



Faculty of Science

## FYST86, Physics: Light-matter Interaction, 7.5 credits

*Fysik: Ljus-materia växelverkan, 7,5 högskolepoäng*

Second Cycle / Avancerad nivå

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### Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2023-12-06. The syllabus comes into effect 2023-12-06 and is valid from the autumn semester 2024.

### General information

The course is an elective course for second-cycle studies for a Degree of Bachelor of Science (180 credits) or Master of Science (120 credits) with a specialisation in physics.

*Language of instruction:* English

*Main field of study*

*Specialisation*

Physics

A1N, Second cycle, has only first-cycle course/s as entry requirements

### Learning outcomes

The aim of the course is to give the student an advanced knowledge in atomic physics and especially on the interaction between light and matter.

### Knowledge and understanding

On completion of the course, the student shall be able to:

- describe the interaction between matter and light by using quantum mechanics.
- orient himself/herself in modern research fields connected to light-matter interaction, such as atoms in strong laser fields, laser cooling and trapping of atoms, manipulation of quantum states.

## Competence and skills

On completion of the course, the student shall be able to:

- independently perform realistic quantum mechanical calculations on existing systems, both analytically and numerically.
- formulate and solve some simple physics problems within atomic physics especially concerning the interaction between atoms and radiation.
- demonstrate an increased competence in presenting reports from lab exercises and be able to discuss the content at an advanced level.
- find, acquire and assess knowledge from literature at an advanced level.

## Judgement and approach

On completion of the course, the student shall be able to:

- independently decide which methods can be used for different problems.
- demonstrate an increased experience of working in groups towards a common goal.

## Course content

- Interaction between atoms and light
- Laser cooling and trapping. Radiation forces
- Atoms in strong fields. Application to extreme optics: attosecond pulses
- Manipulation of atoms, molecules and larger systems with light. Atom Optics.
- Quantum technology with atoms and ions.

## Course design

The teaching consists of lectures, calculation exercises and laboratory work. Participation in laboratory work and thus integrated other teaching is mandatory.

## Assessment

Examination takes place through a written exam at the end of the course and through compulsory laboratory work including preparatory assignments and reports during the course.

For students who have not passed the regular examination, an additional examination opportunity is offered during the scheduled re-examination period.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

## Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction

The written exam is graded according to the grading scale Fail, Pass, Pass with distinction. The laboratory work is graded according to the grading scale Fail, Pass.

For a passing grade on the entire course, a passed exam and passed laboratory work are required.

The final grade for the entire course is determined by the grade on the written exam.

### **Entry requirements**

Admission to the course requires 75 credits in physics and 45 credits in mathematics including knowledge equivalent to FYSB22, Physics: Basic Quantum Mechanics, 7.5 credits and FYSB24 Physics: Atomic and Molecular Physics, 7.5 credits, - or a bachelor's degree in physics or equivalent, including knowledge equivalent to FYSB22 Physics: Basic Quantum Mechanics, 7.5 credits. English 6/B and general entry requirements.

### **Further information**

The course replaces FYST21, Physics: Light - Matter Interaction, 7.5 credits and cannot be included in the degree together with this course.

The course is taken together with FAFN05, Light - Matter Interaction, 7.5 credits, which is a course at The Faculty of Engineering, LTH.

The course examination is scheduled in accordance with LTH's examination schedule.

The course is given at the Department of Physics, Lund University.