



## Master in Physics

The 2024-2025 programme is subject to change. It is provided for information purposes only.

### Programme mnemonic

MA-PHYS

- > Focus *Research* : M-PHYSA
- > Focus *Teaching* : M-PHYSD

### Studies level

Master 120 credits

### Learning language

french

### Schedule

office hours

### Studies category / subcategory

Sciences and technics / Sciences

### Campus

Plaine

- > Discover new consequences of existing theories
- > Conceptualise and model complex principles
- > Formulate working hypotheses or experimental protocols that can be tested and possibly refuted in order to determine the accuracy of these theories
- > Develop, optimise, and exploit experimental devices
- > Analyse data
- > Confront experimental measurements with simulations and theoretical predictions
- **Learning to communicate appropriately depending on context and target audience:**
  - > Present research in a scientifically rigorous way, with an appropriate bibliography
  - > Present various aspects of physics, taking context and target audience into account
- **Developing professional skills while applying ethical principles in one's area of expertise:**
  - > Be self-critical in the evaluation of one's own skills
  - > Respect sources and intellectual property
  - > Be conscious of the importance of applying ethical rules when dealing with technological applications of physics
  - > Act as a teacher, decide how to teach a subject, analyse the organisational and institutional context of the educational system in which one practices (Master programme with a teaching focus)
  - > Conduct—individually or with peers—a critical and rigorous analysis of one's own teaching practices and their impact on students (Master programme with a teaching focus)
- **Communicating in a manner adapted to the context and the public:**
  - > Present research in a scientifically rigorous way, with an appropriate bibliography
  - > Present different aspects of physics in a manner adapted to the context and the public

## Programme objectives

- **Acquiring scientific expertise in physics:**
  - > #Be critical and develop a scientific method: an analytical and rigorous way of thinking
  - > Identify and understand the principles underlying natural phenomena (conservation laws, symmetries, etc.)
  - > Understand the laws of nature through their formulation in classical and quantum mechanics, electromagnetism, quantum field theory, special and general relativity, thermodynamics, statistical physics, astrophysics, etc.
  - > Master the main mathematical, experimental, and technological tools used in modern physics.
  - > Use the fundamental principles of physics to create or innovate
- **Mastering the scientific thought process and approach:**
  - > Deduce new laws from observational facts, possibly through an interdisciplinary approach, and formalise them within a theory

## Programme's added value

- Prizes and distinctions: Nobel 1977, 2013, Wolf Foundation 2004, Gravity Research Foundation 1978, Franqui 1982, 2000, and 2006
- First physics department (in the French Community of Belgium) in number of publications and citations
- Active collaboration with major research centres (CERN, European Space Agency, European Southern Observatory, DESY, ESRF, etc.)
- Many projects and international missions (CMS experience, GAIA, etc.)
- Competitive research grants (4 ERC grants in the last few years)
- Heading the Solvay International Institutes for Physics and Chemistry

A physicist's education requires in-depth knowledge of mathematical tools. It also implies a strong methodology and a scientific background to tackle new problems and develop new avenues of research (in research institutes, but also in the private sector). It involves learning advanced computational tools, and designing and using complex devices. It drives each student towards the most advanced understanding of the properties of nature.

The Master in Physics aims at enabling students to specialise in every possible branch of modern physics, opening the doors to worldwide research, industrial development, or teaching.

For over a century, Brussels has been a widely recognised centre of excellence in physics, through the Solvay Conferences, created in 1911. ULB's Physics Department still hosts the governing board of the International Solvay Institutes for Physics and Chemistry. By organising, on a regular basis, colloquia, chairs, and conferences that students are welcome to attend, the Solvay Institutes contribute to the development and international recognition of the Physics Department.

Lastly, an important aspect of ULB's Physics Department is the constant participation of many researchers (PhD students, post-doctoral researchers, and career researchers) in the teaching activities (projects, dissertation, classes), keeping a tight link between education and research at the highest level.

The physicist's education necessitates an in-depth knowledge of mathematical tools. It also implies both a working method and a scientific background allowing one to tackle new problems and to develop new research axes (in research institutes, but also in the private sector). It implies learning computing sciences as well as designing and using complex devices. It drives each student towards the finest state-of-the-art understanding of the properties of nature.

The Master in Physics aims at allowing students to specialize in every possible field of modern physics and to open to them the doors to worldwide research, industrial development or teaching.

For more than a century, Brussels has been a widely recognized place for physics excellence, through the Solvay Conferences, created in 1911. The ULB Physics Department still hosts the direction of International Solvay Institutes for Physics and Chemistry. Through the organization, on a regular basis, of Colloquia, Chairs and Conferences that students are very welcome to attend, the Solvay Institutes contribute to the development and international recognition of the Physics Department.

Finally, an important aspect of the ULB's Physics Department is the constant participation of many researchers (PhD students,

post-doctoral and confirmed researchers) in the teaching activities (lab practical, exercises, master thesis, training courses), keeping a tight link between physics education and research at the highest level.

## Teaching methods

The programme is balanced between lecture courses, exercise sessions, practical laboratory classes, and individual projects. Courses, exercises, laboratory work, and projects are assigned and coordinated by researchers who are highly involved in international physics research projects and collaborations.

## Succeed in your studies

### Choose

The information and guidance counsellors at the InfOR-études [<https://www.ulb.be/en/studies-info-desk-1>] service will help you choose your studies throughout the year.

### Succeed

Take part in preparatory courses [<https://www.ulb.be/en/studies-info-desk-1>] or get help to succeed [<https://www.ulb.be/en/studies-info-desk-1>], before or during your studies.

### Get help

Apply for financial aid, look for accommodation or a student job, get support [<https://www.ulb.be/fr/aides-services-et-accompagnement/aid-services-and-support-1>] for your specific needs.

## International/Openness

- Students may complete an Erasmus exchange programme for 1 or 2 semesters, in Bloc 1 or 2.
- They may also attend classes in other departments, faculties, or universities (UCL, KUL, ULg, UMons, etc.), subject to approval by the Master jury (Bloc 1 or 2 of the Master).
- Work placements and summer schools are also available at CERN.
- Dissertation topics can be chosen in partnership with research centres (CERN, Royal Meteorological Institute, Royal Observatory of Belgium, etc.), hospitals (Erasmie), and private companies.
- Some courses are given jointly with the Vrije Universiteit Brussel and the KULeuven.

## Job opportunities

Today, a wide range of activities needs a physicist's skills:

- Fundamental research in physics, astrophysics, geophysics, or biophysics (developed in universities or large research centres such as CERN or ESA)
- Applied research (physics, nuclear medicine, imagery, telecommunications, energy production, meteorology, etc.)
- Teaching (in secondary schools or universities)
- Applied research in computer science, engineering, actuarial sciences, etc.



- > Private sector (aerospace, microelectronics, environment, medicine, information technology, banking, insurance, consultancy etc.)

With their strong analytical capabilities, physicists are very much in demand on the job market.

Their broad knowledge base and capacity for adaptation allow physicists to work in a wide range of professions: academic researchers, industrial researchers, teachers, in the financial sector, consulting, etc. They are present wherever new technologies are developed: research laboratories or industrial development and production units. They are able to take up new challenges such as developing new materials, investigating global warming and pollution, developing space missions, and many more. Their skills helps them apply analytical reasoning to other disciplines (environment, finance, biology, medicine, etc.), enabling them to solve the problems encountered in our modern society. All of these qualities make it easy for physicists to find jobs.

#### Contacts

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 <https://sciences.ulb.be/departement-physique>

#### Jury President

Bortolo Matteo MOGNETTI

#### Jury Secretary

Patricia Maria LOSADA PEREZ



# Master in Physics

## Focus Research





Physics is concerned with the fundamental laws that govern nature. From elementary particles to the universe at large, physics explores all possible scales, allowing a better understanding of the structure of matter and how to predict its behaviour.

ULB's Master in Physics provides a comprehensive education in physics covering in particular:

- > Plasma physics
- > Nuclear physics
- > Elementary particle and astroparticle physics
- > Fundamental interaction physics
- > Quantum physics
- > Astrophysics and cosmology
- > Statistical physics
- > Complex systems physics
- > Nonlinear optics
- > Condensed matter physics
- > Hydrodynamics

## Bloc 1 | M-PHYSA | MA-PHYS

### Cours obligatoires









- STAG-F015 **Stage dans un service du département I** | Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA  
 5 credits [seminars: 60h]  first and second terms  French
- STAG-F016 **Stage dans un service du département II** | Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA  
 5 credits [seminars: 60h]  first and second terms  French

### Cours à options

Choisir 50 crédits parmi les cours suivants (en veillant à choisir un minimum de 20 crédits par quadrimestre). Les cours sont répartis en cours à option présentés en modules thématiques et en cours d'intérêt général. L'étudiant peut choisir ses cours dans plusieurs modules thématiques. [Note: pour un souci de cohérence, certains cours sont repris dans plusieurs modules différents.] L'étudiant peut aussi choisir n'importe quel autre cours (y inclus ceux de Bloc 2).

*A total of 50 credits chosen from the following*

#### Module thématique: Astrophysique et microphysique

- PHYS-F412 **Dynamique des fluides et des plasmas** | Bernard KNAEPEN (Coordinator)  
 (optional) 5 credits [lecture: 36h, tutorial classes: 12h]  first term  English/French
- PHYS-F415 **Cosmologie** | Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE  
 (optional) 5 credits [lecture: 24h, tutorial classes: 24h]  second term  French
- PHYS-F426 **Mécanique des milieux continus : hydrodynamique et solides déformables** | Fabian BRAU (Coordinator) and Gregory KOZYREFF  
 (optional) 5 credits [lecture: 24h, tutorial classes: 24h]  second term  French
- PHYS-F431 **Advanced condensed matter physics and quantum many-body systems** | Nathan GOLDMAN (Coordinator)  
 (optional) 5 credits [lecture: 36h, tutorial classes: 12h]  second term  English

PHYS-F432 (optional)	<b><a href="#">Théorie de la gravitation</a></b>   Frank FERRARI (Coordinator) and Stéphane DETOURNAY ⌚ 5 credits [lecture: 36h, tutorial classes: 24h] 📅 first term 🗨️ French
PHYS-F434 (optional)	<b><a href="#">Stellar Atmospheres</a></b>   Sophie VAN ECK (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English Ce cours est donné un an sur deux.
PHYS-F438 (optional)	<b><a href="#">Astrophysics</a></b>   Alain JORISSEN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ English
PHYS-F463 (optional)	<b><a href="#">Théorie quantique des collisions et applications aux réactions nucléaires</a></b>   Michele SFERRAZZA (Coordinator) and Jean-Marc SPARENBERG ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French Ce cours est donné un an sur deux.
PHYS-F467 (optional)	<b><a href="#">Astroparticle physics</a></b>   Juan Antonio AGUILAR SANCHEZ (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English
PHYS-F484 (optional)	<b><a href="#">Gravitational Waves</a></b>   Sébastien CLESSE (Coordinator), Nicolas CHAMEL and Geoffrey COMPERE ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English
<b>Module thématique: Interactions fondamentales</b>	
PHYS-F410 (optional)	<b><a href="#">Quantum field theory I</a></b>   Petr TINIAKOV (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗨️ English
PHYS-F415 (optional)	<b><a href="#">Cosmologie</a></b>   Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
PHYS-F416 (optional)	<b><a href="#">Physique des particules</a></b>   Barbara CLERBAUX (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ French
PHYS-F420 (optional)	<b><a href="#">Particle detection, data acquisition and analysis</a></b>   Gilles DE LENTDECKER (Coordinator), Ioana Codrina MARIS and Pascal VANLAER ⌚ 5 credits [lecture: 12h, tutorial classes: 12h, practical work: 24h] 📅 first term 🗨️ English
PHYS-F422 (optional)	<b><a href="#">Modèle standard des interactions fondamentales</a></b>   Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
PHYS-F432 (optional)	<b><a href="#">Théorie de la gravitation</a></b>   Frank FERRARI (Coordinator) and Stéphane DETOURNAY ⌚ 5 credits [lecture: 36h, tutorial classes: 24h] 📅 first term 🗨️ French
PHYS-F440 (optional)	<b><a href="#">Quantum Field Theory II</a></b>   Riccardo ARGURIO (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 12h] 📅 second term 🗨️ English
PHYS-F467 (optional)	<b><a href="#">Astroparticle physics</a></b>   Juan Antonio AGUILAR SANCHEZ (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English
PHYS-F477 (optional)	<b><a href="#">Physics of Strong Interactions</a></b>   Laurent FAVART (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ English
PHYS-F478 (optional)	<b><a href="#">Solitons and instantons in quantum field theory</a></b>   Michel TYTGAT (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English/French Ce cours n'est pas donné en 2022-23, 2024-25, etc.
<b>Module thématique: Matière, rayonnement et complexité</b>	
HULB-0000 (optional)	<b><a href="#">Cours externe à l'Université</a></b> ⌚ 5 credits 📅 academic year
PHYS-F314 (optional)	<b><a href="#">Electronique</a></b>   Gilles DE LENTDECKER (Coordinator), Juan Antonio AGUILAR SANCHEZ and Yifan YANG ⌚ 5 credits [lecture: 24h, tutorial classes: 6h, practical work: 30h] 📅 first term 🗨️ French
PHYS-F407 (optional)	<b><a href="#">Polymer physics</a></b>   Simone NAPOLITANO (Coordinator) ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨️ French



PHYS-F411 (optional)	<b>Physique non-linéaire</b>   Thomas GILBERT (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ French
PHYS-F412 (optional)	<b>Dynamique des fluides et des plasmas</b>   Bernard KNAEPEN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ English/French
PHYS-F421 (optional)	<b>Nucleosynthesis</b>   Stéphane GORIELY (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English Ce cours n'est pas donné en 2022-23, 2024-25, etc.
PHYS-F427 (optional)	<b>Méthodes asymptotiques en physique</b>   Gregory KOZYREFF (Coordinator) and Fabian BRAU ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
PHYS-F431 (optional)	<b>Advanced condensed matter physics and quantum many-body systems</b>   Nathan GOLDMAN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English
PHYS-F442 (optional)	<b>Physique statistique II</b>   Pierre GASPARD (Coordinator) and PATRICK GROSFILS ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 12h] 📅 first term 🗨️ French
PHYS-F446 (optional)	<b>Processus stochastiques et systèmes complexes</b>   Thomas GILBERT (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
PHYS-F474 (optional)	<b>Quantum optics</b>   Stéphane CLEMMEN (Coordinator) and Serge MASSAR ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ English
PHYS-F476 (optional)	<b>Optique non linéaire et physique des lasers</b>   Mustapha TLIDI (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
PHYS-F481 (optional)	<b>Simulation methods in statistical physics</b>   Bortolo Matteo MOGNETTI (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ English
PHYS-F482 (optional)	<b>Advanced techniques of experimental physics</b>   Denis TERWAGNE (Coordinator), Juan Antonio AGUILAR SANCHEZ and Pascal VANLAER ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨️ English
PHYS-F485 (optional)	<b>Representation of groups and application to physics</b>   Geoffrey COMPERE (Coordinator) and Giulio COLLINUCCI ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 10h] 📅 first term 🗨️ English
PHYS-F509 (optional)	<b>Quantum Information Theory</b>   Stefano PIRONIO (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗨️ English/French
PHYS-H302 (optional)	<b>Eléments d'optique physique</b> ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 📅 second term 🗨️ French

## Autres cours

Moyennant l'approbation du jury, l'étudiant peut aussi choisir n'importe quel autre cours dans la liste suivante :

- > les cours du bloc 2 du Master en sciences physiques
- > les cours du Master : Ingénieur civil physicien de l'École polytechnique de Bruxelles
- > les cours du Master en sciences mathématiques
- > les cours du Master en sciences chimiques

ou n'importe quel autre cours (y compris hors ULB)

HULB-0000 (optional)	<b>Cours externe à l'Université</b> ⌚ 5 credits 📅 academic year
TEMP-0000 (optional)	<b>Cours extérieurs au programme</b> ⌚ 5 credits 📅 academic year 🗨️ French

# Master in Physics

## Focus Research

### Bloc 2 | M-PHYSA | MA-PHYS

## Tronc commun

MEMO-F534 **Mémoire** | Bortolo Matteo MOGNETTI (Coordinator) and Patricia Maria LOSADA PEREZ  
 ⌚ 30 credits [mfe/tfe: 360h] 📅 first and second terms

## Cours à options

Choisir 30 crédits, qui seront spécifiques à la finalité, parmi les cours suivants, ainsi que ceux listés en bloc 1. L'étudiant peut aussi choisir n'importe quel autre cours moyennant l'approbation du jury.

*A total of 30 credits chosen from the following*

### Module thématique: Astrophysique et microphysique

GEOL-F4003 (optional) **Origine de la vie et son évolution sur Terre** | Steeve BONNEVILLE (Coordinator)  
 ⌚ 5 credits [lecture: 36h] 📅 first term 🗨️ French

GEOL-F4004 (optional) **Cosmoschimie et planétologie** | Vinciane DEBAILLE (Coordinator) and Alain JORISSEN  
 ⌚ 5 credits [lecture: 36h] 📅 first term  
 Ce cours est donné un an sur deux.

PHYS-F450 (optional) **Météorologie dynamique** | Stéphane VANNITSEM (Coordinator)  
 ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗨️ French

### Module thématique: Interactions fondamentales

PHYS-F417 (optional) **Advanced Quantum Field Theory** | Glenn BARNICH (Coordinator)  
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ English

PHYS-F418 (optional) **Advanced general relativity** | Glenn BARNICH (Coordinator)  
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ English  
 Ce cours n'est pas donné en 2022-2023, 2024-25, etc.

PHYS-F469 (optional) **Physics beyond the standard model** | Thomas HAMBYE (Coordinator) and Michel TYTGAT  
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, seminars: 12h] 📅 first term 🗨️ English

PHYS-F483 (optional) **Théorie des cordes** | Giulio COLLINUCCI (Coordinator)  
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨️ French  
 Ce cours est donné un an sur deux.

### Module thématique: Matière, rayonnement et complexité

PHYS-F450 (optional) **Météorologie dynamique** | Stéphane VANNITSEM (Coordinator)  
 ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗨️ French

PHYS-F475 (optional) **Nanophysics** | Pierre GASPARD (Coordinator) and James LUTSKO  
 ⌚ 5 credits [lecture: 24h, tutorial classes: 24h, project: 36h] 📅 first term 🗨️ English

PHYS-F480 (optional) **Physics of Interfaces** | Patricia Maria LOSADA PEREZ (Coordinator)  
 ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨️ English

PHYS-F512  
(optional)

**Molecular motors and stochastic processes** | Pierre GASPARD (Coordinator)

5 credits [lecture: 36h, tutorial classes: 24h]  first term  English

## Cours d'intérêt général

*One course chosen from the following*

*One course chosen from the following*

HULB-0000  
(optional)

**Cours externe à l'Université**

5 credits  academic year

HULB-0000  
(optional)

**Cours externe à l'Université**

10 credits  academic year

STAG-F017  
(optional)

**Stage en entreprise, hôpital ou centre de recherche non académique** | Stéphane GORIELY (Coordinator)

10 credits [work placement: 120h]  first and second terms  French



# Master in Physics

## Focus Teaching

Physics is concerned with the fundamental laws that govern nature. From elementary particles to the universe at large, physics explores all possible scales, allowing a better understanding of the structure of matter and how to predict its behaviour.

ULB's Master in Physics provides a comprehensive education in physics covering in particular:

- > Plasma physics
- > Nuclear physics
- > Elementary particle and astroparticle physics
- > Fundamental interaction physics
- > Quantum physics
- > Astrophysics and cosmology
- > Statistical physics
- > Complex systems physics
- > Nonlinear optics
- > Condensed matter physics
- > Hydrodynamics

## Bloc 1 | M-PHYSD | MA-PHYS

### Cours obligatoires

- PEDA-E510 **Pédagogie et didactique, aspects généraux** | Thomas BARRIER (Coordinator) and Nathanaël FRIANT  
 ⌚ 5 credits [lecture: 60h] 📅 first term 🗨️ French
- PHYS-F510 **Didactique de la physique (du secondaire et du supérieur)** | Sébastien CLESSE (Coordinator) and PHILIPPE LEONARD  
 ⌚ 5 credits [lecture: 36h] 📅 first term 🗨️ French
- STAG-F015 **Stage dans un service du département I** | Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA  
 ⌚ 5 credits [seminars: 60h] 📅 first and second terms 🗨️ French
- STAG-F018 **Stage et pratique réflexive I** | Serge MASSAR (Coordinator), Laura LOPEZ HONOREZ and Michele SFERRAZZA  
 ⌚ 5 credits [project: 45h, work placement: 105h] 📅 first and second terms 🗨️ French

### Cours optionnels

Choisir 40 crédits parmi les cours suivants (en veillant à choisir un minimum de 20 crédits par quadrimestre). Les cours sont répartis en cours à option présentés en modules thématiques et en cours d'intérêt général. L'étudiant peut choisir ses cours dans plusieurs modules thématiques. [Note: pour un souci de cohérence, certains cours sont repris dans plusieurs modules différents.] L'étudiant peut aussi choisir n'importe quel autre cours (y inclus ceux de Bloc 2) moyennant l'approbation du jury.

*A total of 40 credits chosen from the following*

#### Module thématique: Astrophysique et microphysique

- PHYS-F412 (optional) **Dynamique des fluides et des plasmas** | Bernard KNAEPEN (Coordinator)  
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨️ English/French
- PHYS-F415 (optional) **Cosmologie** | Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE  
 ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French
- PHYS-F426 (optional) **Mécanique des milieux continus : hydrodynamique et solides déformables** | Fabian BRAU (Coordinator) and Gregory KOZYREFF  
 ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨️ French

- PHYS-F431 (optional) **Advanced condensed matter physics and quantum many-body systems** | Nathan GOLDMAN (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English
- PHYS-F432 (optional) **Théorie de la gravitation** | Frank FERRARI (Coordinator) and Stéphane DETOURNAY  
⌚ 5 credits [lecture: 36h, tutorial classes: 24h] 📅 first term 🗣️ French
- PHYS-F434 (optional) **Stellar Atmospheres** | Sophie VAN ECK (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English  
Ce cours est donné un an sur deux.
- PHYS-F438 (optional) **Astrophysics** | Alain JORISSEN (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗣️ English
- PHYS-F463 (optional) **Théorie quantique des collisions et applications aux réactions nucléaires** | Michele SFERRAZZA (Coordinator) and Jean-Marc SPARENBERG  
⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗣️ French  
Ce cours est donné un an sur deux.
- PHYS-F467 (optional) **Astroparticle physics** | Juan Antonio AGUILAR SANCHEZ (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English
- PHYS-F484 (optional) **Gravitational Waves** | Sébastien CLESSE (Coordinator), Nicolas CHAMEL and Geoffrey COMPERE  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English
- Module thématique: Interactions fondamentales**
- PHYS-F410 (optional) **Quantum field theory I** | Petr TINIAKOV (Coordinator)  
⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗣️ English
- PHYS-F415 (optional) **Cosmologie** | Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE  
⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗣️ French
- PHYS-F416 (optional) **Physique des particules** | Barbara CLERBAUX (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗣️ French
- PHYS-F420 (optional) **Particle detection, data acquisition and analysis** | Gilles DE LENTDECKER (Coordinator), Ioana Codrina MARIS and Pascal VANLAER  
⌚ 5 credits [lecture: 12h, tutorial classes: 12h, practical work: 24h] 📅 first term 🗣️ English
- PHYS-F422 (optional) **Modèle standard des interactions fondamentales** | Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE  
⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗣️ French
- PHYS-F432 (optional) **Théorie de la gravitation** | Frank FERRARI (Coordinator) and Stéphane DETOURNAY  
⌚ 5 credits [lecture: 36h, tutorial classes: 24h] 📅 first term 🗣️ French
- PHYS-F440 (optional) **Quantum Field Theory II** | Riccardo ARGURIO (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 12h] 📅 second term 🗣️ English
- PHYS-F467 (optional) **Astroparticle physics** | Juan Antonio AGUILAR SANCHEZ (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English
- PHYS-F477 (optional) **Physics of Strong Interactions** | Laurent FAVART (Coordinator)  
⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗣️ English
- PHYS-F478 (optional) **Solitons and instantons in quantum field theory** | Michel TYTGAT (Coordinator)  
⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗣️ English/French  
Ce cours n'est pas donné en 2022-23, 2024-25, etc.

## Module thématique: Matière, rayonnement et complexité

- HULB-0000 (optional) **Cours externe à l'Université**  
⌚ 5 credits 📅 academic year
- PHYS-F314 (optional) **Electronique** | Gilles DE LENTDECKER (Coordinator), Juan Antonio AGUILAR SANCHEZ and Yifan YANG  
⌚ 5 credits [lecture: 24h, tutorial classes: 6h, practical work: 30h] 📅 first term 🗣️ French



PHYS-F407 (optional)	<b>Polymer physics</b>   Simone NAPOLITANO (Coordinator) ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨 French
PHYS-F411 (optional)	<b>Physique non-linéaire</b>   Thomas GILBERT (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨 French
PHYS-F412 (optional)	<b>Dynamique des fluides et des plasmas</b>   Bernard KNAEPEN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 first term 🗨 English/French
PHYS-F426 (optional)	<b>Mécanique des milieux continus : hydrodynamique et solides déformables</b>   Fabian BRAU (Coordinator) and Gregory KOZYREFF ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 French
PHYS-F427 (optional)	<b>Méthodes asymptotiques en physique</b>   Gregory KOZYREFF (Coordinator) and Fabian BRAU ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 French
PHYS-F431 (optional)	<b>Advanced condensed matter physics and quantum many-body systems</b>   Nathan GOLDMAN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨 English
PHYS-F442 (optional)	<b>Physique statistique II</b>   Pierre GASPARD (Coordinator) and PATRICK GROSFILS ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 12h] 📅 first term 🗨 French
PHYS-F446 (optional)	<b>Processus stochastiques et systèmes complexes</b>   Thomas GILBERT (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 French
PHYS-F474 (optional)	<b>Quantum optics</b>   Stéphane CLEMMEN (Coordinator) and Serge MASSAR ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 English
PHYS-F476 (optional)	<b>Optique non linéaire et physique des lasers</b>   Mustapha TLIDI (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 French
PHYS-F481 (optional)	<b>Simulation methods in statistical physics</b>   Bortolo Matteo MOGNETTI (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 second term 🗨 English
PHYS-F482 (optional)	<b>Advanced techniques of experimental physics</b>   Denis TERWAGNE (Coordinator), Juan Antonio AGUILAR SANCHEZ and Pascal VANLAER ⌚ 5 credits [lecture: 24h, practical work: 24h] 📅 first term 🗨 English
PHYS-F485 (optional)	<b>Representation of groups and application to physics</b>   Geoffrey COMPERE (Coordinator) and Giulio COLLINUCCI ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, project: 10h] 📅 first term 🗨 English
PHYS-F509 (optional)	<b>Quantum Information Theory</b>   Stefano PIRONIO (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h] 📅 first term 🗨 English/French
PHYS-H302 (optional)	<b>Eléments d'optique physique</b> ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 📅 second term 🗨 French



# Master in Physics

## Focus Teaching

### Bloc 2 | M-PHYSD | MA-PHYS

## Cours obligatoires

- EDUC-E520 **Aspects socio-historiques, psychologiques, culturels, éthiques et de neutralité de l'enseignement** | Jose-Luis WOLFS (Coordinator), Alain COLSOUL, Philippe VIENNE and Pascal VREBOS  
 5 credits [lecture: 60h] first and second terms French
- MEMO-F535 **Mémoire** | Bortolo Matteo MOGNETTI (Coordinator) and Patricia Maria LOSADA PEREZ  
 30 credits [mfe/tfe: 360h] first and second terms
- STAG-F019 **Stages et pratique réflexive II** | Serge MASSAR (Coordinator), Laura LOPEZ HONOREZ and Michele SFERRAZZA  
 10 credits [project: 45h, work placement: 105h] first and second terms French

## Cours optionnels

Choisir 15 crédits parmi les cours suivants, ainsi que ceux listés en bloc 1. L'étudiant peut aussi choisir n'importe quel autre cours moyennant l'approbation du jury.

*A total of 15 credits chosen from the following*

### Module thématique: Astrophysique et microphysique

GEOL-F4003 (optional) **Origine de la vie et son évolution sur Terre** | Steeve BONNEVILLE (Coordinator)  
 5 credits [lecture: 36h] first term French

GEOL-F4004 (optional) **Cosmoschimie et planétologie** | Vinciane DEBAILLE (Coordinator) and Alain JORISSEN  
 5 credits [lecture: 36h] first term  
 Ce cours est donné un an sur deux.

PHYS-F450 (optional) **Météorologie dynamique** | Stéphane VANNITSEM (Coordinator)  
 5 credits [lecture: 24h, tutorial classes: 24h] first term French

### Module thématique: Interactions fondamentales

PHYS-F417 (optional) **Advanced Quantum Field Theory** | Glenn BARNICH (Coordinator)  
 5 credits [lecture: 36h, tutorial classes: 12h] first term English

PHYS-F418 (optional) **Advanced general relativity** | Glenn BARNICH (Coordinator)  
 5 credits [lecture: 36h, tutorial classes: 12h] second term English  
 Ce cours n'est pas donné en 2022-2023, 2024-25, etc.

PHYS-F469 (optional) **Physics beyond the standard model** | Thomas HAMBYE (Coordinator) and Michel TYTGAT  
 5 credits [lecture: 36h, tutorial classes: 12h, seminars: 12h] first term English

PHYS-F483 (optional) **Théorie des cordes** | Giulio COLLINUCCI (Coordinator)  
 5 credits [lecture: 36h, tutorial classes: 12h] second term French  
 Ce cours est donné un an sur deux.

### Module thématique: Matière, rayonnement et complexité

PHYS-F450 (optional) **Météorologie dynamique** | Stéphane VANNITSEM (Coordinator)  
 5 credits [lecture: 24h, tutorial classes: 24h] first term French

PHYS-F475  
(optional)

**Nanophysics** | Pierre GASPARD (Coordinator) and James LUTSKO  
5 credits [lecture: 24h, tutorial classes: 24h, project: 36h] first term English

PHYS-F480  
(optional)

**Physics of Interfaces** | Patricia Maria LOSADA PEREZ (Coordinator)  
5 credits [lecture: 24h, practical work: 24h] first term English

PHYS-F512  
(optional)

**Molecular motors and stochastic processes** | Pierre GASPARD (Coordinator)  
5 credits [lecture: 36h, tutorial classes: 24h] first term English

## Cours d'intérêt général

*One course chosen from the following*

HULB-0000  
(optional)

**Cours externe à l'Université**  
5 credits academic year

HULB-0000  
(optional)

**Cours externe à l'Université**  
10 credits academic year