Post-doctoral position in plasma physics

Pair electron-positron generation with high intensity and high power laser

Advertiser: Centre Lasers Intenses et Applications, University of Bordeaux, CNRS, CEA

Deadline: September 1, 2018

Duration: 18 months

Salary: 2000-2800€ net/month, according to the university regulations

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Project description

The successful applicant will participate to the TULIMA project (Turning Light Into Matter) funded by the ANR for the period 2018-2022. This project aims at studying the production of electron-positron pairs from the collision of two photons (Breit-Wheeler process) in the context of high power and high energy laser research .

A pair generation from photons has already been observed on the Stanford accelerator (SLAC). However, that was a non-linear multi-photon process. Electron-positron pairs were created in a collision of a gamma quanta with four or five optical photons ($\gamma + n\gamma' \rightarrow e^+ + e^-$) [1]. Up to now, the original Breit-Wheeler (BW) process of pairs production from the collision of two photons has never been observed ($\gamma + \gamma' \rightarrow e^+ + e^-$) in spite of its crucial importance in astrophysics. The overview of this research domain is presented in Ref. [2], it is related to studies of QED (Quantum ElectroDynamics) effects in plasmas with lasers. The advent of high power lasers allows to develop new experimental concepts, see Ref. [3,4], permitting to observe and study the basic QED processes.

The TULIMA project is the first step toward the first experimental detection of electron-positron pairs creation. To fulfill this objective, we need a very detailed description of the physical processes involved and will use a set of numerical codes to simulate a realistic experimental situation and predict a detectable signal. The major question is: How to observe the Breit-Wheeler process with available laser sources?

The proposed project aims to:

The adaptation of an existing electron-positron spectrometer in order to detect a single event during a laser shot,

The automation of the high-rate measure acquisitions and their processing,

The experimental validation of this spectrometer on a high-laser intensity facility.

The challenge is to detect a single positron despite a large background noise. The proposed work will consist in developing a new positron detector based on a bundle of fibers and integrating it in our electron-positron spectrometer. To do that, He/She will have access to a simulation tool (GEANT4) and to CELIA experimental facilities (Eclipse 3 and 4).

The postdoctoral fellow position is open for 18 months. He/She will be based in CELIA and will participate in the theoretical, numerical and experimental works related to Breit-Wheeler pairs generation and its detection. He/She will also have to perform experiments on higher intensity lasers out of the Lab by answering "call for proposal" on others facilities.

Requirements: PhD degree or a postdoctoral experience in the experimental Plasma Physics on high intensity lasers. Experience in numerical simulation and code writing would be advantageous. A knowledge of French language is not required. Applicants should be sent (preferably by email) a letter of interest, a detailed CV.

[1] Bamber C. et al. Phys. Rev. D **60**, 092004 (1999).
[2] Mourou G. A., Tajima T. and Bulanov S. V., Reviews of Modern Phys. **78**, 309 (2006).
[3] Pike O. J., Mackenroth F., Hill E. G. and Rose, S. J. Nature Photonics, **8**, 434 (2014).
[4] Ribeyre X. et al., Phys. Rev. E, **93** 013201 (2016).