UNIVERSITÀ DI PAVIA

Dipartimento di Fisica

Dottorato di Ricerca in Fisica

Academic Year 2023/2024

Title:	***Ultrafast Laser Physics***
Lecturers:	G.F. Mancini
Duration:	20h
CFU:	4
Period:	February 2024 or (on demand) March - May 2024

Content: 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^{-16}–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 into 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.

Program & contents:

1- Principles of femtosecond laser systems

- Overview of laser oscillators and pulse amplification
- Parametric generation and amplification
- Pulse measurement/characterisation

2- Time-resolved methods

- Transient absorption (pump-probe) spectroscopy and fluorescence up-conversion
- Time-resolved core-level spectroscopies (X-ray absorption, emission, photoelectron spectroscopy, etc.) using synchrotron and XFEL radiation, as well as table-top High Harmonic Generation (HHG) sources.
- Electron-based methods (scattering, crystallography, microscopy, spectroscopy)

3- Theory (no, or minimal, pre-existing knowledge is required)

-Non-linear optics

Bibliography:

O. Svelto, Principles of Lasers, Springer, New York, ISBN 978-1-4419-1301-2

U. Keller, Ultrafast Lasers - A Comprehensive Introduction to Fundamental Principles with

Practical Applications, Springer International Publishing, eBook ISBN

Requirements: A basic (M.Sc.) knowledge of Photonics and Spectroscopy are recommended.

Notes: This course may be of interest to PhD students in the Schools of Engineering and Physical Chemistry