



## PHYS2M1 - Introduction

### Introduction

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#### 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

## PHYS2M1 - Teaching profile

### Learning outcomes

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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 the role of physics in various parts of the body of knowledge and culture.

2. Demonstrate methodological, technical and practical skills useful for solving problems in physics.

2.1 Choose, knowing their limitations, a method and tools to solve a novel problem in physics.

2.2 Design and use instruments to measure or study a physical system.

2.3 Properly handle computer tools to help solve problems in physics, while knowing the limitations of these tools.

2.4 Design algorithms adapted to the problems addressed and translate them into computer programmes.

2.5 Apply adequate tools, both basic and more advanced, to model complex physical systems and solve specific problems in physics application fields.

3. Apply a scientific approach and reasoning, and identify, using an inductive or deductive approach, the unifying aspects of different situations and experiences.

3.1 Evaluate the simplicity, clarity, rigor, originality of a scientific reasoning, and identify any flaws.

3.2 Develop or adapt a physical reasoning and formalize it.

3.3 Argue the validity of a scientific result and adapt its argumentation to various audiences.

3.4 Show the analogies between different problems in physics, in order to apply known solutions to new problems in physics.

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



## 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
⊗ LPHYS2215	Statistical field theory	Christian Walmsley Hagendorf	EN [q2] [30h] [5 Credits] ⊕ 🌐 > French-friendly

#### ⊗ Gravitation, cosmologie et astroparticules

⊗ LPHYS2221	Astrophysics and astroparticles	Gwenhaël de Wasseige	EN [q2] [30h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2223	utrino physics and dark matter	Marco Drewes	EN [q2] [30h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2224	Advanced cosmology and general relativity	Christophe Ringeval	EN [q1] [30h] [5 Credits] 🌐 > French-friendly

#### ⊗ Physique des particules

⊗ LPHYS2233	Experimental methods in fundamental physics	Agni Bethani (compensates Eduardo Cortina Gil) Giacomo Bruno Eduardo Cortina Gil	EN [q2] [52.5h+7.5h] [10 Credits] 🌐 > French-friendly
⊗ LPHYS2234	Quantum field theory 2	Marco Drewes	EN [q2] [30h] [5 Credits] ⊙ 🌐 > French-friendly

#### ⊗ Physique atomique, moléculaire et optique

⊗ LPHYS2242	Fundamentals of quantum information	Matthieu Génévriez (coord.) Sorin Melinte Bernard Piraux	EN [q2] [30h] [5 Credits] ⊕ 🌐 > French-friendly
⊗ LPHYS2244	Molecular physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2245	Lasers physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2246	Experimental methods in atomic and molecular physics	Clément Lauzin Xavier Urbain	EN [q2] [30h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2247	Special topics in quantum optics	Matthieu Génévriez	EN [q2] [30h] [5 Credits] 🌐 > French-friendly
⊗ LPHYS2248	Ultra-fast laser physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits] ⊙ 🌐 > French-friendly

#### ⊗ Physique de la matière condensée et des milieux continus

⊗ LMAPR2451	Atomistic and nanoscopic simulations	Jean-Christophe Charlier Xavier Gonze Gian-Marco Rignanese	EN [q2] [30h+30h] [5 Credits] 🌐 > French-friendly
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## Supplementary classes

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**To access this Master, students must have a good command of certain subjects. If this is not the case, in the first annual block of their Masters programme, students must take supplementary classes chosen by the faculty to satisfy course prerequisites.**

Rem : These additional teaching units (maximum 60 credits) will be selected in the programme of the second and third annual units of the Bachelor's degree in physics, in consultation with the Study advisor, depending on the previous teaching units followed by the student and his/her training project, and will be submitted to the approval of the School of Physics.

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

## o Enseignements supplémentaires

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## The programme's courses and learning outcomes

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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
<b>Bachelors of the Dutch speaking Community of Belgium</b>	
	Direct access
<b>Foreign Bachelors</b>	
	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"		-	
<b>Masters</b>		-	

## 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 <https://uclouvain.be/en/study/inscriptions/futurs-etudiants.html>).

Students who wish to be admitted on the basis of a dossier are invited to consult the [criteria for the evaluation of application](#).

## Admission and Enrolment Procedures for general registration



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

Useful Contact(s)

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

