PHYS-207 **Quantum mechanics I**

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Cursus	Sem.	Type
Physics	BA4	Obl.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The objective of this course is to familiarize the student with the concepts, methods and consequences of quantum physics.

Content

1. A bit of history: the crisis of classical physics. Black body radiation, photo electric effect, Compton effect.
2. Rutherford's experiment, Bohr atom, de Broglie hypothesis.
3. The Stern and Garlach experiment: quantum states and spin 1/2

4. The axioms of quantum physics: state vectors, operators, measurement, representations

5. Continuous degrees of freedom: translation operator and canonical quantization

6. Time evolution: Schrödinger's equation and Heisenberg's point of view

7. Some simple problems in one dimension

8. Central potentials, angular momentum and hydrogen atom
9. Addition of angular momentum

Keywords

Quantum mechanics, Schrödinger equation, Heisenberg uncertainty principle, wave function, harmonic oscillator, hydrogen atom, spin, entanglement

Learning Prerequisites

Required courses

Basic physics and mathematics undergraduate courses

Important concepts to start the course

Strong working knowledge of calculus and linear algebra (covered in basic math courses).

Learning Outcomes

By the end of the course, the student must be able to:

- Compare Schrödinger's and Heisenberg's viewpoints on quantum physics

- Derive Heisenberg's uncertainty principle
- Characterize the amount of entanglement in a two-spin system
- Contextualise the postulates of quantum physics
- Explain the difference between classical and quantum physics
- Solve the quantum harmonic oscillator with the ladder operator method
- Interpret the measurement process in quantum physics
- Solve Schroendinger's equation for problems in 1,2 and 3 dimensions

Teaching methods

Ex cathedra. Exercises prepared in class.

Expected student activities

Students are expected to regularly attend the theory lectures and the exercise lectures. They are also expected to complete the exercises that are given on a weekly basis, as well as regularly study the learning material offered by the professor (lecture notes, exercises solutions etc).

Assessment methods

Written exam

Resources

Bibliography

The key reference is :
1. "Concepts of Modern Physics" (5th edition), Arthur Beizer (McGraw-Hill Education)
2 "Modern Quantum Mechanics" (2nd edition), J.J. Sakurai, J. Napolitano (Cambridge University Press, 2017)
Other books can be occasionally consulted, most notably
3. "Mécanique Quantique I-II", Cohen-Tannoudji, Diu, Lahoë (Hermann) [Also available in English]

Ressources en bibliothèque

- Find the references at the Library

Notes/Handbook

Lecture notes will be given at the beginning of the course

Moodle Link

- https://go.epfl.ch/PHYS-207