

## 230565 - ULTRA - Ultrafast and Ultraintense Laser Light

<b>Coordinating unit:</b>	230 - ETSETB Barcelona School of Telecommunications Engineering
<b>Teaching unit:</b>	721 - FEN - Department of Physics and Nuclear Engineering
<b>Academic year:</b>	2015 - 2016
<b>Degree:</b>	Master's Degree in Photonics Erasmus Mundus Master's Degree in Photonics Engineering, Nanophotonics and Biophotonics
<b>ECTS credits:</b> 3	<b>Teaching languages:</b> English

### Academic staff

<b>Coordinator:</b>	<a href="#">Jose Trull</a> (UPC)	<a href="mailto:jose.francisco.trull@upc.edu">jose.francisco.trull@upc.edu</a>
<b>Other professors:</b>	<a href="#">Jens Biegert</a> (ICFO)	<a href="mailto:jens.biegert@icfo.eu">jens.biegert@icfo.eu</a>
	<a href="#">Carles Serrat</a> (UPC)	<a href="mailto:carles.serrat-jurado@upc.edu">carles.serrat-jurado@upc.edu</a>

### Degree competences to which the subject contributes

#### Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
3. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
4. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

### Teaching methodology

#### Lectures

#### Activities:

- Visit to the Attoscience lab at ICFO during the activities week

### Objectives and short description of the course

The course will give an overview on the challenges to produce ultra-short and ultra-intense laser light as well as highlight the different physical effects and possibilities pertaining to their usage. We will highlight state of the art methods and novel possibilities at the frontier of science.

### Study load

Total learning time: 75h	Hours large group:	22.5h	30%
	Hours medium group:	0h	0%
	Hours small group:	0h	0%
	Guided activity:	2.25h	3%
	Self study:	50.25h	67%



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### Course index

#### 1. Ultrashort laser and X-ray pulses (J. Biegert)

- 1.1 Basic concepts for ultrabroadband pulses.
- 1.2 Issues in amplification / OPCPA.
- 1.3 Few-cycle pulse propagation.
- 1.4 Few-cycle pulses / the absolute phase / frequency combs.
- 1.5 High-harmonic generation, X-ray and Attosecond pulse generation.

#### 2. Pulse characterization (J. Trull)

- 2.1 General issues.
- 2.2 Short pulse characterization.
- 2.3 Reconstructions methods.
- 2.4 Spatio-temporal characterization.
- 2.5 Pulse shaping techniques.

#### 3. Coherent control and intense matter interaction (C. Serrat)

- 3.1 Basic concepts.
- 3.2 Coherent control schemes.
- 3.3 Optimal control theory.
- 3.4 Attosecond coherent control.

### Qualification system

Homework + Exam (35% + 35%)

Attending and participation in class (30%)

Homework will be given for the three main sections of the course plus a final exam. Active participation in the class is an important aspect and will influence the final grades significantly.

### Bibliography

- Diels & Rudolph, "Ultrashort Laser Pulse Phenomena", Academic Press
- Eberly & Milonni, "Lasers", John Wiley & Sons
- Trebino, "Frequency-Resolved Optical Gating", Kluwer Academic Publishers