UCLouvain

PHYS2M

2020 - 2021

Master [120] in Physics

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In English
Dissertation/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

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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 enroled 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 (reasearch 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.

For a programme-type, and regardless of the focus, options/or elective courses selected, this master will carry a minimum of 120 credits divided over two annual units, corresponding to 60 credits each.

> Tronc commun *[en-prog-2020-phys2m-tronc_commun]*

Une finalité à choisir parmi

> Research Focus *[en-prog-2020-phys2m-lphys200a]*
> Teaching Focus *[en-prog-2020-phys2m-lphys200d]*
> Professional Focus : Medical Physics *[en-prog-2020-phys2m-lphys200s]*

List of electives

> UE au choix *[en-prog-2020-phys2m-lphys210o]*

Preparatory Module *(only for students who qualify for the course via complementary coursework)*

> Master [120] in Physics *[en-prog-2020-phys2m-module_complementaire]*

PHYS2M Detailled programme

Programme by subject

CORE COURSES [65.0]

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

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

					Year 1	Year 2
⊠ Physique statistique et mathématique						
⊠ LPHYS2112	Mathematical physics	Christophe Ringeval	30h	5 Credits	q1	x
⊠ LPHYS2113	Critical phenomena	Philippe Ruelle	22.5h +7.5h	5 Credits	q1	x
⊠ LPHYS2114	Nonlinear dynamics	Christian Hagendorf	22.5h +22.5h	5 Credits	q1	x
⊠ Gravitation, cosmologie et astroparticules						
⊠ LPHYS2122	Cosmology	Christophe Ringeval	30h	5 Credits	q1	x
⊠ Physique des particules						
⊠ LPHYS2131	Fundamental interactions and elementary particles	Christophe Delaere Jean-Marc Gérard Vincent Lemaitre	52.5h +7.5h	10 Credits	q1	x
⊠ LPHYS2132	Quantum field theory 1	Céline Degrande Marco Drewes Michele Lucente	52.5h +7.5h	10 Credits	q1	x
⊠ Physique atomique, moléculaire et optique						
⊠ LPHYS2141	Introduction to quantum optics	Bernard Piraux Xavier Urbain	22.5h +7.5h	5 Credits	q1	x
⊠ LPHYS2143	Optics and lasers	Clément Lauzin	22.5h +22.5h	5 Credits	q1	x
⊠ Physique de la Terre, des planètes et du climat						
⊠ LPHYS2161	Internal geophysics of the Earth and planets	Nicolas Bergeot Véronique Dehant	22.5h +7.5h	5 Credits	q1	x
⊠ LPHYS2162	Introduction to the physics of the climate system and its modelling	Hugues Goosse Jean-Pascal van Ypersele de Strihou	22.5h +22.5h	5 Credits	q1	x
⊠ LPHYS2163	Atmosphere and ocean : physics and dynamics	Thierry Fichefet François Massonnet	52.5h +7.5h	10 Credits	q1	x
⊠ Instrumentation et méthodes numériques						
⊠ LPHYS2101	Analog and digital electronics	Eduardo Cortina Gil Krzysztof Piotrzkowski	45h+45h	10 Credits	q1	x
⊠ LPHYS2102	Detectors and sensors	Eduardo Cortina Gil Krzysztof Piotrzkowski	22.5h +7.5h	5 Credits	q1	x

O Séminaire de physique (5 credits)

					Year 1	Year 2
O LPHYS2191	Physics seminar	Michel Crucifix Marco Drewes Krzysztof Piotrzkowski Xavier Urbain	0h+30h	5 Credits	q1+q2	x

Year
1 2

Activités liées au mémoire (28 credits)

LPHYS2197	Thesis tutorial	Ahmed Adrioueche Jan Govaerts	15h	2 Credits	q1+q2		x
LPHYS2199	Master's thesis			26 Credits	q1+q2		x

Formation en sciences humaines (2 credits)

L'étudiant·e choisit une UE parmi :

LSC2001	Introduction to contemporary philosophy	Peter Verdée	30h	2 Credits	q2	x	x
LSC2220	Philosophy of science	Peter Verdée (compensates Alexandre Guay)	30h	2 Credits	q2	x	x
LFILO2003E	Ethics in the Sciences and technics (sem)		15h+15h	2 Credits	q2	x	x
LTHEO2840	Science and Christian faith	Benoît Bourgine (coord.) Dominique Lambert	15h	2 Credits	q1	x	x

Formation facultative

These credits are not counted within the 120 required credits.

LSST1001	IngénieuxSud	Jean-Pierre Raskin	15h+45h	5 Credits	q1+q2	x	x
LSST1002M	Information and critical thinking - MOOC	Myriam De Kesel Jim Plumat Jean-François Rees	30h+15h	3 Credits	q2	x	x

LIST OF FOCUSES

> Research Focus [en-prog-2020-phys2m-lphys200a]
> Teaching Focus [en-prog-2020-phys2m-lphys200d]
> Professional Focus : Medical Physics [en-prog-2020-phys2m-lphys200s]

RESEARCH FOCUS [30.0]

○ Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

○ Content:

						Year 1	Year 2
⊠ Physique statistique et mathématique							
⊠ LPHYS2211	Group theory	Philippe Ruelle	22.5h +22.5h	5 Credits	q2	x	
⊠ LPHYS2215	Statistical field theory	Christian Hagendorf	30h	5 Credits	q2 ⊕	x	x
⊠ Gravitation, cosmologie et astroparticules							
⊠ LPHYS2221	Astrophysics and astroparticles	Krzysztof Piotrzkowski	30h	5 Credits	q2	x	
⊠ LPHYS2223	utrino physics and dark matter	Marco Drewes	30h	5 Credits	q2	x	
⊠ LPHYS2224	Advanced cosmology and general relativity	Christophe Ringeval	30h	5 Credits	q2	x	
⊠ Physique des particules							
⊠ LPHYS2233	Experimental methods in particle physics	Eduardo Cortina Gil Christophe Delaere Pietro Vischia (compensates Giacomo Bruno)	52.5h +7.5h	10 Credits	q2	x	
⊠ LPHYS2234	Quantum field theory 2	Jan Govaerts	30h	5 Credits	q2 ⊘	x	x
⊠ Physique atomique, moléculaire et optique							
⊠ LPHYS2242	Fundamentals of quantum information	Sorin Melinte Bernard Piraux	30h	5 Credits	q2 ⊕	x	x
⊠ LPHYS2244	Molecular physics	Clément Lauzin	22.5h +7.5h	5 Credits	q2	x	
⊠ LPHYS2245	Lasers physics	Clément Lauzin	22.5h +7.5h	5 Credits	q2	x	
⊠ LPHYS2246	Experimental methods in atomic and molecular physics	Clément Lauzin Xavier Urbain	30h	5 Credits	q2	x	
⊠ LPHYS2247	Special topics in quantum optics	Bernard Piraux	30h	5 Credits	q2	x	
⊠ LPHYS2248	Ultra-fast laser physics	Clément Lauzin	22.5h +7.5h	5 Credits	q2 ⊘	x	x
⊠ Physique de la matière condensée et des milieux continus							
⊠ LMAPR2451	Atomistic and nanoscopic simulations	Jean-Christophe Charlier Xavier Gonze Gian-Marco Rignanese	30h+30h	5 Credits	q2	x	
⊠ Physique de la Terre, des planètes et du climat							
⊠ LPHYS2260	Geodesy and GNSS (Global Navigation Satellite System)		30h	5 Credits	q2 ⊘	x	x
⊠ LPHYS2264	Atmospheric and oceanic waves and instabilities	Michel Crucifix	30h	5 Credits	q2 ⊘	x	x

						Year 1	2
⊠ LPHYS2265	Sea ice-ocean-atmosphere interactions in polar regions	Thierry Fichefet	30h	5 Credits	q2 ⊕	x	x
⊠ LPHYS2266	Physics of the upper atmosphere and space	Viviane Pierrard	22.5h +7.5h	5 Credits	q2	x	
⊠ LPHYS2267	Paleoclimate dynamics and modelling	Qiuzhen Yin	22.5h +7.5h	5 Credits	q2	x	
⊠ LPHYS2268	Forecast, prediction and projection in climate science	François Massonnet	22.5h +7.5h	5 Credits	q2	x	
⊠ LPHYS2269	Remote sensing of climate change	Emmanuel Dekemper	30h	5 Credits	q2 ⊕	x	x

⊠ Compléments de mathématique

⊠ LMAT2130	Partial differential equations	Heiner Olbermann	30h+15h	5 Credits	q1	x	x
⊠ LMAT2160	Training seminar for mathematical researchers	Pierre-Emmanuel Caprace Jean Van Schaftingen	15h	5 Credits	q1	x	x
⊠ LMAT2250	Calculus of variations	Augusto Ponce	30h+15h	5 Credits	q2 ⊕	x	x
⊠ LMAT2265	Complex geometry	Luc Haine	30h+15h	5 Credits	q2 ⊘	x	x
⊠ LMAT2420	Complex analysis	Tom Claeys	30h+15h	5 Credits	q2	x	x
⊠ LMAT2470	Processus stochastiques (statistique)	Donatien Hainaut	30h	5 Credits	q2	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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

O Content:

O Module concevoir, planifier et évaluer des pratiques d'enseignement et d'apprentissage

						Year 1	Year 2
O LPHYS2492	Stages d'enseignements en physique (en ce compris le séminaire d'intégration des stages)	Jim Plumat	15h+40h	7 Credits	q2	x	x
O LSCI2320	Didactique et épistémologie des sciences	Myriam De Kesel (coord.) Jim Plumat Valérie Wathelet	60h	6 Credits	q1	x	x
O LPHYS2471	Didactique et épistémologie de la physique	Jim Plumat	15h+5h	2 Credits	q2	x	x
O LAGRE2220	General didactics and education to interdisciplinarity	Myriam De Kesel Jean-Louis Dufays (coord.) Anne Ghysselinckx Véronique Lemaire Jim Plumat Marc Romainville Benoît Vercruysse	37.5h	3 Credits	q2	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	Valérie Wathelet	15h+5h	2 Credits	q2	x	x
⊠ LBIO2340	Didactique et épistémologie de la biologie	Myriam De Kesel	15h+5h	2 Credits	q2	x	x
⊠ LMAT2320A	Didactique et épistémologie de la mathématique (en ce compris le stage d'écoute)	Thérèse Gilbert Laure Ninove Rosane Tossut	37.5h +10h	4 Credits	q1+q2	x	x
⊠ LGEO2320B	Didactique et épistémologie de la géographie (en ce compris le stage d'écoute)	Marie-Laurence De Keersmaecker	15h+10h	2 Credits	q1	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)	Branka Cattonar Vincent Dupriez	22.5h +25h	4 Credits	q1		x
⊠ LAGRE2120Q	Observation et analyse de l'institution scolaire et de son contexte (en ce compris le stage d'observation)	Branka Cattonar Vincent Dupriez	22.5h +25h	4 Credits	q2		x
O LAGRE2400	See specifications in french	Hervé Pourtois (coord.) Pierre-Etienne Vandamme	20h	2 Credits	q2	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.

						Year 1	2
⊠ LAGRE2020P	Comprendre l'adolescent en situation scolaire, Gérer la relation interpersonnelle et animer le groupe classe.	Véronique Leroy Véronique Leroy (compensates Pascale Steyns) Nathalie Roland	22.5h +22.5h	4 Credits	q1		x
⊠ LAGRE2020Q	Comprendre l'adolescent en situation scolaire, Gérer la relation interpersonnelle et animer le groupe classe.	Véronique Leroy Véronique Leroy (compensates Pascale Steyns) Nathalie Roland	22.5h +22.5h	4 Credits	q2		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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

Content:

						Year 1	Year 2
O LGBIO1113	Anatomie et physiologie des systèmes	Catherine Behets Wydemans Olivier Cornu Greet Kerckhofs	30h+15h	3 Credits	q1	x	x
O LGBIO2050	Medical Imaging	Greet Kerckhofs John Lee Benoît Macq Frank Peeters	30h+30h	5 Credits	q1	x	x
O LPHYS2233A	Experimental methods in particle physics : Introduction and use of GEANT	Eduardo Cortina Gil Christophe Delaere Pietro Vischia (compensates Giacomo Bruno)	22.5h +7.5h	4 Credits	q2	x	x
O LPHYS2504	Use, management and control of radio elements	Pascal Froment	22.5h	3 Credits	q2	x	x
O WRDTH3120	Dosimétrie en radiothérapie et contrôle de qualité	Edmond Sterpin	30h	3 Credits	q2	x	
O WRDTH3160	Dosimétrie informatisée en radiothérapie	Xavier Geets Carine Kirkove Laurette Renard Edmond Sterpin (coord.)	30h+60h	5 Credits	q2		x
O WRPR2001	Notions de base de radioprotection	Pascal Carlier Michaël Dupont François Jamar (coord.) Renaud Lhommel	10h+5h	2 Credits	q1		x
O WRPR2330	Utilisation des radioisotopes et des molécules marquées en biologie	Bernard Gallez (coord.) Thierry Vander Borght	15h+15h	3 Credits	q2		x

UE au choix [25.0]

UE AU CHOIX [25.0]

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

Content:

Year: 1 2

⊠ UE recommandées pour la finalité approfondie

⊠ Physique statistique et mathématique

⊠ LPHYS2316	Advanced mathematical physics	Christian Hagendorf Philippe Ruelle	30h	5 Credits	q1		x

⊠ Physique des particules

⊠ LPHYS2335	Standard model and beyond	Fabio Maltoni	52.5h +7.5h	10 Credits	q1		x
⊠ LPHYS2336	Advanced experimental aspects of fundamental interactions	Giacomo Bruno Vincent Lemaitre Krzysztof Piotrzkowski	52.5h +7.5h	10 Credits	q1		x

⊠ Physique de la matière condensée et des milieux continus

⊠ LMAPR2014	Physics of Functional Materials	Xavier Gonze Luc Piraux Gian-Marco Rignanese	37.5h +22.5h	5 Credits	q1		x
⊠ LMAPR2015	Physics of Nanostructures	Jean-Christophe Charlier (coord.) Xavier Gonze Luc Piraux	37.5h +22.5h	5 Credits	q1		x
⊠ LMAPR2018	Rheology	Evelyne Van Ruymbeke	30h+30h	5 Credits	q2		x
⊠ LMECA2853	Turbulence.	Eric Deleersnijder Grégoire Winckelmans	30h+30h	5 Credits	q1		x
⊠ LMECA2771	Thermodynamics of irreversible phenomena.	Miltiadis Papalexandris	30h+30h	5 Credits	q2		x
⊠ LPHYS2351	Superconductivity	Luc Piraux	22.5h +7.5h	5 Credits	q1		x

⊠ Physique de la Terre, des planètes et du climat

⊠ LENVI2005	Changements climatiques: impacts et solutions	Pierre Delmelle Philippe Marbaix Jean-Pascal van Ypersele de Strihou (coord.)	30h	3 Credits	q2		x
⊠ LGCIV2056	Marine Hydrodynamics	Eric Deleersnijder	30h+15h	5 Credits	q1		x
⊠ LGEO1343	Earth observation by satellite	Eric Lambin	30h+30h	5 Credits	q1		x
⊠ LINMA2510	Mathematical ecology	Eric Deleersnijder (coord.) Denis Dochain Emmanuel Hanert	30h +22.5h	5 Credits	q2 ⊘	x	x

⊠ Instrumentation et méthodes numériques

⊠ LEPL1106	Signaux et systèmes	Luc Vandendorpe Vincent Wertz	30h+30h	5 Credits	q2	x	
⊠ LEPL1110	Eléments finis	Vincent Legat Jean-François Remacle	30h+30h	5 Credits	q2	x	x
⊠ LPHYS2303	Cryophysics and vacuum physics	Vincent Bayot Benoît Hackens Sorin Melinte	30h+15h	5 Credits	q1		x

						Year 1	Year 2
⛒ Compléments de mathématique *NB : l'UE LMAT1271 est vivement conseillée.*							
⛒ LINMA2361	Nonlinear dynamical systems	Pierre-Antoine Absil	30h +22.5h	5 Credits	q1		x
⛒ LMAT1271	Calculation of probability and statistical analysis	Mickaël De Backer (compensates Rainer von Sachs)	30h+30h	6 Credits	q2	x	
⛒ LMAT2240	Low-dimensional topology	Pedro Dos Santos Santana Forte Vaz Pascal Lambrechts	30h+15h	5 Credits	q2 △	x	x
⛒ LMAT2430	Lie's therory elements and differential geometry	Pierre Bieliavsky	30h+15h	5 Credits	q2	x	x
⛒ UE au choix recommandées pour la finalité didactique							
⛒ LSCI2330	Séminaire de recherche en didactique des sciences	Myriam De Kesel Jim Plumat (coord.) Valérie Wathelet	15h+30h	5 Credits	q2	x	x
⛒ LMAT2330	Seminar on the teaching of mathematics	Enrico Vitale	15h+30h	4 Credits	q1+q2	x	x
⛒ LGEO2330	Séminaire de didactique de la géographie	Marie-Laurence De Keersmaecker	0h+30h	5 Credits	q2	x	x
⛒ LAGRE2310	Micro-teaching exercises	Pascalia Papadimitriou Dominique Vandercammen	15h	2 Credits	q1	x	x
⛒ LAGRE2221	Learning and teaching with new technologies	Sandrine Decamps	15h+15h	2 Credits	q1	x	x
⛒ UE au choix recommandées pour la finalité spécialisée							
⛒ WRPR2002	Compléments de radioprotection	Philippe Clapuyt Michaël Dupont François Jamar (coord.)	20h+10h	3 Credits	q2	x	x
⛒ WRDGN3120	Methods, techniques and quality controle in medical imaging	Emmanuel Coche François Jamar Renaud Lhommel Nicolas Michoux (coord.) Bruno Vande Berg	25h+5h	3 Credits	q2		x
⛒ LMECA2600	Introduction to nuclear engineering and reactor technology	Hamid Aït Abderrahim	30h+30h	5 Credits	q1	x	x
⛒ WRPR3010	Questions spéciales de radioprotection	Philippe Clapuyt Michaël Dupont François Jamar (coord.) Sébastien Lichtherte Edmond Sterpin Aude Vaandering Françoise Vanneste	40h	4 Credits	q2	x	x
⛒ WMNUC2100	Master and compelmentary master	Véronique Roelants Thierry Vander Borght (coord.)	15h	2 Credits	q1	x	x
⛒ LGBIO1111	Biologie et physiologie cellulaire	Charles De Smet Christophe De Vleeschouwer Pascal Kienlen-Campard	30h+15h	5 Credits	q2	x	x
⛒ LGBIO1112	Introduction to biomedical engineering	Philippe Lefèvre	45h	5 Credits	q2	x	x

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 competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme's reference framework of learning outcomes in the document *"In which teaching units are the competences and learning outcomes in the programme's reference framework developed and mastered by the student?"*

PHYS2M - Information

Access Requirements

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

Decree of 7 November 2013 defining the landscape of higher education and the academic organization of studies.

The admission requirements must be met prior to enrolment in the University.

SUMMARY

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
Bachelor in Physics		Direct access	
Bachelor in Mathematics	Si l'étudiant a suivi la (unknown URL)	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 (unknown URL)	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	
Bachelors of the Dutch speaking Community of Belgium			
		Direct access	
Foreign Bachelors			
		Access based on application	

Non university Bachelors

> Find out more about links (https://uclouvain.be/fr/etudier/passerelles) 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

> See the website Valorisation des acquis de l'expérience
It is possible to gain admission to all masters courses via the validation of professional experience procedure.

Access based on application

Reminder : all Masters (apart from Advanced Masters) are also accessible on file.

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

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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

O Enseignements supplémentaires

Specific professional rules

The successful completion of the Master's degree with focus on teaching leads to the title of "Agrégé de l'Enseignement Secondaire Supérieur" (AESS).

The Reform of Titles and Functions, in effect on September 1, 2016, aims to harmonize the titles, functions and scales of professionals in basic and secondary education of all networks in the French Community of Belgium.

It also aims to ensure the priority of required titles against sufficient titles and to establish a shortage title regime.

The holder of the AESS can access the functions he can exercise and the scales he can benefit by clicking here.

The University cannot be held responsible for any problems that the student might encounter later with a view to an appointment to teaching 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 enroled 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	SST/SC/PHYS
Denomination	(PHYS)
Faculty	Faculty of Science (SC)
Sector	Sciences and Technology (SST)
Acronym	PHYS
Postal address	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
Website	https://uclouvain.be/fr/facultes/sc/phys

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Jury

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