FULLY FUNDED POSTDOCTORAL SCIENTIST POSITION – CEA\IRAMIS\LIDYL - ORME DES MERISIERS M/F

Directorate

The Directorate for Fundamental Research (DRF), present on all civilian centers of the CEA, has as its main objective to undertake fundamental research in relation to the missions of the CEA in the fields of physics, chemistry and life sciences, in which its excellence is internationally recognized.

Organizational unit

The Interactions, Dynamics and Lasers Laboratory (LIDYL), which is part of the CEA's Institut Rayonnement Matière de Saclay (IRAMIS) and which houses the EMR9000 CNRS-CEA research unit, carries out fundamental research on laser-matter interaction in the ultra-short pulse duration and Ultra-High Intensity (UHI) regimes. LIDYL hosts the cutting-edge ATTOLab-Orme (dedicated to ultrafast dynamics studies in the gas and solid phases at the femtosecond and attosecond time scales) and UHI100 (devoted to relativistic optics, radiation generation and particle acceleration studies) facilities. The latter is based on a 100TW-class Titanium-Sapphire laser coupled to a new experimental area, the geometry and equipment of which have been optimized in the framework of the fitting out of the entirely new LIDYL laboratories implemented on the Orme des Merisiers site of the CEA Paris-Saclay in 2021. The state-of-the-art facility UHI100 allow the use of two intense, synchronized laser beams of ultra-high temporal contrast. This configuration allow the implementation of a large range of experiments in the field of relativistic optics on plasma mirrors as well as on laser particle acceleration in dense and underdense plasmas.

Job description

Research Project: Implementation of Machine Learning techniques on UHI100 laser facility to optimize laser-plasma accelerator for applications in radiotherapy

The tremendous progress of the last 20 years in the domain of laser-plasma accelerators has allowed us to understand the physics of the acceleration process and to optimize the properties of the electron beams working on each different step of the process, from the laser to the electron beam itself. One of the next steps in the field is to develop such Laser-driven Particle Accelerators (LPA) for applications.

Since the first, very recent, experimental demonstration of the huge potential of machine learning techniques to automate and control laser wakefield accelerators, their use in the field has been growing exponentially. Various algorithms are developed and tested to efficiently determine the optimum parameter set that will lead to the ideal laser–driven electron beam for a specific application. Among applications, the LPA, due to their extremely short duration (femtosecond range), are extreme dose rate sources of great interest for radiotherapy, especially in the context of FLASH radiotherapy. Since the first experimental evidence for FLASH effect in 2014 with conventional accelerators, the worldwide community is actively working on trying to understand the basic mechanisms underlying the physical and biological process responsible for the increased preservation of healthy tissue surrounding the tumor treated with ultrashort electron bunches. LPA is a promising alternative source to conventional accelerators for investigating the fundamental physico-chemical processes underlying these biological effects.

The Physics at High Intensity group at LIDYL has strong expertise in LPA, both from the experimental and numerical point of view. Benefiting from a brand new experimental facility equipped with a 100TW class laser system, we have implemented numerous diagnostics along the laser beam transport from the laser area up to the experimental chamber to be able to control the laser and the plasma. The next step is to implement Machine Learning techniques for optimizing the laser-driven electron accelerator to ultimately irradiate samples (biological, chemical …). As part of the EURO-LABS network (European Laboratories for Accelerator Based Sciences), we will benefit from a ML toolkit, developed by GSI (Germany). This tool is conceived for conventional accelerators, and it will have to be adapted to the specificities of LPA and tested on our experimental facility for validation.

This project will benefit from strong support of numerical simulation experts from the PHI group (H. Vincenti and coworkers).

Job type:

A fully funded one year position, in the context of EURO-LABS project (European Laboratories for Accelerator Based Sciences – under grant agreement Grant Agreement No: 101057511). Extensions could be considered depending on funding availability.

The starting date will be around September 2023.

Required qualifications:

The ideal candidate for this position will hold a PhD (before 09/2023), preferably in physics or related disciplines. The candidate must have strong skills and interests in one or more of the following areas:
-laser-plasma acceleration
-laser-solid interaction at high intensity
-Machine Learning techniques
Good knowledge of the Python programming language is essential.

Application/selection procedure:

Candidates must apply online via the CEA career website via (https://www.emploi.cea.fr/offre-de-emploi/liste-offres.aspx) and by additionally emailing a complete file to jobs.lidyl@cea.fr.

The application file will contain:

- a CV;

- a comprehensive record of professional achievements (publications, fellowships, awards, etc…) including a short description of the main personal accomplishments (conceptual, technical, …);
- a cover letter highlighting the motivations for applying to this position;
- contact information for 2 references that might be contacted.

Application deadline: applications will be accepted until the position is filled

Contact: jobs.lidyl@cea.fr.

For more details about the position, please write to sandrine.dobosz@cea.fr