UGA Graduate School
"Quantum" thematic program

Web site: https://master-nanosciences.univ-grenoble-alpes.fr/academic-program/
then select « Graduate School » and « thematic programs »…

Contact: david.ferrand@neel.cnrs.fr

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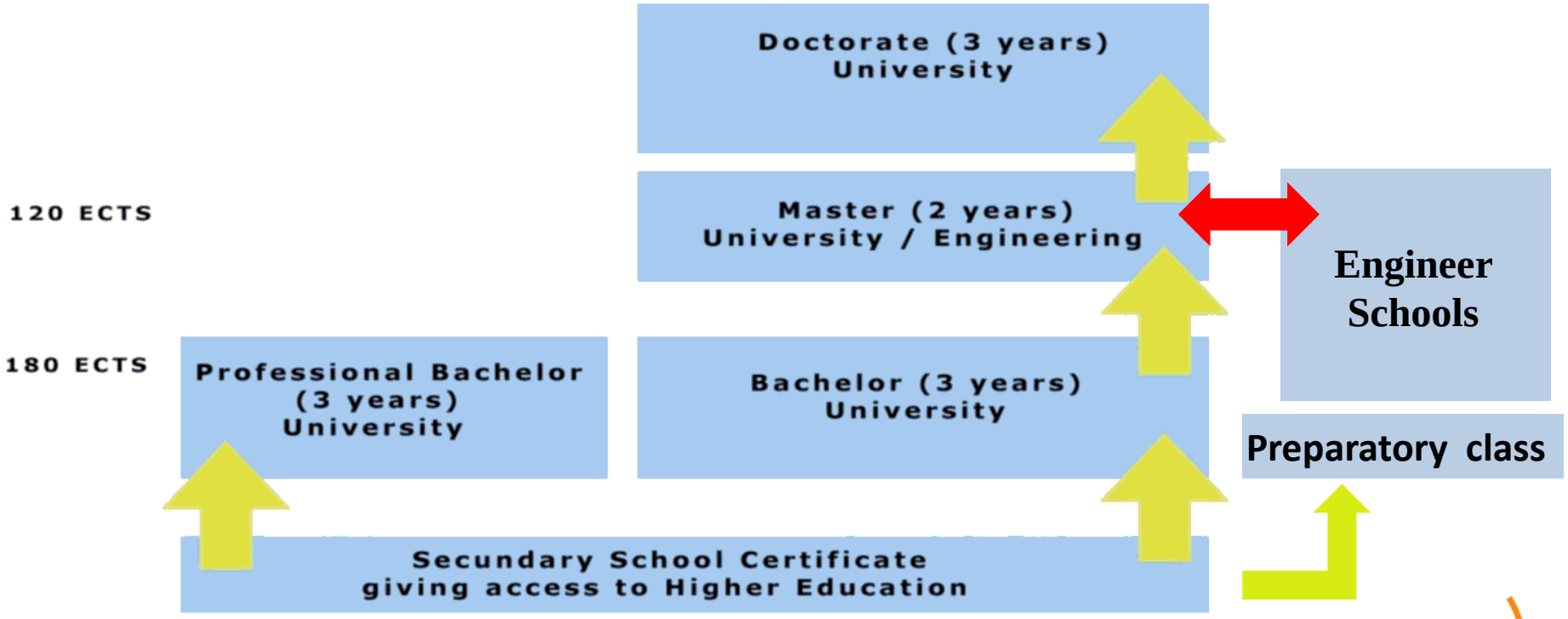
Outline

1. Context: novelty in the teaching offer at UGA for 2021-2026
2. UGA Graduate School: « Quantum » thematic program
3. Possibilities to strenghen student exchanges between Grenoble and Barcelona

1. Context: French academic system



- Two **components of a single University (UGA)**:

UFR Phitem: Physics, Engineering, Earth, Environnement, Mechanics
https://phitem.univ-grenoble-alpes.fr/

(Science faculty)

Phelma: School of engineering in Physics, Applied Physics, Electronics & Materials Science
http://phelma.grenoble-inp.fr/en

(Engineering faculty)

1. Novelty in the teaching offer for 2021-2026

- New teaching accreditation for the whole University for 2021-2026

- @**Phitem**: see web site (still under construction, partly in French): https://phitem.univ-grenoble-alpes.fr/formation/

- **Master programs** @Phitem in « Physics » & « Nanoscience-nanotechnologies » (N2):
  - Physics (**french**): Astrophysics, Particle physics, Quantum matter,… https://master-physique.univ-grenoble-alpes.fr/
  - N2 (**international**): Quantum information-quantum engineering, nanophysics, Soft matter, material engineering, bionanotechnology, nanomedecine,… https://master-nanosciences.univ-grenoble-alpes.fr/home/

- **Graduate School of UGA**: 9 years program to develop international exchanges at Master level and links between different Master /engineer tracks of UGA.

NEW

- 15 thematic programs selected: one fully dedicated to « **Quantum** »

NEW

See: https://master-nanosciences.univ-grenoble-alpes.fr/graduate-school-and-research/graduate-school-program-quantum/graduate-school-program-quantum-801863.kjsp?RH=3972980646879902

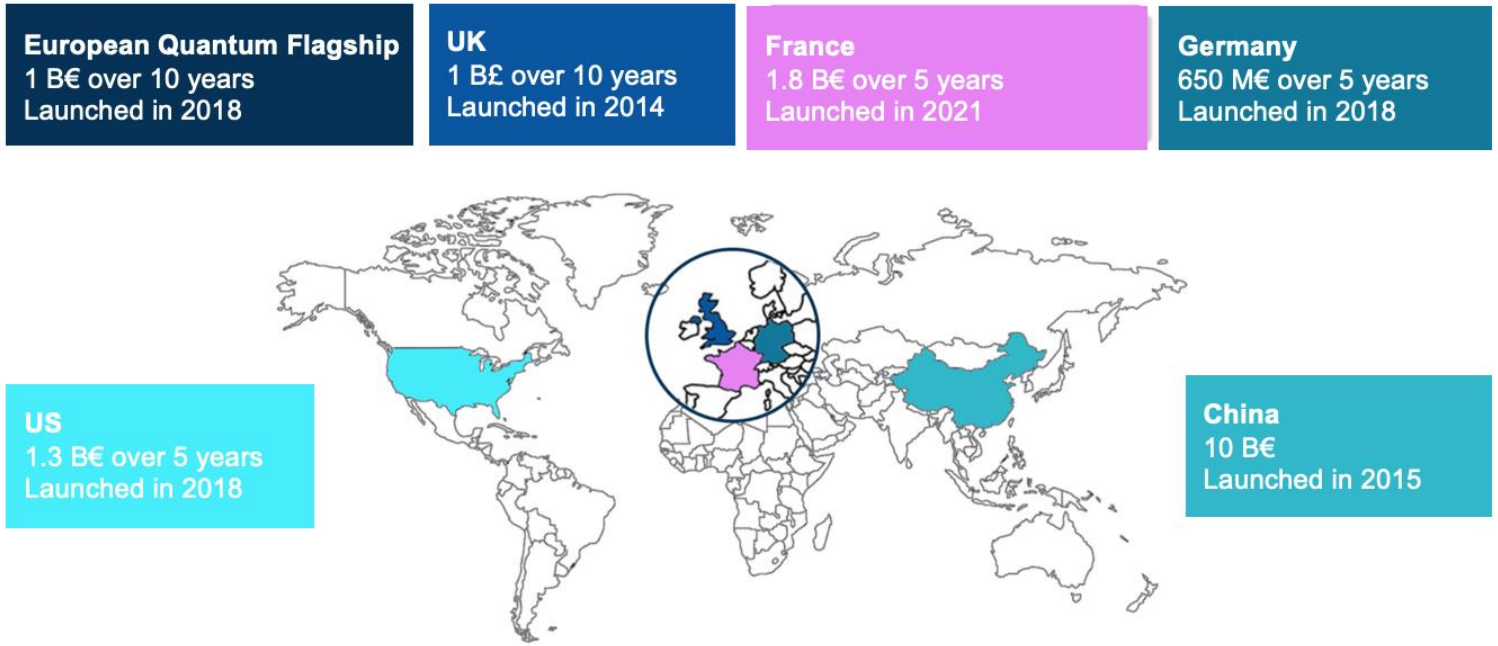
(other thematic programs will open, for instance on Soft matter, see link above)

1. Context : Why a thematic program Quantum in Grenoble ?

January 21th 2021 : the French President announced the launch of the **national quantum strategy**, which includes:

- New resources for researchers, **including training**, but also for start-ups and manufacturers;
- The development of quantum computing and technologies;
- Investments in all technologies around quantum: communications, sensors, cryptography.

A huge investment : 1.8 B€ over 5 years.



Source **CNRS** : https://www.cnrs.fr/fr/cnrsinfo/la-recherche-francaise-au-coeur-du-plan-quantique

1. Context : Why a thematic program Quantum in Grenoble ?

Creation of an **interdisciplinary Center for Quantum Science and Technologies**

Research

Perimeter :

Physics, Informatic, Mathematics, Philosophy, Sociology

Possible research netwoks :

Quantum Engineering, Quantum information and Software, Humanities and Social Sciences for Quantum, Quantum Materials, Energy and Enabling Technologies.

Companies

Formation

(to appear during academic year 2021-2022)

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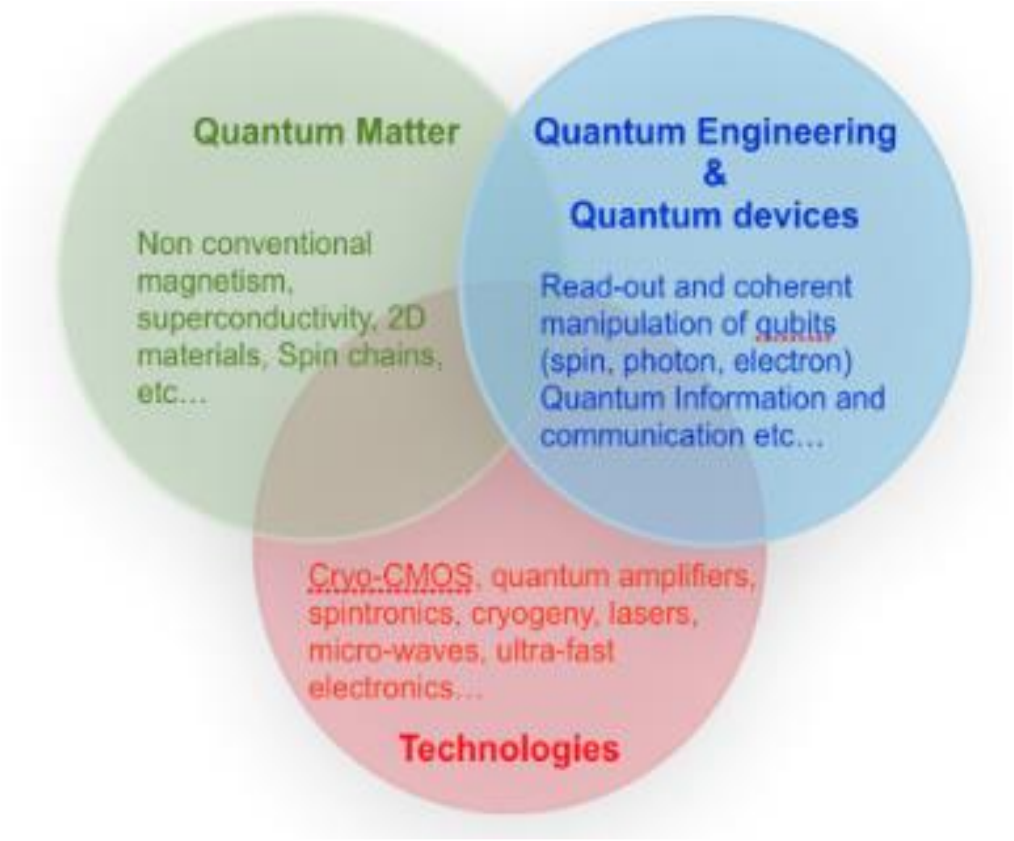
2. UGA Graduate School: « Quantum » thematic program

2. UGA Graduate School : Quantum thematic program for Master students

- New training offer at Master level, topics covered:



See: https://master-nanosciences.univ-grenoble-alpes.fr/graduate-school-and-research/graduate-school-program-quantum/graduate-school-program-quantum-801863.kjsp?RH=3972980646879902

2. Quantum thematic program description

- Association of Master programs and engineer tracks of UGA:

  "Nanophysics-quantum physics" Master 1 (**first year**) NEW
  « Photonics and micro-electronics engineer track, Phelma engineer school 2A (**first year**)

  "Quantum Information-Quantum Engineering" Master 2 (**second year**) NEW
  "Nanophysics" Master 2 (**second year**)
  "Photonics and semiconductors" Master 2 (**second year**)

- Program action summary:
  - Offers specific high-level trainings on quantum properties of matter and light **shared by all tracks: Start in September 2021**
  - Offers mobility grants at Master level for **2 years** for international students: **First call in Spring 2022** NEW
  - Transverse actions with mathematics, informatics, electronics, philosophy, humanities,…
  - Links with predoctoral european schools like ESONN, frontiers of condensed matter,…

https://master-nanosciences.univ-grenoble-alpes.fr/graduate-school-and-research/graduate-school-program-quantum/graduate-school-program-quantum-801863.kjsp?RH=3972980646879902

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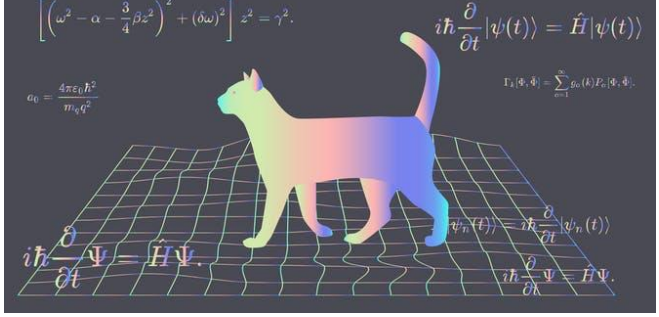
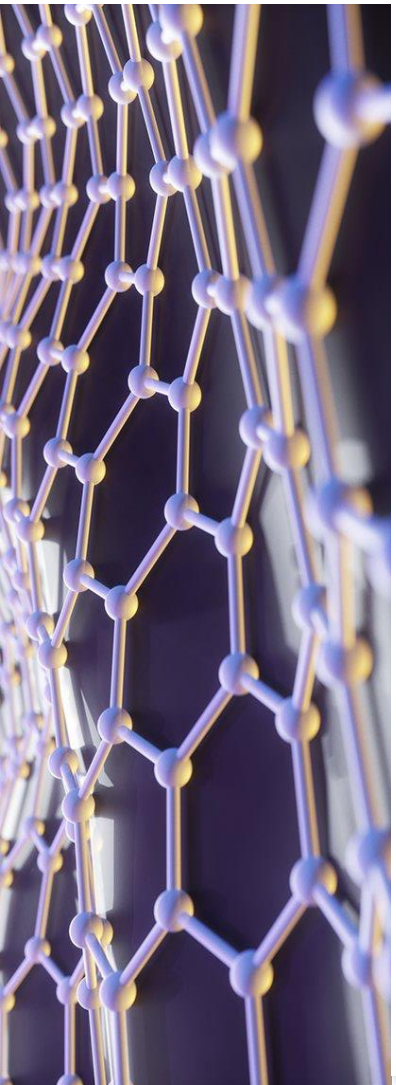
MASTER NANOSCIENCES, NANOTECHNOLOGIES



M1 NanoPhysics-Quantum Physics

https://master-nanosciences.univ-grenoble-alpes.fr/academic-program/nanophysics/m1-nanophysics-quantum-physics/



Semester 7 (30 ECTS)

Professional insertion or foreign language(3 ECTS)
Quantum physics I (3 ECTS)
Solid state physics I (3 ECTS)
Semiconductors physics (6 ECTS)
Optics (6 ECTS)
Magnetism and nanosciences (3 ECTS)

Statistical physics (3 ECTS)
Mechanics at the micro & nano-scale (3 ECTS)
Surface and interface (3 ECTS)
Image and signal processing (3 ECTS)
Electrochemistry (3 ECTS)

} Elective courses (2 choices)

Semester 8 (24 ECTS + 6 ECTS Research internship)

Nanosciences I (3 ECTS)
Quantum Labworks (3 ECTS)
Quantum statistics and interactions (3 ECTS)
Solid state physics II (3 ECTS)
Nanophysics with local probes (3 ECTS)
Modeling and numerical simulations (3 ECTS)

Physics of 2D materials (3 ECTS)
Molecular electronics and magnetism (3 ECTS)
Molecular Physics (3 ECTS)
Interaction Ray-Matter (3 ECTS)
Thin Films (3 ECTS)

} Elective courses (2 choices)

Motivation :

Offering a solid background in nanophysics and quantum physics for students willing to pursue in these thematics in M2

Taught in english

Contact: nedjma.bendiab@univ-grenoble-alpes.fr

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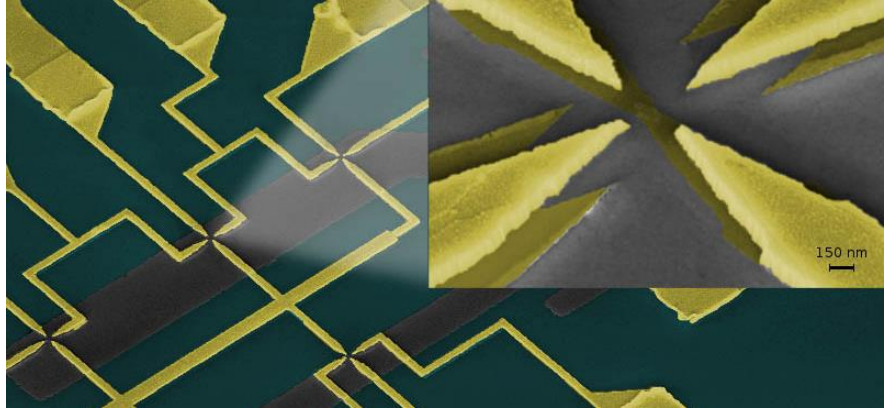
MASTER NANOSCIENCES, NANOTECHNOLOGIES



M2 NanoPhysics

Program https://master-nanosciences.univ-grenoble-alpes.fr/academic-program/nanophysics/

Fundamentals: 9 ECTS

Elaboration of nanostructures-physics of 2D materials (3 ECTS)

Quantum optics (3 ECTS)*

Quantum Condensed Matter (3 ECTS)*

* Substutions possible within all N2 Master programs

Taught in english

Applications: 9 ECTS

Nanophotonics (3 ECTS)

Advanced microelectronics (CIME Nanotech)(3 ECTS)

Nanomagnetism and spintronics (3 ECTS)*

Nanomaterials and energy (3 ECTS)*

} Elective courses (1 choice)

Advanced instrumentation & characterizations : 6 ECTS

From nanofabrication in research labs to VLSI (3 ECTS)

Advanced characterization (electron ,X rays, synchroton) (3 ECTS)

Thematic and interdisciplinary projects (6 ECTS)

Modeling in Nanoscience, Advanced seminars, project

Contact : helene.bea@cea.fr

Master thesis (30 ECTS)

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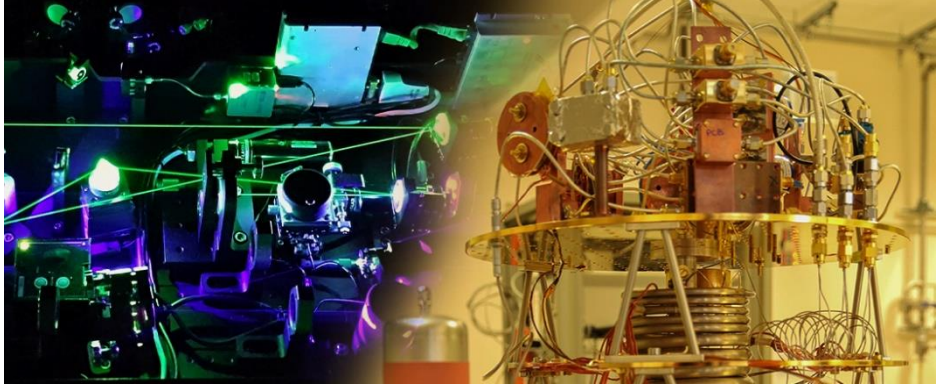
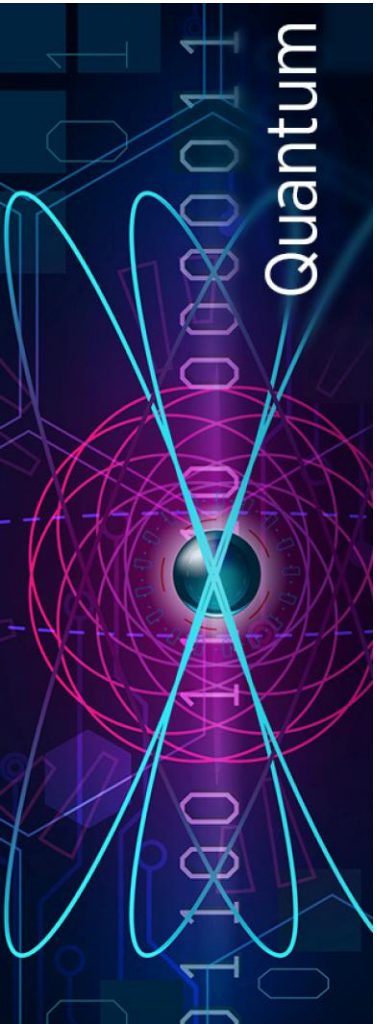
MASTER NANOSCIENCES, NANOTECHNOLOGIES



M2 QIQE

Quantum Information & Quantum Engineering



Program: https://master-nanosciences.univ-grenoble-alpes.fr/academic-program/quantum-engineering-quantum-information/

Taught in english

Fundamentals:
Open Quantum systems (3 ECTS)
Quantum optics (3 ECTS)
Quantum Condensed Matter (3 ECTS)

NEW

Implementations:
Solid state qubits (3 ECTS)
Nanomagnetism and spintronics (3 ECTS)
Quantum algorithms (3 ECTS)

Advanced instrumentations:
Microwave and cryoelectronics (3 ECTS)
From nanofabrication in research labs to VLSI (3 ECTS)

Thematic and interdisciplinary projects (6 ECTS)
Seminars, Practicals (Bell's inequalities, IBM-Q Experience, ..)

Master thesis (30 ECTS)

Contact : franck.balestro@neel.cnrs.fr

Grenoble INP phelma
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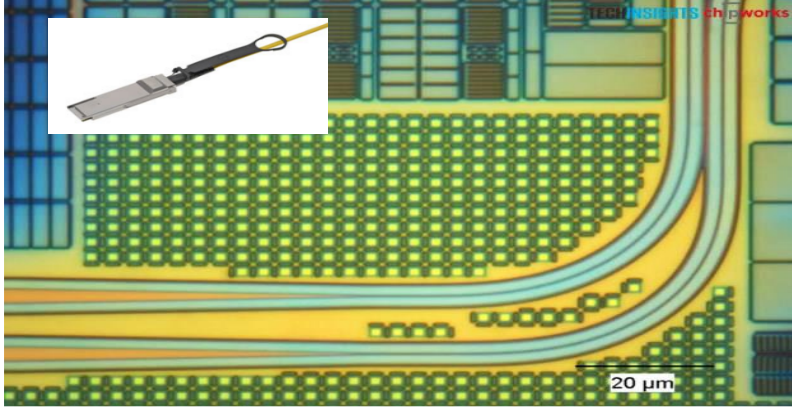
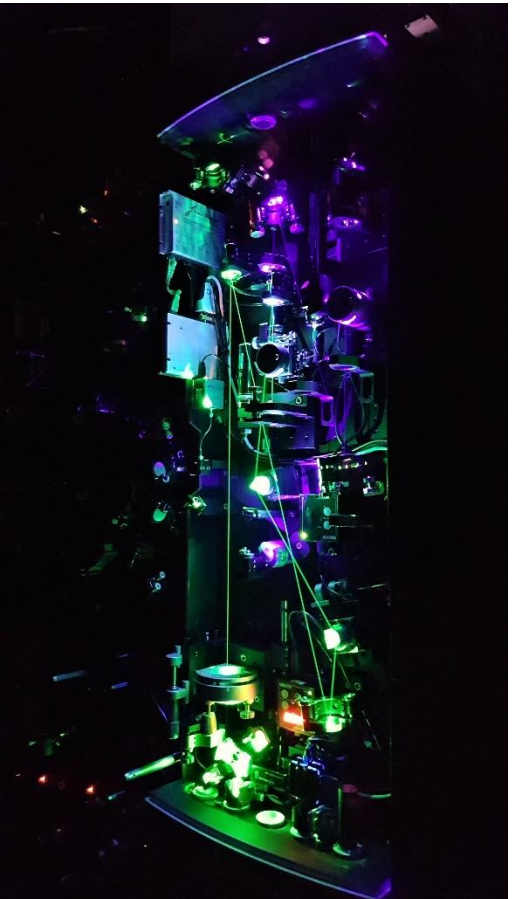
Phelma engineer School
& Phitem Master program



M2 PhSem

Photonics and semiconductors

Program: https://phelma.grenoble-inp.fr/en/studies/master-physique-parcours-photonique-et-semi-conducteurs#page-presentation



Elaboration and characterization of materials

- Photolithography
- Physics of thechnological processes
- Techniques of characterization

Photonics	Optoelectronics	Semiconductors
Nonlinear optics	Optics & Semiconductors	Physics of semiconductors III
Guided optics	THz Optoelectronics	Physics of advanced MOS components
Optical signal processing	Photovoltaic components	Reliability of components and circuits
Quantum optics	CMOS Sensors	Quantum condensed matter

Taught in French

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Contact :
benoit.boulanger@neel.cnrs.fr

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3. Open possibilities to strenghen student exchanges between Grenoble and Barcelona

3. Development of international exchanges with Barcelona

- Running exchange with UB: **EMM-Nano+ Erasmus-mundus Master** (5 Universities involved)

  includes **Quantum engineering**; material engineering, Bionanotechnologies,…
  See https://www.emm-nano.org/ , https://master-nanosciences.univ-grenoble-alpes.fr/
  Contact@UGA (david.ferrand@neel.cnrs.fr) , **Contact@UB** (shernandez@ub.edu)

- Graduate School of UGA, **quantum thematic program** :

  Mobility grant for Master students for two years **starting in Spring 2022.**
  Invitation of Professor researchers for a stay or for extended seminar contributions (online).

- **Grenoble interdisciplinary Center for Quantum Science and Technologies**

  Student mobility grants at Master 1 level but also at **Master 2 level** (**open after a 4 year spanish Bsc**)
  PhD grants.
  Invitation of researchers and professors, **research programs**,…
  Start during the academic year 2021-2022.

3. Development of international exchanges with Barcelona

- **Erasmus+ exchange** (Master and Bachelor levels):

  New period started in 2021 for 6 years by EU.
  Due to covid-19, existing programs have been extended for one year.
  A renew of exchange agreement will be done in 2021-2022 for the next 6 years !
  Opportunity to redefine and stimulate the exchange offer between Grenoble and Barcelona ?

  Phitem: exchange with UAB in physics & geology ? to be extended to Nanosciences (1 ex/year)

- Open to establish **double degree diploma** at Master level with Barcelona:

  With our new Master program on **Quantum information-quantum engineering.**
  Contact me if you may be interested ?
  I can also relay other proposals with other programs (Soft Matter, material engineering, Bionanotechnologies and others…)

Thank you for your attention