Post-doctoral position (24 months)

Project: Laser-plasma acceleration with superluminal laser pulses

Laboratory: Laboratoire d'Optique Appliquée (LOA), ENSTA, CNRS, École Polytechnique, Institut Polytechnique de Paris, Palaiseau, France

Context

Laser-plasma accelerators (LPAs) are a compact alternative to conventional accelerators and can generate ultra-relativistic electron beams over centimeter-scale distances thanks to extreme accelerating fields (>100 GV/m). A key limitation for beam energy is the dephasing between accelerated electrons and the plasma wake: electrons eventually outrun the accelerating phase, which caps the effective acceleration length and final energy. We explore a dephasing-free concept based on superluminal laser pulses, where the focal point can be made to propagate through the plasma at an arbitrarily controlled velocity, including faster than the speed of light in vacuum. This is achieved by combining an axiparabola, which focuses each annular portion of the near-field at a different longitudinal position, with a controlled radial delay introduced via spatiotemporal couplings (STC). Experimentally, these STC can be implemented using a lens doublet that introduces a tunable radial delay. A more advanced, programmable method would be to use a large-aperture spatial light modulator (SLM) to impose tailored spectral phase and space-dependent delay. This added programmability would enable greater control over the laser propagation to implement flying-focus.

The position

The postdoctoral researcher will lead the experimental implementation of a flying-focus laser pulse for laser wakefield acceleration on LOA's 100 TW-class laser and extend the approach to the Apollon petawatt facility. The work will focus on creating and tuning the spatiotemporal couplings required for controlled focal-velocity propagation, with a particular emphasis on exploring the possibility of using large-aperture spatial light modulators to imprint programmable, radius-dependent spectral phase and delay. The postdoc will develop the associated spatiotemporal metrology, integrate the flying-focus optics into high-intensity beamlines and carry out laser-plasma acceleration experiments. A key research direction will be to explore new designs using flying-focus to improve LWFA-based X-ray sources. Although this is primarily an experimental position, we also encourage applications from motivated candidates with a strong simulation and/or theoretical background; the project scope can be adapted to the successful applicant's expertise and interests.

Requirements

- PhD in Physics with strong interest for experimental physics.
- Expertise in one of the followings: laser-plasma accelerators, high-intensity lasers, laser-plasma interaction, optics.
- Ability to work in team, coordinate with PhD students and staff and lead experimental campaigns.
- Good oral and written communication skills in order to write scientific articles and present results in international conferences.
- Experience with one of the following would be a plus: optical design software (Zemax), Particle-in-cell simulations, Spatial light modulators (SLMs).

Contact: Lucas Rovige: lucas.rovige@ensta.fr / Cédric Thaury: cedric.thaury@ensta.fr

How to apply: Send a CV (including a publication list and conference participation), along with a cover letter and up to two letters of recommendation, to Lucas Rovige.

Application deadline: For full consideration, apply by May 15th 2026. Applications will be then reviewed on a rolling basis until the position is filled.

General information: Starting date is flexible, typically September 2026, but earlier or later dates can be accommodated. Salary will be determined based on the candidate's experience (typ. gross salary of 3131€/month to 4143 €/month depending on experience). The position comes with health and pension benefits.