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

MASTER THESIS PROPOSAL

Dates: April 2020 - September 2021

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

Title of the master thesis: Strong field phenomena driven by waveforms

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

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Keywords: atto-science, ultrafast phenomena, high harmonic generation, above threshold ionization, tunnelling ionization

Summary of the subject (maximum 1 page):

Third-generation femtosecond technology (3FST) offers the potential for femtosecond light tunable over several octaves, multi-terawatt few-cycle pulses, and synthesized multi-octave light transients. Unique tunability, temporal confinement, and waveform variety in combination with unprecedented average powers will extend nonlinear optics and laser spectroscopy to previously inaccessible wavelength domains, ranging from the far IR to the x-ray regime. The underlying concepts, technologies, and proof-of-principle experiments are being currently explored in several laboratories around the world. A conceptual design study of a prototypical tunable and wideband source demonstrates the potential of 3FST for pushing the frontiers of femtosecond and attosecond science. The consequences, from a theoretical viewpoint, of the utilization of these laser sources to drive strong field phenomena are still unexplored. Only few attempts have been done so far, but still many questions remain to be answered.

The aim of this project is to theoretically study strong field phenomena, for example high-order harmonic generation (HHG) and above-threshold ionization (ATI), driven by multi-octave light transients and to explore the ultimate limits, under the guidance of experimental colleagues.



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We could work using only the classical equations and optimization tools (looking for the 'optimal waveforms' for different strong field processes). If time permits, we could do some tests with the 1D-TDSE as well.

Additional information (if needed):

- * Required skills : basic understanding of theoretical physics methods and numerical approaches
- * Miscellaneous :