Announcement

Experimental Quantum Optics

Prof. Kubanek

Description

The course gives an introduction into the field of Quantum Optics. Basic concepts and experimental methods are introduced. Theoretical tools will be covered when needed.

The laser plays a central role in Quantum Optics experiments. Therefore, we will start with a brief introduction to laser physics. We then discuss the Quantum nature of light and study light-matter interaction in different systems. Afterwards, we turn to the fascinating physics of cavity quantum electrodynamics. Finally, we discuss current research directions in the field.

Instruction language

English

Attendance time

5 hours per week

Duration

1 semester

Allocation to study programmes

- Physics M.Sc., elective module, 1st or 2nd semester
- Wirtschaftsphysik M.Sc., elective module, 1st - 3nd semester
- Biophysics M.Sc., elective module, 1st or 2nd semester
- Advanced Materials M.Sc., elective module, 1st or 2nd semester

Prerequisites

Formal prerequisites: None

Recommended prerequisites: optics, atomic physics, quantum mechanics

Learning Outcomes

Students who have taken this course are expected to be familiar with concepts and techniques used in modern quantum optics. The course is targeted to prepare students for performing research in the fields of quantum optics.

Content

- Laser physics
- Quantum nature of light
- Interaction of light and matter
- Atomic and “atom-like” systems
- Cavity Quantum Electrodynamics
- Current research topics in Quantum Optics, Quantum Information and Quantum Sensing

Literature

Specific literature will be provided throughout the course. In depth literature research is also part of independent preparation of the student presentations.

Quantum Optics books for general preparation:

- C.C. Gerry and P.L. Knight, Introductory Quantum Optics (Cambridge University Press,Cambridge, 2005).
- G. Grynberg, A. Aspect and C. Fabre, Introduction to Quantum Optics
- M. Fox, Quantum Optics An introduction (Oxford University Press)
- G. Agarwal, Quantum Optics, (Cambridge University Press, Cambridge, 2013).
- M.O. Scully and M.S. Zubairy, Quantum Optics (Cambridge University Press, Cambridge, 1997)

More specialized books:

- C. Cohen-Tannoudji, J. Dupont-Roc, and G. Grynberg - Atom Photon Interactions (Wiley-Interscience)
  Comment: “Specialized on Light Atom Interaction”
- S. Haroche, J. – M. Raimond – Exploring the quantum, (Oxford University Press 2006)
  Comment: “Specialized on cavity quantum electrodynamics”
- M. Nielsen, I. Chuang – Quantum Computation and Quantm Information, (Cambridge University Press, Cambridge, 2009).
  Comment: “Specialized on quantum information”

Teaching and learning methods

Lecture (4 hours per week)

Exercise (1 hours per week)

Assessment

The course includes lectures, problem sets and a journal club 1 hour / week. Active participation throughout the semester and, in particular, during journal club is required for final grading in written or oral examination.

Lecturer

Prof. Kubanek, Institute of Quantum Optics