Ph.D. thesis defence announcement

Mr. Simon BOLAÑOS

Will defend his Ph.D. thesis of the Université Paris-Saclay, prepared at the École Polytechnique

Doctoral School n. 572 Ondes et Matière (EDOM), Ph.D. specialty: Physics

Titled

Investigation of magnetic reconnection driven by high-power laser

Monday, the 23rd of December 2019, 10am
Amphithéâtre Becquerel, École Polytechnique
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In front of a jury composed by:

M. Thomas Grismayer (IST)	Rapporteur
M. Guillaume Aulanier (LESIA)	Rapporteur
M. Jacques Robert (LPGP)	Examiner
M. Bérénice Loupias (CEA)	Examiner
M. Julien Fuchs (LULI)	Supervisor
M. Roch Smets (LPP)	Co-supervisor

Key-words:
plasmas, high-power laser, astrophysics, magnetic reconnection

Summary:

The work which will be presented lies in the frame of the magnetic reconnection (MR) process driven by high-power lasers. The focus of the study has been to understand its dynamics in various conditions (e.g., in the presence of a guide-field that is the magnetic component of the reconnection plane), or when changing the plasma beta (defined as the ratio of the plasma pressure over the magnetic pressure) or the reconnection geometry. To complete the analysis of the experimental data gathered at various facilities (LULI, LMJ), the results obtained using a hybrid-PIC code were compared to the experimental results to highlight the features of the mechanism at play.

In a first time, the results from a couple of experiments, performed using the LULI2000 laser facility, are presented. These experiments were aimed at investigating the dynamic of magnetic reconnection in a non-coplanar configuration between two magnetic toroids induced by two near-by laser spots irradiating solids targets. Despite being distinct from the astrophysical plasmas where the beta parameter is low ($\sim 10^{-3}$ in the solar corona and ~ 1 in the solar wind), such HEDP reconnection experiments (where beta is of the order of several tens) are of interest to investigate fundamental issues in MR such as the influence of a guide field on the dynamic of the MR. We will notably show that, prior to MR, the presence (1) of a weak guide-field, or (2) of a quadrupolar, out-of-plane, magnetic field component can both strongly modify the growth of the MR.

Then we will discuss recent experimental results on MR obtained using the LMJ/ PETAL facility at CEA (France). This facility offers specifically the possibility to investigate MR in a low (~ 1) beta condition due to the high laser energy that can be delivered on target, resulting in high-strength produced magnetic fields. It also offers the possibility to use several laser irradiation spots, hence allowing to evaluate the effect of MR in the ICF context where a large number of lasers hit the wall of a holhraum. MR potentially impacts on the interaction along the holhraum wall of the plasmas generated at these sites. We will notably show that the presence of several contiguous laser irradiation spots modifies MR, as compared to having only two neighbouring spots. The transfer of the induced magnetic energy to the plasma can thus be modified.