Call for applications for PhD student position in the laboratory of excellence, labex plas@par

Title: **Study of short pulse amplification by Brillouin Backscattering in the strong coupling regime**

A fundamental process in a plasma is a so-called 3-wave coupling process in which two transverse electromagnetic waves are coupled via a plasma response (the third wave). The plasma then can become an amplifying medium: if we cross in a plasma a long energetic pulse (pump pulse) of moderate intensity and a short pulse (seed) of low intensity, we will have energy transfer from the pump to the seed thanks to the excitation of the plasma wave. This plasma response can either be an electron plasma wave (Raman) or an ion-acoustic wave (Brillouin). The amplitude of the seed will grow strongly on short time scales: in the optimal case the pump energy (of pulse duration some tens of ps) is completely taken up and compressed in the short pulse (typically some 100 fs) that will thus reach the highest intensities. Most of the studies performed in the past have focused on Raman amplification.

The PhD project aims at studying in depth an alternative scheme, where the coupling is between the ion acoustic waves and the electromagnetic radiation, in the so called "strong coupling Brillouin scattering" regime. Analytical studies and particle-in-cell (PIC) numerical simulations have already shown the interest of this regime for a large number of plasma parameters [1] and experimental studies have proven the feasibility of the energy transfer via this process [2], however the interaction is far from being optimised, even if preliminary studies have shown the possibility of reaching very high intensities. The PhD subject involves analytical study of the equations describing Stimulated Brillouin Scattering in the strong coupling regime, as well as other instabilities that can develop during the propagation of the light pulses and that will affect the quality of the coupling and of the amplified pulse (Stimulated Raman backscattering, filamentation of the pump or the seed after amplification, relativistic self-focusing). The larger part of the thesis will be a numerical study of the parameters that can optimise the coupling, such as the plasma density profile, the seed pulse duration and the plasma temperature. The student will benefit from discussions and collaboration with the CPhT (Ecole Polytechnique) team "Laser plasma interaction".

[1] A.A. Andreev, C. Riconda, V.T. Tikhonchuk & S. Weber, Phys. Plasmas 13, 053110 (2006); [2] L. Lancia, J.-R. Marqu`es, M. Nakatsutsumi, C. Riconda, S. Weber, S. Huller, A. Mancic, P. Antici, V.T. Tikhonchuk, A. Héron, P. Audebert & J. Fuchs. Phys. Rev. Lett. 104, 025001 (2010)

Requirements for the candidate: Interest in plasma theory and numerical simulations. Knowledge of programming in fortran or C.

Location and starting date: TIPS/LULI, Université Pierre et Marie Curie: the LULI laboratory has two sites one in Ivry-sur Seine, where the theory group is located, and another site in Ecole Polytechnique, Palaiseau. See also web page http://www.luli.polytechnique.fr
Starting date: October 1st, 2013

Application with detailed CV, copies of degree diplomas and grades, two reference letters, copies of any previous research-related work and personal statement explaining your motivation. Application deadline is *May 15, 2013*. The application should be sent preferably by e-mail to the following address: caterina.riconda@upmc.fr or C. Riconda TIPS/LULI, 3, Rue Galilée, Ivry-sur-Seine 94200 France.