



ERASMUS MUNDUS



## EUROPHOTONICS-POESII MASTER COURSE

### PROPOSAL FOR A MASTER THESIS

Dates: April 1<sup>st</sup>, 2016 – September 30<sup>th</sup>, 2016

**Laboratory: ICFO, Ultracold Quantum Gases Group**  
**City, Country: Castelldefels (Barcelona), Spain**

**Title of the master thesis: Experiments with ultracold quantum gases (to be discussed)**

**Name of the tutor of the master thesis: Leticia Tarruell**

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### **Summary of the subject (maximum 1 page):**

In recent years ultra-cold atomic gases have emerged as a novel platform for the study of quantum many-body systems, giving access to phenomena originally studied in condensed-matter in a novel and highly controlled setting. In this context, quantum gases trapped in the potential created by interfering laser beams are a particularly clear example. By replacing the electrons by atoms, and the crystalline structure of solids by an optical lattice, these systems indeed provide the cleanest quantum « materials » that can be studied in the laboratory. Atoms in optical lattices therefore appear as ideal test systems for studying the physics of strongly correlated materials. Furthermore, these systems also offer the intriguing opportunity of reaching extreme parameter regimes which are not accessible in the solid-state context.

Our group has recently set up at ICFO an experimental apparatus which routinely produces Bose-Einstein condensates of potassium, as well as laser-cooled clouds of fermionic atoms. During the internship the candidate will have the possibility to develop an experimental project which will then be implemented on the main apparatus. Depending on the background, interests and abilities of the candidate, possible project include the development of a magnetic field measurement and stabilization system, the assembly of a 2D magneto-optical trap, or the construction of an optical lattice setup.

**Keywords: quantum gases, quantum optics, atomic physics, quantum simulators, optical lattices**

**Additional information:**

\* Required skills: The candidate should have a good knowledge of quantum optics, atomic physics and condensed matter physics, and a strong motivation to perform experimental work.

\* Miscellaneous: