UE Quantum Physics I

Niveau d'étude
Bac +4

ECTS
3 crédits

Composante
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

Période de l'année
Automne (sept. à dec./janv.)

> **Langue(s) d'enseignement:** Anglais

> **Ouvert aux étudiants en échange:** Oui

> **Code d'export Apogée:** PAX7NQAB

Présentation

Description

Goal: This course is a deepening of the quantum mechanics concepts introduced in the undergraduate courses. The fundamental principle of quantum mechanics are illustrated by applications to nanoscale condensed-matter systems taken from recent research works and by discussing prospects for quantum information technologies. The concepts presented in this course are prerequisites for many second-year courses related to nanophysics and quantum engineering. A good knowledge in quantum mechanics is indeed more and more essential for technological research and development of nanoscale quantum devices.

Content

- **Chapter 1**: Introduction and recalls on the quantum mechanics postulates and formalism (Dirac notation, Hilbert space). Two-level system, Zeeman effect, spin Hamiltonian. Tensorial product notation for states and operators. Many-body quantum states (bosons and fermions).
  Exercices: Basics of quantum mechanics formalism.
- **Chapter 2**: Recalls on confinement problem. Electron bound states in a potential.
  Exercises: Example of 1D confinement problems, quantum harmonic oscillator.
- **Chapter 3**: Introduction to atomic physics. Spherical symmetry, angular and spin kinetic momenta. Mean field approximation, central potential, many electrons atoms, Hund rules, spin-orbit coupling, optical transitions.
  Exercises: Grotrian diagrams, spin-orbit coupling, fine and hyperfine structure.
- **Chapter 4**: Approximation methods for eigenstate calculations, perturbation theory, variational method.

Exercises: Application to electronic systems.

- **Chapter 5**: Time evolution. General equation for the time evolution, two-level systems, perturbation theory, Fermi golden rules.
Exercises: Application to Rabi oscillations.

Prerequisites: Basics of quantum mechanics.

Bibliography: Quantum mechanics, C. Cohen-Tannoudji, Vol. 1, ISBN-13: 978-0471164333, Vol. 2, ISBN-13: 978-0471569527.

Heures d'enseignement

UE Quantum Physics I - CMTD	Cours magistral - Travaux dirigés	24h

Période : Semestre 7

Infos pratiques

Campus

> Grenoble - Domaine universitaire