



LUNDS UNIVERSITET  
Lunds Tekniska Högskola

*Course syllabus*

## Ljus - materia växelverkan Light - Matter Interaction

**FAFN05, 7,5 credits, A (Second Cycle)**

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED F/Pi

Date of Decision: 2023-04-18

### General Information

Main field: Nanoscience.

Elective for: F4, F4-tf, F4-f, F4-axn, MFOT1, MNAV1

Language of instruction: The course will be given in English

### Aim

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. An introduction to several modern research fields such as atoms in strong laser fields, laser cooling and trapping of atoms, quantum computers will be given.

### Learning outcomes

*Knowledge and understanding*

For a passing grade the student must

- be able to underdescribe the interaction between matter and light by using quantum mechanics.
- be able to orient himself/herself in research problems at a relatively high level, just below PhD education.

*Competences and skills*

For a passing grade the student must

- be able to perform independently realistic quantum mechanical calculations on existing systems both analytically and numerically.
- be able to formulate and solve some simple physics problems within atomic physics especially concerning the interaction between atoms and radiation.

- have obtained an increased competence in presenting written reports from lab exercises and be able to discuss the content at an advanced level.
- be able to search, acquire and assess knowledge from literature at an advanced level.

### *Judgement and approach*

For a passing grade the student must

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

## Contents

- 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 communication and quantum computers

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)

**Assessment:** Written exam. Two mandatory laboratory exercises with numerical preparation assignment and written report.

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.

## Admission

**Assumed prior knowledge:** Basic Atomic Physics and Quantum Mechanics.

**The number of participants is limited to:** No

**The course overlaps following course/s:** FAF190

## Reading list

- Christopher J. Foot: Atomic Physics. Oxford University Press, 2005. Foot, C.J.: Atomic Physics. Oxford University Press 2005 (Chap. 7-14).
- Laboratory instructions.

## Contact and other information

**Teacher:** Anne L'Huillier, [anne.lhuillier@fysik.lth.se](mailto:anne.lhuillier@fysik.lth.se)

**Course coordinator:** Andreas Walther, [andreas.walther@fysik.lth.se](mailto:andreas.walther@fysik.lth.se)

**Course homepage:**

<http://www.atomic.physics.lu.se/education/elective-courses/fafn05-fyst21-light-matter-interaction/>

**Further information:** It is mandatory to attend the first lecture in order to be admitted to the course.