Post: **Postdoctoral Researcher in Experimental Atomic and Molecular Physics**
Location: Laboratoire Aimé Cotton (LAC), CNRS, Université Paris Saclay, Orsay, France
Team: Condensed cold matter (MFC, LAC)
Contract: Fixed Term, 2 years, starting as soon as possible

Improved nanometric control of ions and electrons via laser ionization and coincident detection

Job description:
The 2-year post-doctoral position is part of the project CITRON (*Correlated Ion elecTRon fOr Nanoscience*) funded by the European Research Council (ERC) and of the project FIBback (*Focused Ion Beam by correlated electron feedback*) funded by the Agence Nationale de la Recherche (ANR, fr: National Agency for Research). This project is a collaboration between Laboratoire Aimé Cotton (LAC) and Orsay Physics company, with support of Institut des Sciences Moléculaires d'Orsay (ISMO) and Service de Physique de l'Etat Condensé (SPEC).

The successful applicant will be hosted in the Paris region laboratory LAC located at Orsay City.

Many applications rely on extreme miniaturization, which imposes to control the energy, the number and the locations of electrons or ions at the nanometric level. The long-term goal of our projects is to harness the simultaneous production, coincident detection and fast control of both ions and electrons in a bid to enhance ion and electron beam properties.
More specifically, in contrast with standard tools, the proposed developments rely on the ionization of a neutral atomic species and on the simultaneous production, detection and control of both the ion and the electron. Such a detection in coincidence yields correlated information on both particles that can be used to improve the beam properties, like the deterministic knowledge of the creation of the charged particles, and the correction of their trajectories in real time. Using this novel technique, which we have recently demonstrated, we propose to develop three innovative prototypes:
• 1) A focused ion beam using feedback control with unprecedented focused properties. This will be used to realize semiconductor circuit-editing at the (sub-)nm scale.
• 2) A deterministic source of (potentially) any type of ion for controlled implantation at the nm level. This will be used for on-demand doping of quantum devices.
• 3) A high-resolution electron-energy-loss microscope (HREELM) with precise knowledge of the electron energy and the position on the sample. It be used to realize both imaging and vibrational spectroscopy for surface analysis.

During the two years, the post-doctoral researcher will work on one of the three setups. The successful applicant will have to work on atomic beam laser excitation and with fast time and position sensitive detectors. He/She will also strongly interact with other PhD students throughout the duration of the project and will thus have a decisive role to maximise the synergy between them and other groups for an optimal knowledge transfer.

Keywords:
Atomic and molecular physics, Rydberg atoms, ion beam, electron beam, electron microscopy, focused ion beam, charged particles optics, time and position sensitive detectors.

Publications from the team:

Cesium Rydberg-state ionization study by three-dimensional ion-electron correlation: Toward a monochromatic electron source; R Hahn, A Trimeche, C Lopez, D Comparat, YJ Picard; Physical Review A 103 (4), 042821 (2022); https://doi.org/10.1103/PhysRevA.103.042821

Ion and electron ghost imaging; A. Trimeche, C. Lopez, D. Comparat, and Y. J. Picard; Phys. Rev. Research 2, 043295 (2020); https://doi.org/10.1103/PhysRevResearch.2.043295

Real-time trajectory control of deterministically produced ions; C. Lopez, A. Trimeche, D. Comparat, Y.J. Picard; Phys. Rev. Applied 11 064049 (2019); https://doi.org/10.1103/PhysRevApplied.11.064049

Design for a high-resolution electron energy loss microscope; M. Mankos, K. Shadman, R. Hahn, Y. J. Picard, D. Comparat, O. Fedchenko, G. Schönhense, L. Amiaud, A. Lafosse, N. Barrett; Ultramicroscopy, 207 112848 (2019); https://doi.org/10.1016/j.ultramic.2019.112848

Ion microscopy based on laser-cooled cesium atoms; M. Viteau, M. Reveillard, L. Kime, B. Rasser, P. Sudraud, Y. Bruneau, G. Khalili, P. Pillet, D Comparat, I. Guerri, A. Fioretti, D. Ciampini, M. Allegrini, F. Fuso; Ultramicroscopy 164, 70 (2016); https://doi.org/10.1016/j.ultramic.2015.12.007

Requirements:
The applicant should have a PhD in several of the relevant area of experimental physics or chemical physics: molecular, atomic physics, spectroscopy, optics and lasers, charged particles physics, surface science. He/She will be expected to display the initiative and creativity, together with the appropriate skills and knowledge, required to meet the project goals.

Interested applicants should email a CV, a brief description of research interests and the contact details of 2 referents to D. Comparat (daniel.comparat@universite-paris-saclay.fr) and Y. Picard (yan.picard@universite-paris-saclay.fr)