

PHYS2M1 - Introduction

Introduction

Introduction

The physicist possesses great capacities of reasoning and abstraction. He/she continually asks questions about the physical world around him/her in order to understand how it works. He/she observes, makes assumptions, formalizes concepts, and writes and solves the equations governing them in order to confront them with observations and experience. Thanks to his/her advanced and versatile scientific training, he/she contributes to the great challenges of the Society of today and tomorrow. He/she is involved in cutting-edge research and the resolution of important questions related to the genesis and evolution of the Universe, fundamental interactions between elementary particles, quantum optics, statistical physics, origins of the Earth, global climate change, sustainable development, energy choices, etc.

The skills developed by the physicist as part of his/her training, including his/her ability to model and characterize large data sets, can be valued in many professions specific to the realms of today's physics, such as superconductivity, instrumentation and metrology, laser physics, nuclear physics, nonlinear physics, cosmology, astrophysics, astronomy, planetology, geophysics, meteorology, climatology, oceanography and glaciology, or fields as diverse as medical sciences, space sciences and signal processing, but also actuarial sciences, finance, consultancy, banking and all areas where statistical methods, IT and tools related to artificial intelligence are important. Through his/her teamwork skills, the physicist also develops skills in communication, scientific popularization and management. His/her various skills enables him/her to contribute to the creation of tomorrow's jobs.

The objective the Master [120] in Physics is to enable you : (1) to master the fundamental laws and essential tools of today's physics and (2) to acquire disciplinary skills and cross-cutting essential to exercise a professional activity related to physics. It does not give access to the PhD in Science.

Your profile

You hold a Bachelor's degree in physics or a Bachelor's or Master's degree in a discipline related to physics and you want complete in one year your training in physics. You then have the profile to begin a Master [60] in Physics. You will have the chance to receive a personalized training with internationally recognized teachers.

Your future job

The training in physics aims at mastering advanced physical and mathematical tools. It develops skills such as curiosity and scientific rigor, the capacity for abstraction, the modeling of complex physical problems, the sense of precision and experimental measurement as well as the ability to work in a team and to communicate.

Thanks to this versatile training, there are many career opportunities.

One main track is to start a career in develops 9e 1 w 0 0.5 acit a 380.04299927 Tm bnities.

PHYS2M1 - Teaching profile

Learning outcomes

Observe and understand the physical reality of the world around him/her, understand it, explain it and model it, these are the challenges that the student enrolled in the Master [60] in Physics is preparing to meet. This programme aims to develop mastery of the fundamental laws and essential tools of today's physics. It leads to the acquisition of skills such as the ability to analyze a physical problem, the ability of abstraction and modeling, the rigor in reasoning and expression, the autonomy and the ability to communicate, including in English.

At the end of his/her training at the Faculty of Sciences, the student will have acquired the disciplinary and cross-disciplinary knowledge, and skills needed to perform numerous professional activities. His/her modeling and in-depth understanding of phenomena, his/her liking for research and his/her scientific rigor will be sought not only in scientific professions (research, development, teaching, etc.), but also more generally in the current and future Society.

On successful completion of this programme, each student is able to :

1. Master and use in depth the specialized knowledges of physics.

1.1 Formulate the fundamental concepts of current physical theories, highlighting their main ideas, and link these theories together.

1.2 Identify and apply physical theories to solve a problem.

1.3 Know and use adequately the principles of experimental physics : measurements, their uncertainties, measuring instruments and their calibration, the processing of data by computer tools.

1.4 Explain and design a measurement method and implement it.

1.5 Model complex systems and predict their evolution using numerical methods, including computer simulations.

1.6 Retrace the historical evolution of physical concepts and recognize their application in various fields (e.g., engineering, medicine, etc.).

8.1 Achieve a level of expertise in a chosen field of contemporary physics.

8.2 Deepen a subject beyond current knowledge.

Programme structure

The programme leading to the Master's [60] degree in physics includes :

- 30 credits of specialized training in physics, to be chosen from a list of teaching units organized into subject blocks,
- 2 credits of training in human sciences, to be chosen from a list of teaching units,
- 18 credits of activities related to the Master's thesis,
- 10 credits of elective teaching units, to be selected from a list of teaching units organized into subject blocks.

Typical programmes, according to the different orientations of the research in physics carried out at UCLouvain, are proposed on the website of the School of Physics in the "Education and Training" section. There are nine of them. They relate to :

- statistical physics and mathematical physics,
- formal aspects of fundamental interactions,
- theory and phenomenology of fundamental interactions,
- experimentation in physics of fundamental interactions,
- instrumentation in physics of fundamental interactions,
- atomic, molecular physics and optics from the theoretical point of view,
- atomic, molecular physics and optics from the experimental point of view,
- physical climatology,
- physics of the Earth and planets.

PHYS2M1 Programme

Detailed programme by subject

CORE COURSES [50.0]

- Mandatory
- ⊗ Optional
- △ Not offered in 2024-2025
- ⊙ Not offered in 2024-2025 but offered the following year
- ⊕ Offered in 2024-2025 but not the following year
- △ ⊕ Not offered in 2024-2025 or the following year
- Activity with requisites
- 🌐 Open to incoming exchange students
- 🚫 Not open to incoming exchange students
- (FR) Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

○ Formation spécialisée en physique (30 credits)

NB : Des programmes types en fonction des orientations de la recherche en sciences physiques à l'UCLouvain sont proposés sur le site Web de l'école de physique. L'étudiant-e choisit 30 crédits parmi :

The students have to choose 28 credits minimum between the following courses

⊗ Physique statistique et mathématique

⊗ LPHYS2112	Mathematical physics	Christophe Ringeval	EN [q1] [30h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2113	Critical phenomena	Philippe Ruelle	EN [q1] [22.5h+7.5h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2114	Nonlinear dynamics	Michel Crucifix	EN [q1] [22.5h+22.5h] [5 Credits] 🌐 > French-friendly

⊗ Gravitation, cosmologie et astroparticules

⌘ LPHYS2122	Cosmology	Christophe Ringeval	EN [q2] [30h] [5 Credits] > French-friendly
⌘ Physique des particules			
⌘ LPHYS2131	Fundamental interactions and elementary particles	Agni Bethani (compensates Christophe Delaere) Céline Degrande Christophe Delaere Vincent Lemaître	EN [q1] [52.5h+7.5h] [10 Credits] > French-friendly
⌘ LPHYS2132	Quantum field theory 1	Céline Degrande Marco Drewes	EN [q1] [52.5h+7.5h] [10 Credits] > French-friendly
⌘ Physique atomique, moléculaire et optique			
⌘ LPHYS2141	Introduction to quantum optics	Mathieu Génévriez Xavier Urbain	EN [q1] [22.5h+7.5h] [5 Credits] > French-friendly
⌘ LPHYS2143	Optics and lasers	Clément Lauzin	EN [q1] [22.5h+22.5h] [5 Credits] > French-friendly
⌘ Physique de la Terre, des planètes et du climat			
⌘ LPHYS2161	Internal geophysics of the Earth and planets		EN [q1] [22.5h+7.5h] [5 Credits] > French-friendly
⌘ LPHYS2162	Introduction to the physics of the climate system and its modelling	Hugues Goosse Francesco Ragone	EN [q1] [22.5h+22.5h] [5 Credits] > French-friendly
⌘ LPHYS2163	Atmosphere and ocean : physics and dynamics		



UE au choix [10.0]

Philippe Ruelle

UE AU CHOIX [10.0]

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o Content:

⊗ Physique statistique et mathématique










⊗ LPHYS2211	Group theory	Philippe Ruelle	EN [q2] [22.5h+22.5h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2211	Statistical field theory	Christian Walmsley Hagendorf	EN

Physique statistique et mathématique

⊗ Physique statistique et mathématique

Emmanuel Dekemper

⌘ **Physique de la Terre, des planètes et du climat**

⌘ LPHYS2260	Geodesy and GNSS (Global Navigation Satellite System)		EN [q2] [30h] [5 Credits]   > French-friendly
⌘ LPHYS2264	Oscillations and instabilities in the climate system	Michel Crucifix	EN [q2] [30h] [5 Credits]   > French-friendly
⌘ LPHYS2265	Sea ice-ocean-atmosphere interactions in polar regions	Thierry Fichet	EN [q2] [30h] [5 Credits]   > French-friendly
⌘ LPHYS2266	Physics of the upper atmosphere and space	Viviane Pierrard	EN [q2] [22.5h+7.5h] [5 Credits]  > French-friendly
⌘ LPHYS2267	Paleoclimate dynamics and modelling	Qiuzhen Yin	EN [q2] [22.5h+7.5h] [5 Credits]  > French-friendly
⌘ LPHYS2268	Forecast, prediction and projection in climate science	François Massonnet	EN [q2] [22.5h+7.5h] [5 Credits]  > French-friendly
⌘ LPHYS2269	Remote sensing of climate change	Emmanuel Dekemper	

Supplementary classes

The programme's courses and learning outcomes

For each UCLouvain training programme, a [reference framework of learning outcomes](#) specifies the the skills expected of every graduate on completion of the programme. Course unit descriptions specify targeted learning outcomes, as well as the unit's contribution to reference framework of learning outcomes.

	Direct access
Bachelier en sciences de l'ingénieur - orientation ingénieur civil	Access with additional training
Bachelors of the Dutch speaking Community of Belgium	
	Direct access
Foreign Bachelors	
	Direct access

Non university Bachelors

> Find out more about [links](#) to the university

Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
"Licenciés"		-	
Masters		-	

Holders of a non-University 2nd cycle degree

Access based on validation of professional experience

> It is possible, under certain conditions, to use one's personal and professional experience to enter a university course without having the required qualifications. However, validation of prior experience does not automatically apply to all courses. Find out more about [Validation of priori experience](#).

Access based on application

Access based on application : access may be granted either directly or on the condition of completing additional courses of a maximum of 60 ECTS credits, or refused.

The first step in the procedure is to submit a file online (see

Teaching method

Most teaching units are given by default in English.

Various teaching methods are used : lectures, flipped classroom, project-based learning, etc. Exercise and practical lab sessions are organized for certain teaching units. Individual or group projects are planned for most of the teaching units. These projects play a significant role (around 20%) in the final grade.

Almost all teaching units have a website on the MoodleUCL platform. Useful information is provided, as well as syllabi and other documents essential to student's work.

The Master's thesis is a formative activity that must lead students to demonstrate their ability to (1) deal in depth with a physical problem in all its real complexity, by conducting a personal research, under the direction of a promoter, and (2) write a summary of his/her work and defend it in public in a rigorous and educational way, while being able to answer relatively specific questions. The various stages are : constitution of a relevant bibliography on the subject, reading and understanding of the selected articles, implementation and execution of the project, analysis and interpretation of the results obtained, writing of a synthesis manuscript and oral presentation of the latter. To carry out this project, the student is embedded in a research group with which he/she can interact.

A "thesis tutorial" introduces the student to scientific communication and, in particular, to the oral presentation of a scientific subject in English.

Evaluation

The evaluation methods comply with the [regulations concerning studies and exams](#). More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading "Learning outcomes evaluation method".

The evaluation methods are in accordance with the regulations for studies and examinations. More details on the terms and conditions specific to each teaching unit are available in their fact sheet under the heading "Assessment of student achievement".

The student is evaluated on the basis of the personal work that he/she will have accomplished (readings, consultation of databases and bibliographical references, writing of monographs and reports, presentation of seminars, dissertation, etc.). When the training requires it, the student is also evaluated regarding his/her ability to assimilate the masterly taught subject. The evaluation of the Master's thesis is based on the work performed during the year and its written and oral presentation.

To obtain the average, the marks obtained for the different teaching units are weighted by their respective credits.

If a student enrolled in an exam at the January session has not been able to present the examination for reasons of force majeure which are duly justified, he/she may ask the President of the Jury for permission to present the examination at the June session. The President of the Jury judges the relevance of the application and, if the course owner agrees, may authorize the student to present the examination at the June session.

Possible trainings at the end of the programme

The only university programme directly accessible from the Master [60] in Physics is the Agrégation de l'enseignement secondaire supérieur (30 credits). It is also possible to complete in one year the Master [120] in Physics giving access to the PhD in Science and specialized Masters. The attention of students is drawn to the fact that such a course requires the submission of two Master's theses and may include up to 15 credits of additional teaching units.

Contacts

Curriculum Management

Entity

Structure entity

Denomination

Faculty

Sector

Acronym

Postal address

Website

Academic supervisor: [Vincent Lemaître](#)

Jury

SST/SC/PHYS

[\(PHYS\)](#)

Faculty of Science [\(SC\)](#)

Sciences and Technology [\(SST\)](#)

PHYS

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<https://uclouvain.be/fr/facultes/sc/phys>

- President: [Christophe Ringeval](#)
- Secretary: [Christophe Delaere](#)
- Study advisor: [François Monnet](#)
- Study advisor: [Gauthier Durieux](#)

Useful Contact(s)

- Administrative manager for the student's annual program: [Catherine De Roy](#)

