UCLouvain

lphys2248

2023

Ultra-fast laser physics

5.00 credits	22.5 h + 7.5 h	Q2

This biannual learning is being organized in 2023-2024

Teacher(s)	Lauzin Clément ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Having followed LPHYS2143 is an asset
Main themes	This teaching unit reviews the building and use of femto and attosecond pulses to measure spectroscopic or dynamic quantities. It deals with the basic principles allowing the building of such ultra-short light sources, the tools developed to characterize them and several applications where this short time scale or extreme frequency stabilised light sources are used.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M and PHYS2M1)** AA1.3, AA1.4, AA1.5, AA1.6, AA 2.2, AA4.2, AA 5.1, AA5.2,AA 5.3, AA 6.3, AA 6.5, AA7.1, AA7.2, AA 7.5, AA 8.1. **b. Specific learning outcomes of the teaching unit** 1 At the end of this teaching unit, the student will be able to: 1. use and characterize ultra-fast light sources ; 2. build a femtosecond oscillator ; 3. characterize in the time and frequency domains these ultra-fast light-sources ; 4. consider the use of those sources to tackle original problems in physics.
Evaluation methods	The evaluation is made on the quality of a written report and oral examination based on experimental or theoretical projects and ex-cathedra lectures.
Teaching methods	Lectures, laboratories, practical project
Content	The teaching unit follows the following structure : 1) Introduction • Mode-locking and elements of nonlinear optics • Dispersion compensation schemes 2) Study and use of ultra-fast lasers in the frequency domain • Optical frequency comb synthesis from mode-locked lasers • Frequency comb and its use to measure light frequency • Continuous wave laser stabilization using an optical frequency comb • New techniques in distance measurement 3) Study and use of ultra-fast lasers in the time domain • Techniques to measure the pulse duration • How to produce attosecond pulses • Use of femtosecond lasers and attosecond lasers to study vibrational and electronic degrees of freedom in molecules and solids 4) Latest news in research concerning or using ultra-fast lasers.
Bibliography	Agrawal, “Non-linear fiber optics”, Elsevier. L. Gallmann, U. Keller, “Femtosecond and Attosecond Light Sources and Techniques for Spectroscopy”, Handbook of high-resolution spectroscopy, Wiley online library, 2011. P. Maddaloni, , P. De Natale, M. Bellini,. “ Laser-based measurements for time and frequency domain applications: a handbook”. CRC Press 2016.

Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [60] in Physics	PHYS2M1	5		🔍
Master [120] in Physical Engineering	FYAP2M	5		🔍
Master [120] in Physics	PHYS2M	5		🔍