



# Master Physique

## Quantum technologies - European program

### Présentation

#### English presentation:

Recent advances in physics (high energy physics, quantum physics, condensed matter...) and related disciplines (astrophysics, life sciences, medical treatment and medical imaging...) are based on gathering, in laboratories or within national and international collaborations, a great diversity of skills and knowledge such as:

- Knowledge about fundamental theoretical and experimental physics;
- A broad view of the discipline: currently accepted theories, major open questions and plans to address them...
- Excellent knowledge of practical tools for modeling and analysis (mathematics, statistics, signal processing, database management, numerical simulations, instrumental developments);
- Ease with high-level experimental techniques;
- Teamwork and communication skills (project management, English, report writing, oral presentations).

The main objective of the Master of Physics is to train candidates to fit effectively into this framework, providing them with sound theoretical and practical bases, and giving them the opportunity to start specializing gradually through courses, personal projects and internships. The training aims to provide students with the necessary skills to carry out research and / or development work by focusing on:

- Autonomy in the analysis of a complex problem and the proposal of approaches (theoretical, numerical and / or experimental);
- Solid skills in computing (especially for the analysis of large datasets);
- Collaborative work;
- Ability to communicate scientific results.

The Master of Physics is a research-driven training, leading to fundamental or applied research, work in the *Science, Technology, Engineering and Mathematics* -STEM- industry (especially high-tech) and trades of education or dissemination of science. From a professional point of view, the training prepares either for a career as a researcher or a research engineer in the disciplinary fields concerned, or for a career in a sector where the knowledge and / or skills acquired as physicists prove to be useful. Thanks to a long-standing partnership with [Télécom Physique Strasbourg](#), the Master's degree also assumes the role of contributing to the formation of young engineers. In parallel with research-focused objectives, the Master of Physics also prepares students to pass the French recruitment competition for teachers Agrégation de Physique-Chimie, Option Physique through a specific track PA (Préparation à l'Agrégation). The mastery of the disciplinary foundations of Physics and Chemistry give rise to a solid theoretical and practical professional training in the trades of the education.

The Master of Physics consists of **7 tracks** with of a common first M1 year followed by a specialization at the M2 level. The content of each course is described in the specific pages. The courses are taught in English during the two years. For the main lectures, tutorial classes are duplicated with French and English teaching languages. M1 training consists of a common core of general physics taught through courses and tutorials in the first and second semester. Experimental training is an important part of the curriculum, with projects hosted by local laboratories. During these two semesters, optional courses allow students to discover the different possible tracks and specializations. The ties with ongoing academic research are ensured by weekly seminars given by researchers from Strasbourg laboratories during the first semester. In addition, students will train to actual research work via supervised projects and research internships in physics laboratories through (both in M1 and M2).

#### Résumé français:

Le master Physique de l'Université de Strasbourg est porté par la Faculté de Physique et Ingénierie, en partenariat avec [l'Observatoire d'Astrophysique de Strasbourg \(ObAS\)](#), [Télécom Physique Strasbourg \(TPS\)](#) et [l'École supérieure de biotechnologie de](#)

Composante	• <a href="#">Faculté de physique et ingénierie</a>
Langues d'enseignement	• Anglais
Niveau d'entrée	BAC +3
Durée	2 ans
ECTS	120
Volume global d'heures	800
Formation à distance	Hybride (mixte : enseignements à distance et présentiel)
Régime d'études	• FI (Formation initiale)
Niveau RNCP	Niveau 7
RNCP	•
Disciplines	<ul style="list-style-type: none"> <li>• Physique - Milieux denses et matériaux</li> <li>• Physique - Milieux dilués et optique</li> <li>• Mathématiques appliquées et applications des mathématiques</li> <li>• Sciences de l'information et de la communication</li> <li>• Informatique</li> </ul>
Lieu	Strasbourg
Campus	<ul style="list-style-type: none"> <li>• Campus Cronenbourg</li> <li>• Campus Esplanade</li> </ul>
Formation internationale	Formation ayant des partenariats formalisés à l'international
Lieu(x) à l'étranger	Denmark, Spain, Czech Republic, Germany, Italy, Finland, Portugal.
Secteurs d'activité	<ul style="list-style-type: none"> <li>• <a href="#">Recherche-développement scientifique</a></li> <li>• <a href="#">Enseignement supérieur et post-secondaire non supérieur</a></li> </ul>
Code ROME	<ul style="list-style-type: none"> <li>• <a href="#">Management et ingénierie études, recherche et développement industriel</a></li> <li>• <a href="#">Recherche en sciences de l'Univers, de la matière et du vivant</a></li> <li>• <a href="#">Enseignement supérieur</a></li> </ul>
Stage	Obligatoire
Stage à l'étranger	Possible

Strasbourg (ESBS) et avec les *Instituts Thématiques Interdisciplinaires* ITI/EUR [HiFunMat](#), [IRMIA++](#) et [QMat](#). Après une première année de formation généraliste fortement mutualisée, il propose 6 parcours orientés vers la recherche -Astrophysics and data science (Astro); Physics of Quantum and Soft Condensed Matter (PhyQS); Cell physics; Radiation physics, detector, instrumentation and imaging (PRIDI); Subatomic and astroparticle physics (SAP) and Quantum Technologies-European Program -s'appuyant sur les laboratoires Strasbourgeois et un parcours permettant de préparer le concours de recrutement de l'Agrégation de Physique-Chimie-Option Physique.

## Objectifs

### English version

This Master's track **Quantum technology-European program -QTEP-** is dedicated to quantum sciences and technologies. It prepares experts for industries of the future and cutting-edge laboratories. It is both fundamental and applied research-oriented. It aims to train scientists, engineers and technologists specialized in quantum sciences and technologies. The cursus is multidisciplinary, covering several areas of quantum ranging from quantum sciences (physics, chemistry, mathematics), quantum systems/materials and technology, to calculation/simulation tools and applications. It proposes a balanced training in experimental, theoretical and modeling quantum sciences and technologies, at a higher level of expertise.

This course offers original training on an international scale. The Master QTEP is supported at European level ([DigiQ European project](#)) providing access to an European Master certificate, and at national level by QuantEdu-France (as part of the French National Quantum Strategy) and by [ITI Qmat](#).

### French version

Ce parcours de Master **Technologies quantiques-Programme européen -QTEP-** est dédié aux sciences et technologies quantiques. Il prépare les experts des industries du futur et des laboratoires de pointe. Il est axé à la fois sur la recherche fondamentale et appliquée. Le parcours « QTEP » vise à former des scientifiques et ingénieurs spécialisés dans les sciences et technologies quantiques. Le cursus est multidisciplinaire, couvrant plusieurs domaines du quantique allant des sciences quantiques (physique, chimie, mathématiques), systèmes/matériaux et technologies quantiques aux outils et applications de calcul/simulation. Il propose une formation équilibrée en sciences et technologies quantiques expérimentales, théoriques et de modélisation, à un niveau d'expertise supérieur. Ce parcours se présente sous une forme originale au niveau international.

Le parcours QTEP est soutenu au niveau européen (projet européen [DigiQ](#)) donnant accès à un certificat de Master européen, et au niveau national par QuantEdu-France (dans le cadre de la Stratégie Nationale Quantique Française) et par [l'Institut thématique interdisciplinaire \(ITI\) Qmat](#).

## Insertion professionnelle

- An internship and a course (teaching unit) are dedicated to training for professional integration.
- Un stage et une unité d'enseignement sont dédiées à l'insertion professionnelle.

## Métiers visés

The aim of the Master is to train Physicists who can hold senior positions in public research institutions (Researcher, Researcher-Teacher or Research Engineer), R & D engineers or management positions in industry, and teachers in secondary or higher education. RNCP fields include: Quantum physicist, Quantum technologist, Data Science, Management and Engineering of studies-research-development in industry, Management and engineering methods and industrialization, Researcher, Higher education teacher, Process engineer, expert/advisor in Information and Communication Technologies.

Pour connaître en détail l'insertion professionnelle de nos diplômés, consultez [cette page](#).

## Les + de la formation

1. Master Track in Quantum Science and Quantum Technologies.
2. Combined multidisciplinary trainings in fundamental Quantum sciences and Applied quantum technologies.
3. Strong international visibility : European certification of the Master track possible (European DIGIQ certificate).
4. Enhanced exposure to research.
5. Extended research internship.

## Candidater

- Find out the information relative to [admission and registration on the site of the University of Strasbourg](#)
- Pour connaître les modalités de candidature, consultez [la page dédiée](#) sur le site de l'Université de Strasbourg.

## Prérequis obligatoires

At the M1 level

16/07/2024

Alternance

Non

## Aménagements pour les publics ayant un profil spécifique

See page of / Voir la page du [régime spécial d'études \(RSE\)](#)

### Droits de scolarité

- To know about the registration fees, [check the dedicated page on the site of the University of Strasbourg](#)
- Pour connaître les droits de scolarité, consultez la page dédiée [sur le site de l'Université de Strasbourg](#).

### Contacts

#### Responsable(s) de parcours

- [Jean-François Dayen](#)

#### Référente administrative

- [Isabelle Huber](#)

- All the courses of this master are taught in English. B2 level (CEFR scale) is required.
- Our master of Physics assumes that candidates should have a solid knowledge of classical mechanics and classical electrodynamics. The students should as well know and be able to apply the laws of quantum mechanics.
- Some experience with programming languages is needed.

#### **At the M2 level**

- All the courses of this master are taught in English. A B2 level (CEFR scale) is required.
- A knowledge of a programming language and algorithmic (ex : C, Python ...) is strongly recommended to be able to adequately follow some optional trainings.
- Candidates must have a strong background in modern physics (Electromagnetism, quantum mechanics).
- The Master's program is intensive, and it is not possible to have a parallel job. Financial resources must be guaranteed. Students with very good academic records may apply for the Master [QMat](#) scholarship.

## **Stage**

### **Stage en France**

Durée du stage : 16 weeks / 16 semaines

Période du stage : February to June, second year

### **Stage à l'étranger**

Durée du stage : 16 weeks / 16 semaines

Période du stage : February to June, second year

# Programme des enseignements

## Quantum technologies - European program

### Master 1 - Physique - Quantum technologies - European program

Master 1 - Physique - Physics research - Tronc commun

Semester 1 - Physics research				
	CM	TD	TP	CI
UE 1 - Semestre 1 - Quantum mechanics and statistical mechanics	9 ECTS	-	-	-
Quantum mechanics	26h	26h	-	-
Statistical mechanics	26h	26h	-	-
UE 2 - Semestre 1 - Numerical physics and Current research in physics	6 ECTS	-	-	-
Numerical physics	16h	-	16h	-
Current research in physics	14h	-	-	-
UE 3 - Semestre 1 - Experimental physics I	6 ECTS	-	-	-
Experimental physics I	-	-	56h	-
UE 4 - Semestre 1 - Elective course (2 to choose among)	6 ECTS	-	-	-
Liste UE 4 - choisir 2 parmi 10				
Mécanique des milieux continus	26h	-	-	-
Astrophysical objects and their observations	26h	-	-	-
Group theory	26h	-	-	-
Ionizing radiation and detection methods	26h	-	-	-
General relativity	26h	-	-	-
Advanced quantum mechanics	26h	-	-	-
Project	26h	-	-	-
Photonics for quantum science and technology	26h	-	-	-
Soft condensed matter	26h	-	-	-
Focus : sciences physiques ou mathématiques	20h	-	-	-
UE 5 - Semestre 1 - Free course	3 ECTS	-	-	-

	CM	TD	TP	CI
<b>Liste UE 5 - choisir 1 parmi 9</b>				
Mécanique des milieux continus	26h	-	-	-
Astrophysical objects and their observations	26h	-	-	-
Group theory	26h	-	-	-
Ionizing radiation and detection methods	26h	-	-	-
General relativity	26h	-	-	-
Advanced quantum mechanics	26h	-	-	-
Project	26h	-	-	-
Photonics for quantum science and technology	26h	-	-	-
Soft condensed matter	26h	-	-	-
<b>UE facultative (au-delà de 30 ECTS validés) - Bases de mécanique quantique et physique statistique TEST</b>				
Bases de mécanique quantique	16h	-	-	-
Bases de physique statistique	16h	-	-	-

<b>Semester 2 - Physics research</b>				
	CM	TD	TP	CI
<b>UE 1 - Semestre 2 - Nuclear physics and elementary particles 6 Solid state physics 9 ECTS</b>				
Nuclear physics and elementary particles	26h	26h	-	-
Solid State physics	26h	26h	-	-
<b>UE 2 - Semestre 2 - Numerical simulations 3 ECTS</b>				
Numerical simulations	12h	-	16h	-
<b>UE 3 - Semestre 2 - Experimental physics II and Laboratory internship 12 ECTS</b>				
Experimental physics II (in laboratory)	4h	-	16h	-
Laboratory internship	-	-	-	-
<b>UE 4 - Semestre 2 - Elective course (1 to choose among) 3 ECTS</b>				
<b>Liste UE 4 - choisir 1 parmi 9</b>				
Particles and astroparticles	26h	-	-	-
Stellar physics	26h	-	-	-
Atomic and molecular physics	26h	-	-	-
Introduction to physics of living systems	26h	-	-	-
Relativistic quantum mechanics	26h	-	-	-
Numerical methods in physics	26h	-	-	-
Project	26h	-	-	-
Electronics for quantum science and technology	26h	-	-	-
Phénomènes critiques et physique statistique hors-équilibre	26h	-	-	-
<b>UE 5 - Semestre 2 - Free course 3 ECTS</b>				

	CM	TD	TP	CI
<b>Liste UE 5 - choisir 1 parmi 9</b>				
Particles and astroparticles	26h	-	-	-
Stellar physics	26h	-	-	-
Atomic and molecular physics	26h	-	-	-
Introduction to physics of living systems	26h	-	-	-
Relativistic quantum mechanics	26h	-	-	-
Numerical methods in physics	26h	-	-	-
Project	26h	-	-	-
Electronics for quantum science and technology	26h	-	-	-
Phénomènes critiques et physique statistique hors-équilibre	26h	-	-	-
<b>Liste UE facultative Facultatif</b>				
UE 7 - Semestre 2 - Optional	-	-	-	-
Voluntary internship	-	-	-	-

### Master 2 - Physique - Quantum technologies - European program

<b>Semester 3 - Quantum technologies - European program</b>				
	CM	TD	TP	CI
UE 1 - Semestre 3 - Quantum technology and applications <span style="float: right;">6 ECTS</span>	-	-	-	-
Quantum technology and applications	28h	14h	-	-
UE 2 - Semestre 3 - Quantum physics of devices and sensors <span style="float: right;">6 ECTS</span>	-	-	-	-
Quantum physics of devices and sensors	28h	14h	-	-
UE 3 - Semestre 3 - Advanced Laboratory Practicals <span style="float: right;">6 ECTS</span>	-	-	-	-
Advanced Laboratory Practicals	-	-	70h	-
UE 4 - Semestre 3 - Compulsory modules (choose 4 among) <span style="float: right;">9 ECTS</span>	-	-	-	-
<b>Liste UE 4 - choisir 4 parmi 10</b>				
Hybrid quantum devices	18h	-	-	-
Open quantum systems	18h	-	-	-
Quantum information	18h	-	-	-
Computer science for quantum technologists	18h	-	-	-
Many-body physics and quantum simulations	18h	-	-	-
Spin technologies	18h	-	-	-
Molecular Quantum Technologies	18h	-	-	-
Quantum systems of atoms and light	18h	-	-	-
Advanced Topics in Quantum Technology 1 (choose 1 DIGIQ Course)	18h	-	-	-
Advanced Topics in Quantum Technology 2 (choose 1 DIGIQ Course)	18h	-	-	-
UE 5 - Semestre 5 - UE Libre <span style="float: right;">3 ECTS</span>	-	-	-	-

	CM	TD	TP	CI
<b>Liste UE 5 - choisir 1 parmi 10</b>				
Hybrid quantum devices	18h	-	-	-
Open quantum systems	18h	-	-	-
Quantum information	18h	-	-	-
Computer science for quantum technologists	18h	-	-	-
Many-body physics and quantum simulations	18h	-	-	-
Spin technologies	18h	-	-	-
Molecular Quantum Technologies	18h	-	-	-
Quantum systems of atoms and light	18h	-	-	-
Advanced Topics in Quantum Technology 1 (choose 1 DIGIQ Course)	18h	-	-	-
Advanced Topics in Quantum Technology 2 (choose 1 DIGIQ Course)	18h	-	-	-

<b>Semester 4 - Quantum technologies - European program</b>				
	CM	TD	TP	CI
UE 1 - Semestre 4 - Professional integration <span style="float: right;">3 ECTS</span>	-	-	-	-
Professional integration	18h	-	-	-
UE 2 - Semestre 4 - Long-term internship 15 weeks (full times) <span style="float: right;">27 ECTS</span>	-	-	-	-
Internship	-	-	-	-
<b>Liste UE facultative Facultatif</b>				
Optional	-	-	-	-
Voluntary internship	-	-	-	-