Master in Physics

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

Programme objectives

- Acquire 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

- Master the scientific thought process and approach:
  ○ Deduce new laws from observational facts, possibly through an interdisciplinary approach, and formalise them within a theory
  ○ 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
  ○ To master the main mathematical, experimental and technological tools of modern physics
  ○ To use fundamental principles of physics to create or innovate
  ○ To deduce new laws from observational facts, possibly through an interdisciplinary approach, and to formalize them within a theory
  ○ To discover new consequences of existing theories
  ○ To conceptualize and to model complex principles
  ○ To formulate working hypothesis or experimental protocols that can be tested and possibly refuted to assess the precision of these theories
  ○ To develop, optimize and exploit experimental devices
  ○ To analyze data
  ○ To confront experimental measurements with theoretical predictions and with simulations

- Learn to communicate appropriately depending on context and target audience:
  ○ To present research in a scientifically rigorous way, with an appropriate bibliography
  ○ To present various aspects of physics, taking context and target audience into account

- Develop professional skills while applying ethical principles in one's area of expertise:
  ○ To be self-critical in the evaluation of one's own skills
  ○ Respect sources and intellectual property
  ○ To be conscious of the importance of applying ethical rules when dealing with technological applications of physics
  ○ To 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)

- To communicate in a manner adapted to the context and the public:
  ○ To present research in a scientifically rigorous way, with an appropriate bibliography
It implies learning computing sciences and to develop new research axes (in research institutes, but also in the private sector). It involves learning mathematical tools. It also implies a strong methodology and a scientific background allowing one to tackle new problems of mathematical tools. It also implies both a working method and a scientific background, in order for the physicist 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. The ULB Physics Department still hosts the direction of International Solvay Institutes for Physics and Chemistry. The Solvay Institutes contribute to the development and international recognition of the Physics Department.

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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.

Students may complete an Erasmus exchange programme for 1 or 2 semesters, in the Bloc 1 or 2. They may also attend classes in other departments, faculties, or universities (UCL, KUL, ULG, UMon, etc.), subject to approval by the Master jury (Bloc 1 or 2 of the Master).

Dissertation topics can be chosen in partnership with research centres (CERN, Royal Meteorological Institute, Royal Observatory of Belgium, etc.), hospitals (Erasme), and private companies.

Some courses are given jointly with the Vrije Universiteit Brussel and KULeuven.

Job opportunities

Today, a wide range of activities needs a physicist’s skills:
Faculty of Sciences

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 exert in a wide range of capacities: academic researcher, industrial researcher, teacher, financial sector, consultant,... They are encountered where new technologies develop, in research laboratories, in development or production industry units. They are apt to take up new challenges such as inventing new materials, investigating global warming and pollution, developing space missions... Their physics background helps them to apply analytical reasoning to other disciplines (environment, finance, biophysics, medicine,...), thereby enabling them to solve the problems encountered in our modern societies. Thanks to all of these qualities, physicists easily find jobs.

Contacts

ma-phys@ulb.ac.be
+32 2 650 55 03
https://sciences.ulb.be/departement-physique

Jury President
Bortolo Matteo MOGNETTI

Jury Secretary
Patricia Maria LOSADA PEREZ
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**

<table>
<thead>
<tr>
<th>COURS</th>
<th>CREDITS</th>
<th>DESCRIPTION</th>
<th>PRÉPARATEURS</th>
<th>MODALITÉS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS-F435</td>
<td>5 credits</td>
<td>Stage dans un service du département I</td>
<td>Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA</td>
<td>60h seminars (30h first term, 30h second term) French</td>
</tr>
<tr>
<td>PHYS-F436</td>
<td>5 credits</td>
<td>Stage dans un service du département II</td>
<td>Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA</td>
<td>60h seminars (30h first term, 30h second term) French</td>
</tr>
</tbody>
</table>

**Cours à options**

Choose 50 credits from the following courses (ensuring a minimum of 20 credits per semester). The courses are divided into thematic modules and general interest courses. The student can choose courses from different thematic modules. [Note: for coherence, some courses are repeated in different thematic modules.] The student can also choose any other course (including those from Bloc 2).

A total of 50 credits chosen from the following:

**Module thématique: Astrophysique et microphysique**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>MATH-F426</td>
<td>5 credits</td>
<td>Mécanique des milieux continus : hydrodynamique et solides déformables</td>
<td>Fabian BRAU (Coordinator) and Gregory KOZYREFF</td>
<td>24h lecture, 24h tutorial (30h second term) French</td>
</tr>
<tr>
<td>PHYS-F412</td>
<td>5 credits</td>
<td>Dynamique des fluides et des plasmas</td>
<td>Bernard KNAEPEN (Coordinator)</td>
<td>36h lecture, 12h tutorial (18h first term) French</td>
</tr>
<tr>
<td>PHYS-F415</td>
<td>5 credits</td>
<td>Cosmologie</td>
<td>Thomas HAMBYE (Coordinator)</td>
<td>30h lecture, 18h tutorial (30h second term) French</td>
</tr>
<tr>
<td>PHYS-F421</td>
<td>5 credits</td>
<td>Nucleosynthesis</td>
<td>Stéphane GORIELY (Coordinator)</td>
<td>36h lecture, 12h tutorial (30h second term) English</td>
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</table>

Ce cours n’est pas donné en 2022-23.
<table>
<thead>
<tr>
<th>COURS</th>
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<th>ANNÉE</th>
<th>LANGUE</th>
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<tbody>
<tr>
<td>PHYS-F431</td>
<td>Advanced condensed matter physics and quantum many-body systems</td>
<td>Nathan GOLDMAN (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F432</td>
<td>Théorie de la gravitation</td>
<td>Frank FERRARI (Coordinator) and Stéphane DETOURNAY</td>
<td>5</td>
<td>36h, 24h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F434</td>
<td>Atmosphères stellaires</td>
<td>Sophie VAN ECK (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>French</td>
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<tr>
<td>PHYS-F438</td>
<td>Astrophysique</td>
<td>Alain JORISSEN (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F432</td>
<td>Théorie quantique des collisions et applications aux réactions nucléaires</td>
<td>Pierre DESCOUVEMENT (Coordinator)</td>
<td>5</td>
<td>24h, 24h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F467</td>
<td>Physique des astroparticules</td>
<td>Juan Antonio AGUILAR SANCHEZ (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>French</td>
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**Module thématique: Interactions fondamentales**

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<tbody>
<tr>
<td>PHYS-F410</td>
<td>Théorie quantique des champs I</td>
<td>Petr TINIAKOV (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F415</td>
<td>Cosmologie</td>
<td>Thomas HAMBYE (Coordinator)</td>
<td>5</td>
<td>30h, 18h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F416</td>
<td>Physique des particules</td>
<td>Barbara CLERBAUX (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F420</td>
<td>Détetection de particules, acquisition et analyse de données</td>
<td>Gilles DE LENTDECKER (Coordinator), Ioana Codrina MARIS and Pascal VANLAE</td>
<td>5</td>
<td>12h, 24h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F422</td>
<td>Modèle standard des interactions fondamentales</td>
<td>Michel TYTGAT (Coordinator) and Thomas HAMBYE</td>
<td>5</td>
<td>30h, 18h</td>
<td>second term</td>
<td>French</td>
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<tr>
<td>PHYS-F432</td>
<td>Théorie de la gravitation</td>
<td>Frank FERRARI (Coordinator) and Stéphane DETOURNAY</td>
<td>5</td>
<td>36h, 24h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F440</td>
<td>Théorie quantique des champs II</td>
<td>Riccardo ARGURIO (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F467</td>
<td>Physique des astroparticules</td>
<td>Juan Antonio AGUILAR SANCHEZ (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F477</td>
<td>Physique des interactions fortes</td>
<td>Laurent FAVART (Coordinator)</td>
<td>5</td>
<td>24h, 24h</td>
<td>second term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F478</td>
<td>Solitons and instantons in quantum field theory</td>
<td>Petr TINIAKOV (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>second term</td>
<td>English</td>
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**Module thématique: Matière, rayonnement et complexité**

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<tbody>
<tr>
<td>PHYS-F407</td>
<td>Polymer physics</td>
<td>Simone NAPOLITANO (Coordinator)</td>
<td>5</td>
<td>24h, 24h</td>
<td>first term</td>
<td>French</td>
</tr>
<tr>
<td>PHYS-F411</td>
<td>Physique non-linéaire</td>
<td>Thomas GILBERT (Coordinator)</td>
<td>5</td>
<td>36h, 12h</td>
<td>first term</td>
<td>French</td>
</tr>
</tbody>
</table>

Ce cours n'est pas donné en 2022-23, 2024-25, etc.
Dynamique des fluides et des plasmas | Bernard KNAEPEN (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h]  
First term  French

Advanced condensed matter physics and quantum many-body systems | Nathan GOLDMAN (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h]  
Second term  French

Physique statistique II | Pierre GASPARD (Coordinator) and PATRICK GROSFILS
5 credits [lecture: 36h, tutorial classes: 12h]  
First term  French

Processus stochastiques et systèmes complexes | Thomas GILBERT (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  
Second term  French

Optique quantique | Stéphane CLEMMEN (Coordinator) and Serge MASSAR
5 credits [lecture: 24h, tutorial classes: 24h]  
English

Optique non linéaire et physique des lasers | Mustapha TLIDI (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  
Second term  French

Méthodes numériques pour la mécanique statistique | Bartolo Matteo MOGNETTI (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  
Second term  French

Quantum Information Theory | Stefano PIRONIO (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  
First term  French

How To Make (almost) Any Experiment Using Digital Fabrication | Denis TERWAGNE (Coordinator)
5 credits [lecture: 24h, practical work: 24h]  
Second term  French

Cours d’intérêt général

Cours externe à l’Université
5 credits  Academic year

Compléments de mathématiques : Analyse appliquée | Ignace LORIS (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h]  
Second term  French

Représentation des groupes et application à la physique | Geoffrey COMPERE (Coordinator) and Giulio COLLINUCCI
5 credits [lecture: 24h, tutorial classes: 24h]  
French

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

Méthodes asymptotiques en physique | Gregory KOZYREFF (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  
Second term  French

Techniques avancées de physique expérimentale | Alain JORISSEN (Coordinator), Gilles DE LENTDECKER, Denis TERWAGNE and Pascal VANLAER
5 credits [lecture: 24h, practical work: 24h]  
First term  French

Eléments d’optique physique | Marc HAELETERMAN (Coordinator)
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’Ecole 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)

Cours externe à l’Université
5 credits  Academic year
Cours extérieurs au programme

5 credits  academic year  French
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.

A total of 30 credits chosen from the following

Module thématique: Astrophysique et microphysique

GEOL-F4003 Cosmosochimie, planétologie, origine de la vie et son évolution sur Terre I | Steeve BONNEVILLE (Coordinator)
5 credits [lecture: 36h]  first term  French
Ce cours n’est pas donné en 2022-23, 2024-25, etc.

GEOL-F4004 Cosmosochimie, planétologie, origine de la vie et son évolution sur Terre II | Vinciane DEBAILLE (Coordinator) and Alain JORISSEN
5 credits [lecture: 36h]  first term

PHYS-F414 Structure et évolution stellaire | Lionel SIESS (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h]  first term  French
Ce cours n’est pas donné en 2022-23, 2024-25, etc.

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

Module thématique: Interactions fondamentales

PHYS-F417 Théorie quantique des champs avancée | Glenn BARNICH (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  first term  French

PHYS-F418 Gravitation avancée | Glenn BARNICH (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h]  second term  French
Ce cours n’est pas donné en 2022-2023, 2024-25, etc.

PHYS-F469 Physics beyond the standard model | Laura LOPEZ HONOREZ (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h, seminars: 12h]  first term  English
Ce cours n’est pas donné en 2021-22, 2023-24 etc.

PHYS-F483 Théorie des cordes | Giulio COLLINUCCI (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h]  second term  French
Ce cours n’est pas donné en 2021-22, 2023-24 etc.

Module thématique: Matière, rayonnement et complexité

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

PHYS-F475 Nanophysique | Pierre GASPARD (Coordinator) and James LUTSKO
5 credits [lecture: 24h, tutorial classes: 24h]  first term  French
PHYS-F480  Physics of Interfaces | Patricia Maria LOSADA PEREZ (Coordinator)
- 5 credits [lecture: 24h, practical work: 24h]
- first term
- English

PHYS-F512  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  Cours externe à l'Université
- 5 credits
- academic year

HULB-0000  Cours externe à l'Université
- 10 credits
- academic year

PHYS-F507  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-F435**  
  Stage dans un service du département I | Juan Antonio AGUILAR SANCHEZ (Coordinator) and Michele SFERRAZZA  
  5 credits [seminars: 60h]  
  first and second terms  
  French

- **PHYS-F443**  
  Stage et pratique réflexive I | Serge MASSAR (Coordinator), Laura LOPEZ HONOREZ and Michele SFERRAZZA  
  5 credits [practical work: 12h, work placement: 48h]  
  first and second terms  
  French

- **PHYS-F510**  
  Didactique de la physique (du secondaire et du supérieur) | Pasquale NARDONE (Coordinator) and Sébastien CLESSE  
  5 credits [lecture: 36h]  
  first term  
  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).

**A total of 40 credits chosen from the following**

- **Module thématique: Astrophysique et microphysique**
  - **MATH-F426**  
    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-F412**  
    Dynamique des fluides et des plasmas | Bernard KNAEPEN (Coordinator)  
    5 credits [lecture: 36h, tutorial classes: 12h]  
    first term  
    French
<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>Coordinator</th>
<th>Credits</th>
<th>Lectures</th>
<th>Tutorial classes</th>
<th>Term</th>
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<tr>
<td>PHYS-F415</td>
<td>Cosmologie</td>
<td>Thomas HAMBYE (Coordinator)</td>
<td>5</td>
<td>30h</td>
<td>18h</td>
<td>2nd Term</td>
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<td>PHYS-F421</td>
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<td>Stéphane GORIELY (Coordinator)</td>
<td>5</td>
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<td>12h</td>
<td>2nd Term</td>
<td>English</td>
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<td>PHYS-F431</td>
<td>Advanced condensed matter physics and quantum many-body systems</td>
<td>Nathan GOLDMAN (Coordinator)</td>
<td>5</td>
<td>36h</td>
<td>12h</td>
<td>2022-23</td>
<td>French</td>
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<tr>
<td>PHYS-F432</td>
<td>Théorie de la gravitation</td>
<td>Frank FERRARI (Coordinator) and Stéphane DETOURNAY</td>
<td>5</td>
<td>36h</td>
<td>24h</td>
<td>1st Term</td>
<td>French</td>
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<td>PHYS-F434</td>
<td>Atmosphères stellaires</td>
<td>Sophie VAN ECK (Coordinator)</td>
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<td>Pierre DESCOUVEMONT (Coordinator)</td>
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<td>Juan Antonio AGUILAR SANCHEZ (Coordinator)</td>
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<td>Petr TINIAKOV (Coordinator)</td>
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Ce cours n'est pas donné en 2022-23, 2024-25, etc.

Ce cours ne sera pas donné en 2019-2020.

Ce cours n'est pas donné en 2021-22.
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<td>Bernard KNAEPEN (Coordinator)</td>
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<td>Nathan GOLDMAN (Coordinator)</td>
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<td>Pierre GASPARD (Coordinator) and PATRICK GROSFILS</td>
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<td>Thomas GILBERT (Coordinator)</td>
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<td>Stéphane CLEMMEN (Coordinator) and Serge MASSAR</td>
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<td>Mustapha TLIDI (Coordinator)</td>
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<td>Bertolo Matteo MOGNETTI (Coordinator)</td>
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<td>Stefano PIRONIO (Coordinator)</td>
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<td><strong>How To Make (almost) Any Experiment Using Digital Fabrication</strong></td>
<td>Denis TERWAGNE (Coordinator)</td>
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**Cours d'intérêt général**

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<td>Ignace LORIS (Coordinator)</td>
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<td>Geoffrey COMPERE (Coordinator) and Giulio COLLINUCCI</td>
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<td>Gregory KOZYREFF (Coordinator)</td>
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<td><strong>Techniques avancées de physique expérimentale</strong></td>
<td>Alain JORISSEN (Coordinator), Gilles DE LENTDECKER, Denis TERWAGNE and Pascal VANLAER</td>
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<td>Marc HAELTERMAN (Coordinator)</td>
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Cours obligatoires

EDUC-E520  
**Aspects socio-historiques, psychologiques, culturels, éthiques et de neutralité de l'enseignement**  
José-Luis WOLFS (Coordinator), Alain COLSOUL, Philippe VIENNE and Pascal VREBOS  
5 credits [lecture: 60h]  |  academic year  |  French

MEMO-F535  
**Mémoire**  
Bortolo Matteo MOGNETTI (Coordinator) and Patricia Maria LOSADA PEREZ  
30 credits [mfe/tfe: 360h]  |  first and second terms

PHYS-F511  
**Stage et pratique réflexive II**  
Serge MASSAR (Coordinator), Laura LOPEZ HONOREZ and Michele SFERRAZZA  
10 credits [practical work: 24h, work placement: 96h]  |  academic year  |  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.

A total of 15 credits chosen from the following

**Module thématique: Astrophysique et microphysique**

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

GEOL-F4004  
**Cosmoschimie, planétologie, origine de la vie et son évolution sur Terre II**  
Vinciane DEBAILLE (Coordinator) and Alain JORISSEN  
5 credits [lecture: 36h]  |  first term

PHYS-F414  
**Structure et évolution stellaire**  
Lionel SIÈSS (Coordinator)  
5 credits [lecture: 36h, tutorial classes: 12h]  |  first term  |  French

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

**Module thématique: Interactions fondamentales**

PHYS-F417  
**Théorie quantique des champs avancée**  
Glenn BARNICH (Coordinator)  
5 credits [lecture: 24h, tutorial classes: 24h]  |  first term  |  French

PHYS-F418  
**Gravitation avancée**  
Glenn BARNICH (Coordinator)  
5 credits [lecture: 24h, tutorial classes: 24h]  |  second term  |  French

PHYS-F469  
**Physics beyond the standard model**  
Laura LOPEZ HONOREZ (Coordinator)  
5 credits [lecture: 36h, tutorial classes: 12h, seminars: 12h]  |  first term  |  English

PHYS-F483  
**Théorie des cordes**  
Giulio COLLINUCCI (Coordinator)  
5 credits [lecture: 36h, tutorial classes: 12h]  |  second term  |  French
Module thématique: Matière, rayonnement et complexité

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

PHYS-F475  Nanophysique | Pierre GASPARD (Coordinator) and James LUTSKO
☐ 5 credits [lecture: 24h, tutorial classes: 24h]  ☐ first term  ☐ French

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

PHYS-F512  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  Cours externe à l'Université
☐ 5 credits  ☐ academic year

HULB-0000  Cours externe à l'Université
☐ 10 credits  ☐ academic year