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ICFO
The Institute
of Photonic
Sciences



Master in Photonics – “PHOTONICS BCN” Master ERASMUS+ “EuroPhotonics”

MASTER THESIS PROPOSAL

Dates: April 2020 - September 2021

Laboratory: Quantum Optic Theory
Institution: ICFO – Institute of Photonic Sciences
City, Country: Castelldefels, Spain

Title of the master thesis: Quantum simulators for quantum technologies

**Name of the master thesis supervisor and co-supervisor:
Maciej Lewenstein**

(for external proposals a co-supervisor from the program is needed)

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Keywords: quantum simulators, ultracold atoms, quantum annealers, quantum technologies, quantum photonic simulators, trapped ions

Summary of the subject (maximum 1 page):

Quantum simulators constitute today one of the pillars of quantum technologies. The QOT group at ICFO has a very wide program of investigations of various kind of quantum simulators for various platforms: ultracold atoms in traps, ultracold atoms in optical lattices, ultracold trapped ions, Rydberg atoms, dipolar atomic and molecular gases, photonic systems, and more. The focus of this line of research is on

- i) Systems with topological order
- ii) Systems mimicking dynamical synthetic gauge fields and lattice gauge theories
- iii) Systems in synthetic dimension, mimicking bilayer graphene etc.
- iv) System with long range interactions

Most of these problems deal with strongly correlated quantum many body systems, and as such require the use of the most advanced methods of theoretical physics, and numerical simulations. Collaborations and bilateral guidance with experimental groups is necessary.



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The MSc student will join one of the running research projects in the above areas, and contribute to a joint publication with the other members of the group. The student will be supervised by M. Lewensttein and one of the senior postdocs from the group.

Additional information (if needed):

* Required skills : **good preparation in methods of theoretical physics and numerical skills are welcome**

* Miscellaneous :