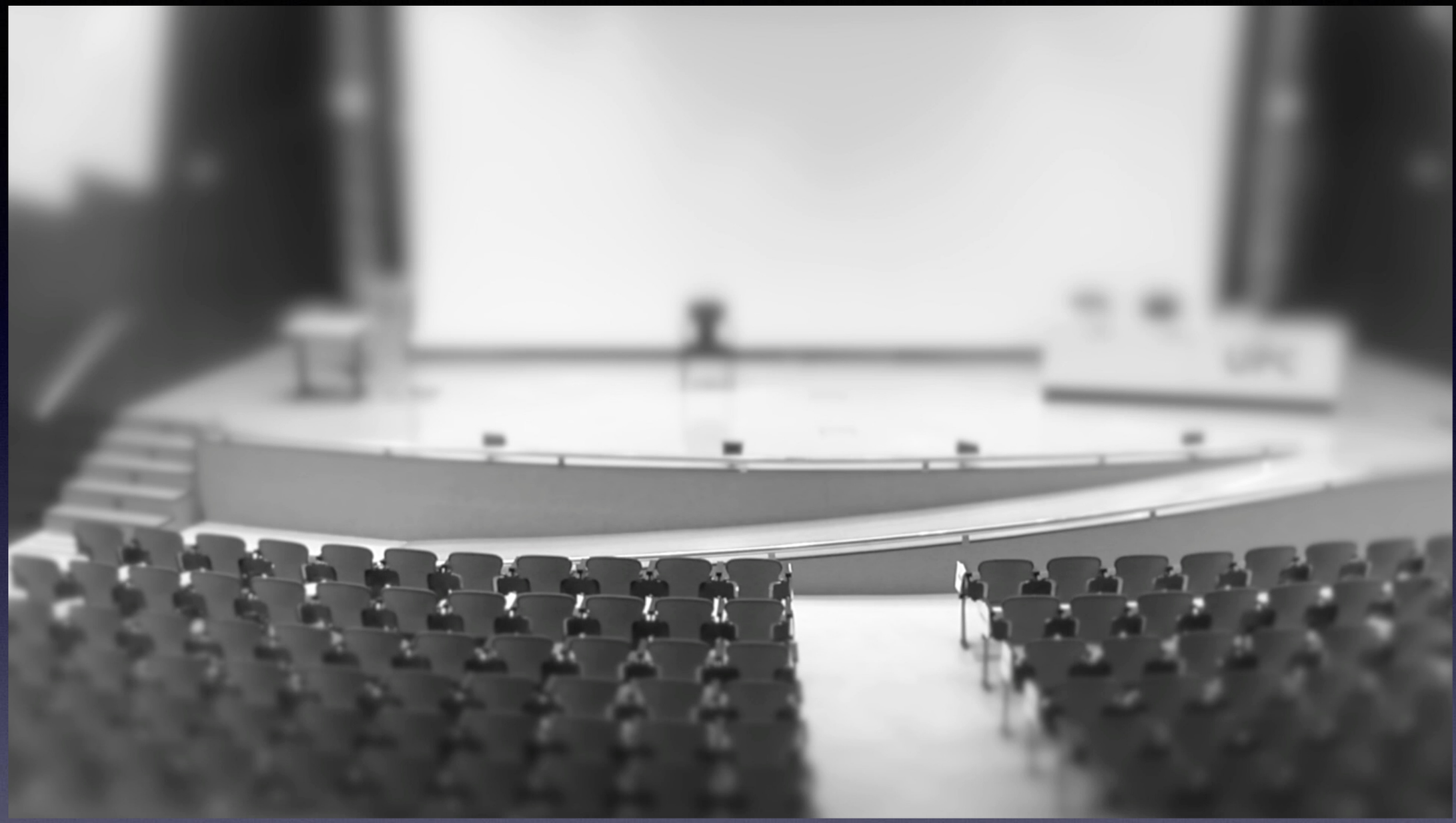
Master's Degree in ENGINEERING PHYSICS



Academic coordinator: Jordi.Marti@upc.edu

ETSETB-Barcelona School of Telecommunications Engineering

&

Department of Physics

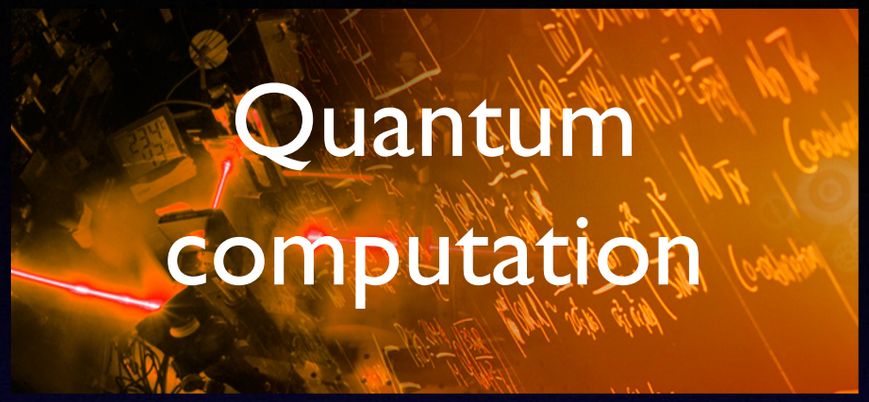
telecos BCN

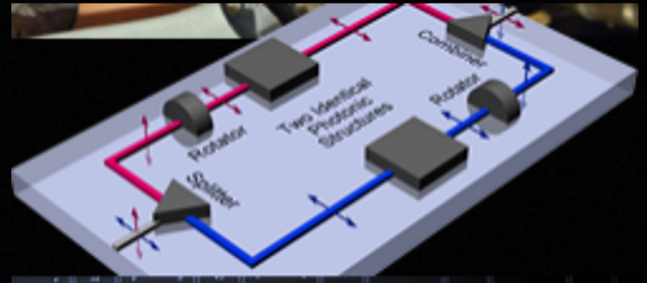
Physics for engineering in the 21st century

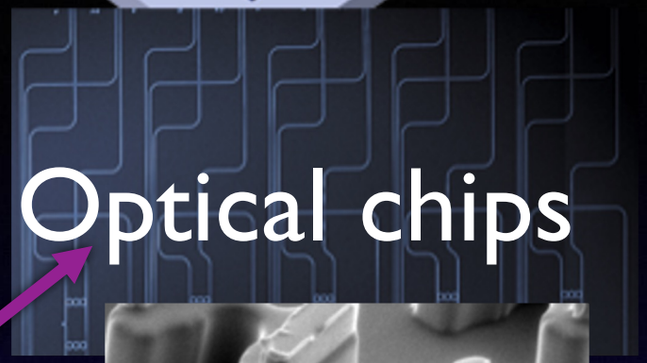
50 ANYS UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH sense limits

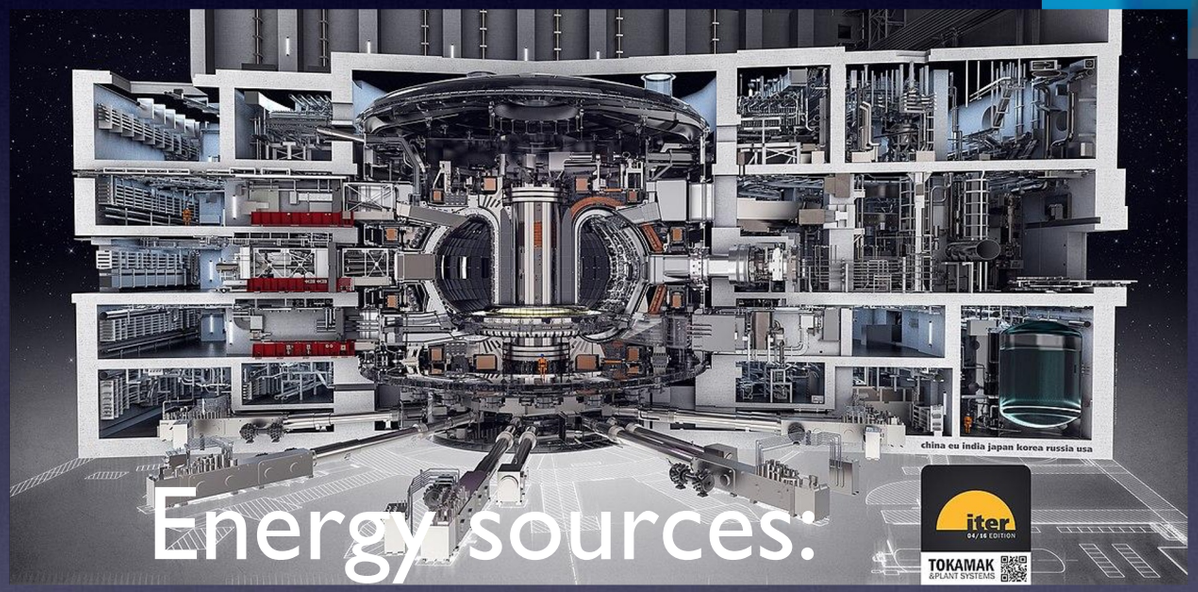
Motivation

What is Engineering Physics?



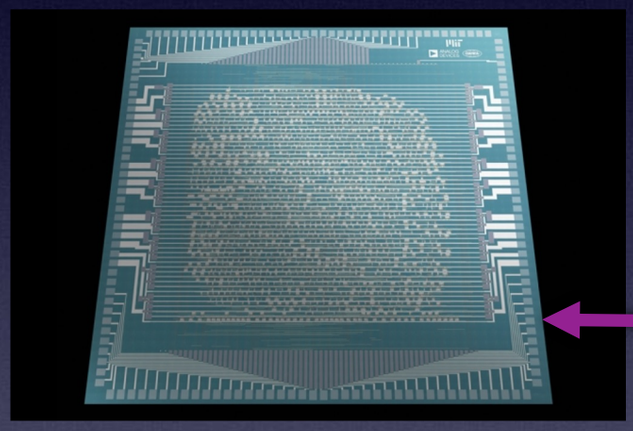




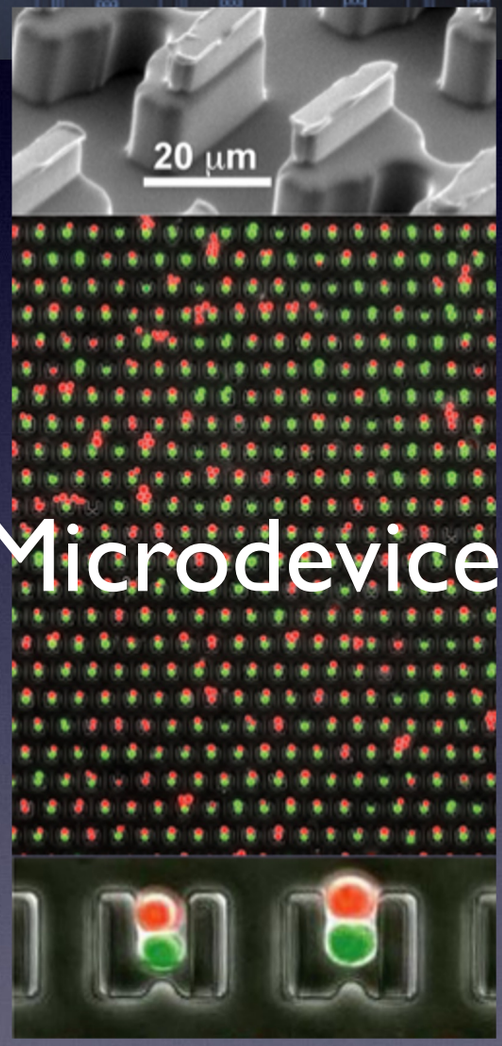


Energy sources:

fusion and green energies



Microdevices



Biomedical engineering:

Physical Chemistry of Drugs

➡ Master Erasmus Mundus BIOPHAM

Motivation*

1. Education in Engineering Physics (EP) in UPC: our studies are the natural continuation from Bachelor (BEP, started 2011) to Master (MEP, started 2019), highly recommendable to complete bachelor studies

2. During the first two years, success in MEP > 90%

3. After MEP, good option to continue an academic career through several PhD programs:

Computational and Applied Physics, Photonics,
Nuclear and Ionizing Radiation Engineering,
Applied Mathematics…

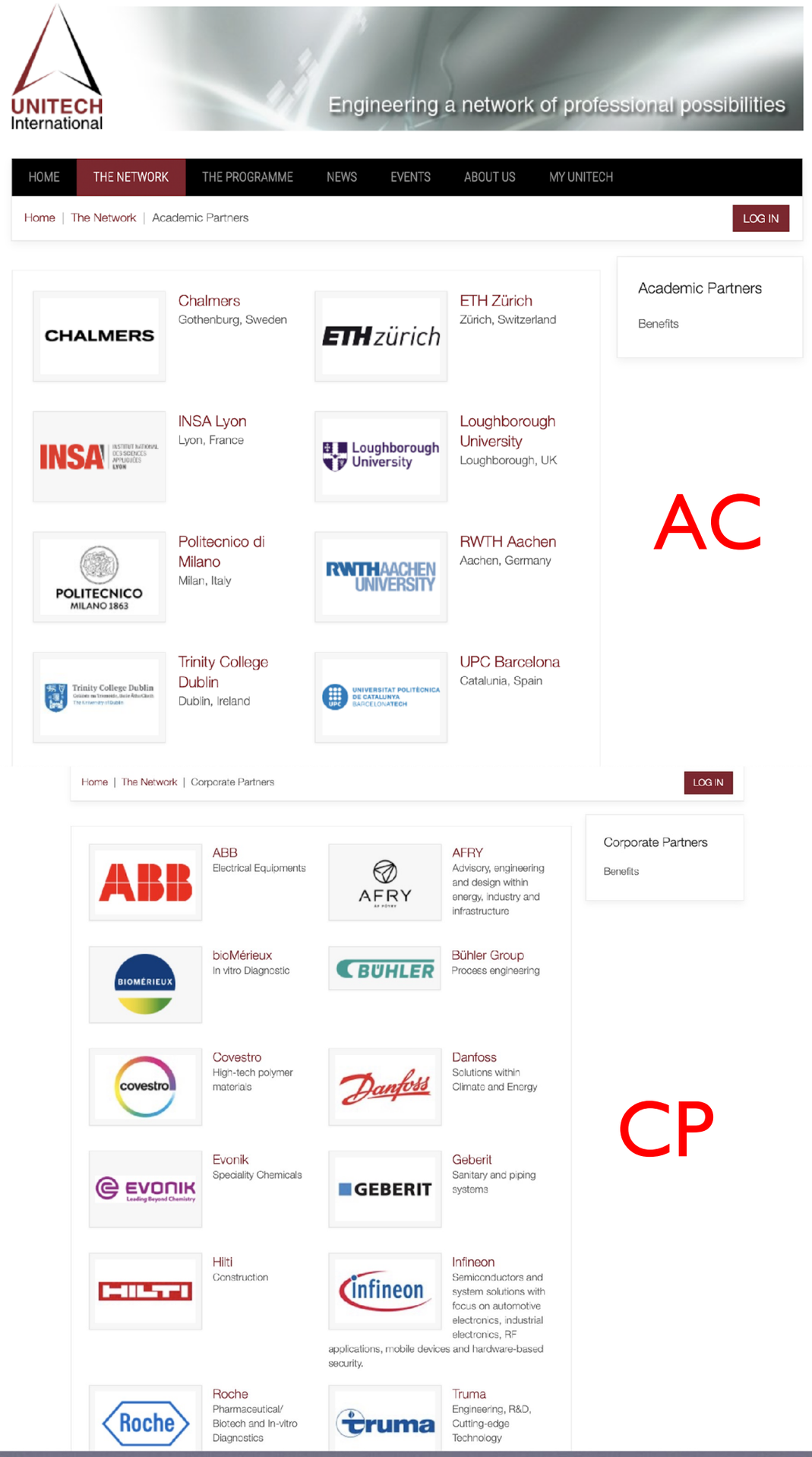
*Note: With a master, you can earn +20000€/year compared to having only a bachelor

4. Other options after Master: working at industry, laboratories, large facilities, mobility…

5. Agreements of MEP with a large list of important companies https://telecos.upc.edu/ca/empreses/convenis-de-cooperacio-educativa/empreses-amb-convenis (more than 300 contacts) and laboratories (ALBA Syncrothon, Hospital Universitari Dexeus, Radiofísica Hospitalaria, Barcelona Supercomputing Center, ICFO…)

6. Full staff from Department of Physics and Departments of Engineering at UPC are collaborating in EP education ➡ high profile professors very active in research: they offer PhD positions.

7. Agreements with ALBA, UNITECH program (internships, contracts): https://www.upc.edu/sri/en/students/students-mobility-office/unitech/unitech-outgoing/what-is



AC

CP

Selective process

Academic exchange in AC

Internship in CP after academic exchange

Option of taking modules

Option of getting a job

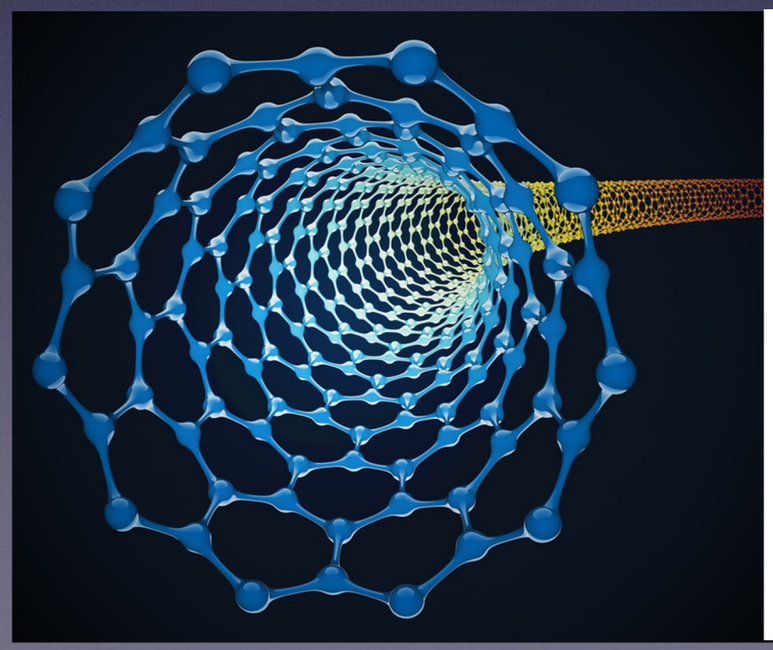
References

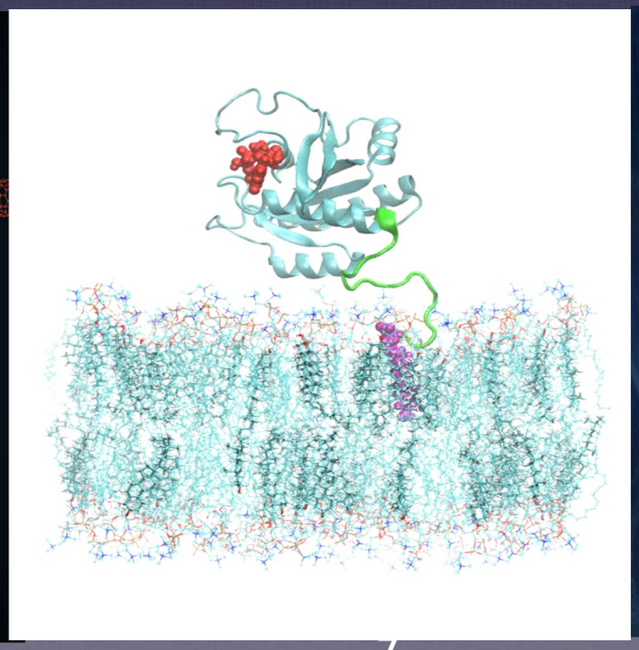
1. Master of Engineering in Engineering Physics, Cornell University, USA.
2. Master in Engineering Physics, Polytechnique Montréal, Quebec, Canada.
3. Master in Engineering Physics, Politecnico de Milano, Italy.
4. Master's programme in Engineering Physics, KTH, Sweden.
5. Master's Programme in Engineering Physics, Aalto University, Finland
6. Master in Applied and Engineering Physics, Technical University of Munich, Germany
7. Master of Science in Engineering Physics, Ghent University, Belgium
8. etc...in Spain ours is the only existing one

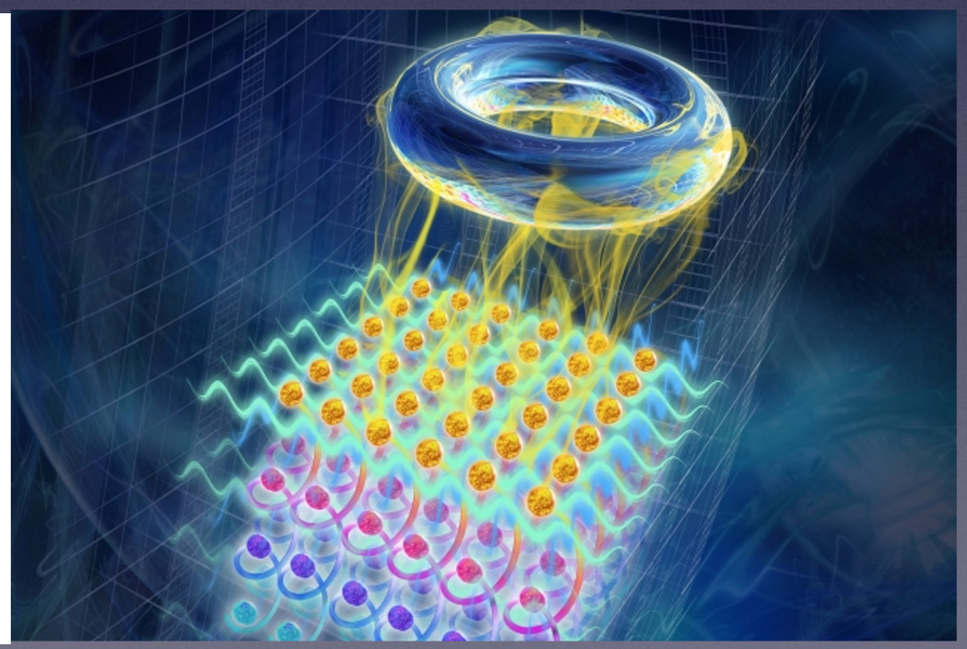
Objectives

1. Offer an innovative Master program with a proper combination of Advanced Physics (experimental and computational) and cutting-edge Engineering (new technologies).

2. Connected with active research groups in the UPC in a rich variety of topics: nanomaterials, quantum optics, instrumentation, molecular and complex fluids, Biophysics, quantum matter, Physics of nuclear power plants. . .







Objectives

3. Connected with the ETSETB network for cooperation with the private and public technological sector.

Twitter of MEF: https://twitter.com/efmasterupc?lang=ca

Instagram: master_engineering_physics_upc

Webs

engineeringphysics.masters.upc.edu

telecos.upc.edu/ca/estudis/masters/masters-degree-in-engineering-physics

Academic Organization

1. Hosted and managed by the ETSETB, Campus Nord, Barcelona.

2. Academic direction by a Coordinator/Head of studies, assisted by an Academic Commitee (Physics department + Telecommunications School)

3. Each student has a tutor, helping in enrollment, advice on elective topics, etc.

4. All classrooms in Campus Nord, UPC. Labs in the same campus, in Terrassa campus and in the Alba Synchroton.

5. Master Thesis (MT) in research groups of UPC and other Research Institutions or technological companies local and abroad. Three annual grants (1 k€ after tax, each) offered by Physics Department (PD) to develop MT within research groups in PD

Program

1. The Master extent is of 60 ECTS corresponding to two semesters.

2. The Program is organized in three modules:

A. Compulsory courses: 23 ECTS

A. Elective courses: 20 ECTS

A. Master thesis: 17 ECTS

Program

A. Compulsory courses: 5 subjects

1. Critical phenomena and complexity (5 ECTS):

Dynamical systems: bifurcation, chaos, pattern formation,…

Stochastic Processes: Markov, first passage and relaxation times,…

Non-equilibrium critical phenomena: percolation, absorbing-state phase transitions,…

Complex networks: large-scale structure, dynamical processes, network models,…

2. Quantum matter (5 ECTS):

Perturbation Theory and Variational Methods: Time independent perturbation theory, time dependent perturbation theory, Fermi's golden rule, variational methods,…

Scattering theory in quantum mechanics: Cross sections, Lipmann-Schwinger equation, T-matrix and Bohr approximation,…

The many-body problem in quantum mechanics: Bose and Fermi statistics, second quantization, creation and anihilation operators, Hartree-Fock approximation, Gross-Pitaevskii equation and Bogoliubov approximation transitions,…

Magnetic systems: Ferromagnetic states of matter, magnons, superconductivity and Cooper pairs,…

Physics of lattice systems: Quantum systems on discrete lattices, Fermi and Bose Hubbard models,…

3. Surface engineering and microdevices (5 ECTS):

Physical Chemistry of surfaces: characterization of solid surfaces, solid-liquid and solid-gas interfaces, characterization techniques (electron microscopy, scanning tunneling, spectroscopy), applications in sensors and catalysis, functionalization of nano- and microreactors…

Micromechanics and microfluidics: biosensor structure, fabrication technologies (lithography, etching, micromachining), design and simulation…

Micro-devices applied to communication circuits: planar circuits and transmission lines, amplifiers, band-pass filters,…

4. Large facilities: synchrotron and neutron sources (5 ECTS):

Basics of particle accelerators: types of accelerators, methods, magnetic systems, diagnostics, beam characteristics,…

Generation of electromagnetic radiation: Bremsstrahlung, synchrotron radiation (SR), beamlines and experiments: Alba SR facility,…

Ion accelerators and spallation sources: CERN accelerators, LHC, Mainz Microtron, neutron sources, Isis, European Spallation Source, Barcelona Synchrotron Park (ALBA): work *in situ*,…

Basics of X-ray and neutron scattering: beamlines, inelastic neutron scattering, diffraction at synchrotron sources,…

X-ray absorption fine structure (XAFS) and Hard X-Ray Synchrotron Imaging Techniques

5. Project management (3 ECTS):

Project planning: management of: scope, time, quality, people, communication, risk,…

Project implementation and monitoring: project preparation and closure, with individual and group case studies,…

Software for project management: available computational tools and resources.

"Students will learn to design, manage and monitor international technology and engineering projects"

Program

B. Elective courses (MEP own offer): 5 subjects of 4 ECTS each among:

1. Physics of materials (1st. Semester)
2. Machine learning with neural networks (2nd. Semester)
3. Numerical methods for continuum systems (1st. S.)
4. Computational astrophysics (1st. S.)
5. Atomic and molecular Physics (1st. S.)
6. Complexity in biological systems (2nd. S.)
7. Molecular and soft condensed matter (2nd. S.)
8. Stochastic methods for optimization and simulation (2nd. S.)

Program

B. Elective courses (MEP + Erasmus Mundus BIOPHAM)
https://www.master-biopham.eu

2 additional subjects of 4 ECTS (april-may, limited enrolment):

1. Materials Science of Drugs (2nd. S.)
2. Biophysical and Materials Science Characterisation (2nd. S.)

Program

B. Elective courses: in addition to our offer our students can choose up to a maximum of 12 ECTS in other UPC Masters of 4 ECTS each among:

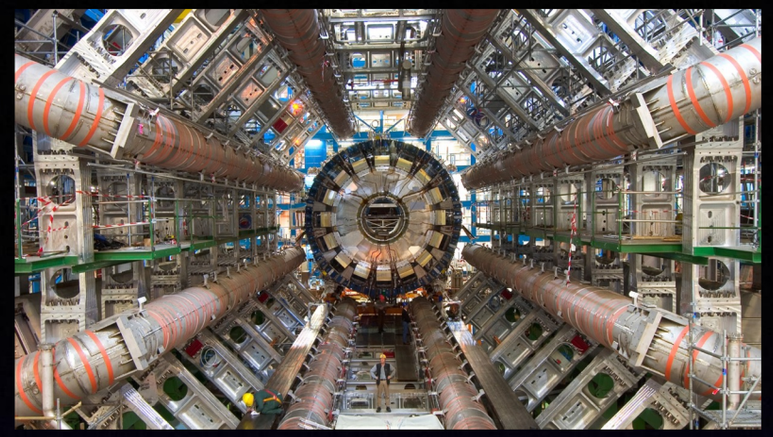
1. Fundamentals of Nuclear Engineering and radiologic protection (Master in nuclear engineering)
2. Energy technology (Master in chemical engineering)
3. Renewable energy technology (Master in energy engineering)
4. Quantum optics (Master of photonics)
5. Laser Applications in Remote Sensing (Master of photonics)
6. Introduction to computer vision (Master's degree in Telecommunications Engineering)
7. Data mining (Master in big data management and analytics)
8. Biomaterials (Master in materials science and engineering)

Tracks (itineraries):

We suggest the students to follow one of the following tracks:

1. Engineering: enrolling elective topics such as *Physics of Materials*, *Fundamentals of Nuclear Engineering and Radiologic Protection* (Master in nuclear engineering), *Energy Technology* (Master in chemical engineering) or *Renewable Energy Technology* (Master in energy engineering)
2. Biosystems and soft matter: enrolling elective topics such as *Complexity in Biological Systems, Molecular and Soft Condensed Matter, Materials Science of Drugs, Biophysical and Materials Science Characterisation*
3. Computational and Simulation: enrolling elective topics such as *Machine Learning with Neural Networks, Numerical Methods for Continuum Systems, Computational Astrophysics, Stochastic Methods for Optimization and Simulation*

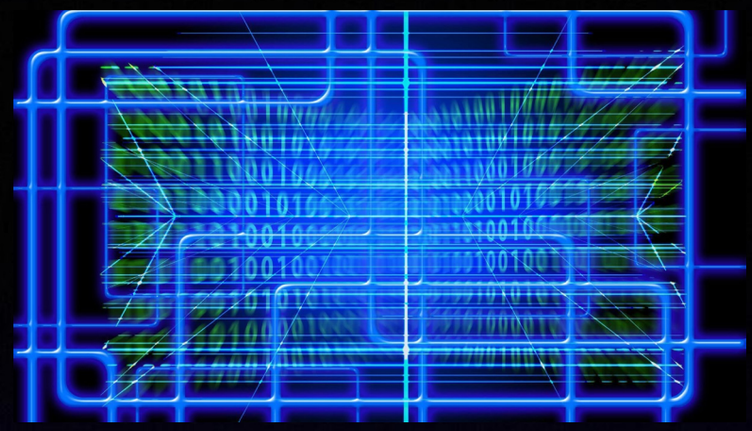
Program



C. Master thesis: 17 ECTS

1. Experimental/Engineering/Theoretical work supervised by Professors of the Master.
2. Open to be done in other UPC centers or abroad under the supervision of a co-director of the Academic Staff of the Master.
3. This semester, three awards of 1 k€ are given to the best students of the master in order to help their Ms.Thesis studies.
4. List: https://intranet.etsetb.upc.edu/serveis/pdi/docencia/ofertes_pfc/totes_ofertes.html
5. This academic year, we have had contacts for M.Thesis + PhD grants (from IRB, ICFO, foreign…)

Schedule



New academic course will start by mid-September 2022

Modality: Face-to-Face, timeline: mornings (monday to friday).

1. Pre-Enrollment open until july

https://www.upc.edu/en/masters/access-and-admission/pre-enrolment

2. But late pre-enrollment (if capacity of 30 not yet fulfilled) and full enrollment process during first half of september is also allowed.

Master's Degree in ENGINEERING PHYSICS

Emails: capestudis.mastereefisica@etsteb.upc.edu
masters.etsetb@upc.edu

Compulsory courses: 23 ECTS

Critical phenomena and complexity

Quantum Matter

Surface engineering and microdevices

Large facilities: synchrotron and neutron sources

Project management

Elective courses: 20 ECTS

Molecular and soft condensed matter,
Atomic and molecular physics,
Physics of materials,
Complexity in biological systems,
Machine learning with neural networks,
Numerical methods for continuum systems,
Stochastic methods for optimization and simulation,
Computational astrophysics,
Biophysical & material science characterization,
Materials science of drugs, etc.

Enroll!