Université de Strasbourg

Sciences, Technologies, Santé | 2024-2025

DIPLÔME NATIONAL DE MASTER CONTRÔLÉ PAR L'ÉTAT

Master Physique
Physics of Quantum and Soft Condensed Matter

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 (Preparation 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	• Faculté de physique et ingénierie
Langues d'enseignement	• Anglais
Niveau d'entrée	BAC +3
Durée	2 ans
ECTS	120
Volume global d'heures	750
Formation à distance	Non, uniquement en présentiel
Régime d'études	• FI (Formation initiale)
Niveau RNCP	Niveau 7
Disciplines	• Physique - Milieux denses et matériaux • Physique - Milieux dilués et optique • Génie électrique, électronique, photonique et systèmes
Taux de réussite	On average 80% over the last 10 years
Lieu	Master 1: Campus Esplanade, Master 2: Campus Cronenbourg
Campus	• Campus Esplanade • Campus Cronenbourg
Secteurs d'activité	• Fabrication de composants et cartes électroniques • Fabrication d'instruments et d'appareils de mesure, d'essai et de navigation ; horlogerie • Télécommunications • Recherche-développement scientifique • Recherche-développement en sciences physiques et naturelles • Activités pour la santé humaine • Programmation, conseil et autres activités informatiques • Enseignement • Enseignement secondaire • Enseignement supérieur et post-secondaire non supérieur
Code ROME	• Recherche en sciences de l'Univers, de la matière et du vivant • Enseignement supérieur • Management et ingénierie études, recherche et développement industriel

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:

The specialty Physics of Quantum and Soft Condensed Matter (PhyQS) is one of the seven specialties offered in the second year (M2) of the Master of Physics. The first year (M1) of the Master of Physics is common to all specialties. The PhyQS Master aims to provide physicists with a broad fundamental training, suitable for both experimental and theoretical research. The first semester of the PhyQS track includes a core advanced courses on quantum mechanics applied to condensed matter physics, statistical physics and radiation-matter interaction. In parallel, students can, through their choice of elective courses, orient their training either towards quantum sciences and nanomaterials (electronic, optical, magnetic, spintronic properties of low-dimensional, mesoscopic or open quantum systems...), or towards the physics of soft matter and complex systems (surfaces and interfaces, complex fluids, colloids, active matter...). A project, focusing of modern topics in condensed matter physics is proposed during the first semester. This project can be experimental, numerical or both. The second semester consists in a research internship of at least four months.

French version:

La spécialité Physique de la matière quantique et matière molle est l'une des sept spécialités offerte en deuxième année de master de physique. La première année du master de physique (M1) est commune à toutes les spécialités. Le premier semestre du parcours PhyQS comprend un tronc commun de cours de mécanique quantique avancée appliquée à la physique de la matière condensée, de physique statistique et à d'interaction rayonnement-matière. En parallèle, les étudiants peuvent orienter leur formation soit vers les sciences quantiques et les nanomatériaux (propriétés électroniques, optiques, magnétiques, spintroniques des systèmes quantiques de basse dimension, mésoscopiques ou ouverts...), soit vers la physique de la matière molle et des systèmes complexes (surfaces et interfaces, fluides complexes, colloïdes, matière active...) grâce un large choix de matières. Un projet axé sur des sujets contemporains en physique de la matière condensée est proposé au premier semestre. Ce projet peut être expérimental, numérique ou les deux. Le deuxième semestre consiste en un stage de recherche d'une durée minimale de quatre mois.

Stage	Obligatoire
Stage à l'étranger	Non prévu
Alternance	Non

Aménagements pour les publics ayant un profil spécifique

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

- Stephane Berciaud
- Dominique Aubert

Référente administrative

- Isabelle Huber

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.

Pour connaitre en détail l'insertion professionnelle de nos diplômés, consultezcette page.

Les + de la formation

- State of the art theoretical, experimental and numerical skillset
- Multidisciplinary training in condensed matter physics (quantum physics and quantum materials, physics of low-dimensional nanostructures, light-matter interaction, complex systems, soft matter, etc.)
- Direct exposure to an international research environment.Extended research internship.

Critères de recrutement

M1 : Bachelor degree or equivalent (French or foreign "licence") in physics or applied physics.
M2 : The direct admission to the M2 level is possible for students with strong academic records that have the M1 level.

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

- 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 (Electrodynamics, quantum mechanics, statistical physics, condensed matter physics).
- 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.

French version

Au niveau M1

- Tous les cours de ce master sont dispensés en anglais. Le niveau B2 (échelle CECR) est requis.
- Notre master de physique suppose que les candidats possèdent une solide connaissance de la mécanique classique et de l'électrodynamique classique. Les étudiants doivent également connaître et être capables d'appliquer les lois de la mécanique quantique.
- Une certaine expérience avec les langages de programmation est nécessaire.

Au niveau M2

- Tous les cours de ce master sont dispensés en anglais. Un niveau B2 (échelle CECR) est requis.
- La connaissance d'un langage de programmation (ex : C, Python ...) est fortement recommandée pour pouvoir suivre certaines formations optionnelles.
- Les candidats doivent avoir une solide expérience en physique moderne (électrodynamique, mécanique quantique, physique statistique, physique de la matière condensée).
- Le programme de Master est intensif et il n'est pas possible d'avoir un emploi en parallèle. Les ressources financières doivent être suffisantes. Les étudiants ayant de très bons résultats académiques peuvent postuler pour la bourse Master QMat.

Stage

Stage en France

Durée du stage : 16 weeks

Période du stage : Master 2, second semester

Programme des enseignements

Physics of Quantum and Soft Condensed Matter

Master 1 - Physique - Physics of Quantum and Soft Condensed Matter

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
Liste UE 5 - choisir 1 parmi 9				
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	-	-	-
UE facultative (au-delà de 30 ECTS validés) - Bases de mécanique quantique et physique statistique TEST	-	-	-	-
Bases de mécanique quantique	16h	-	-	-
Bases de physique statistique	16h	-	-	-

Semester 2 - Physics research

	CM	TD	TP	CI
UE 1 - Semestre 2 - Nuclear physics and elementary particles 6 Solid state physics 9 ECTS	-	-	-	-
Nuclear physics and elementary particles	26h	26h	-	-
Solid State physics	26h	26h	-	-
UE 2 - Semestre 2 - Numerical simulations 3 ECTS	-	-	-	-
Numerical simulations	12h	-	16h	-
UE 3 - Semestre 2 - Experimental physics II and Laboratory internship 12 ECTS	-	-	-	-
Experimental physics II (in laboratory)	4h	-	16h	-
Laboratory internship	-	-	-	-
UE 4 - Semestre 2 - Elective course (1 to choose among) 3 ECTS	-	-	-	-
Liste UE 4 - choisir 1 parmi 9				
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	-	-	-
UE 5 - Semestre 2 - Free course 3 ECTS	-	-	-	-

	CM	TD	TP	CI
Liste UE 5 - choisir 1 parmi 9				
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	-	-	-
Liste UE facultative Facultatif				
UE 7 - Semestre 2 - Optional	-	-	-	-
Voluntary internship	-	-	-	-

Master 2 - Physique - Physics of Quantum and Soft Condensed Matter

Semester 3 - Physics of Quantum and Soft Condensed Matter

		CM	TD	TP	CI
UE 1 - Semestre 3 - Advanced Quantum Mechanics: applications to Condensed Matter	6 ECTS	-	-	-	-
Advanced Quantum Mechanics: applications to Condensed Matter		42h	-	-	-
UE 2 - Semestre 3 - Advanced Statistical Mechanics: out-of-equilibrium processes	6 ECTS	-	-	-	-
Advanced Statistical Mechanics: out-of-equilibrium processes		42h	-	-	-
UE 3 - Semestre 3 - Radiation-Matter Interaction: applications to Condensed Matter	6 ECTS	-	-	-	-
Radiation-Matter Interaction: applications to Condensed Matter		42h	-	-	-
UE 4 - Semestre 3 - Options (4 to choose among)	9 ECTS	-	-	-	-

	CM	TD	TP	CI
Liste UE4 - choisir 4 parmi 14				
Project	18h	-	-	-
Many-body physics and quantum simulations	18h	-	-	-
Open quantum systems	18h	-	-	-
Light-matter interactions at extreme scales	18h	-	-	-
Quantum dynamics: light and matter	18h	-	-	-
Spin technologies	18h	-	-	-
Nanomagnetism and spintronics	18h	-	-	-
Electrons in solids: theory and modelling	18h	-	-	-
Low dimensional nanostructures	18h	-	-	-
Physics in two dimensions (surfaces & van der Waals materials)	18h	-	-	-
Surfaces and Interfaces in soft condensed matter	18h	-	-	-
Interactions in soft condensed matter	18h	-	-	-
Physics of active systems	18h	-	-	-
Polymer physics	18h	-	-	-
UE 5 - Semestre 3 - UE libre 3 ECTS	-	-	-	-
Liste UE5 - choisir 1 parmi 14				
Project	18h	-	-	-
Many-body physics and quantum simulations	18h	-	-	-
Open quantum systems	18h	-	-	-
Light-matter interactions at extreme scales	18h	-	-	-
Quantum dynamics: light and matter	18h	-	-	-
Spin technologies	18h	-	-	-
Nanomagnetism and spintronics	18h	-	-	-
Electrons in solids: theory and modelling	18h	-	-	-
Low dimensional nanostructures	18h	-	-	-
Physics in two dimensions (surfaces & van der Waals materials)	18h	-	-	-
Surfaces and Interfaces in soft condensed matter	18h	-	-	-
Interactions in soft condensed matter	18h	-	-	-
Physics of active systems	18h	-	-	-
Polymer physics	18h	-	-	-

Semester 4 - Physics of Quantum and Soft Condensed Matter

	CM	TD	TP	CI
UE 1 - Semestre 4 - Professional integration 3 ECTS	-	-	-	-
Professional integration	18h	-	-	-

	CM	TD	TP	CI
UE 2 - Semestre 4 - Long-term internship 15 weeks 27 ECTS	-	-	-	-
Long-term internship 15 weeks (full times)	-	-	-	-
Liste facultative Facultatif				
Optional	-	-	-	-
Voluntary internship	-	-	-	-