhD, the student will tackle an open and important question and challenge for the field of plasma acceleration: how to generate ultra-low emittance beams and how to preserve their beam quality during plasma acceleration for both electrons and positrons, and what are the various tolerances to achieve beam quality preservation, at levels relevant for high energy physics particle collider applications.

It is strongly preferred that the internship be pursued by a PhD. Both the internship and the PhD will be part of a recently obtained ERC project (Starting Grant from the European Research Council). In addition to the usual financial support for the PhD from the graduate school, the student will have a complementary salary funded by the ERC grant.

[1] S. Corde et al., Nature 524, 442 (2015).
[2] I. Blumenfeld et al., Nature 445, 741 (2007).
[3] M. Litos et al., Nature 515, 92 (2014).

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Oui, la prolongation en thèse dans le cadre du projet ERC est fortement souhaitée**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: Ecole doctorale (EDOM) et bourses Monge (Ecole polytechnique), plus un complément de salaire payé par le financement ERC. Activité d'enseignement (monitorat) possible à l'Ecole polytechnique.**

Lumière, Matière, Interactions	**Oui**	Lasers, Optique, Matière	**Oui**