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The Institute  
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Sciences



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Initiative d'excellence  
Aix-Marseille



## **Master in Photonics – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”**

### **MASTER THESIS PROPOSAL**

**Dates: April - September 2020**

**Laboratory : ICFO-QOT**

**Institution: Institut de Ciències Fotoniques**

**City, Country : Casteldefels, Spain**

**Title of the master thesis: Frontiers of Attosecond Science, Quantum Simulations and Many Body Physics**

**Name of the master thesis supervisor: Maciej Lewenstein**

Email address : Maciej.Lewenstein@icfo.eu

Phone number : 626723233

Mail address : Carrer de Veciana 19, 08023 Barcelona

**Keywords : attosecond science, quantum simulations, many body physics**

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

The MSc student will join one of the running research projects in the ICFO-QOT. The concrete choice will depend on the current efforts in the group (that change adjusting to scientific needs), student's preferences and preparation, availability of supervisor/co-supervisor and resources for a specific theme. At this stage ICFO-QOT can absorb one MSc student in this area. QOT-ICFO studies and develops in particular

1) Interactions of matter (atoms, molecules, solid state, 2D materials etc.) with ultrashort laser pulses. This leads to high harmonic generation (HHG), above threshold ionization (ATI), multi-electron ionization. So far, the studies of these phenomena did not consider the quantum nature of electromagnetic radiation. We develop systematic theory of quantum attophysics and seek for experimentally relevant and observable quantum phenomena.

2) Attophysics can be mimicked using ultracold atoms, ions, etc. We study these possibility focusing on analogies between the strongly laser driven solid state and strongly shaken atoms in optical lattices



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**Additional information :**

\* Required skills: Good level of theoretical physics, numerical methods and computer skills, good knowledge of mathematical methods of physics and statistics.

\* Miscellaneous :