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ICFO
The Institute
of Photonic
Sciences



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

MASTER THESIS PROPOSAL

Dates: April 2021 - September 2022

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

Title of the master thesis: Ultra intense laser-matter interactions

**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: atto-science, high harmonic generation, above-threshold ionization, multi-electron ionization

Summary of the subject (maximum 1 page):

Ultrafast physics, employing various kinds of lasers from TerraHerz to mid-infrared, is today one of the most important branches of laser physics, promising fascinating applications ranging from biology to quantum information. The QOT group at ICFO has a very wide program of investigations of various aspects of atto-science and ultra intense laser-matter interactions. In particular, we study various targets in strong laser fields: atoms, molecules, solid state, and even strongly correlated condensed matter system, as well as topological materials. Important aspects concern the use of “structured light”, with “exotic” polarization and orbital angular momentum dynamics, in order to generate transient topological order or transient topological superconductivity. Other important line of research concerns quantum electro-dynamical aspect of the mentioned processes, involving full QED description of super-intense laser matter interactions. Many of these problems deal with non-perturbative dynamics of strongly correlated quantum 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 :