

**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 - 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.

## Programme structure

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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

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### CORE COURSES [65.0]

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- 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...)

### 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]  > French-friendly	X
⊗ LPHYS2113	Critical phenomena	Philippe Ruelle	EN [q1] [22.5h+7.5h] [5 Credits]  > French-friendly	X
⊗ LPHYS2114	Nonlinear dynamics	Michel Crucifix	EN [q1] [22.5h+22.5h] [5 Credits]  > French-friendly	X



#### ⊗ Gravitation, cosmologie et astroparticules

⊗ LPHYS2122	Cosmology	Christophe Ringeval	EN [q2] [30h] [5 Credits]  > French-friendly	X
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#### ⊗ Physique des particules

⊗ LPHYS2131	Fundamental interactions and elementary particles	Agni Bethani (compensates) Christophe Delaere Céline Degrande Christophe Delaere Vincent Lemaitre	EN [q1] [52.5h+7.5h] [10 Credits]  > French-friendly	X
		Marco Drewes	[10 Credits]  > French-friendly	X

#### ⊗ Physique atomique, moléculaire et optique

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

#### ⊗ Physique de la Terre, des planètes et du climat

⊗ LPHYS2161	Internal geophysics of the Earth and planets		EN [q1] [22.5h+7.5h] [5 Credits]  > French-friendly	X
⊗ LPHYS2162	Introduction to the physics of the climate system and its modelling	Hugues Goosse Francesco Ragone	EN [q1] [22.5h+22.5h] [5 Credits]  > French-friendly	X
⊗ LPHYS2163	Atmosphere and ocean : physics and dynamics	Thierry Fichet François Massonnet	EN [q1] [52.5h+7.5h] [10 Credits]  > French-friendly	X

#### ⊗ Instrumentation et méthodes numériques

	Analog and digital electronics	Eduardo Cortina Gil	X EN [q1] [45h+45h] [10 Credits]	
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Year

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⌘ LSC2001

Introduction to contemporary philosophy

Peter Verdée  
Peter Verdée  
(compensates  
Charles Pence)

## LIST OF FOCUSES

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- > [Research Focus](#) [ en-prog-2024-phys2m-lphys200a ]
- > [Teaching Focus](#) [ en-prog-2024-phys2m-lphys200d ]
- > [Professional Focus : Medical Physics](#) [ en-prog-2024-phys2m-lphys200s ]

## RESEARCH FOCUS [30.0]

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- 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, ...)

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

Year



## ⌘ Physique atomique, moléculaire et optique

⌘ LPHYS2242

Fundamentals of quantum information

Matthieu  
Génévriez (coord.)  
Sorin Melinte  
Bernard Piroux

EN









## **UE au choix [25.0]**

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				Year	
				1	2
⊗ LGBIO1112	Introduction to biomedical engineering	Benoit Delhaye (compensates) Philippe Lefèvre Sophie Demoustier (compensates) Philippe Lefèvre Greet Kerckhofs (compensates) Philippe Lefèvre	PR [q2] [45h] [5 Credits]	x	x

⊗ **Optional courses :**

*These credits are not counted within the 120 required credits.*

⊗ LSST1001		Stéphanie Merle Jean-Pierre Raskin	PR [q1+q2] [15h+45h] [5 Credits]	x	x
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## Alternatives

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> [Master \[120\] in Physics \[professional focus of Medical Physics : UCLouvain-KULeuven\]](https://uclouvain.be/en-prog-2024-phys2m-programme) [ <https://uclouvain.be/en-prog-2024-phys2m-programme> ]

### **MASTER [120] IN PHYSICS [PROFESSIONAL FOCUS OF MEDICAL PHYSICS : UCLOUVAIN-KULEUVEN]**

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- 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]

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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 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, ...)

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

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## o Enseignements supplémentaires

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## Course prerequisites

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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

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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.

## 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.

Unless explicitly mentioned, the bachelor's, master's and licentiate degrees listed in this table or on this page are to be understood as those issued by an institution of the French, Flemish or German-speaking Community, or by the Royal Military Academy.

**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](#).

Concerning the specific program in medical physics in co-graduation UCLouvain - KU Leuven, [specific information](#) is applicable. Apply at <https://www.kuleuven.be/english/application/instructions>

### University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			



## Specific professional rules

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Successful completion of the master's course with

## Possible trainings at the end of the programme

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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

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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

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