CH-360

Atoms and radiation

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Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Spectroscopy, i.e. measurement of the response of a system to a perturbing electromagnetic field, is one of the most important tools to study microscopic systems. This course provides the basics of spectroscopy, discussing in detail the interaction between atoms and electromagnetic radiation.

Content

Reminder
- Early concepts of the atom
- Electromagnetic radiation
- Radiating bodies

Spectroscopies Fundamentals
- Emission, absorption and dispersion of light
- Quantum mechanics modelling: Einstein coefficients and Planck law
- The spectral shapes of atomic transitions
- Time-dependent quantum mechanics problems

Radiation measurements:
- Spectrometers
- Interferometers
- Detectors

Fundamentals of Lasers:
- Stimulated absorption and emission of radiation
- Technology, basics and limitations
- Gas, dye, excimer and solid state lasers

Non-Linear Optics
- Non-linear effects
- Second Harmonic Generation
- Sum Frequency Generation and Difference Frequency Generation

Ultrafast Physics
- Short light pulses generation
- Mode-locking
- Pulse propagation and chirp
- Pulse amplification

Strong field physics
- High Harmonic Generation

- Attosecond pulse production
- Attosecond experiments

Keywords

Atoms, electromagnetic radiation, spectroscopy, laser, light measurement, non-linear optics, ultrafast physics

Learning Prerequisites

Recommended courses

Quantum mechanics, Electromagnetism

Learning Outcomes

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

- Link classical and quantum mechanical pictures for the interaction of atoms with electromagnetic radiation
- Discuss effects of the environment on atomic spectra
- Explain the relation between atomic properties and spectroscopic line shapes
- Explain the physics behind a laser
- Explain Strong field physics
- Discuss attosecond physics
- Choose an appropriate spectroscopic technique for a given problem

Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Demonstrate a capacity for creativity.
- Access and evaluate appropriate sources of information.
- Use a work methodology appropriate to the task.
- Demonstrate the capacity for critical thinking

Assessment methods

30% course project
20% mid-term
50% oral exam

Supervision

Office hours	Yes
Others	Office: CH H1 565, CH H1 545

Resources

Bibliography

W. Demtröder : Laser Spectroscopy (Springer Verlag, Berlin 1997)
Hertel :Atoms, Molecules and optical physics

Ressources en bibliothèque

- Atoms, Molecules and Optical Physics / Hertel
- Laser spectroscopy / Demtröder

Notes/Handbook

Lecture notes