



Dottorato di Ricerca in Fisica

Title:	<i>Ultrafast Laser Physics</i>
Lecturers:	Giulia Fulvia Mancini
Duration:	20 hours of frontal lectures
CFU:	4
Period:	March - May even years, every other year (2022, 2024, ...)
Content:	<p>Learning pre-requisites: A basic (M.Sc.) knowledge of Photonics and Diffraction are recommended</p> <p>Learning Objectives: The course will cover fundamental concepts and recent developments in the field of ultrafast laser physics, and it will introduce the basic theory to understand ultrafast (10^{-15}-10^{-9}s) phenomena in chemistry, biology and condensed matter physics. It has the goal to give also to the non-expert an efficient starting position to enter the field of ultrafast laser physics providing all the detailed derivations. The course will cover fundamental technological and theoretical aspects of: (i) Linear pulse propagation and dispersion compensation, (ii) Nonlinear pulse propagation and nonlinear optics with ultrashort pulses, (iii) Pulse generation, pulse duration measurements</p> <p>Program and contents: <u>Principles of femtosecond laser systems</u><ul style="list-style-type: none">• Overview of laser oscillators and pulse amplification• Pulse measurement/characterization<u>Time-resolved methods</u><ul style="list-style-type: none">• Transient absorption (pump-probe) spectroscopy• Time-resolved core-level spectroscopies (X-ray absorption, emission, RIXS) using synchrotron and XFEL radiation• Time-resolved Coherent Diffractive Imaging methods with XFEL and table-top High Harmonic Generation (HHG) sources & Fundamentals of Fourier Optics• Electron-based methods (scattering, crystallography, microscopy, spectroscopy)<u>Theory</u><ul style="list-style-type: none">• Linear & Non-linear optics<p>Expected results: The student shall be capable of formulating original questions upon reading an article in ultrafast science</p><p>Teaching Methods:<ul style="list-style-type: none">• Interactive lectures• Group activities in the classroom• Homework<p>Reference textbooks:<ul style="list-style-type: none">• U. Keller, Ultrafast Lasers - A Comprehensive Introduction to Fundamental Principles with Practical Applications, Springer International Publishing, eBook ISBN 978-3-030-82532-4, 2021• O. Svelto, Principles of Lasers, Springer, New York, ISBN 978-1-4419-1301-2<p>Learning verification methods: Oral presentation on a selected topic & discussion on the overall program</p></p></p></p>
Notes	This course may be of interest to PhD students in the Schools of Engineering and Physical Chemistry