

PHYS-334

Atomic, molecular physics and optics

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Cursus	Sem.	Type
Physics	BA6	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

This course presents the fundamental physics of atoms and molecules, their structure and their interaction with electromagnetic fields.

Content

- Hydrogen atom (reminders and complements)
- Fine and hyperfine structure of the hydrogen atom
- Hydrogen atoms in external fields, vector and tensor operators
- Alkali and Rydberg atoms
- Helium and two-electron atoms
- Many-electron atoms and the periodic table
- Atoms interacting with light
- Light propagation
- Elementary principles of the laser
- Chemical bonding in molecules
- Electronic and vibrational spectra of molecules
- Elements of organic chemistry - building blocks of life
- Elements of inorganic chemistry - crystalline materials
- From molecules to nanostructures

Keywords

Atoms, Molecules, Optics

Learning Prerequisites**Important concepts to start the course**

Fundamentals of quantum mechanics, angular momentum, perturbation theory, dipoles and multipoles, dipolar radiation, chemical bonding, molecular structure

Learning Outcomes

- Analyze the structure of simple atoms and molecules

- Use quantum mechanics to solve problems of atomic physics
- Interpret observations in atomic, molecular and optical physics
- Apply quantum mechanics and classical electrodynamics to light-matter interactions problem

Transversal skills

- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools

Teaching methods

Ex-Cathedra, problem solving classes, numerical exercises

Expected student activities

Lecture participation, problem solving, numerical investigations

Assessment methods

Written exam

Resources

Bibliography

Atkins and Friedman, *Molecular quantum mechanics*
Brandsen and Joachain, *Physics of atoms and molecules*
Walraven, *Atomic physics*
Van der Straten and Metcalf, *Atoms and molecules interacting with light*

Ressources en bibliothèque

- [Find your references at the Library](#)

Références suggérées par la bibliothèque

- [Atomic physics / Walraven](#)

Moodle Link

- <https://go.epfl.ch/PHYS-334>