

PHYS2M

2015 - 2016

Master [120] in Physics

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In frenchDissertation/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: **Faculté des sciences (SC)**Programme code: **phys2m** - Francophone Certification Framework: 7**Table of contents**

Introduction	2
Teaching profile	3
- Learning outcomes	3
- Programme structure	4
- Detailed programme	5
- Programme by subject	5
- Course prerequisites	15
- The programme's courses and learning outcomes	15
Information	16
- Admission	16
- Supplementary classes	18
- Teaching method	19
- Evaluation	19
- Mobility and/or Internationalisation outlook	19
- Possible trainings at the end of the programme	19
- Certificates	19
- Contacts	20

PHYS2M - Introduction

Introduction

PHYS2M - Teaching profile

Learning outcomes

The programme for the Master in Physics provides training in the fundamental laws and essential tools of modern physics, with a focus that enables students successfully to enter either the world research (research focus) or the world of teaching (teaching focus), or the medical world (professional focus in medical physics). An opening into the industrial or medical worlds is also possible by doing the dissertation in an industrial or a hospital environment.

This training leads to the acquisition of skills such as ability to analyse a problem in physics, abstraction and modelling, rigour in reasoning and expression, a critical attitude, self-assessment and ability to communicate, including in English.

Students who aim to go on to do research should choose the **research focus**. The themes for this focus are summarized in the title : **From elementary particles to the cosmos : experience and theory, Earth and light**. These words define the essence of research done in the Department at the theoretical and experimental level : the search for elementary particles, fundamental interactions in the infinitesimal and the cosmos, changes in the nucleus and its applications, study of the atom, the molecule and properties of light. The internal and external structure of the Earth system is also studied as well as the dynamics of climate.

The **professional focus in medical physics is to prepare physicists for the profession of hospital physicist and the radiotherapy qualification**. The Master is, however, not enough: an additional year of work placement in a medical environment is necessary, together with some extra courses, to satisfy the legal requirements.

The **teaching focus** is a specially adapted programme designed for teachers at higher levels in secondary education.

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

1. Maitriser et utiliser de manière approfondie les savoirs spécialisés de la physique.

1.1 Formuler les concepts fondamentaux des théories physiques actuelles, en mettant en évidence leurs principales idées, et relier entre elles ces théories.

1.2 Identifier et appliquer des théories physiques à la résolution d'un problème.

1.3 Connaître et employer adéquatement les principes de la physique expérimentale: les mesures, leurs incertitudes, les instruments de mesure et leur calibration, le traitement de données par des outils informatiques.

1.4 Expliquer et concevoir une méthode de mesure et la mettre en Œuvre.

1.5 Modéliser des systèmes complexes et prédire leur évolution par des méthodes numériques, y inclus des simulations informatisées.

1.6 Retracer l'évolution historique des concepts physiques et reconnaître le rôle de la physique dans divers pans de l'ensemble des connaissances et de la culture.

2. Démontrer des compétences méthodologiques, techniques et pratiques utiles à la résolution des problèmes en physique.

2.1 Choisir, en connaissant leurs limitations, une méthode et des outils pour résoudre un problème inédit en physique.

2.2 Concevoir et utiliser des instruments pour effectuer une mesure ou pour étudier un système physique.

2.3 Manipuler correctement des outils informatiques d'aide à la résolution de problèmes en physique, tout en connaissant les limitations de ces outils.

2.4 Concevoir des algorithmes adaptés aux problèmes poursuivis et les traduire en programmes informatiques.

2.5 Appliquer des outils adéquats, tant de base que plus avancés, pour modéliser des systèmes physiques complexes et résoudre des problèmes spécifiques dans tous les domaines d'application de la physique en respectant les contraintes imposées par le contexte.

3. Appliquer une démarche et un raisonnement scientifique, et dégager, en suivant une approche inductive ou déductive, les aspects unificateurs de situations et expériences différentes.

3.1 Evaluer la simplicité, la clarté, la rigueur, l'originalité d'un raisonnement scientifique et en décèler les failles éventuelles.

3.2 Développer ou adapter un raisonnement physique et le formaliser.

3.3 Argumenter la validité d'un résultat scientifique et adapter son argumentation à des publics variés.

3.4 Montrer les analogies entre différents problèmes en physique, afin d'appliquer des solutions connues à de nouveaux problèmes.

4. Construire des nouvelles connaissances et réaliser une recherche relative à des problématiques touchant à un ou plusieurs domaines de la physique actuelle.

4.1 Développer de façon autonome son intuition physique en anticipant les résultats attendus et en vérifiant la cohérence avec des résultats déjà existants.

4.2 Analyser un problème de recherche et sélectionner les outils adéquats pour l'étudier de façon approfondie et originale.

5. Apprendre et agir de manière autonome afin de poursuivre sa formation d'une manière indépendante, y compris dans de nouveaux champs de connaissances.

5.1 Rechercher dans la littérature physique des sources et évaluer leur pertinence.

5.2 Lire et interpréter un texte de physique avancé et le relier aux connaissances acquises.

5.3 S'initier à un nouveau champ de connaissances.

5.4 Juger de façon autonome la pertinence d'une démarche scientifique et l'intérêt d'une théorie physique.

6. Travailler en équipe et collaborer avec des étudiants et des professionnels d'autres champs disciplinaires afin d'atteindre des objectifs communs et de produire des résultats.

6.1 Partager les savoirs et les méthodes.

6.2 Identifier les objectifs et responsabilités individuels et collectifs et travailler en conformité avec ces rôles.

6.3 Gérer, individuellement et en équipe, un projet d'envergure dans tous ses aspects.

6.4 Evaluer sa performance en tant qu'individu et membre d'une équipe et évaluer les performances des autres.

6.5 Reconnaître et respecter les points de vue et opinions des membres d'une équipe.

7. Communiquer efficacement en français et en anglais et de manière adaptée au public visé

7.1 Rédiger des textes scientifiques selon les conventions de la discipline en citant convenablement les sources.

7.2 Structurer un exposé oral et faire apparaître les éléments clés du sujet.

7.3 Distinguer les objectifs, les méthodes et les concepts de la thématique présentée.

7.4 Adapter l'exposé au niveau d'expertise des interlocuteurs.

7.5 Utiliser des outils médiatiques et informatiques variés pour communiquer (expliquer, rédiger, publier) des concepts et des résultats physiques.

7.6 Discuter avec des collègues d'autres disciplines.

8. S'il choisit la finalité approfondie, aborder activement une dynamique de recherche.

8.1 Atteindre un niveau d'expertise dans un domaine choisi de la physique contemporaine.

8.2 Approfondir un sujet au-delà des connaissances actuelles.

9. S'il choisit la finalité médicale, exercer le métier de physicien dans le milieu hospitalier.

9.1 Identifier et appliquer les techniques de diagnose (imagerie) et traitement propres aux physiciens dans le milieu hospitalier.

9.2 Intervenir en milieu clinique.

9.3 Entreprendre une recherche fondamentale et clinique.

10. S'il choisit la finalité didactique, mobiliser les compétences nécessaires pour entamer efficacement le métier d'enseignant du secondaire supérieur, en physique, et pouvoir y évoluer positivement.

10.1. Intervenir en contexte scolaire, en partenariat avec différents acteurs.

10.2. Enseigner en situations authentiques et variées.

10.3. Exercer un regard réflexif et se projeter dans une logique de développement continu.

Pour plus de détails, consultez l'Agrégation de l'enseignement secondaire supérieur (sciences physiques).

Programme structure

The programme comprises core subjects of 72 credits, a focus of 30 credits (research, teaching or professional in medical physics) and 18 credits for optional subjects.

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-2015-phys2m-lphys220t.html]

Focuses

- > [Research focus](#) [en-prog-2015-phys2m-lphys200a]
- > [Teaching focus](#) [en-prog-2015-phys2m-lphys200d]
- > [Professional focus:Medical Physics](#) [en-prog-2015-phys2m-lphys200s]

Options courses

- > [Physique des particules et cosmologie](#) [en-prog-2015-phys2m-lphys211o.html]
- > [Physique statistique et physique mathématique](#) [en-prog-2015-phys2m-lphys214o.html]
- > [Physique de la Terre, des planètes et du climat](#) [en-prog-2015-phys2m-lphys212o.html]
- > [Lumière, atomes et molécules](#) [en-prog-2015-phys2m-lphys213o.html]
- > [Unités d'enseignement au choix](#) [en-prog-2015-phys2m-lphys240o.html]

PHYS2M Detailed programme

Programme by subject

CORE COURSES [60.0]

- Mandatory
- △ Courses not taught during 2015-2016
- ⊕ Periodic courses taught during 2015-2016
- ⊗ Optional
- ⊖ Periodic courses not taught during 2015-2016
- Activity with requisites

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

Year

1 2

o Unités d'enseignement (UE) de base (30 credits)

comporte 30 crédits à choisir parmi les UE suivantes

⊗ LFSAB1104	Numerical methods	Vincent Legat	30h+30h	5 Credits	1q	x
⊗ LMAPR2014	Physics of Functional Materials	Xavier Gonze, Luc Piraux, Gian-Marco Rignanese	37.5h +22.5h	5 Credits	1q	x
⊗ LPHY2110	Phénomènes critiques (théorie statistique des champs)	Philippe Ruelle	22.5h	4 Credits	1q	x
⊗ LPHY2111	Introduction à la dynamique non linéaire	Jean Bricmont	30h+15h	5 Credits	1q	x
⊗ LPHY2120	Quantum Field Theory	Jean-Marc Gérard	22.5h	4 Credits	1q	x
⊗ LPHY2121	Fundamental interactions	Jean-Marc Gérard	22.5h	4 Credits	1q	x
⊗ LPHY2125	Relativistic quantum mechanics	Fabio Maltoni	15h+15h	4 Credits	1q	x
⊗ LPHY2130	Physique nucléaire I et physique du neutron	Thierry Delbar	45h	5 Credits	1q	x
⊗ LPHY2131	Particle Physics (I)	Christophe Delaere, Vincent Lemaître	22.5h +7.5h	5 Credits	1q	x

						Year	
						1	2
⊗ LPHY2137	Analog Electronics	Eduardo Cortina Gil	22.5h +22.5h	5 Credits	1q	x	
⊗ LPHY2140	Photons, atoms and molecules	André Nauts, Xavier Urbain	30h	5 Credits	1q	x	
⊗ LPHY2141	Optique et lasers	Alain Cornet, Clément Lauzin	30h+10h	5 Credits	1q	x	
⊗ LPHY2150	Physique et dynamique de l'atmosphère et de l'océan I	Michel Crucifix, Thierry Fichet	45h+9h	6 Credits	1q	x	
⊗ LPHY2153	Introduction to the physics of the climate system and its modeling	Hugues Gooose, Jean-Pascal van Ypersele de Strihou	30h+15h	5 Credits	1q	x	
⊗ LPHY2160	Internal Geophysics of the Earth and planets	Nicolas Bergeot, Véronique Dehant (coord.)	30h	5 Credits	1q	x	
⊗ LPHY2162	Physics of the upper atmosphere and space	Viviane Pierrard	22.5h	4 Credits	1q	x	
⊗ LPHY2171	Mathematical Physics	Christophe Ringeval	30h+15h	4 Credits	1q	x	
⊗ LPHY2238	Analog and Digital Signal Processing	Giacomo Bruno	22.5h +15h	4 Credits	1q	x	
⊗ LPHY2371	Numerical Simulation in Physics	Michel Crucifix, Bernard Piraux	22.5h +37.5h	5 Credits	1q	x	
⊗ LPHY2372	Experimental methods	Krzysztof Piotrkowski, Xavier Urbain	30h+15h	4 Credits	1q	x	

o Philosophie (une des trois UE suivantes) : (2 credits)

⊗ LSC2001	Introduction to contemporary philosophy	Nathalie Frogneux, Vincent Israel-Hoenen (compensates Nathalie Frogneux)	30h	2 Credits	2q	x	x
⊗ LSC2220	Philosophy of science	Alexandre Guay	30h	2 Credits	2q	x	x
⊗ LFILO2003E	Ethics in the Sciences and technics (sem)	Bernard Feltz, Hervé Jeanmart, René Rezsóhazy	15h+15h	2 Credits	2q	x	x

o Mémoire (28 credits)

○ LPHY2998	Thesis tutorial	Eduardo Cortina Gil, Jan Govaerts, Annick Sonck	15h	2 Credits	1q		x
○ LPHY2999	Mémoire	N.		26 Credits	1 ou 2q		x

LIST OF FOCUSES

- > **Research focus** [en-prog-2015-phys2m-lphys200a]
 > **Teaching focus** [en-prog-2015-phys2m-lphys200d]
 > **Professional focus:Medical Physics** [en-prog-2015-phys2m-lphys200s]

RESEARCH FOCUS [30.0]

- Mandatory
 △ Courses not taught during 2015-2016
 ⊕ Periodic courses taught during 2015-2016
 ☒ Optional
 ⊖ Periodic courses not taught during 2015-2016
 ■ Activity with requisites

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

Year

1 2

☒ Physique des particules et cosmologie (30 credits)

Les étudiants choisissent 30 crédits parmi la liste des UE ci-dessous.

☒ LPHY2122	Quantum field theory II	Claude Duhr (compensates Jan Govaerts), Jan Govaerts	30h	5 Credits	2q	x	
☒ LPHY2126	Cosmology	Christophe Ringeval	22.5h +7.5h	5 Credits	2q	x	
☒ LPHY2133	Elementary Particle Physics II	Krzysztof Piotrkowski	30h	5 Credits	2q	x	
☒ LPHY2135	Computing and numerical methods in particle physics	Giacomo Bruno, Christophe Delaere	15h +22.5h	4 Credits	2q	x	
☒ LPHY1221	Group theory	Philippe Ruelle	22.5h +15h	5 Credits	2q	x	
☒ LPHY2239	Data acquisition, digital electronics and microelectronics	Eduardo Cortina Gil	22.5h +22.5h	6 Credits	2q	x	
☒ LPHY2234	Neutrino Physics and Astroparticles	Giacomo Bruno, Vincent Lemaître	30h	5 Credits	2q	x	

☒ Physique statistique et physique mathématique (30 credits)

Les étudiants choisissent 30 crédits parmi la liste des UE ci-dessous.

☒ LINMA2380	Matrix theory	Paul Van Dooren	30h +22.5h	5 Credits	1q	x	
☒ LMAT2130	Partial differential equations : Poisson and Laplace equations	Augusto Ponce, Jean Van Schaftingen	30h+30h	5 Credits	1q	x	
☒ LMAT2160	Mathematics seminar	Pedro Dos Santos Santana Forte Vaz, Marino Gran, Tim Van der Linden	15h+30h	6 Credits	2q	x	
☒ LMAT2260	Compléments d'analyse et de géométrie complexe	Tom Claeys, Luc Haine	45h	6 Credits		x	
☒ LMAT2470	Processus stochastiques (statistique)	Franz Bruss	30h	5 Credits	2q	x	
☒ LPHY2126	Cosmology	Christophe Ringeval	22.5h +7.5h	5 Credits	2q	x	
☒ LPHY2122	Quantum field theory II	Claude Duhr (compensates Jan Govaerts), Jan Govaerts	30h	5 Credits	2q	x	
☒ LPHY1221	Group theory	Philippe Ruelle	22.5h +15h	5 Credits	2q	x	
☒ LMECA2771	Thermodynamics of irreversible phenomena.	Miltiadis Papalexandris	30h+30h	4 Credits	2q	x	

⌘ Physique de la terre, des planètes et du climat (30 credits)

Les étudiants choisissent 30 crédits parmi la liste des UE ci-dessous.

⌘ LMAPR2510	Mathematical ecology	Eric Deleersnijder, Emmanuel Hanert, Thierry Van Effeltherre	30h +22.5h	5 Credits	2q	x	
⌘ LMECA2771	Thermodynamics of irreversible phenomena.	Miltiadis Papalexandris	30h+30h	4 Credits	2q	x	
⌘ LPHY2151	Physique et dynamique de l'atmosphère et de l'océan II	Michel Crucifix, Thierry Fichetef	30h	5 Credits	2q	x	
⌘ LPHY2161	Geodesy and GNSS (Global Navigation Satellite System)	Nicolas Bergeot, Véronique Dehant	30h	5 Credits	2q	x	
⌘ LPHY2252	Supplements in climate system modeling	Michel Crucifix, Thierry Fichetef, Hugues Goosse, Qiuzhen Yin	45h+7.5h	6 Credits	2q	x	
⌘ LPHY2253	Remote sensing of climate change	Didier Fussen	22.5h +15h	5 Credits	2q	x	
⌘ LPHY2126	Cosmology	Christophe Ringeval	22.5h +7.5h	5 Credits	2q	x	

⌘ Lumière, atomes et molécules (30 credits)

Les étudiants choisissent 30 crédits parmi la liste des UE ci-dessous.

⌘ LPHY1221	Group theory	Philippe Ruelle	22.5h +15h	5 Credits	2q	x	
⌘ LPHY2144	Physique moléculaire	Clément Lauzin, André Nauts	22.5h	4 Credits	2q	x	
⌘ LPHY2245	Lasers and applications	Alain Cornet, Clément Lauzin	45h+15h	6 Credits	2q	x	
⌘ LPHY2253	Remote sensing of climate change	Didier Fussen	22.5h +15h	5 Credits	2q	x	
⌘ LPHY2239	Data acquisition, digital electronics and microelectronics	Eduardo Cortina Gil	22.5h +22.5h	5 Credits	2q	x	
⌘ NSPHY2206	Photoémission	N.	22h+8h	3 Credits	2q	x	
⌘ NSPHY2111	Introduction à la science des couleurs	N.	22h+8h	3 Credits	2q	x	
⌘ NSPHY2214	Simulations en optique (optique numérique)	N.	8h+22h	2 Credits	2q	x	
⌘ NSPHY2215	Profils spectraux	N.	22h+8h	3 Credits	2q	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

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

Year

1 2

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

○ LAGRE2220	General didactics and education to interdisciplinarity	Myriam De Kesel (coord.), Jean-Louis Dufays, Anne Ghysseleinckx, Jim Plumat, Marc Romainville, Cedric Roure, Bernadette Wiame	37.5h	3 Credits	2q	x	x
○ LPHY2310	Stages d'enseignements en physique (en ce compris le séminaire d'intégration des stages)	Jim Plumat	15h+40h	7 Credits	1 + 2q	x	x
○ LSCI2320	Didactique et épistémologie des sciences	Myriam De Kesel (coord.), Jim Plumat, Valérie Wathelet	60h	6 Credits	1q	x	x
○ LPHYS2340	Didactique et épistémologie de la physique	Jim Plumat	15h+5h	2 Credits	2q	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	2q	x	x
⊗ LBIO2340	Didactique et épistémologie de la biologie	Myriam De Kesel	15h+5h	2 Credits	2q	x	x
⊗ LMAT2320A	Didactique et épistémologie de la mathématique (en ce compris le stage d'écoute)	Christiane Hauchart	37.5h +10h	4 Credits	1q	x	x
⊗ LGEO2320A	Didactique et épistémologie de la géographie (en ce compris le stage d'écoute)	Marie-Laurence De Keersmaecker	37.5h +10h	4 Credits	1q	x	x

o Module comprendre et analyser l'institution scolaire et son contexte

○ LAGRE2120	The school institution and its context	Branka Cattonar (coord.), Vincent Dupriez, Simon Enthoven, Caroline Letor, Rudi Wattiez	22.5h +25h	4 Credits	1 ou 2q	x	x
○ LAGRE2400	See specifications in french	Anne Ghysseleinckx	20h	2 Credits	2q	x	x

o Module animer un groupe et travailler en équipe

○ LAGRE2020	To understand the adolescent in school situation, to manage the interpersonal relationship and to animate the class group	Natacha Biver, James Day, Xavier Dejemepe, Bernard Demuyssere, Jean Goossens, Pierre Meurens, Pascale Steyns (coord.), Philippe van Meerbeeck (compensates James Day), Pascal Vekeman	22.5h +22.5h	4 Credits	1 ou 2q	x	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

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

						Year	
						1	2
○ WRDTH3120	Dosimétrie en radiothérapie et contrôle de qualité	Stefaan Vynckier	30h	3 Credits		x	
○ WRDTH3160	Dosimétrie informatisée en radiothérapie	Vincent Grégoire, Pierre Scalliet, Stefaan Vynckier (coord.)	30h+60h	5 Credits			x
○ WRPR2330	Utilisation des radioisotopes et des molécules marquées en biologie	Bernard Gallez (coord.), Thierry Vander Borgh	15h+15h	3 Credits			x
○ LGBIO2050	Medical Imaging	Anne Bol, John Lee, Benoît Macq, Frank Peeters	30h+30h	5 Credits	1q	x	x
○ WRDTH3131	Radiobiologie	Vincent Grégoire, Pierre Scalliet (coord.)	22.5h	2 Credits			x
○ WRPR2001	Notions de base de radioprotection	Vincent Grégoire (coord.), Patrick Smeesters	10h+5h	2 Credits	2q		x
○ LPHY2135	Computing and numerical methods in particle physics	Giacomo Bruno, Christophe Delaere	15h +22.5h	4 Credits	2q	x	x
○ LPHY2340	Use, management and control of radio elements	Pascal Froment	22.5h	3 Credits	2q	x	x
○ LGBIO1113	Anatomie et physiologie des systèmes	Catherine Behets Wydemans, Olivier Cornu, Renaud Ronsse	30h+15h	3 Credits	1q	x	x

OPTIONS [30.0]

L'étudiant complète son programme avec 30 crédits à choisir dans les options et les cours au choix ci-dessous.

L'étudiant choisit au moins 20 crédits d'une option et complète le programme de son option dans la liste des UE au choix ou d'une autre option.

- > Physique des particules et cosmologie [en-prog-2015-phys2m-lphys211o]
- > Physique statistique et physique mathématique [en-prog-2015-phys2m-lphys214o]
- > Physique de la Terre, des planètes et du climat [en-prog-2015-phys2m-lphys212o]
- > Lumière, atomes et molécules [en-prog-2015-phys2m-lphys213o]
- > Unités d'enseignement au choix [en-prog-2015-phys2m-lphys240o]

PHYSIQUE DES PARTICULES ET COSMOLOGIE [20.0]

- Mandatory
- △ Courses not taught during 2015-2016
- ⊕ Periodic courses taught during 2015-2016
- ⊗ Optional
- ⊖ Periodic courses not taught during 2015-2016
- Activity with requisites

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

						Year	
						1	2
⊗ LPHY2130	Physique nucléaire I et physique du neutron	Thierry Delbar	45h	5 Credits	1q		x
⊗ LPHY2223	Strong interactions and symmetries	Jean-Marc Gérard, Fabio Maltoni	30h	5 Credits	1q		x
⊗ LPHY2224	Electroweak interactions	Jan Govaerts, Fabio Maltoni	22.5h	5 Credits	1q		x
⊗ LPHY2263	Astrophysique et éléments d'astrophysique nucléaire	Andrea Giammanco	30h	5 Credits	1q		x
⊗ LPHY2502	Séminaire de cosmologie, physique des particules et phénoménologie	Andrea Giammanco	0h+15h	5 Credits			x
⊗ LPHY2236	Ionizing radiation measurement: detectors and Nuclear electronics.	Eduardo Cortina Gil	37.5h +55h	5 Credits	1q		x
⊗ LPHY2237	Cosmology II	Christophe Ringeval	22.5h +7.5h	5 Credits	1q		x

PHYSIQUE STATISTIQUE ET PHYSIQUE MATHÉMATIQUE [20.0]

- Mandatory
- △ Courses not taught during 2015-2016
- ⊕ Periodic courses taught during 2015-2016
- ⊗ Optional
- ⊖ Periodic courses not taught during 2015-2016
- Activity with requisites

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

						Year	
						1	2
⊗ LINMA2361	Nonlinear dynamical systems	Pierre-Antoine Absil	30h +22.5h	5 Credits	1q		x
⊗ LMAT2270	Geometry symplectic and mathematical physics	N.	30h+15h	5 Credits	2q	△	x
⊗ LMAT2410	Partial differential equation : heat equation, brownian moves and numerical aspects	Augusto Ponce, Jean Van Schaftingen	30h+15h	5 Credits	2q		x
⊗ LPHY2212	Physique mathématique avancée	Christian Hagendorf, Philippe Ruelle	30h+15h	4 Credits	1q		x
⊗ LPHY2501	Séminaire de physique théorique et mathématique	Fabio Maltoni	0h+15h	5 Credits			x
⊗ LPHY2263	Astrophysique et éléments d'astrophysique nucléaire	Andrea Giammanco	30h	5 Credits	1q		x
⊗ LSC2002	Elements of mathematics and physics history	Patricia De Grave, Michel Willem	30h	4 Credits	1q		x

PHYSIQUE DE LA TERRE, DES PLANÈTES ET DU CLIMAT [20.0]

● Mandatory

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

						Year	
						1	2
⊗ LBIR1348	General Hydrology	Charles Bielders, Marnik Vanclooster (coord.)	30h +22.5h	5 Credits	1q		x
⊗ LGEO1343	Remote sensing	Eric Lambin	30h+30h	5 Credits	1q		x
⊗ LMECA1120	Introduction to finite element methods.	Vincent Legat	30h+30h	5 Credits	2q		x
⊗ LMECA2141	Rheology	Vincent Legat, Evelyne Van Ruymbeke	30h+30h	5 Credits	1q		x
⊗ LMECA2853	Turbulence.	Eric Deleersnijder, Grégoire Winckelmans	30h+30h	5 Credits	1q		x
⊗ LPHY2263	Astrophysique et éléments d'astrophysique nucléaire	Andrea Giammanco	30h	5 Credits	1q		x
⊗ LPHY2504	Seminar of physical climatology and geophysics	Thierry Fichet	0h+15h	5 Credits		x	x

LUMIÈRE, ATOMES ET MOLÉCULES [20.0]

● Mandatory

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

						Year	
						1	2
⊗ LPHY2242	Méthodes d'analyse en physique atomique et moléculaire	Xavier Urbain	30h	5 Credits	2q		x
⊗ LPHY2243	Questions spéciales d'optique quantique	Bernard Piraux	37.5h	5 Credits	2q		x
⊗ LPHY2263	Astrophysique et éléments d'astrophysique nucléaire	Andrea Giammanco	30h	5 Credits	1q		x
⊗ LPHY2246	Basses pressions et physique du vide	Benoît Hackens, Sorin Melinte	30h	5 Credits	1q		x
⊗ LPHY2273	Cryophysique et questions spéciales de supraconductivité	Vincent Bayot, Luc Piraux	45h+15h	6 Credits	1q		x
⊗ LPHY2503	Séminaire de physique atomique, moléculaire et optique	Xavier Urbain	0h+15h	5 Credits			x
⊗ NSPHY2213	Optronique	N.	22h+8h	3 Credits	1q		x
⊗ NSPHY2212	Biophotonique	N.	22h+8h	3 Credits	1q		x

UNITÉS D'ENSEIGNEMENT AU CHOIX [10.0]

● Mandatory

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

						Year	
						1	2
⊗ LPHY2505	Séminaire sur les fondements de la physique	N.	15h	5 Credits		x	x
⊗ LMAPR2631	Surface Analysis	Arnaud Delcorte, Bernard Nysten	30h+15h	5 Credits	2q	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	2q	x	x
⊗ LMAT2330	Seminar on the teaching of mathematics	Christiane Hauchart, Enrico Vitale	15h+30h	4 Credits	1 + 2q	x	x
⊗ LGEO2330	Séminaire de didactique de la géographie	Marie-Laurence De Keersmaecker	0h+30h	5 Credits		x	x
⊗ LAGRE2310	Micro-teaching exercises	Pascalina Papadimitriou, Dominique Vandercamme	15h	2 Credits	1q	x	x
⊗ LAGRE2221	Learning and teaching with new technologies	Marcel Lebrun	15h+15h	2 Credits	1q	x	x

⊗ UE au choix recommandées pour la finalité spécialisée : physique médicale

⊗ WRPR2002	Compléments de radioprotection	Philippe Clapuyt, François Jamar, Pierre Scalliet (coord.), Patrick Smeesters	20h+10h	3 Credits		x	x
⊗ WRDGN3120	Methods, techniques and quality controle in medical imaging	Emmanuel Coche (coord.), François Jamar, Renaud Lhommel, Nicolas Michoux, Bruno Vande Berg	25h+5h	3 Credits		x	x
⊗ LMECA2600	Introduction to nuclear engineering and reactor technology	Hamid Ait Abderrahim	30h+30h	5 Credits	1q	x	x
⊗ WRPR3010	Questions spéciales de radioprotection	Philippe Clapuyt, François Jamar, Sébastien Lichtherte, Pierre Scalliet (coord.), Patrick Smeesters, Stefaan Vynckier	40h	4 Credits		x	x
⊗ WMNUC2100	Master and compelmentary master	François-Xavier HANIN, Thierry Vander Borgh (coord.)	15h	2 Credits	1q	x	x
⊗ LPHY2236	Ionizing radiation measurement: detectors and Nuclear electronics.	Eduardo Cortina Gil	37.5h +55h	5 Credits	1q	x	x
⊗ LGBIO1111	Biologie et physiologie cellulaire	Charles De Smet, Christophe De Vleeschouwer, Pascal Kienlen-Campard	30h+15h	5 Credits	2q	x	x
⊗ LGBIO1112	Introduction to biomedical engineering	Philippe Lefèvre	45h	5 Credits	2q	x	x

Course prerequisites

A document entitled [en-prerequis-2015-phys2m.pdf](#) specifies the activities (course units - CU) with one or more pre-requisite(s) within the study programme, that is the CU whose learning outcomes must have been certified and for which the credits must have been granted by the jury before the student is authorised to sign up for that activity.

These activities are identified in the study programme: their title is followed by a yellow square.

As the prerequisites are a requirement of enrolment, there are none within a year of a course.

The prerequisites are defined for the CUs for different years and therefore influence the order in which the student can enrol in the programme's CUs.

In addition, when the panel validates a student's individual programme at the beginning of the year, it ensures the consistency of the individual programme:

- It can change a prerequisite into a corequisite within a single year (to allow studies to be continued with an adequate annual load);
- It can require the student to combine enrolment in two separate CUs it considers necessary for educational purposes.

For more information, please consult [regulation of studies and exams](#).

The programme's courses and learning outcomes

For each UCL 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?"

The document is available by clicking [this link](#) after being authenticated with UCL account.

PHYS2M - Information

Admission

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

- [University Bachelors](#)
- [Non university Bachelors](#)
- [Holders of a 2nd cycle University degree](#)
- [Holders of a non-University 2nd cycle degree](#)
- [Adults taking up their university training](#)
- [Personalized access](#)

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCL Bachelors			
		Direct access	
Bachelor in Mathematics	Si l'étudiant a suivi la Minor in Physics [30.0](unknown URL)	On the file: direct access or access with additional training	
Bachelor in Engineering	Si l'étudiant a suivi la Minor in Physics [30.0](unknown URL)	On the file: direct access or access with additional training	
Others Bachelors of the French speaking Community of Belgium			
		Direct access	
Bachelors of the Dutch speaking Community of Belgium			
		Direct access	
Foreign Bachelors			
		Direct access	

— Non university Bachelors

Diploma	Access	Remarks
---------	--------	---------

> 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

Diploma	Access	Remarks
---------	--------	---------

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

> MA en sciences de l'ingénieur industriel finalités automatisation, électricité, électromécanique, électronique, informatique, mécanique, emballage et conditionnement, industrie et textile, génies physique et nucléaire > MA en sciences industrielles, finalités électronique, génies physique et nucléaire	Accès direct au master moyennant ajout éventuel de 15 crédits max	Type long
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------	-----------

Adults taking up their university training

> See the website www.uclouvain.be/en-vae

Tous les masters peuvent être accessibles selon la procédure de valorisation des acquis de l'expérience.

Personalized access

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

Admission and Enrolment Procedures for general registration

Supplementary classes

To enrol for this Masters, the student must have a good command of certain subjects. If this is not the case, they must add preparatory modules to their Master's programme.

● Mandatory

△ Courses not taught during 2015-2016

⊕ Periodic courses taught during 2015-2016

⊗ Optional

⊖ Periodic courses not taught during 2015-2016

■ Activity with requisites

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

○	Supplementary classes	N.		Credits	
---	-----------------------	----	--	---------	--

Teaching method

For all the focuses, the programme comprises core subjects including the basic courses necessary for the general training and for the different focuses. The basic courses provide training in the theory but also an introduction to experimental methods and requirements. They are more advanced in nature than the introductory courses for the bachelor's degree. There are also optional subjects which deal with areas common to several focuses, either theoretical or experimental. The choice of courses should therefore be dictated by the skills that students wish to develop. The basic courses from the core subjects and the optional subjects that students can choose ensure the same high level training for all physics students.

The dissertation and the focus courses reflect different ambitions. At the end of this training, students will be in close contact with research through their dissertation. Working in a team, supervised by researchers and lecturers, they will discover, through the focus courses and activities, the aims of current research and the different objectives of the focuses. This clearly requires individual work, attendance at seminars, contacts with researchers in the field and consultation of reference works.

Students may, if they wish, replace the research focus by an exchange visit abroad under the Erasmus scheme. This is equivalent to 30 credits.

Entry to the doctoral programme is possible, irrespective of the focus.

Advanced teaching in other subjects than physics is possible for students doing the teaching focus.

Evaluation

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

Students will mainly be assessed on the basis of individual work (e.g. reading, consultation of databases and bibliographic references, writing monographs and reports, presentation of seminars, dissertation and work placement). Where necessary, students will also be assessed on how much they have learned from lectures. Assessment of the dissertation is done on the basis of work over the year and how it is presented both in written and oral form.

Mobility and/or Internationalisation outlook

Students doing the research focus are encouraged to do a placement outside the French Community of Belgium under a Socrates/Erasmus exchange scheme or equivalent (Mercator, Erasmus Belgica), preferably for courses during the second semester of the first year or the first semester of the second year. The placement can either take the form of courses, for a maximum of 30 credits, or preparation for the dissertation.

Courses on special topics are given by many visiting lecturers from different foreign institutions and some Belgian ones. These courses are usually in English.

Possible trainings at the end of the programme

Whatever focus is chosen, the Master in Mathematics gives direct access to the doctorate in science.

In addition there are two specially adapted advanced training programmes for which diplomas may be awarded :

1) A year of further study at Mol, after the 120 credit Master, enables students to take the English-speaking inter-university programme entitled [Master in nuclear engineering](#) organized by the BNEN (Belgian Nuclear Higher Education Network). (The intensive courses are given in English by lecturers from different Belgian universities at the Belgian Nuclear Research Centre at Mol).

2) Students who have successfully completed the Master with a professional focus in medical physics may gain the expert qualification in radiotherapy, medical radiophysics or radiology if they undertake a further year of work placement after the 120 credit Master. This work placement will also include some additional courses required by the Federal Agency for Nuclear Control (Agence fédérale de contrôle nucléaire). This will cover or provide additional training in the following subjects ([Regulation article 51.7](#)) :

• Principles, techniques and quality control in medical imaging

• Special issues in radioprotection etc.

• Radiochemistry, radiotoxicology and radiopharmacy

• Risk assessment for radioactive waste in the environment in both normal and accidental circumstances and emergency plan for nuclear risks.

Certificates

The course listed in the professional focus may count towards the award of the [certificate of further study in radioprotection and application of ionizing radiations](#), for those who wish to obtain a qualification in the monitoring and protection of workers and the population against the danger of ionizing radiations.

Eligibility : doctors, pharmacists, veterinary surgeons, holders of a science degree, civil engineers, agricultural engineers, industrial engineers.

Students must, among other things, take advanced course in nuclear physics and nuclear techniques :

- PHY2236 : Nuclear Detectors and Electronics and Measurement of Ionizing Radiation
- PHY2360 : Atomic, Nuclear and Radiation Physics
- PHY2340 : Production, Use, Management and Control of Radioelements

Contacts

Curriculum Managment

Entite de la structure PHYS

Acronyme	PHYS
Dénomination	Ecole de physique
Adresse	Chemin du Cyclotron 2 bte L7.01.04 1348 Louvain-la-Neuve Tél 010 47 32 94 - Fax 010 47 30 68
Site web	https://www.uclouvain.be/phys
Secteur	Secteur des sciences et technologies (SST)
Faculté	Faculté des sciences (SC)
Commission de programme	Ecole de physique (PHYS)

Academic Supervisor : [Eduardo Cortina Gil](#)

Jury:

Président : [Thierry Fichet](#)

Secrétaire : [Philippe Ruelle](#)

Usefull Contacts

Secrétaire de l'Ecole de physique : [Roseline Van Dyck](#)

