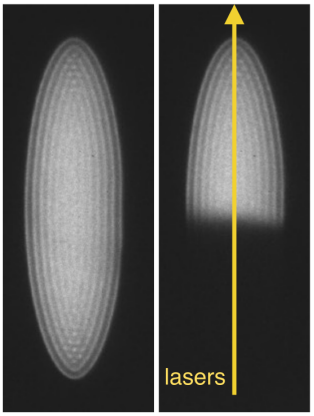
INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Physique des Interactions Ioniques et Moléculaires
CNRS identification code: UMR7345
Internship director'surname: Romain Dubessy
e-mail: romain.dubessy@univ-amu.fr Phone number: 04 13 94 64 13
Web page: Group webpage
Internship location: Aix-Marseille Université, campus de Saint Jérôme. The Laboratory is located 20 minutes from the Vieux Port, in a pleasant, sunny environment.

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: A*midex grant

Dynamics in ultracold plasmas



Laser-cooled atomic samples provide highly controllable and versatile platforms to study complex phenomena. The ion trapping group in Marseilles studies laser-cooled calcium ions Ca^+ trapped in linear radio-frequency (rf) traps. At temperatures lower than 1 K the trapped ions form a regular structure, called a Coulomb crystal, minimizing the total energy, as shown on the figure, which displays the fluorescence of the ions imaged by a camera. By playing with the lasers addressing the ions it is possible to shelve part of the cloud in a "dark state", triggering a phase separation between bright and dark ions, as shown on the right figure. By studying this process one can measure experimentally the self-diffusion coefficients in a one-component strongly correlated plasma, which is the topic of this internship offer.

This internship is at the frontier of atomic, quantum and plasma physics. The student will learn to produce and trap ions in radio-frequency traps, and to laser-cool samples to temperatures in the mK range. He/she will participate in all stages of the experiments and contribute to their improvement by implementing an automated data acquisition and analysis sequence. The student will acquire state-of-the-art knowledge of an atomic physics experiment. He/she will join a group (currently 4 permanent staff, 2 post-docs and 2 PhD students) working on three projects based on laser-cooled ions: plasma physics (this internship offer), frequency metrology and biomolecule detection.

The group is starting a new experiment aiming at creating a ultracold atomic sample of neutral calcium atoms in a magneto-optical trap (MOT), that will be photo-ionized to create a ultracold neutral plasma sample (mixing ions and electrons) enabling the study of dense and cold neutral plasmas. The student will have the opportunity to start a PhD on this topic, contribute to a new experiment and advance the understanding of ultracold neutral and non-neutral plasmas.

Required skills : A previous experience with optics 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.

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

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