

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In EnglishDissertation/Graduation Project : **YES** - Internship : **NO**Activities in English: **YES** - Activities in other languages : **NO**Activities on other sites : **optional**Main study domain : **Sciences**Organized by: **Faculty of Science (SC)**Programme acronym: **PHYS2M** - Francophone Certification Framework: 7**Table of contents**

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PHYS2M - 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 Master [120] in Physics constitutes the logical continuation of the Bachelor in Physics. Its purpose is to enable you (1) to completely master the fundamental laws and essential tools of today's physics, (2) to specialize in a field of physics, (3) to acquire disciplinary skills and cross-cutting essential to exercise a professional activity related to physics, and (4) to train you, depending on the chosen focus, for a specific job. Three focuses are proposed: the research focus, the specialized focus on medical physics, which trains you for the profession of hospital physicist, and the teaching focus.

Your profile

You hold a Bachelor's degree in physics or in a discipline related to physics. You want to develop advanced knowledge and skills in physics. You want to deepen the fundamental theories of physics and gain a solid background in experimental and modeling techniques as well as in data analysis. You want to conduct research in universities, public research institutes or industrial laboratories, or to teach physics in high schools, or to practice physics in hospitals. You plan to perform a PhD in science. You then have the profile to begin a Master [120] 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 research (university laboratories, private laboratories, European Organization for Nuclear Research - CERN, Atomic Energy Commission, Institute for Space Aeronomy of Belgium, Royal Meteorological Institute of Belgium, Royal Observatory of Belgium, etc.) or in secondary or higher education (high schools).

Physicists also find jobs in the private or financial sector. Some of them work in the medical area as a hospital physicist, in the high technology industry (telecommunications, optics, aeronautics, space industry, medical equipment, etc.), in the field of energy, in the area of information technology (big data processing, design of calculation programmes, etc.), for banks and insurance companies, in the field of environmental consultancy and in the sector of scientific communication and popularization.

Your programme

The programme of the Master [120] in Physics, which can be completed in two years, offers :

- an advanced and specialized training in physics that prepares you for the job of researcher, teacher or hospital physicist, depending on the focus chosen.
- a deepening of the fundamental theories of physics,
- a learning of the most advanced experimental and modeling techniques of today's physics,
- teaching units taught, for most of them, in English,
- a lot of practical works (exercises, laboratories, and personal or group projects),
- the possibility to conduct research within the Master's thesis in one of the research institutes of UCLouvain, one of the federal scientific institutes in which academic members of the School of Physics work, a private company or a hospital,
- the possibility to follow part your studies in a foreign university.

PHYS2M - 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 [120] in Physics is preparing to meet. This programme aims to develop mastery of the fundamental laws and essential tools of today's physics, with a focus that allows entering the world of research or industry (research focus), the world of education (training focus) or the hospital environment (specialized focus on medical 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.

4. Build new knowledge and research related to issues in one or more areas of current physics.

4.1 Develop an autonomous physical intuition by anticipating expected results and verifying consistency with existing results.

4.2 Analyze a research problem and select the appropriate tools to study it in a thorough and original way.

5. Learn and act autonomously to continue training in an independent way.

5.1 Search in the physical literature for sources and assess their relevance.

5.2 Read and interpret an advanced physics text and relate it to acquired knowledge.

5.3 Acquire new scientific and technical skills.

5.4 Judge autonomously the relevance of a scientific approach and the interest of a physical theory

6. Work in a team and collaborate with students and professionals in other disciplinary fields to achieve common goals and produce results.

6.1 Share knowledge and methods.

6.2 Identify individual and collective goals and responsibilities, and work in accordance with these roles.

6.3 Manage, individually and as a team, a major project in all its aspects.

6.4 Evaluate your performance as an individual and team member, and evaluate the performance of others.

6.5 Recognize and respect the views and opinions of team members.

- 7.4 Adapt the presentation to the level of expertise of the interlocutors.
- 7.5 Use a variety of media and computer tools to communicate (explain, write, publish) concepts and physical results.
- 7.6 Discuss with colleagues from other disciplines.
8. If he/she chooses the research training, actively address a research theme.
- 8.1 Achieve a level of expertise in a chosen field of contemporary physics.
- 8.2 Deepen a subject beyond current knowledge.
9. If he/she chooses the specialized focus on medical physics, practice the profession of physicist in the hospital environment.
- 9.1 Identify and apply the imaging and treatment techniques specific to physicists in the hospital environment.
- 9.2 Intervene in a clinical setting.
- 9.3 Undertake basic and clinical research.
10. If he/she chooses the teaching focus, mobilize the necessary skills to effectively start the profession of teacher in physics in high schools, and be able to evolve positively there.
- 10.1. Intervene in school context, in partnership with different actors.
- 10.2. Teach in authentic and varied situations.
- 10.3. Exercise a reflexive glance and to project him/her/self in a logic of continuous development.

For more details, consult the Aggregation of Upper Secondary Education (Physical Sciences).

The contribution of each teaching unit to the programme's reference for learning outcomes can be found in the document "Through which teaching units the skills of the programme's reference system are developed and mastered by the student?".

The document is accessible by means of identification with the global UCLouvain identifier by clicking [PHYS2A](#).

Programme structure

The programme leading to the Master's [120] degree in physics includes a core curriculum, which consists of :

- 30 credits of specialized training in physics, to be chosen from a list of teaching units organized into subject blocks and to be followed during the first semester of the first annual unit,
- 5 credits of physics seminar, to be followed during the second annual unit,
- 2 credits of training in human sciences, to be chosen from a list of teaching units and to be followed during the first or second annual unit,
- 28 credits of activities related to the Master's thesis, which include the Master's thesis itself (26 credits) and the thesis tutorial (2 credits), to be carried out during the second annual unit.

The programme also includes 30 credits of teaching units specific to the chosen focus, to be followed during the first or second annual unit, as well as 25 credits of elective teaching units, to be selected from a list of teaching units organized into subject blocks and to be followed mainly during the second annual unit.

PHYS2M Programme

Detailed programme by subject

CORE COURSES [65.0]

- Mandatory
- ✂ Optional
- △ Not offered in 2021-2022
- ⊖ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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

o Formation spécialisée en physique (30 crédits)

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 les UE ci-dessous (les UE LPHYS2143 et LPHYS2102 sont vivement conseillées pour les étudiant-e-s inscrit-e-s à la finalité spécialisée) :

⊗ Physique statistique et mathématique

⊗ LPHYS2112	Mathematical physics	Christophe Ringeval	EN [q1] [30h] [5 Credits]	X	
⊗ LPHYS2113	Critical phenomena	Philippe Ruelle	EN [q1] [22.5h+7.5h] [5 Credits]	X	
⊗ LPHYS2114	Nonlinear dynamics	Christian Walmsley Hagendorf	EN [q1] [22.5h+22.5h] [5 Credits]	X	

⊗ Gravitation, cosmologie et astroparticules

⊗ LPHYS2122	Cosmology	Christophe Ringeval	EN [q1] [30h] [5 Credits]	X	
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⊗ Physique des particules

⊗ LPHYS2131	Fundamental interactions and elementary particles	Christophe Delaere Jean-Marc Gérard Vincent Lemaître	EN [q1] [52.5h+7.5h] [10 Credits]	X	
⊗ LPHYS2132	Quantum field theory 1	Céline Degrande Marco Drewes	EN [q1] [52.5h+7.5h] [10 Credits]	X	

⊗ Physique atomique, moléculaire et optique

⊗ LPHYS2141	Introduction to quantum optics	Xavier Urbain	EN [q1] [22.5h+7.5h] [5 Credits]	X	
⊗ LPHYS2143	Optics and lasers	Clément Lauzin	EN [q1] [22.5h+22.5h] [5 Credits]	X	

⊗ Physique de la Terre, des planètes et du climat

⊗ LPHYS2161	Internal geophysics of the Earth and planets	Nicolas Bergeot Véronique Dehant	EN [q1] [22.5h+7.5h] [5 Credits]	X	
⊗ LPHYS2162	Introduction to the physics of the climate system and its modelling	Hugues Goosse Jean-Pascal van Ypersele de Strihou	EN [q1] [22.5h+22.5h] [5 Credits]	X	
⊗ LPHYS2163	Atmosphere and ocean : physics and dynamics	Thierry Fichet François Massonnet	EN [q1] [52.5h+7.5h] [10 Credits]	X	

⊗ Instrumentation et méthodes numériques

⊗ LPHYS2101	Analog and digital electronics	Eduardo Cortina Gil	EN [q1] [45h+45h] [10 Credits]	X	
⊗ LPHYS2102	Detectors and sensors	Eduardo Cortina Gil	EN [q1] [22.5h+7.5h] [5 Credits]	X	

o Séminaire de physique (5 crédits)

⊗ LPHYS2191	Physics seminar	Michel Crucifix Marco Drewes Xavier Urbain	EN [q1+q2] [0h+30h] [5 Credits]		X
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o Activités liées au mémoire (28 crédits)

⊗ LPHYS2197	Thesis tutorial	Ahmed Adriouèche Jan Govaerts	EN [q1] [15h] [2 Credits]		X
⊗ LPHYS2199	Master's thesis		EN [q1+q2] [] [26 Credits]		X

o Formation en sciences humaines (2 crédits)

L'étudiant-e choisit une UE parmi :

⊗ LSC2001	Introduction to contemporary philosophy	Peter Verdée	EN [q2] [30h] [2 Credits]	X	X
⊗ LSC2220	Philosophy of science	Pieter Thyssen (compensates Alexandre Guay)	EN [q2] [30h] [2 Credits]	X	X
⊗ LFILO2003E	Ethics in the Sciences and technics (sem)	Hervé Jeanmart Charles Pence René Rezsöházy	EN [q2] [15h+15h] [2 Credits]	X	X

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⌘ LTHEO2840	Science and Christian faith	Benoît Bourguine Dominique Lambert	PK [q1] [15h] [2 Credits]	x	x

⌘ Formation facultative

These credits are not counted within the 120 required credits.

⌘ LSST1001	IngénieuxSud	Stéphanie Merle Jean-Pierre Raskin (coord.)	PK [q1+q2] [15h+45h] [5 Credits]	x	x
⌘ LSST1002M	Information and critical thinking - MOOC	Myriam De Kesel Jean-François Rees	PK [q2] [30h+15h] [3 Credits]	x	x

LIST OF FOCUSES

- > **Research Focus** [en-prog-2021-phys2m-lphys200a]
- > **Teaching Focus** [en-prog-2021-phys2m-lphys200d]
- > **Professional Focus : Medical Physics** [en-prog-2021-phys2m-lphys200s]

RESEARCH FOCUS [30.0]

- Mandatory
- ⊗ Optional
- △ Not offered in 2021-2022
- ⊖ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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

Year

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Content:

⊗ Physique statistique et mathématique

⊗ LPHYS2211	Group theory	Philippe Ruelle	EN [q2] [22.5h+22.5h] [5 Credits]	X	
⊗ LPHYS2215	Statistical field theory	Christian Walmsley Hagendorf	EN [q2] [30h] [5 Credits] ⊖	X	X

⊗ Gravitation, cosmologie et astroparticules

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

⊗ Physique des particules

⊗ LPHYS2233	Experimental methods in fundamental physics	Giacomo Bruno Eduardo Cortina Gil Christophe Delaere	EN [q2] [52.5h+7.5h] [10 Credits]	X	
⊗ LPHYS2234	Quantum field theory 2	Jan Govaerts	EN [q2] [30h] [5 Credits] ⊕	X	X

⊗ Physique atomique, moléculaire et optique

⊗ LPHYS2242	Fundamentals of quantum information		EN [q2] [30h] [5 Credits] ⊖	X	X
⊗ LPHYS2244	Molecular physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits]	X	
⊗ LPHYS2245	Lasers physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits]	X	
⊗ LPHYS2246	Experimental methods in atomic and molecular physics	Clément Lauzin Xavier Urbain	EN [q2] [30h] [5 Credits]	X	
⊗ LPHYS2247	Special topics in quantum optics	Matthieu Génévriez	EN [q2] [30h] [5 Credits]	X	
⊗ LPHYS2248	Ultra-fast laser physics	Clément Lauzin	EN [q2] [22.5h+7.5h] [5 Credits] ⊕	X	X

⊗ 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]	X	
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⊗ Physique de la Terre, des planètes et du climat

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

⊗ Compléments de mathématique

⊗ LMAT2130	Partial differential equations	Heiner Obermann	EN [q1] [30h+15h] [5 Credits]	x	x
⊗ LMAT2160	Training seminar for mathematical researchers	Pierre-Emmanuel Caprace Jean Van Schatingen	FR [q1] [15h] [5 Credits]	x	x
⊗ LMAT2250	Calculus of variations	Augusto Ponce	FR [q2] [30h+15h] [5 Credits] ⊖	x	x
⊗ LMAT2265	Complex geometry		FR [q2] [30h+15h] [5 Credits] Δ ⊕	x	x
⊗ LMAT2420	Complex analysis	Tom Claey's	EN [q2] [30h+15h] [5 Credits] Δ	x	x
⊗ LMAT2470	Processus stochastiques (statistique)	Donatien Hainaut	FR [q2] [30h] [5 Credits]	x	

TEACHING FOCUS [30.0]

IMPORTANT NOTE: In accordance with article 138 para. 4 of the decree of 7 November 2013 concerning higher education and the academic organisation of studies, teaching practice placements will not be assessed in the September session. Students are required to make every effort to successfully complete the teaching practice in the June session, subject to having to retake the year.

- Mandatory
- ⊗ Optional
- △ Not offered in 2021-2022
- ⊙ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- (FR) Teaching language (FR, EN, ES, NL, DE, ...)

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

Year

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o Content:**o Module concevoir, planifier et évaluer des pratiques d'enseignement et d'apprentissage**

○ LPHYS2492	Stages d'enseignements en physique (en ce compris le séminaire d'intégration des stages)	Jim Plumat	(FR) [q1+q2] [45h+10h] [7 Credits]	x	x
○ LSCI2320	Didactique et épistémologie des sciences	Myriam De Kesel Nathalie Matthys Jim Plumat	(FR) [q1] [60h] [6 Credits]	x	x
○ LPHYS2471	Didactique et épistémologie de la physique	Jim Plumat	(FR) [q2] [15h+5h] [2 Credits]	x	x
○ LAGRE2220	General didactics and education to interdisciplinarity	Stéphane Colognesi Myriam De Kesel Jean-Louis Dufays Anne Ghysselinckx Véronique Lemaire Olivier Maes Jim Plumat Benoît Vercrusse	(FR) [q1 or q2] [37.5h] [3 Credits]	x	x

o Didactique et épistémologie d'une autre discipline (en ce compris le stage d'écoute) (2 credits)

un cours au choix parmi les cours suivants

⊗ LCHM2340	Didactique et épistémologie de la chimie	Nathalie Matthys	(FR) [q2] [15h+5h] [2 Credits]	x	x
⊗ LBIO2340	Didactique et épistémologie de la biologie	Myriam De Kesel	(FR) [q2] [15h+5h] [2 Credits]	x	x
⊗ LMAT2320A	Didactique et épistémologie de la mathématique (en ce compris le stage d'écoute)	Laure Ninove	(FR) [q1+q2] [37.5h+10h] [4 Credits]	x	x
⊗ LGEO2320B	Didactique et épistémologie de la géographie (en ce compris le stage d'écoute)	Marie-Laurence De Keersmaecker	(FR) [q1] [15h+10h] [2 Credits]	x	x

o Module comprendre et analyser l'institution scolaire et son contexte**o Séminaire d'observation et d'analyse de l'institution scolaire et de son contexte (en ce compris le stage d'observation) (4 credits)**

Choisir 1 des activités suivantes. Le cours et le séminaire doivent être suivis au même quadrimestre.

⊗ LAGRE2120P	Observation et analyse de l'institution scolaire et de son contexte (en ce compris le stage d'observation)	Samir Barbana (compensates Vincent Dupriez) Branka Cattonar	(FR) [q1] [22.5h+25h] [4 Credits]		x
⊗ LAGRE2120Q	Observation et analyse de l'institution scolaire et de son contexte (en ce compris le stage d'observation)	Samir Barbana (compensates Vincent Dupriez) Branka Cattonar	(FR) [q2] [22.5h+25h] [4 Credits]		x
○ LAGRE2400	See specifications in french	Hervé Pourtois (coord.) Pierre-Etienne Vandamme	(FR) [q2] [20h] [2 Credits]	x	x

o Module animer un groupe et travailler en équipe

o Comprendre l'adolescent en situation scolaire, gérer la relation interpersonnelle et animer le groupe classe (4 credits)

Choisir 1 des activités suivantes. Le cours et le séminaire doivent être suivis au même quadrimestre.

⌘ LAGRE2020P	Comprendre l'adolescent en situation scolaire, Gérer la relation interpersonnelle et animer le groupe classe.	Baptiste Barbot Véronique Leroy Nathalie Roland	⌘ [q1] [22.5h+22.5h] [4 Credits]		x
⌘ LAGRE2020Q	Comprendre l'adolescent en situation scolaire, Gérer la relation interpersonnelle et animer le groupe classe.	Baptiste Barbot Véronique Leroy Nathalie Roland	⌘ [q2] [22.5h+22.5h] [4 Credits]		x

PROFESSIONAL FOCUS : MEDICAL PHYSICS [30.0]

Les étudiants ayant choisi cette finalité doivent obligatoirement avoir choisi les cours PHY 2130, PHY 2236 et PHY 2340 parmi les cours de base et les cours au choix. Ils suivront aussi tous les cours repris ci-dessous.

- Mandatory
- ⊗ Optional
- △ Not offered in 2021-2022
- ⊖ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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

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Content:

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○ LGBIO1113	Systems Anatomy and Physiology	Catherine Behets Wydemans Olivier Cornu Greet Kerckhofs	[FR] [q2] [30h+15h] [3 Credits]	x	x
○ LGBIO2050	Medical Imaging	Greet Kerckhofs John Lee Benoît Macq Frank Peeters	[EN] [q1] [30h+30h] [5 Credits]	x	x
○ LPHYS2233A	Experimental methods in fundamental physics - Introduction and use of GEANT	Giacomo Bruno Eduardo Cortina Gil Christophe Delaere	[EN] [q2] [22.5h+7.5h] [4 Credits]	x	x
○ LPHYS2504	Use, management and control of radio elements	Pascal Froment	[FR] [q2] [22.5h] [3 Credits]	x	x
○ WRDTH3120	Dosimétrie en radiothérapie et contrôle de qualité	Edmond Sterpin	[FR] [q2] [30h] [3 Credits]	x	
○ WRDTH3160	Dosimétrie informatisée en radiothérapie	Xavier Geets Carine Kirkove Laurette Renard Edmond Sterpin (coord.)	[FR] [q2] [30h+60h] [5 Credits]		x
○ WRPR2001	Notions de base de radioprotection	Pascal Carlier Michaël Dupont François Jamar (coord.) Renaud Lhommel	[FR] [q1] [10h+5h] [2 Credits]		x
○ WRPR2330	Utilisation des radioisotopes et des molécules marquées en biologie	Bernard Gallez (coord.) Thierry Vander Borgh	[FR] [q2] [15h+15h] [3 Credits]		x

UE au choix [25.0]

UE AU CHOIX [25.0]

- Mandatory
- ⊗ Optional
- △ Not offered in 2021-2022
- ⊙ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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

Year

1 2

o Content:

⊗ UE recommandées pour la finalité approfondie

⊗ Physique statistique et mathématique

⊗ LPHYS2316	Advanced mathematical physics	Philippe Ruelle Christian Walmsley Hagendorf	EN [q1] [30h] [5 Credits]		X
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⊗ Physique des particules

⊗ LPHYS2335	Standard model and beyond	Fabio Maltoni	EN [q1] [52.5h+7.5h] [10 Credits]		X
⊗ LPHYS2336	Accelerator, astroparticle, and gravitational wave physics	Giacomo Bruno Eduardo Cortina Gil Gwenhaël de Wasseige Vincent Lemaître Vincent Lemaître (compensates Giacomo Bruno)	EN [q1] [52.5h+7.5h] [10 Credits]		X

⊗ Physique de la matière condensée et des milieux continus

⊗ LMAPR2014	Physics of Functional Materials	Xavier Gonze Luc Piraux Gian-Marco Rignanese	EN [q1] [37.5h+22.5h] [5 Credits]		X
⊗ LMAPR2015	Physics of Nanostructures	Jean-Christophe Charlier (coord.) Xavier Gonze Luc Piraux	EN [q1] [37.5h+22.5h] [5 Credits]		X
⊗ LMAPR2018	Rheology	Evelyne Van Ruymbeke	EN [q2] [30h+30h] [5 Credits]		X
⊗ LMECA2854	Heat and mass transfer II	Yann Bartosiewicz Matthieu Duponcheel	EN [q2] [30h+30h] [5 Credits]		X
⊗ LMECA2771	Thermodynamics of irreversible phenomena.	Miltiadis Papalexandris	EN [q2] [30h+30h] [5 Credits]		X
⊗ LPHYS2351	Superconductivity	Luc Piraux	EN [q1] [22.5h+7.5h] [5 Credits]		X

⊗ Physique de la Terre, des planètes et du climat

⊗ LENVI2005	Changements climatiques: impacts et solutions	Yannick Agnan (compensates Pierre Delmelle) Philippe Marbaix Jean-Pascal van Ypersele de Strihou (coord.)	FR [q2] [30h] [3 Credits]		X
⊗ LGCIV2056	Marine Hydrodynamics	Eric Deleersnijder	EN [q1] [30h+15h] [5 Credits]		X
⊗ LGEO1343	Earth observation by satellite	Eric Lambin	FR [q1] [30h+30h] [5 Credits]		X
⊗ LINMA2510	Mathematical ecology	Eric Deleersnijder Emmanuel Hanert Thierry Van Effelterre	EN [q2] [30h+22.5h] [5 Credits] ⊕	X	X

⊗ Instrumentation et méthodes numériques

				Year	
				1	2
⊗ LEPL1106	Signals and systems	Julien Hendrickx Luc Vandendorpe	FR [q2] [30h+30h] [5 Credits]	x	
⊗ LEPL1110	Finished elements	Vincent Legat Jean-François Remacle	FR [q2] [30h+30h] [5 Credits]	x	x
⊗ LPHYS2303	Cryophysics and vacuum physics	Vincent Bayot Benoît Hackens Sorin Melinte	EN [q1] [30h+15h] [5 Credits]		x

⊗ Compléments de mathématique

NB : l'UE LMAT1271 est vivement conseillée.

⊗ LINMA2361	Nonlinear dynamical systems	Pierre-Antoine Absil	EN [q1] [30h+22.5h] [5 Credits]		x
⊗ LMAT1271	Calculation of probability and statistical analysis	Rainer von Sachs	FR [q2] [30h+30h] [6 Credits]	x	
⊗ LMAT2240	Low-dimensional topology	Pedro Dos Santos Santana Forte Vaz Pascal Lambrechts	EN [q2] [30h+15h] [5 Credits]	x	x
⊗ LMAT2430	Lie's theory elements and differential geometry	Pierre Bieliavsky	FR [q2] [30h+15h] [5 Credits]	x	x

⊗ UE au choix recommandées pour la finalité didactique

⊗ LSCI2330	Séminaire de recherche en didactique des sciences	Myriam De Kesel Jim Plumet	FR [q2] [15h+30h] [5 Credits]	x	x
⊗ LMAT2330	Seminar on the teaching of mathematics	Enrico Vitale	FR [q1+q2] [15h+30h] [4 Credits] Δ	x	x
⊗ LGEO2330	Séminaire de didactique de la géographie		FR [q2] [0h+30h] [5 Credits] Δ	x	x
⊗ LAGRE2310	Micro-teaching exercises	Pascalina Papadimitriou Dominique Vandercammen	FR [q1] [15h] [2 Credits]	x	x
⊗ LAGRE2221	Learning and teaching with new technologies	Sandrine Decamps	FR [q1] [15h+15h] [2 Credits]	x	x

⊗ UE au choix recommandées pour la finalité spécialisée

⊗ WRPR2002	Compléments de radioprotection	Dana Ioana Dumitriu Michaël Dupont François Jamar (coord.)	FR [q2] [20h+10h] [3 Credits]	x	x
⊗ WRDGN3120	Methods, techniques and quality control in medical imaging	Emmanuel Coche François Jamar Renaud Lhommel Nicolas Michoux (coord.) Bruno Vande Berg	FR [q2] [25h+5h] [3 Credits]		x
⊗ LMECA2600	Introduction to nuclear engineering and reactor technology	Hamid Aït Abderrahim	EN [q1] [30h+30h] [5 Credits]	x	x
⊗ WRPR3010	Questions spéciales de radioprotection	Dana Ioana Dumitriu Michaël Dupont François Jamar (coord.) Sébastien Lichtherte Edmond Sterpin Aude Vaandering Françoise Vanneste	FR [q2] [40h] [4 Credits]	x	x
⊗ WMNUC2100	Master and complementary master	Véronique Roelants Thierry Vander Borghet (coord.)	FR [q1] [15h] [2 Credits]	x	x
⊗ LGBIO1111	Cell biology and physiology	Charles De Smet Christophe De Vleeschouwer Pascal Kienlen-Campard	FR [q2] [30h+15h] [5 Credits]	x	x
⊗ LGBIO1112	Introduction to biomedical engineering	Philippe Lefèvre	FR [q2] [45h] [5 Credits]	x	x

⊗ Optional courses :

These credits are not counted within the 120 required credits.

⊗ LSST1001	IngénieursSud	Stéphanie Merle Jean-Pierre Raskin (coord.)	FR [q1+q2] [15h+45h] [5 Credits]	x	x
⊗ LSST1002M	Information and critical thinking - MOOC	Myriam De Kesel Jean-François Rees	FR [q2] [30h+15h] [3 Credits]	x	x

Supplementary classes

To access this Master, students must have a good command of certain subjects. If this is not the case, they must add supplementary classes at the beginning of their Master's programme in order to obtain the prerequisites for these studies.

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.

- Mandatory
- ✂ Optional
- △ Not offered in 2021-2022
- ⊙ Not offered in 2021-2022 but offered the following year
- ⊕ Offered in 2021-2022 but not the following year
- △ ⊕ Not offered in 2021-2022 or the following year
- Activity with requisites
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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

o Enseignements supplémentaires

Course prerequisites

There are no prerequisites between course units (CUs) for this programme, i.e. the programme activity (course unit, CU) whose learning outcomes are to be certified and the corresponding credits awarded by the jury before registration in another CU.

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.

PHYS2M - Information

Access Requirements

Master course admission requirements are defined by the French Community of Belgium Decree of 7 November 2013 defining the higher education landscape and the academic organisation of courses.

General and specific admission requirements for this programme must be satisfied at the time of enrolling at the university.

In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.

SUMMARY

- > [General access requirements](#)
- > [Specific access requirements](#)
- > [University Bachelors](#)
- > [Non university Bachelors](#)
- > [Holders of a 2nd cycle University degree](#)
- > [Holders of a non-University 2nd cycle degree](#)
- > [Access based on validation of professional experience](#)
- > [Access based on application](#)
- > [Admission and Enrolment Procedures for general registration](#)

Specific access requirements

Since this program is taught in English, no prior proof of French language proficiency is required, except for students wishing to access the didactic program who must provide proof of a CEFR level C1 proficiency.

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

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
Bachelor in Physics		Direct access	
Bachelor in Mathematics	Si l'étudiant a suivi la Titre inconnu:Iminphys	Access based on application	In some cases, the UCLouvain Enrolment Office, after reviewing their online enrolment or re-enrolment application, will ask the students concerned to provide an enrolment authorisation from the faculty/ school.
Bachelor in Engineering	Si l'étudiant a suivi la Titre inconnu:Iminphys	Access based on application	In some cases, the UCLouvain Enrolment Office, after reviewing their online enrolment or re-enrolment application, will ask the students concerned to provide an enrolment authorisation from the faculty/ school.
Bachelor in Geography : General	Crédits de la Minor in Physics acquis	Access based on application	In some cases, the UCLouvain Enrolment Office, after reviewing their online enrolment or re-enrolment application, will ask the students concerned to provide an enrolment authorisation from the faculty/ school.
Others Bachelors of the French speaking Community of Belgium			
		Direct access	

Bachelier en sciences de l'ingénieur, orientation ingénieur civil	Access based on application
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Bachelors of the Dutch speaking Community of Belgium

Direct access

Foreign Bachelors

Access based on application

Non university Bachelors

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

Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
"Licenciés"		Direct access	
Masters		Direct access	

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

Admission on the basis of a submitted dossier may be granted either directly or on the condition of completing additional coursework 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

Specific professional rules

Successful completion of the master's course with **teaching focus** leads to the award of the master's degree with teaching focus and the title of secondary school education specialist.

The [Réforme des Titres et Fonctions](#) ("Titles and Functions Reform"), in force since 1 September 2016, is intended to harmonise the titles, functions and pay scales of basic and secondary education professionals in French Community of Belgium networks.

It also aims to guarantee the priority of preferred titles over minimum titles and to establish a regime for titles in short supply.

AESS holders can learn which functions they can carry out and the pay scales from which they can benefit by [clicking here](#).

The university cannot be held responsible for any problems that students may encounter at a later date with a view to a teaching appointment in the French Community of Belgium.

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.

The physics seminar is composed of three series of presentations to which students must attend : lectures of general interest, more specific seminars dealing with physics research carried out in UCLouvain research institutes and testimonials from former students on their professional background.

Evaluation

The evaluation methods comply with the regulations concerning studies and exams (<https://uclouvain.be/fr/decouvrir/rgee.html>). 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.

Mobility and/or Internationalisation outlook

Most teaching units are given by default in English.

Students who have chosen the research focus are encouraged to study abroad outside the Wallonia-Brussels Federation within the framework of a Socrates/Erasmus agreement or equivalent (Mercator, Erasmus Belgica), preferably during the second semester of the first annual unit or the first semester of the second annual unit. This study stay will consist of following several teaching units proposed by the host university, for a maximum of 30 credits, and/or preparing the Master's thesis. For a list of Belgian and foreign universities

Possible trainings at the end of the programme

Whatever the focus chosen, the Master's [120] degree gives direct access to the PhD in Science.

In addition, there are two particularly adapted programmes that allow for further study and obtaining specific diplomas :

1) An additional year of study at Mol, after the Master's [120] degree, allows to follow the English-speaking interuniversity programme giving the title of "Master in Nuclear Engineering" managed by BNEN (Belgian Nuclear Higher Education Network) (intensive courses are given in English by professors from different Belgian universities at the Mol Nuclear Research Center).

2) For students who have completed and passed a Master's [120] degree with specialized focus on medical physics, an expert's license in radiotherapy, medical radiophysics or radiology may be obtained by carrying out a 1-yr internship after the Master [120]. This internship also includes some additional teaching units required by the Federal Agency for Nuclear Control. These teaching units provide additional training in the following areas :

- principles, techniques and quality control in medical imaging ;
- special radiological protection issues and supplements ;
- radiochemistry, radiotoxicology and radiopharmacy ;
- assessment of the risks of radioactive releases into the environment in normal and accidental situations, and emergency plan for nuclear risks.

In addition, UCLouvain Masters (usually 60) are widely available to UCLouvain Masters' graduates. For example :

- the Master [120] in Science and Environmental Management and the Master [60] in Science and Environmental Management (direct access with possible supplements) ;
- the different Masters [60] in management science (direct access through examination of the file) : see the list ;
- Master [60] in Information and Communication in Louvain-la-Neuve or Master [60] in Information and Communication in Mons.

Certificates

The teaching units listed in the specialized focus on medical physics may be followed for obtaining certificates of complementary studies in radiation protection and application of ionizing radiation for persons wishing to obtain accreditation for the surveillance and protection of workers and population against the danger of ionizing radiation.

Accessibility : doctors, pharmacists, veterinarians, science graduates, civil engineers, agronomists, industrial engineers.

These students will, among other things, have to follow advanced teaching units in nuclear physics and nuclear techniques :

LPHYS2102 Detectors and sensors

LPHY2360 Atomic, nuclear and radiation Physics

LPHYS2504 Production, use, management and control of radioelements.

Contacts

Curriculum Management

Entity

Structure entity

Denomination

Faculty

Sector

Acronym

Postal address

SST/SC/PHYS

(PHYS)

Faculty of Science (SC)

Sciences and Technology (SST)

PHYS

Chemin du Cyclotron 2 - bte L7.01.04

1348 Louvain-la-Neuve

Tel: +32 (0) 10 47 32 94 - Fax: +32 (0) 10 47 30 68

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

Website

Academic supervisor: [Michel Crucifix](https://uclouvain.be/repertoires/michel.crucifix) (<https://uclouvain.be/repertoires/michel.crucifix>)

Jury

- President: [Eduardo Cortina Gil](https://uclouvain.be/repertoires/eduardo.cortinagil) (<https://uclouvain.be/repertoires/eduardo.cortinagil>)
- Secretary: [Christophe Delaere](https://uclouvain.be/repertoires/christophe.delaere) (<https://uclouvain.be/repertoires/christophe.delaere>)
- Study advisor: [François Massonnet](https://uclouvain.be/repertoires/francois.massonnet) (<https://uclouvain.be/repertoires/francois.massonnet>)
- Study advisor: [Céline Degrande](https://uclouvain.be/repertoires/celine.degrande) (<https://uclouvain.be/repertoires/celine.degrande>)

Useful Contact(s)

- Administrative manager for the student's annual program: [Christine Henry de Frahan](https://uclouvain.be/repertoires/christine.henrydefrahan) (<https://uclouvain.be/repertoires/christine.henrydefrahan>)
- Secretary of the School of physics: [Catherine De Roy](https://uclouvain.be/repertoires/catherine.deroy) (<https://uclouvain.be/repertoires/catherine.deroy>)

