

Quantum Theory of Light (WS17/18)

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Lectures: Matthias Kleinmann, Otfried Gühne, Mondays 8:30 a.m., room B205
Exercise classes: Ana Costa, Thursdays 12:30 p.m., room B019

Introduction

1. Quantization of the electromagnetic field

- (a) Reminder: Electromagnetic waves
- (b) Single mode cavity
- (c) Example: Casimir effect
- (d) Thermal light
- (e) Multi-mode fields in 3d

2. Coherent states

- (a) Radiation from classical current
- (b) Elementary properties of the displacement operator
- (c) Properties of coherent states
- (d) Physics of coherent states
- (e) Squeezed states
- (f) Expansions into coherent states

3. Quantum coherence and classical coherence

- (a) First order coherence, classical
- (b) First order coherence, quantum
- (c) Second order coherence, classical
- (d) Second order coherence, quantum
- (e) Addendum: Beam splitter

4. Light and atoms

- (a) Dipole approximation
- (b) Two-level atom
- (c) Two-level atom with quantized field
- (d) Dressed states
- (e) Spontaneous emission

5. Interlude: Some foundations of quantum theory

- (a) Mixed states
- (b) Composed systems
- (c) Partial trace
- (d) Operations
- (e) Bells theorem

6. Open quantum systems

- (a) von Neumann equation
- (b) Lindblad equation
- (c) Microscopic derivation
- (d) Quantum-optical master equation