Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition :

Responsable du stage / *internship supervisor*: Julien Fuchs

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Nom du Laboratoire / *laboratory name*: LULI

Code d'identification :UMR7605 Organisme :CNRS

Site Internet / *web site*: http://www.luli.polytechnique.fr/

Adresse / *address:* Ecole Polytechnique, Palaiseau

Lieu du stage / *internship place*: LULI

Titre du stage / *internship title*: **Amplifying at high energy short laser pulses using plasma based amplifiers**

Résumé / *summary*

The work will consist in participating and analyzing an experiment that will be performed at LULI, using the ELFIE laser system, aiming at amplifying a sub-ps laser pulse using a plasma-based amplification scheme. Amplification of light at high intensities in a plasma is of interest since high power density and large heat loads can be sustained. We particularly want to exploit a scheme in which energy is unidirectionally transferred, via an ion plasma wave (Brillouin backscattering) in the *strong coupling* regime, from a long energetic laser pulse to a short less energetic one, which is amplified. Major advantages of this scheme over Raman-based (using electron plasma waves) ones are the following: no precise frequency tuning is needed to fulfill the resonance condition, full depletion of the pump can be attained, stability is gained with respect to frequency mismatches (typically due to density inhomogeneities).

We have already demonstrated, at LULI, the feasibility of energy amplification of a short laser pulse under these conditions [L. Lancia et al., Phys. Rev. Lett. (2010)]. The short 'seed' beam was made to cross with the more energetic 'pump' pulse in a preformed plasma under an angle which limited the overlapping. A factor 30 in relative amplification (with respect to the simple seed propagation into the plasma) of the seed was obtained and the pump underwent full depletion in the overlapping region. Although we could attain record amplification in that experiment, we were limited by (1) the beams overlap, (2) strong attenuation experienced by the beams due to diffraction over plasma inhomogeneities, and (3) the limited energy available at LULI.

We thus propose now to improve this plasma amplifier scheme by having the two beams counter-propagating, in a gas jet in order to increase the overlapping region between the two pulses. We propose to explore new regimes in terms of energy (higher energies of the beams) and relative intensity of the two beams.

We expect these results to have a significant impact on the development of plasma amplification schemes. These offer prospects to the community to overcome present day technology limitations in manipulating light at high intensities and open new perspectives in high field science.

The experiment is planned at LULI for mid-June, mid-July 2013. During the training period, the student will have the responsibility to prepare and deploy some diagnostics analyzing the properties of the light beams that are made to be crossed in the gas jet, and will analyze the results subsequently.

A PhD work is open to prolong the work, with further experiments already planned abroad (Canada, Germany).

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: CEA/CNRS**

Lasers et matière	**x**	Lumière, Matière : Mesures Extrêmes	**x**
Optique de la science à la technologie	**x**	Plasmas : de l'espace au laboratoire	

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