INTERNSHIP TITLE	**Painted optical potentials for ultra cold gases in microgravity**
PLEASE SELECT M1 OR M2	M2
NAME OF THE SUPERVISOR(S) (E-MAIL, TEL)	BATTELIER Baptiste Mail: baptiste.battelier@institutoptique.fr
LABORATORY	LABORATOIRE PHOTONIQUE NUMERIQUE NANOSCIENCES

RESEARCH PROJECT (MAX. 1 PAGE)

Our research group is devoted to the production of ultra-cold quantum gases in microgravity. The main goal is to achieve atom interferometers with large scale factor to push the sensitivity until the fundamental limits of these systems.

To test the equivalence principle with quantum particles the ICE project aims to develop a matter wave interferometer with two atomic species operating in weightlessness. A micro-gravity simulator installed in the laboratory allows to put the science chamber in weightlessness during 500 ms, and in a highly repetitive way. The production of ultra-cold atom sources on the simulator will allow to reach the aimed sensitivity for the atom interferometer.

To produce a Bose-Einstein condensate, an optical tweezer traps the atoms in a high vacuum chamber at the focused point of a far-red detuned laser. One originality of our set up is the ability to modulate spatially the position of the highly focused laser beam. If the frequency modulation is fast compared to the movement of the atom (for instance defined the trap frequency of the tweezer), the atoms "feel" the time averaged potential leading to a good trade-off between the capture volume and the trap depth, then optimizing the loading of the atoms in the dipole trap.

The objective of this internship is to develop a new optical bench to improve this painted potential, by extending the technique in 3D. Based on spatial modulation in 2D dimensions using two crossed acousto-optical modulators, it will create a 3D painted potential in a crossed configuration. Special care will be taken about the robustness of the system which has to be compliant with the zero-g simulator. The implementation in the microgravity experiment is planned for a potential Ph. D in the group after the internship.

The work will take place at LP2N within Institut d'Optique d'Aquitaine. The candidate will be asked an advanced expertise in the following fields: atom physics and ultra-cold gas, laser, electronics, servo lock systems, computer science and signal processing.

Possibility of Ph D Thesis after the internship: YES (Funding to be confirmed: CNES/Plan Quantique France 2030 QAFCA)