PROPOSITION DE STAGE 2024

☐ Licence ☐ Master 1 ☑ Master 2 ☐ Fin d'études

Intitulé / Title : Advanced electric field reconstruction analysis for Laser wakefield acceleration in plasmas

NOM DU LABORATOIRE / LABORATORY NAME :
Laboratoire de Physique des Gaz et des Plasmas

Code d'identification : UMR8578

Organisme/institution : CNRS et UPSaclay

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STAGE / INTERNSHIP :

Durée / Duration : 5 à 6 mois à partir de début mars

Prise en charge du transport / Payment for transport : OUI / NON

Rénumération / Scholarship : OUI / ~~NON~~

Possibilité de thèse : NON

RÉSUMÉ / SUMMARY :

Laser Wakefield Acceleration (LWFA) [1] relies on the excitation of high amplitude accelerating fields in plasmas to produce relativistic electron beams with high intensity and short duration. This physical mechanism relies on the nonlinear coupling of an intense laser beam (of the order of a few 1018W/cm²) with a plasma. The intense laser beam, focused inside a gas target ionizes the gas, generating a plasma, and drives plasma waves which can trap and accelerate relativistic electron beams. The properties of the laser beam strongly influence the quality of the electron beam exiting the plasma.

The ITFIP group at LPGP has achieved significant improvements in the comparison of experimental data to simulation results by using advanced analysis methods. The reconstruction of the intense laser field driving LWFA from fluence measurements during experiments and the use of these fields in the simulation of laser plasma interaction allowed us to obtain unprecedented agreements between the simulated and measure spectra of the accelerated electron beams. This work also demonstrated that the interaction and electron beam quality are highly dependent on the degree of symmetry of the laser energy distribution in the transverse planes in the interaction volume [2,3].

The objective of the proposed internship is to use the advanced methods developed by the ITFIP group to analyse data obtained during recent experiments. Phase reconstruction algorithms will be used [4] to retrieve the laser electric field from fluence distributions measured at multiple planes and from multiple shots. The laser beam quality will be evaluated and used as input for PIC simulations.

The desired candidate has a deep knowledge of electromagnetism and in particular geometric and physical optics, the capacity and the motivation to adapt and write well-structured and documented Python scripts for data analysis, critical thinking and some experience in writing reports with LaTeX. A basic knowledge of plasma physics would help the candidate in understanding the scientific context in which the internship will take place.

[1] E. Esarey et al., Rev. Mod. Phys. 81, 1229 (2009), https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.81.1229

[2] L. Dickson et al., Phys. Rev. Accel. Beams 25, 101301 (2023), https://journals.aps.org/prab/abstract/10.1103/PhysRevAccelBeams.25.101301

[3] I. Moulanier et al., Phys. Plasmas 30, 5, 053109 (2023), https://arxiv.org/abs/2305.02275

[4] I. Moulanier et al., J. Opt. Soc. Am. B 40, 9, 2450-2461 (2023), https://hal.science/hal-04200885v1