Faculty of Science

FYSC11, Physics: Atomic and Molecular Physics, 7.5 credits

Fysik: Atom- och molekylfysik, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus is an old version, approved by Study programmes board, Faculty of Science on 2010-12-15 and was last revised on 2010-12-15. . The revised syllabus applied from 2010-12-15. , spring semester 2011.

General Information

Language of instruction: Swedish and English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements
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Learning outcomes

Knowledge and understanding

On completion of the course, the student should:

- be able to explain the quantum mechanical concepts needed to describe the modern atom and the molecular physics.
- be able to describe some basic experiment from the atom and molecular physics history
- be able to describe emission and absorption of light in atoms.

Skills and abilities

On completion of the course, the student should:

- be able to use basic quantum mechanical concepts and apply them to issues on the physics of atoms and molecules,
- be able to plan, carry out and present experiment
- be able to analyse simple atomic and molecular spectra,
- at a general level be able to illustrate and describe current research within atomic physics and synchrotron light physics.

Judgement and approach

On completion of the course, the student should:

- be able to evaluate experimental results
- show an ability to assess the applicability and limitations of physical models
- independently be able to acquire new knowledge and present these in oral and written form
- demonstrate an understanding of the role of atomic physics in society.

Course content

The thematic content of the course:

- Introduction to quantum mechanical concepts.
- Angular momentum: the electron spin and orbital angular momentum.
- Theoretical treatment of elementary atomic structure: quantum mechanical treatment of the hydrogen atom, fine structure, the helium atom, spin wave functions, the Pauli principle, the LS-approximation in atoms with two valence electrons, the central field approximation. Experimental observations of effects connected to these phenomena.
- Electric dipole approximation, radiative transitions in the hydrogen atom.
- Basic theoretical treatment of many-electron atoms.
- X-ray radiation, X-ray spectra, X-ray spectroscopy, Moseley's law.
- Auger effect, Auger spectroscopy.
- Emission and absorption of light.
- Interaction with external field. Hyperfine - and isotope structure.
- Two - and polyatomic molecules. The LCAO-method. Molecular orbitals. Rotations. Vibrations.
- Laser and applications within laser physics.
- Synchrotron light and applications within synchrotron light physics.
- Applications within astrophysics.
- Plasmas in thermal equilibrium: distribution rules, radiative transfer, line profiles.
- The history of atomic physics.
- Basic experiment in atomic physics history e g the Stern-Gerlach experiment, Lamb's and Rutherford's experiment that led to the discovery of the Lamb shift, Rydberg spectral experiments.

Course design

The teaching consists of teaching sessions, group tuition and supervision in connection with laboratory sessions, computer exercises and seminars. The lessons are mainly devoted to overview the theoretical course and problem-solving. Dissemination of research results is an important element in the course on class hours, often in connection with showing the current activities. The laboratory work mainly consists of laboratory sessions, computer exercises and overviews in connection to these. All items belonging to the laboratory work is compulsory. The laboratory items of the course is given a total score and the lab performance is graded. It is an essential part of the course that the student presents given assignments to the group.

Assessment

The examination routines contain both written hand-ins and an oral test. Normally, three examinations are given per academic year and module. Extra examinations can be given after agreement with course teacher and director of studies.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course requires approved examination/passed laboratory reports/passed written hand-ins and participation in all compulsory parts.

The final grade of the course is decided through a weighted average of the grades for the oral examination and the laboratory sessions according to their individual credits.

Entry requirements

For admission to the course, knowledge is required equivalent 60 credits physics including the course FYSA21 Thought Tools in Science, 30 credits, or the equivalent.

Further information

The course may not be included in a higher education degree together with FYSA31, Modern physics, 30 credits, or FYSB04 Atomic and Molecular Physics, 7.5 credits.

Subcourses in FYSC11, Physics: Atomic and Molecular Physics

Applies from H14

1003 Exam, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
1004 Laboratory Exercises, 2,5 hp
Grading scale: Fail, Pass, Pass with distinction

Applies from V11

1001 Oral Exam, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
1002 Laboratory Exercises and Projects, 2,5 hp
Grading scale: Fail, Pass, Pass with distinction