PROPOSITION DE STAGE
INTERNSHIP PROPOSAL

26

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

Nom du laboratoire / *Laboratory name* :

Code d'identification : UMR8578 Organisme / *Institution* : CNRS / UPSaclay

Adresse / *Adress* : LPGP, Bât. 210, rue Henri Becquerel
Université Paris-Saclay, 91405 Orsay

Site Internet / *web site* : www.lpgp.universite-paris-saclay.fr

Lieu de stage / *Internship place* : LPGP, Bâtiment 210, Campus Orsay Vallée

Responsable de stage / *Internship supervisor* :

Nom / *Name* : Massimo Prénom / *First name* : Francesco

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Autres contacts / *Other contacts* :

Stage / *Internship*

Durée/duration : 5-6 mois

Prise en charge du transport / *Payment for transport* : Non/No

Rémunération / Scholarship : gratification stage M2

Intitulé du stage :

Diagnostic numérique de rayonnement pour la modélisation de l'intéraction laser-plasma
Numerical radiation diagnostic for laser-plasma interaction modelling

Résumé / *Summary* :

Particle in Cell (PIC) codes [1] are essential tools to study a variety of laser-plasma interaction phenomena at the kinetic level.
This internship project aims at developing and testing a Python postprocessing library, able to compute the electromagnetic radiation emitted by numerical particles whose trajectories were simulated with a PIC code. The proposed approach has many applications for laser-plasma interaction, e.g. advanced electromagnetic radiation sources and plasma mirrors

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Sujet de stage / *Internship*

Particle in Cell (PIC) codes [1] are essential tools to study a variety of laser-plasma interaction phenomena at the kinetic level.

To compute the spectrum of electromagnetic radiation emitted by the numerical particles in PIC simulations, dedicated numerical diagnostics can be employed either during the simulation or during a subsequent post-processing phase [2]. Recently, novel approaches have been proposed to compute the emitted electromagnetic fields directly in the time domain [3,4,5]. Such approaches offer promising opportunities for studies that require the complete knowledge of the spatial distribution of the emitted radiation also in the time domain.

The ITFIP team is actively involved in a theoretical and numerical modelling program focused on plasma components for future particle accelerators based on Laser Wakefield Acceleration [6], for which PIC codes are an essential investigation tool.

The proposed internship will focus on the implementation and validation of a postprocessing radiation diagnostic based on a time-domain approach for PIC simulations, in particular for the open-source PIC code Smilei [1]. The work will involve studying the underlying theoretical formalism, implementing the corresponding numerical method, and assessing its performance on relevant PIC simulation cases.

The methods and/or the results of the internship will contribute to the laser-plasma acceleration experimental campaigns where the team ITFIP is involved with multiple collaborators in the Plateau of Saclay and at the international level.

References

[1] https://smileipic.github.io/Smilei/Understand/algorithms.html, J. Derouillat et al., Computer Physics Communications 222 (2018), https://arxiv.org/abs/1702.05128
[2] D. Maslarova, Communications Physics 9 (2026), https://doi.org/10.1038/s42005-026-02542-6
[3] M. Pardal et al., Computer Physics Communications 285 (2023) https://doi.org/10.1016/j.cpc.2022.108634
[4] A. Frazzitta et al., Instruments 7 (2023), https://doi.org/10.3390/instruments7040052
[5] C. H. Wen et al., The European Physical Journal D 80 (2026), https://doi.org/10.1140/epjd/s10053-026-01142-x
[6] E. Esarey et al., Rev. Mod. Phys. 81, 1229 (2009), https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.81.1229