UCLouvain

lphys1241

2020

Quantum Physics 1

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Drewes Marco ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	*The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	This teaching unit consists of an introduction to the conceptual and physical bases of quantum physics, which governs the microscopic world.
Aims	**a. Contribution of the teaching units to the learning outcomes of the programme** 1.1, 1.3, 1.4, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 **b. Specific learning outcomes of the teaching unit** 1 At the end of this teaching unit, the student will be able to: 1. describe phenomena of the microscopic world by the formalism of wave mechanics and understand the fundamental differences with classical physics; 2. understand and use the relationship between operators and observables; 3. solve the one-dimensional Schrödinger equation in the presence of different potentials, including that of the harmonic oscillator; 4. determine the temporal evolution of a quantum system; 5. understand the concept of quantum entanglement. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The evaluation is based on a written exam on the theoretical notions and their application to problems of the physics of the microscopic world. It tests the knowledge and understanding of the notions presented during the teaching unit, the ability to analyze a quantum physics problem, the mastery of calculation techniques and the coherent presentation of this analysis
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The learning activities consist of lectures (ex cathedra) and practical work sessions. The lectures are intended to introduce the fundamental concepts, to motivate them by showing examples and establishing results, to show their reciprocal links and their relations with other teaching units of the Bachelor's programme in physics. The practical work sessions aim at learning to model phenomena of microscopic physics through quantum physics, to choose and use calculation methods for their analysis and to interpret the results obtained. Both activities are face-to-face.
Content	Complementary to the teaching units LPHY1111, LPHY1112, LPHY 1221 and LPHY1202, which laid the foundations of classical mechanics, relativistic mechanics, electromagnetism, wave physics and mathematical methods in physics, the teaching unit provides the student with an introduction to the conceptual bases of quantum physics of the microscopic world. The following subjects are covered in the teaching unit: • Discovery and observation of quantum phenomena in the microscopic world. • Feynman probability amplitude concept. • The Schrödinger equation. • Examples of one-dimensional solutions and physical applications. • The harmonic oscillator. • The principle of linear superposition and temporal evolution. • Uncertainty relationships. • Quantum intricacy and Bell's theorem.
Inline resources	This teaching unit is present on MoodleUCL, where students can find the syllabus, practical exercises, historical complements and, finally, quizzes proposed during the theoretical course.

Bibliography	• **J. Weyers, *Quantum Physics,*** Syllabus (disponible sur MoodleUCL). • **D. J. Griffiths**, ***Introduction to Quantum Mechanics*** , ed. Pearson . • **R. P. Feynman**, ***The Feynman Lectures on Physics, vol III*** , ed. Addison Wesley. • **J. Preskill, *Lecture notes on Quantum Computation, (*** web).
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Minor in Scientific Culture	MINCULTS	5		
Additionnal module in Mathematics	APPMATH	5		
Bachelor in Physics	PHYS1BA	5	LPHYS1112	
Minor in Physics	MINPHYS	5		