

## Faculty of Sciences



## PHYS1BA Baccalauréat en sciences physiques (Bachelor of Physical Sciences)



### Study objectives

The programme aims at the acquisition of :

- Mastery of the basic concepts and fundamental laws of physics
- The specific approach of the physicist, namely that of comprehension, critical analysis and modelling the physical phenomena of nature, with the help of mathematical and numerical tools and experimental techniques proper to physics
- Professional qualities such as the capacity to analyse problems related to physics, abstraction and modelling; rigour in reasoning and expression; a critical mind; self-evaluation capacities and communication skills.

### General presentation of the programme

Available as a single programme in itself with minors, or as a reinforcement module in Physics, it comprises theoretical courses, exercises sessions, laboratory work and/or supervised study, and the accomplishment of a personal piece of work (project).

The first year is entirely in common with the bachelor's programme of Mathematical Science.

The possible choice of a minor is made as from the 3rd quadrimester. The minors on offer, at this stage, are : the minor in Mathematics (SC/MATH) and in Applied Sciences and Engineering : Applied Chemistry and Physics (FSA/MAPR).

The student may also choose another minor from the University programme list, on the basis of a project to be elaborated together with the study advisor.

Instead of doing a minor, the student may complete his programme with a complementary training programme in Physics for 30 credits, equally spread over the 2nd and 3rd years. This module comprises both compulsory and optional courses.

Language courses accompany the programme and are aimed at mastering scientific English.

### Principal Subjects

The major in Physics comprises the elements listed below and totals 150 credits. The courses numbered must be followed in order ; the details of the prerequisites feature in the specifications of each of the courses.

General Physics (1-2-3) : 37 credits

- Actualities in Mathematics and Physics (2 credits)
- General Physics 1 (8 credits)
- General Physics 2 (8 credits)
- General Physics 3 (4 credits)
- Classical and Optical Electromagnetism (4 credits)
- Integrated Exercises (4 credits)
- Supervised tasks and personal project (7 credits)

Theoretical and Mathematical Physics (22 credits)

- Quantum Mechanics 1 (5 credits)
- Quantum Mechanics 2 (5 credits)
- Mathematical Methods in Physics (4 credits)
- Limited Relativity (4 credits)
- General Relativity (4 credits)

Atoms and Molecules, Nuclei, Particules (6 credits)

- Atoms and Molecules (3 credits)
- Elementary Nuclei and particules (3 credits)

Macroscopic and Statistical Physics (12 credits)

- Statistical and Thermodynamic Physics 1 (4 credits, including 1 credit in Chemistry)
- Statistical and Thermodynamic Physics 2 (4 credits, including 1 credit in Chemistry)
- Physics of fluids 1 (3 credits)
- Physics of fluids 2 (3 credits)

Astronomy and Geophysics (2 credits)

Experimental and Numerical Physics (15 credits)

- Numerical Calculations: Methods and Software Tools (7 credits)

- Computing and Numerical Methods (4 credits)
  - Numerical Simulation in Physics (4 credits)
- Mathematics (43 credits)
- Mathematical Analysis 1 (5 credits)
  - Mathematical Analysis 2 (5 credits)
  - Linear Algebra (8 credits)
  - Geometry 1 (7 credits)
  - Mathematical Methods in Classical Mechanics 1 (5 credits)
  - Complex Analysis (4 credits)
  - Mathematical Methods in Classical Mechanics 2 (4 credits)
  - Probability Calculations and Statistical Analysis (5 credits)
- Chemistry (2 credits, c.f. Statistical and Thermodynamic Physics 1 et 2)
- Optional courses, including Chemistry (3 credits)
- English (6 credits)
- Philosophy (2 credits)

### **Minors or other available options**

In addition to the major in Physics, the students have three other possibilities :

- either to opt for more in-depth studies in Physics (30 credits), with complements in the different sub-disciplines of Physics
- or to opt for a minor in Mathematics, Geography or Applied Sciences and Engineering : Applied Physics and Chemistry
- or to opt for another minor from the University programme list, on the basis of a project to be elaborated together with the study advisor.

## **Evaluation**

### **Admission to the programme**

#### **Conditions of admission**

The conditions and regular admission requirements are specified on the web page :

<http://www.ucl.ac.be/etudes/libres/en/acces.html>

#### **Special admission conditions**

Programme re-orientation is possible from the bachelor programmes in Sciences or Applied sciences.

#### **Admission requests, special rules and regulations**

In the case of programme re-orientation, admission requests must be addressed to the Academic Secretary

Address : Place des sciences 2 - 1348 Louvain-la-Neuve

## **Positioning of the programme**

### **Positioning of the programme within the University cursus**

The bachelor's degree in Physical Sciences entitles automatic access to the master's of Physical Sciences, orientated towards the domains of their applications (Medical Physics, Industrial Physics, Meteorology, Simulation Methods, etc.), towards research (doctorate) or towards teaching ("agrégation"), or towards the master's of Spatial Sciences ( not organised at UCL).

### **Other studies accessible upon completion of the programme**

Subject to the completion of an appropriate minor, the bachelor's degree entitles direct access to certain orientations of the master's of Mathematical Science and Applied Sciences and Engineering-Physical Engineering (possibly by means of an adapted programme).

## **Useful contacts**

### **Programme management**

**PHYS** Département de physique

**Contact** :Nathalie Micha

and the Department of Physics

### **Study Advisor**

B. Piraux et Ph. Ruelle

### **Exam Juries**

#### **1st year**

President : Jean Mawhin

Secretary : Jan Govaerts

#### **2nd year**

President : Still to be determined

Secretary : Still to be determined

#### **3rd year**

President : Still to be determined

Secretary : Still to be determined

### List of accessible minors

- Minor in Theology
- Minor in Philosophy
- Minor in Law
- Minor in Criminology
- Minor in Information and Communication (\*)
- Minor in Political Sciences
- Minor in Sociology and Anthropology
- Minor in Human and Social Sciences
- Minor in Economics
- Minor in Business Studies
- Minor in Linguistics
- Minor in Hispanic Studies (\*)
- Minor in Italian Studies (\*)
- Minor in French Studies (\*)
- Minor in Latin Studies
- Minor in Greek Studies
- Minor in Oriental Studies
- Minor in Literature Studies
- Minor in History
- Minor in Medieval Studies
- Minor in History of Art and Archaeology (\*)
- Minor in Musicology
- Minor in Psychology and Education (\*)
- Minor in Human Nutrition
- Minor in General Biomedical Sciences
- Minor in Medication Sciences (\*)
- Minor in Physical Activity, Health and Culture of Movement (\*)
- Minor in Mathematics
- Minor in Geography
- Minor in Statistics
- Minor in Engineering Sciences : Applied Chemistry and Physics
- Minor in Engineering Sciences : Construction
- Minor in Engineering Sciences : Electricity
- Minor in Engineering Sciences : Applied Mathematics
- Minor in Engineering Sciences : Mechanics
- Minor in Urban Architecture
- Minor in Computing Science (\*)
- Minor in Biomedical Engineering
- Minor in Gender Studies
- Minor in Culture and Creation
- Minor in European Studies

(\*) *Minor with access criteria.*

### Detailed content of standard programme

#### MAFY 11BA First year of studies

<u>MAT1131</u>	Linear Algebra[45h+45h] (8 credits) (in French)	Jean-Roger Roisin (coord.), Jean-Pierre Tignol
<u>MAT1121</u>	Mathematical analysis 1[30h+30h] (5 credits) (in French)	Thierry De Pauw, Patrick Habets, Jean Mawhin (coord.)
<u>PHY1111</u>	General Physics 1[45h+45h] (8 credits) (in French)	Denis Favart, Jan Govaerts
<u>MAFY1181</u>	Actualities in Mathematics and Physics[15h] (2 credits) (in French)	Francis Borceux, Bernard Piraux
<u>MAT1122</u>	Mathematical analysis 2[30h+30h] (5 credits) (in French)	Thierry De Pauw, Patrick Habets, Jean Mawhin (coord.)
<u>MAT1141</u>	Geometry I[45h+30h] (7 credits) (in French)	Francis Borceux
<u>MAT1151</u>	Numerical analysis : tools and software of calculus[30h+45h]	Pierre Bieliavsky

	(7 credits) (in French)	
<u>MAT1161</u>	Mathematical methods in classical mathematics 1[22.5h+30h] (5 credits) (in French)	Jean Bricmont, Luc Haine
<u>PHY1112</u>	General Physics 2[45h+45h] (8 credits) (in French)	Denis Favart, Jan Govaerts
<u>ANG1861</u>	Reading and listening comprehension of scientific texts[6h] (2 credits) (in French)	Ahmed Adrioueche, Isabelle Druant, Annick Sonck
<b>One course to be chosen from among the following :</b>		
<u>BIO1114</u>	Introduction to biology[30h+7.5h] (3 credits) (in French)	Michel Baguette, Claude Remacle, Philippe van den Bosch Sanchez de Aguilar (supplée Claude Remacle) Jean-Paul Declercq
<u>CHM1112</u>	General Chemistry[22.5h+22.5h] (3 credits) (in French)	
<i>CHM 1112 - compulsory in the 2nd year if not followed in the 1st year</i>		
<u>ESPO1111A</u>	Political Economics (Part 1)[40h+10h] (4 credits) (in French)	N.
<u>BIR1130A</u>	Introductions aux sciences de la terre[30h] (3 credits) (in French)	Joseph Dufey, Philippe Sonnet

## PHYS 12BA Second year of studies

<u>MAT1261</u>	Mathematical methods of classic mechanics 2[22.5h+30h] (4 credits) (in French)	Jean Bricmont, Luc Haine
<u>MAT1271</u>	Calculation of probability and statistical analysis[30h+30h] (5 credits) (in French)	Rainer von Sachs
<u>PHY1211</u>	General Physics 3[30h+30h] (4 credits) (in French)	Denis Favart, Jan Govaerts
<u>PHY1223</u>	Special Relativity[22.5h+15h] (4 credits) (in French)	Jean-Marc Gérard, Jan Govaerts
<u>PHY1271</u>	Computer Science and Numerical Methods[15h+30h] (4 credits) (in French)	Giacomo Luca Bruno
<u>ANG1862</u>	Reading and listening comprehension of scientific texts[30h] (2 credits) (in French)	Ahmed Adrioueche
<i>If this course has not been followed in the first year</i>		
<u>CHM1112</u>	General Chemistry[22.5h+22.5h] (3 credits) (in French)	Jean-Paul Declercq
<u>SC1120</u>	Philosophy[30h] (2 credits) (in French)	Bernard Feltz
<i>SC1120 - compulsory in the 3rd year if not followed in the 2nd year</i>		
<u>MAT1222</u>	Complex analysis[30h+15h] (4 credits) (in French)	Luc Haine
<u>PHY1222</u>	Quantum mechanics[45h+30h] (5 credits) (in French)	Jacques Weyers
<u>PHY1251</u>	Statistical physics and Thermodynamics I[30h+22.5h] (4 credits) (in French)	Pierre Defrance, Hugues Goosse
<u>PHY1252</u>	Fluid physics[22.5h+15h] (3 credits) (in French)	André Berger
<u>PHY1261</u>	Astronomy and geophysics[15h+7.5h] (2 credits) (in French)	Véronique Dehant, Jean-Pascal van Ypersele de Strihou
<u>PHY1212</u>	Integrated exercises in general physics[0h+30h] (4 credits) (in French)	Thierry Fichet, Vincent Lemaitre, Krzysztof Piotrkowski

### Complementary studies in Physics ( at least 15 credits )

*The students who have opted to further their studies in Physics will take :*

#### One of the two following courses :

<u>PHY1221</u>	Group theory[22.5h+15h] (4 credits) (in French)	Philippe Ruelle, Philippe Ruelle
<u>PHY1272</u>	Analogic electronics[22.5h+22.5h] (4 credits) (in French)	René Prieels
<u>CHM1243</u>	Introduction to organic chemistry and to biochemistry[22.5h+22.5h] (3 credits) (in French)	Jean-Paul Declercq, Agnès Gnagnarella

#### Courses to be chosen in the 2nd or in the 3rd year

<u>CHM1251A</u>	Éléments de cristallographie[15h+15h] (2 credits) (in French)	Jean-Paul Declercq
<b>A minimum of 6 credits to be chosen from among the following courses (not taken previously) :</b>		
<u>PHY1221</u>	Group theory[22.5h+15h] (4 credits) (in French)	Philippe Ruelle, Philippe Ruelle
<u>PHY1272</u>	Analogic electronics[22.5h+22.5h] (4 credits) (in French)	René Prieels
<u>BIO1114</u>	Introduction to biology[30h+7.5h] (3 credits) (in French)	Michel Baguette, Claude Remacle, Philippe van den Bosch Sanchez de Aguilar (supplée Claude Remacle) Joseph Dufey, Philippe Sonnet
<u>BIR1130A</u>	Introductions aux sciences de la terre[30h] (3 credits) (in French)	
<u>ESPO1111A</u>	Political Economics (Part 1)[40h+10h] (4 credits) (in French)	N.
<u>MAT1251</u>	Exercices on the use of mathematical software[15h] (2 credits) (in French)	Christian Fabry

**Minor**

*The students who have opted for a minor - minor in Mathematics, minor in Geography, minor in Engineering Sciences : Applied Chemistry and Physics or a minor to be chosen from the UCL programme, will choose 15 credits from the programme of the minor chosen.*

**PHYS 13BA Third year of studies**

<u>PHY1311</u>	Classical electromagnetism[37.5h+15h] (4 credits) ▲ (in French)	N.
<u>PHY1321</u>	Mathematical methods in Physics[30h+30h] (4 credits) ▲ (in French)	N.
<u>PHY1322</u>	Mécanique quantique 2[45h+22.5h] (5 credits) ▲ (in French)	N.
<u>PHY1352</u>	Physics of fluids[22.5h+7.5h] (3 credits) ▲ (in French)	N.
<i>If this course has not been followed in the second year</i>		
<u>SC1120</u>	Philosophy[30h] (2 credits) (in French)	Bernard Feltz
<u>PHY1331</u>	Elementary nuclei and particules[30h+10h] (3 credits) ▲ (in French)	N.
<u>PHY1341</u>	Atoms and molecules[30h+10h] (3 credits) ▲ (in French)	N.
<u>PHY1351</u>	Statistical and thermodynamic physics 2[30h+22.5h] (4 credits) ▲ (in French)	N.
<u>PHY1323</u>	General Relativity[22.5h+15h] (4 credits) ▲ (in French)	N.
<u>PHY1371</u>	Numerical Simulation in Physics[22.5h+30h] (4 credits) ▲ (in French)	N.
<u>ANG1863</u>	Anglais - expression orale[30h] (2 credits) ▲ (in English)	Philippe Denis, Philippe Neyt (coord.), Colleen Starrs, Françoise Stas
<u>PHY1312</u>	Travaux dirigés[0h+60h] (7 credits) ▲ (in French)	N.

**Complementary studies in Physics ( at least 15 credits )**

*The students who have opted to further their studies in Physics will take the following courses :*

<u>PHY1342</u>	Condensed Matter[30h+10h] (3 credits) ▲ (in French)	N.
<u>PHY1372</u>	Experimental methods[30h+7.5h] (3 credits) ▲ (in French)	N.

*If this course has not been followed in the second year of the bachelor programme*

<u>CHM1251A</u>	Éléments de cristallographie[15h+15h] (2 credits) (in French)	Jean-Paul Declercq
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**A minimum of 9 credits to be chosen from the following courses (not followed previously) :**

<u>PHY1221</u>	Group theory[22.5h+15h] (4 credits) (in French)	Philippe Ruelle, Philippe Ruelle
<u>PHY1272</u>	Analogic electronics[22.5h+22.5h] (4 credits) (in French)	René Prieels
<u>PHY1324</u>	Relativist Quantum Mechanics[15h+15h] (2 credits) ▲ (in French)	N.
<u>PHY1373</u>	Signal processing - Information theory[22.5h+15h] (3 credits) ▲ (in French)	N.
<u>MAT1251</u>	Exercices on the use of mathematical software[15h] (2 credits) (in French)	Christian Fabry
<u>SC2002</u>	Elements of mathematics and physics history[30h] (4.5 credits) (in French)	Patricia De Grave






**Minor**

*The students who have opted for a minor - minor in Mathematics, minor in Geography, minor in Engineering Sciences : Applied Chemistry and Physics or a minor to be chosen from the UCL programme, will choose 15 credits from the programme of the minor chosen.*

**Minor in Mathematics (30 credits)**

*The programme of the minor in Mathematics is made up of 30 credits, according to choice, from among the mathematics courses of the MATH major. These courses may be spread over the second and third years, respecting the different prerequisites. The PHYS bachelors who have already followed this minor will be admitted to the masters of Mathematical Sciences (possibly with an adapted programme). However, any student desirous of making this change in orientation is encouraged to contact the Study Advisor of the MATH department as soon as possible.*

<u>MAT1231</u>	Multilinear algebra and group theory[30h+30h] (6 credits) (in French)	Jean-Roger Roisin, Jean-Pierre Tignol
<u>MAT1221</u>	Mathematical analysis 3[45h+45h] (9 credits) (in French)	Thierry De Pauw, Camille Debiève, Jean

<u>MAT1223</u>	Differential equations[30h+15h] (5 credits) (in French)	Mawhin
<u>MAT1241</u>	Geometry II[45h+15h] (6 credits) (in French)	Denis Bonheure
<u>MAT1321</u>	Functional analysis and partial differential equations[45h+45h] (8 credits)  (in French)	Pierre Bieliavsky N.
<u>MAT1322</u>	Measure theory[22.5h+15h] (3 credits)  (in French)	N.
<u>MAT1323</u>	Topology[22.5h+15h] (3 credits)  (in French)	N.
<u>MAT1331</u>	Commutative algebra[45h] (4 credits)  (in French)	N.
<u>MAT1351</u>	Numerical analysis : approximation, interpolation, integration (in French)	
<u>MAT1371</u>	Probability[30h+22.5h] (5 credits)  (in French)	N.