INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Physique des Interactions Ioniques et Moléculaires (PIIM)
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Internship location: Aix-Marseille Université – Campus de Saint Jérôme - Marseille

Thesis possibility after internship: **YES**
Funding: YES (not yet secured, application for a doctoral school fellowship)

Ultracold neutral plasma physics

Context: Laser-cooled atomic samples provide highly controllable and versatile platforms to study complex phenomena. The ion trapping group in Marseilles is developing a new experiment at the frontier of quantum and plasma physics. It aims at creating a dilute sample of about 10^9 Calcium atoms at a temperature in the mK range held in a magneto-optical trap. This ultra-cold atom cloud will then be photo-ionized to create a ultra-cold neutral plasma and study its dynamics. The experiment aims at demonstrating for the first time the control of the initial density distribution of the plasma, using a digital micro-mirror device to shape the photo-ionization laser pulse. This will provide an ideal platform to study the physics of strongly correlated plasma [1].

Master project: This internship offer is at the frontier of atomic, quantum and plasma physics. The student will take part in optimizing and characterizing the production of laser-cooled atomic clouds with temperatures in the mK range. He/she will participate in all stages of the experiments and contribute to their improvement. We have recently finished the baking of the vacuum vessel and are now currently searching for the first spectroscopy signal on the new experiment. The student will acquire state-of-the-art knowledge of an atomic physics experiment, including: laser control and stabilization, beam shaping, absorption and fluorescence imaging and data analysis. He/she will join a group (currently 3 permanent staff, 1 post-doc and 3 PhD students) working on three projects based on laser-cooled atoms and ions: transport in ultracold plasma (this internship offer), frequency metrology and biomolecule detection.

Required skills : A previous experience with optics (internship or lab works) is appreciated but not mandatory. A good understanding of atom-light interaction and quantum mechanics is required, as well as the curiosity of exploring the frontiers of atomic, quantum and plasma physics.

PhD proposal: This master project will be followed by an PhD aiming at studying transport properties in ultracold strongly coupled neutral plasma, focusing in particular on scenarios that could serve as benchmark for molecular dynamics simulations or hydrodynamic codes.

References:

[1] Bergeson et al., Exploring the crossover between high-energy-density plasma and ultracold neutral plasma physics, Physics of Plasmas **26** 100501 (2019)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/NO Soft Matter and Biological Physics: YES/NO
Quantum Physics: YES/NO Theoretical Physics: YES/NO