



Education and Culture DG

ERASMUS MUNDUS

euroPHOTONICS

ERASMUS MUNDUS

EuroPhotonics Master

3rd and 4th semester in Barcelona

Crina Cojocaru

Universitat Politècnica de Catalunya

Physics and Nuclear Engineering Department



UNIVERSITAT POLITÈCNICA
DE CATALUNYA

UAB
Universitat Autònoma
de Barcelona

U
UNIVERSITAT DE BARCELONA
B

ICFO
Institut
de Ciències
Fotòniques

EUROPHOTONICS @ BCN

In Barcelona the master courses are shared between

Euromphotonics Master
&
MSc in Photonics



UNIVERSITAT POLITÈCNICA
DE CATALUNYA

UAB
Universitat Autònoma
de Barcelona

U
UNIVERSITAT DE BARCELONA
B

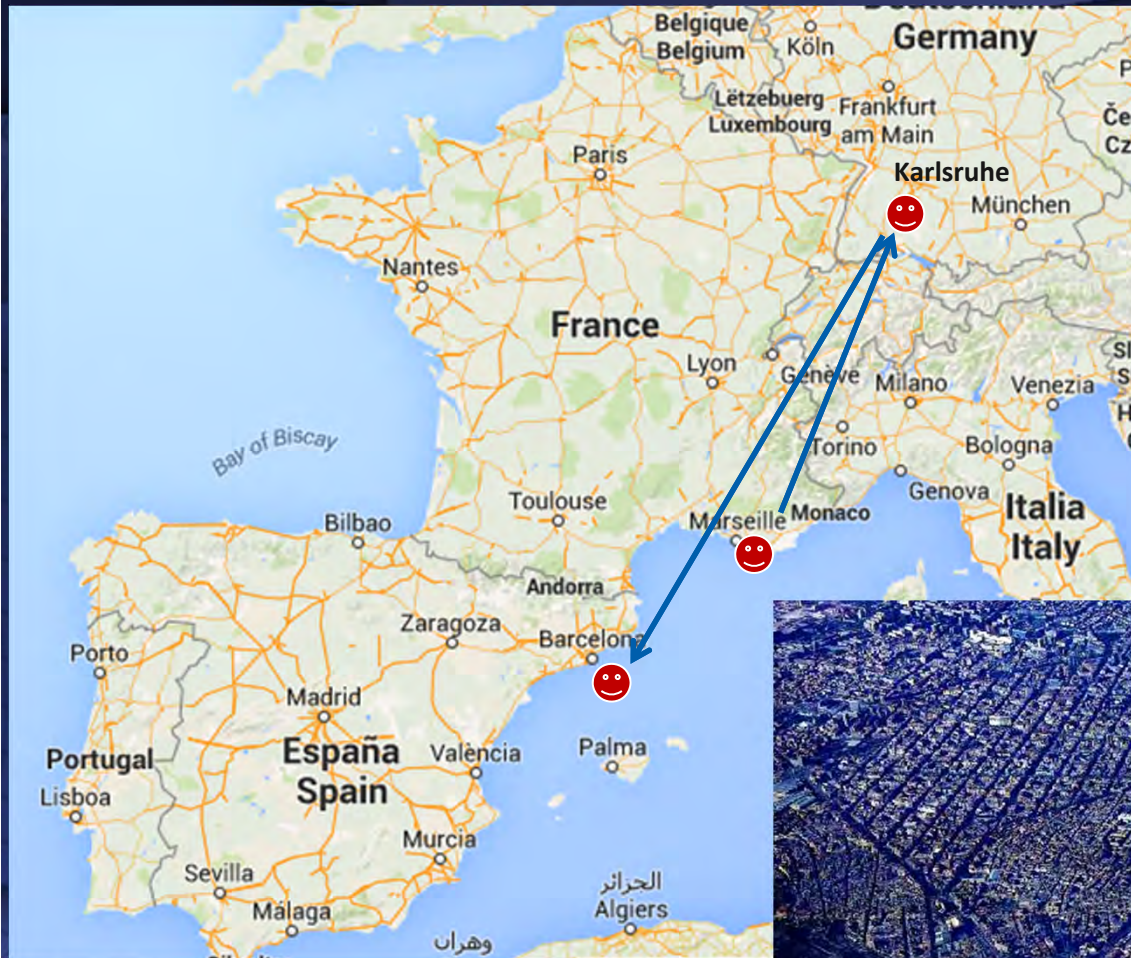
ICFO
Institut
de Ciències
Fotòniques

<http://www.euromphotonics.org/>

<http://www.photonicsbcn.eu/>

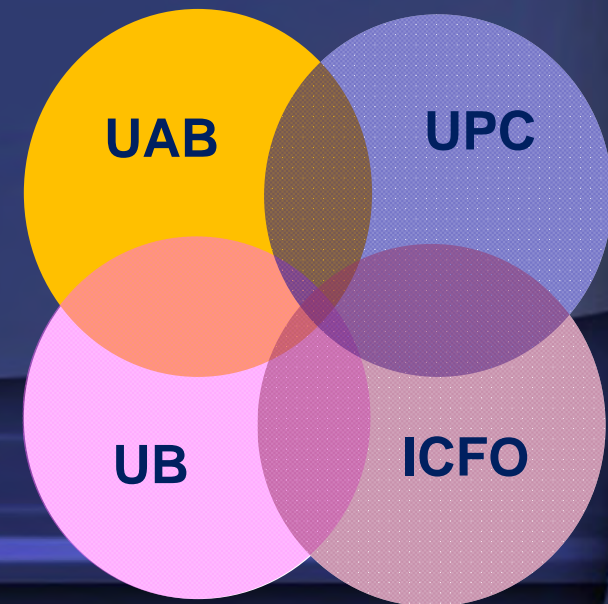
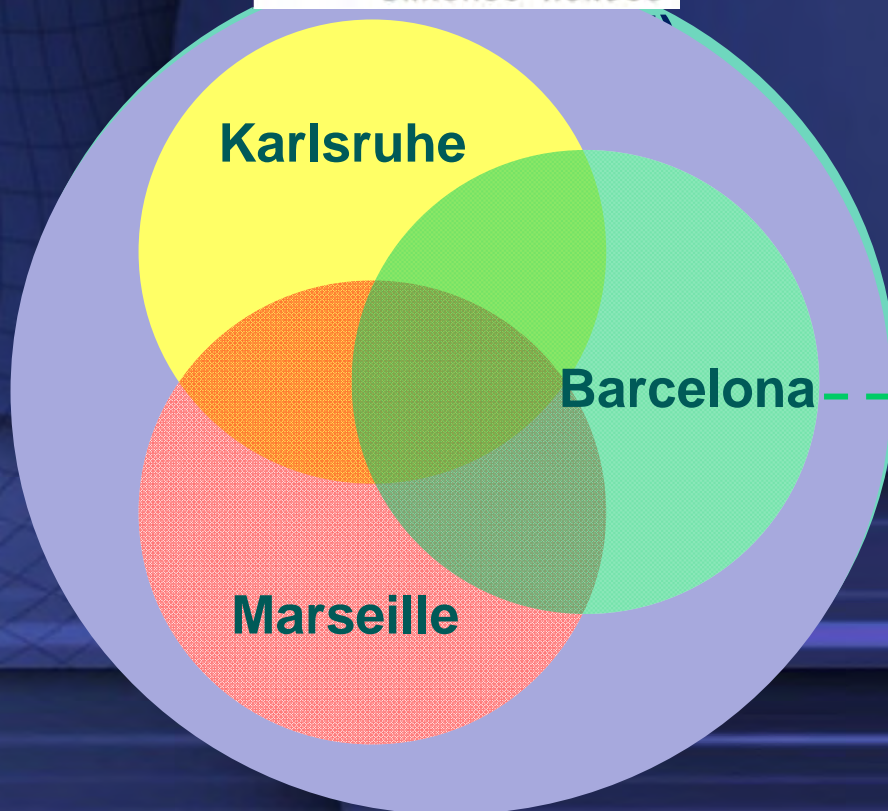
EUROPHOTONICS @ BCN

Barcelona



EUROPHOTONICS @ BCN

4 partner institutions: a larger number of photonic areas are covered



The students remain essentially in a single Campus

OBJECTIVES

- Provide knowledge and training in different areas of Photonics, considering both fundamental and applied aspects.
- Flexibility: the student can choose the most appropriate courses, to get either general (fundamental or broadband) training, or more specialized training, in different possible areas.
- Develop competences and skills that will help the student to initiate either a research or a professional carrier.

EUROPHOTONICS @ BCN



UNIVERSITAT POLITÈCNICA
DE CATALUNYA

UAB
Universitat Autònoma
de Barcelona

U
UNIVERSITAT DE BARCELONA
B

ICFO^R
Institut
de Ciències
Fotòniques

CD6 Center

- Optical engineering: sensors, vision, metrology, opt. design, adaptive optics, color science.
- Image processing, liquid crystal, machine vision.
- Nonlinear optics and dynamics
- Lasers
- Nanomaterials, remote sensing.
- Opt. fiber commun.& networks

- Applied optics: image proc., diffractive optics
- Thin films
- Optical tweezers
- Optoelectronics devices, CMOS
- Quantum information

- Quantum & nonlinear optics, Quantum information
- Image processing, diffractive optics, metrology.
- Synchrotron light, X-ray optics
- Thin films, multilayers.

- Nanophotonics and photonic materials
- Advanced optical imaging
- Quantum & Atom optics
- Nonlinear optics & devices, ultrafast light.
- Biophotonics, opt. tweezers

PROFESSORS

- UPC

Department of Optics & Optometry

Ferran Laguarda

Fidel Vega

Elisabet Pérez

Jaume Pujol

Montserrat Arjona

Maria S. Millán

Josep Arasa

Santi Royo

Jesús Armengol

Department of Physics and Nuclear Engineering

Ramon Vilaseca

Jose Trull

Kestutis Staliunas

Crina Cojocar

Carles Serrat

Cristina Masoller

Department of Signal Theory and Communications

Josep Prat

José A. Lázaro

Carles Puente

David Artigas

C. Santos

Juan Pérez

F. Rocabosch

Department of Electronics Engineering

Ramon Alcubilla

Cristóbal Voz

Joaquim Puigdollers

PROFESSORS

- UAB

Department of Physics, Optics Group

Ramón Corbalán
Francesc Pi

Jordi Mompart
Verónica Ahufinger

Gaspar Orriols
Juan Campos

Department of Physics, Quantum Information Group

R. Muñoz-Tapia
Anna Sanpera

Emili Bagán

John Calsamiglia

- UB

Department of Applied Physics and Optics

Ignasi Juvells
Mario Montes

Santiago Vallmitjana
Estela Martín

Salvador Bosch
Artur Carnicer

Department of Electronics

Mauricio Moreno
Frank Güel

Blas Garrido

Sergi Hernández

Department of Matter Structure & Constituents

Artur Polls

Muntsa Guilleumas

PROFESSORS

- ICFO

Lluís Torner

Niek van Hulst

Jordi Martorell

Jens Biegert

Antonio Acín

Frank Koppens

Pablo Loza

Gonçal Badenes

Morgan Mitchell

Romain Quidant

Juan Perez Torres

Valerio Prune

Hugues Ridematten

Calendar

- 3rd Semester:
 - from **October 12th 2015** to **April 2016**
 - **3 teaching blocks**

- 4th Semester (Master thesis):
 - from **April** to **Sept. 10th 2016**

EUROPHOTONICS @ BCN

3rd semester in Barcelona

Elective courses. List of teaching units

Quantum Optics (QUANTOP)	12 ECTS
---------------------------------	----------------

Biophotonics and Imaging (BIOIMA)	12 ECTS
--	----------------

Materials and Nanophotonics (MATNANO)	12 ECTS
--	----------------

Telecomm. & Photonics Circuits (TELPHO)	12 ECTS
--	----------------

Optical Engineering (OPTENG)	12 ECTS
-------------------------------------	----------------

EUROPHOTONICS @ BCN

Quantum Optics

12 ECTS

Quantum optics	3
Quantum simulators, BE cond. & ultracold quantum gases	3
Quantum information theory: communication and computation	3
Advanced quantum optics with applications	3

Biophotonics and imaging

12 ECTS

Experimental optical techniques in biology	3
Optical micromanipulation workshop	3
Visual biophotonics and multispectral imaging	3
Image processing in biophotonics	3

Materials and nanophotonics

12 ECTS

Photonic materials and metamaterials	3
Nonlinear optics	3
Nanophotonics	3
Ultrafast and ultraintense laser light	3

Telecommunications and Photonic Circuits

12 ECTS

Fibers and telecommunications	3
Integrated photonics	3
Photonics systems in telecommunications	3
Optoelectronics and photovoltaic technology	3

Optical Engineering

12 ECTS

Laser systems and applications	3
Building optomechanical systems	3
Managing light with devices	3
Measuring with light (optical metrology)	3

Additive key competencies

5 ECTS

Business and Patents in Photonics

5

- provide fundamental entrepreneurial skills required to successfully start and develop a technology based business,
- learn how to develop a project in a large company environment.
- incite business awareness and to explore the hard and fascinating way leading from cutting-edge research to the marketplace.

EUROPHOTONICS @ BCN

All the information about:

- **Timetable**
- **Course program**
- **Course content**

<http://www.photonicsbcn.eu/index.php/erasmus-mundus-master-and-phd/67-master-thesis>

■ **“ACTIVITIES” Weeks**

- One *“activities week”* after each teaching block (6 regular teaching weeks): visits to labs or companies, special experiences, presentations,...

■ **SEMINARS and visiting professors**

- A slot of 2 hours/week is devoted to external seminars given by invited scientists.
- Short courses

3rd semester in Barcelona

- **Requirement to get the official Spanish Master Degree Diploma:**
30 ECTS courses followed in Barcelona.
- These courses are shared with the “local” Master in Photonics (see **Timetable**).
- The choice of these 30 ECTS courses among different teaching units is free: there is no minimum nor maximum number of courses or credits to be chosen from each module. The official Spanish Master Degree Diploma does not require definition of any specialty. The list of teaching units and courses are given in the **Course Program**.
- All the details about the objectives, contents and evaluation system of each course are given in the **Course Contents**.

<http://www.photonicsbcn.eu/index.php/erasmus-mundus-master-and-phd/67-master-thesis>

Remark

The choice of courses for the 3rd semester in Barcelona is not completely free: there is a requirement established by KIT (Karlsruhe) that have to be fulfilled in order to get the *KIT Master Degree Diploma*:

- at least **16 ECTS** chosen in Barcelona must be coherent with one of the four «specialities» defined by Karlsruhe:
 - I **Photonic Materials & Devices**
 - II **Advanced Spectroscopy**
 - III **Biomedical Photonics**
 - IV **Optical Systems**
 - V **Solar Energy**
- the student has to cover a total of 6 ECTS of “**Additive key competencies**” along the whole master program (be it in Karlsruhe, Barcelona or Marseille).
- the rest of courses, up to 30 ECTS, can be any of the other courses included in Table 2, even those not associated to any specialty, or the additive key competencies courses

TABLE 1

Course name <i>(Courses offered in Barcelona)</i> <i>(See the contents of each course in the Annex or in the Course Contents document)</i>	Credits ECTS	Module name <i>(only for guidance purpose)</i>					Additive key competencies
		Nano- and bio-photonics	Quantum Optics	Opt. Engineering			
				General	Telecom, remote s.	Imaging	
Nanophotonics	3	✓	✓	✓			
Photonic Materials and Metamaterials	3	✓	✓	✓			
Integrated Photonics	3	✓		✓	✓		
Ultrafast and Ultraintense Laser Light	3	✓	✓	✓	✓		
Optical Micromanipulation workshop	3	✓		✓			
Optical Image in Biology and Medicine	3	✓				✓	
Quantum Optics	5	✓	✓				
Quantum Information theory: Communication and computation	3		✓		✓		
Quantum simulators, Bose Einstein Condensates and Ultracold Quantum Gases	3		✓				
Advanced Quantum Optics with Applications	3	✓	✓				
Building Optomechanical systems	3			✓		✓	
Measuring with Light	3	✓		✓	✓	✓	
Laser Systems and Applications	3	✓		✓	✓		
Optoelectronics and Photovoltaics technology	3	✓		✓	✓		
Fibers & Telecommunications	3			✓	✓		
Photonics systems in Telecommunications	3			✓	✓		
(Beam propagation and Fourier Optics) (*)	(5)	✓		✓	✓	✓	
Visual Biophotonics and Multispectral Imaging	3	✓		✓		✓	
Image Processing in Biophotonics	3	✓		✓		✓	
Business and Patents in Photonics	5						✓
Spanish or Catalan Language (**)	1						✓

(*) This course might not be accessible to Europhotonics students because of time schedule.

(**) Language courses have a special regime. There are free language courses, but for certain language courses payment of some tuition fees might be necessary. Ask about that to the Master organizers.

A one-page description of each course is given in an Annex (see "Course Contents" separate file).

TABLE 2

Course name (offered in Barcelona) (See the contents of each course in the Annex or in the <u>Course Contents</u> document)	Credits ECTS	Relationship with the Master "specialties" defined by Karlsruhe <i>(A minimum of 12 ECTS must be chosen from one of these specialties –see previous page–)</i>					
		I-Photonic Materials & devices	II- Advanc. Spectrosc.	III Biomed. Photonics	IV- Optical Systems	V- Solar Energy (**)	
Nanophotonics	3	✓	✓	✓		(✓)	
Photonic Materials and Metamaterials	3	✓				(✓)	
Integrated Photonics	3	✓			✓	(✓)	
Ultrafast and Ultraintense Laser Light	3		✓				
Optical Micromanipulation workshop	3			✓	✓	(Contact Master's responsible projs.)	
Optical Image in Biology and Medicine	3			✓	✓		
Quantum Optics	3	<i>(No defined speciality)</i>					
Quantum Information theory: Communication and computation	3				✓		
Quantum simulators, Bose Einstein Condensates and Ultracold Quantum Gases	3	<i>(No defined speciality)</i>					
Advanced Quantum Optics with Applications	3		✓				
Building Optomechanical systems	3				✓		
Measuring with Light	3	✓	✓	✓	✓		
Laser Systems and Applications	3		✓	✓	✓		
Optoelectronics and Photovoltaics tech	3	✓					(✓)
Fibers & Telecommunications	3	✓			✓		
Photonics systems in Telecommunications	3		✓		✓		
(Beam propagation and Fourier Optics) (*)	(5)				(✓)		
Visual Biophotonics and Multispectral Imaging	3			✓	✓		
Image Processing in Biophotonics	3			✓	✓		
Business and Patents in Photonics	5	<i>"Additive key competency"</i>					
Spanish or Catalan Language (**)	1	<i>"Additive key competency"</i>					
Total number of credits ECTS	57 (+5)	18	18	21	33 (+5)	(**)	

(*) This course might not be accessible to Europhotonics students because of time schedule.

(**) Language courses are not mandatory and have a special regime. There are free language courses, but for certain language courses payment of some tuition fees might be necessary. Ask about that to the Master organizers. Language courses credits cannot be included within the 30 ECTS credits necessary to get the Spanish official Master Degree Diploma; interested students should take them additionally).

(***) In principle "Solar Energy" specialty requires a mandatory course from Karlsruhe. Thus in this case student should contact Master's responsible professors in Karlsruhe and Barcelona.

4th semester in Barcelona:

MSc Thesis

30 ECTS

- Possibilities to do scientific research work (fundamental or applied), in many different areas of Photonics
- Around 50-60 project proposals every year (see the list at www.photonicsbcn.eu)
- Possibility to do the project in a external research center, university or company

4th semester in Barcelona:

MSc Thesis

30 ECTS

PROPOSAL FOR A MASTER THESIS

2013-2014

Laboratory: "Nonlinear Optics, Nonlinear Dynamics and Lasers" (DONLL) research group
Physics and Nuclear Engineering Department
Polytechnic University of Catalonia

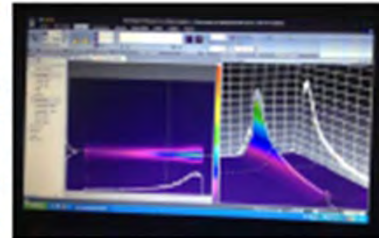
City, Country: Terrassa, Spain

Title of the master thesis: "Ultra short pulse characterization, a new in-situ approach using disordered nonlinear crystals"

Name of the tutor of the master thesis: Jose Trull and Crina Cojocaru
Email address: crina.maria.cojocaru@upc.edu, jose.francisco.trull@upc.edu
Phone number: 93 739 8571
Mail address: GALA building, Rambla Sant Nebridi 22
08222 TERRASSA (BARCELONA)

Summary of the subject:

Materials with a random distribution of the nonlinear quadratic coefficient have been studied recently in relation with the very broad angular and wavelength bandwidth second harmonic generation. These structures, allows the phase-matching (PM) condition, simultaneously, for different nonlinear interactions over the whole transparency range of the crystal. They also allow second harmonic generation in the transverse direction, very useful for applications in autocorrelation devices.



This project is devoted to *the study and measurement of different characteristics (pulse duration, shape, chirp, temporal structure and tilting) of an ultra-short pulse*, using this nonlinear optics method. The final goal is *to build a simple device that can control the chirp and pulse duration and tilt at a desired plane*, using a system which would work for different wavelengths without any tuning or adjusting parameter.

Keywords : nonlinear optics, short pulse measurements, photonic crystals

EUROPHOTONICS @ BCN

- COOPERATION WITH OTHER UNIVERSITIES AND RESEARCH CENTERS in Spain and abroad
- CONTINUE WITH IMPROVING QUALITY ...
- LINKS WITH COMPANIES (*for sponsoring, internships,...*)

HAMAMATSU
Photon is our business

RADIANTIS

SENSOFAR

Ocean
Optics

Mikropack ▶

FOTONICA 21

SECPhO

SECPhO 5 years
2009 2014
Southern European Cluster
in Photonics and Optics

Research & Development

more info

<http://www.secpho.org/en/>

VISA in SPAIN

- You should apply for a student visa in the Spanish Embassy in Germany or France.
- There are two options:
 - short term visa (less than 6 months)
 - long term visa (more than 6 months)
- Check the needed documents at the Embassy
- There is also the possibility to apply for the visa in Spain, once you arrive there (keep it only as second option!). In this case you have to have a valid visa in Germany/France when you arrive to Barcelona.
- **OMI (International Students Office in Barcelona (Ms. Eulalia Miñarro <Maria.Eulalia.Minarro@upc.edu>)**

Campus Nord, Building BIB (Library)
C. Jordi Girona, 1-3, 08034 Barcelona
Tel. 93 401 69 37

E-mail: oficina.mobilitat.internacional@upc.edu
<http://www.upc.edu/sri/students/qui-som>

OIRI (Information and International Relations Office in the Campus of Terrassa
<http://www.upc.edu/sri/students/qui-som>)

International student nationality	Arrival	Visa	Procedures to do at your arrival
EU students: Citizens of European Union countries (and Switzerland)	(do not need a visa to enter in Spain)	without a visa	Census registrar - European Union citizens register (It is an easy procedure, please contact the International Students Office (OMI-OIRI) at your arrival)
Non-EU students: Citizens of non European Union Countries (nationality from states that are not members of the European Union) International student nationality	If they come from their country (outside of the European Union)	Short term student visa (stay for studies of less than 6 months)	No procedure to do
	With a student visa (obtained in the Consulate of Spain of their origin country)	Long term student visa (stay for studies longer than 6 months)	Census registrar - Procedure to obtain the stay for studies (TIE) card (please contact OMI-OIRI at your arrival)
International student nationality	They come from another European Union country after a stay for studies there.	Short term student visa (stay for studies of less than 6 months)	No procedures to do
	With a student visa (obtained in the Consulate of Spain of the European Union country where they were previously)	Long term student visa (stay for studies longer than 6 months)	Census registrar - Procedure to obtain the stay for studies (TIE) card (please contact OMI-OIRI at your arrival)
International student nationality	They come from another European Union country after a stay for studies there.	Student permit until 6 months for mobility inside the European Union	Procedure to obtain the Student Permit for Mobility inside the European Union (please contact OMI-OIRI at your arrival)
	Without a student visa (mobility inside EU- not recommended)	Long term student permit for mobility inside the European Union	Procedure to obtain the stay for studies (TIE) card (please contact OMI-OIRI at your arrival)

EUROPHOTONICS @ BCN

Accommodation in Barcelona

- Usually, students live in rented apartments (or in rented rooms):



<http://www.bcn-housing-students.com/>

<http://www.couchsurfing.org/>

http://www.loquo.com/es_es

<http://11870.com/pro/pis-3>

- **Student residences** (not too many):

www.resa.es (in particular: Residence “Torre Girona”, in Campus Nord of UPC)

<http://www.agorabcn.com/>

Contacts

- Crina Cojocaru (UPC): crina.maria.cojocaru@upc.edu
- Jordi Mompart (UAB): jordi.mompart@uab.cat
- David Artigas (ICFO): david.artigas@icfo.es
- Salvador Bosch (UB): sbosch@ub.edu
- Ramon Vilaseca (director , UPC): ramon.vilaseca@upc.edu

Administration:

- Alba Rubies (secretary): alba.rubies@upc.edu
- Eulalia Miñarro (international office, UPC): maria.eulalia.minarro@upc.edu

Web pages of most of the research groups or research centers related with the Europhotonics Master in Barcelona

- Institute of Photonic Sciences, ICFO
<http://www.icfo.es>
- Centre for Sensors, Instrumentation and Systems Development, CD6 (UPC)
<http://www.cd6.upc.edu>
- Remote sensing research group, RSLAB (UPC):
<http://www.tsc.upc.edu/rs/>
- Free-space optical communications (UPC):
<http://www.tsc.upc.edu/fsoc/>.
- Applied Optics and Image Processing research group, GOAPI (UPC)
<http://www.goapi.upc.edu>
- Optical Communications Group, GCO (UPC)
<http://www.tsc.upc.es/gco>
- Group on Nonlinear Dynamics, Nonlinear Optics and Lasers, DONLL (UPC)
<http://donll.upc.edu/>
- Micro and nano.technologies research group, MNT
<http://webmnt.upc.es>
- Optics Group (UAB)
<http://optica.uab.es>
- Physical Optics reseach group (UB)
<http://www.ub.edu/optics/>

EUROPHOTONICS @ BCN

About Barcelona



EUROPHOTONICS @ BCN

About Barcelona



That's all!

... and we are ready to answer any possible question!