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Fakultät für Naturwissenschaften, Fachbereich Physik

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Theoretical Quantum Optics

PD Dr. Maxim A. Efremov

Description

The field of quantum optics has witnessed significant theoretical and experimental developments in recent years. This special lecture series provides an in-depth and wide-ranging introduction to the subject, emphasising throughout the basic principles and their applications. This course should be useful for graduate students in physics as well as for research workers who want to become familiar with the ideas of quantum optics.

Content

- Interaction between matter and light
- Two-level quantum systems and classical field
- Density matrix (single atom and an ensemble), Maxwell-Bloch equations
- Three-level quantum systems in two or more classical fields (dark states, adiabatic following, and slow light)
- Free-field quantization (Fock, coherent, and squeezed states)
- Quantum phase-space distributions (photon optics and Wigner function)
- Atom-Quantized field interaction (Jaynes-Cummings model, generation of coherent and squeezed states; Wigner-Weisskopf model)
- Atom optics with classical and quantized light fields (entanglement of atoms and field)

Literature

- W.P. Schleich, *Quantum Optics in Phase Space* (Wiley-VCH, Weinheim, 2001)
- L. Mandel and E. Wolf, *Optical Coherence and Quantum Optics* (Cambridge University Press, 1995)
- W. Vogel and D.-G. Welsch, *Quantum Optics* (Wiley-VCH, Weinheim, 2006)
- R.J. Glauber, *Quantum Theory of Optical Coherence* (Wiley-VCH, Weinheim, 2007)
- M.O. Scully and M.S. Zubairy, *Quantum Optics* (Cambridge University Press, Cambridge, 1997)
- C.C. Gerry and P.L. Knight, *Introductory Quantum Optics* (Cambridge University Press, Cambridge, 2005)

Prerequisites

A basic knowledge of quantum mechanics, electrodynamics and classical statistics is assumed.

Details

- Lecture (3 SWS), exercises (2 SWS)
- 6 ECTS credits

Lecturer

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