

Theoretical Quantum Optics

Theoretische Quantenoptik

Lecture

Tuesday 8h00 c.t.

Thursday 8h00 c.t.

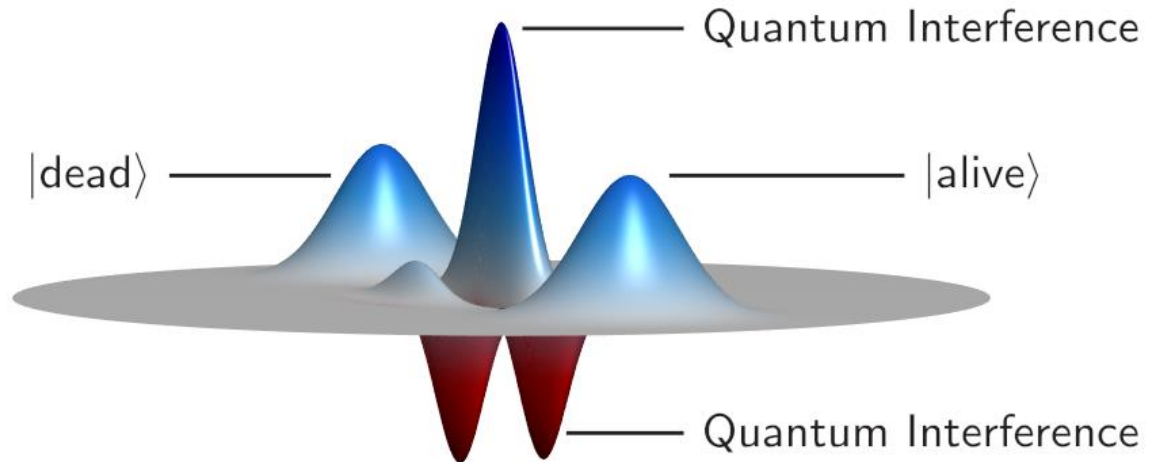
Start: 17.10.2023

Venue: D8H33

Tutorials

Monday 12h00 c.t. in D8H33

Tuesday 10h00 c.t. in C5S06



Optical Schrödinger's Cat
© Wikipedia

Lecture – Table of contents

Week (approx.)	Contents	Pages in script
1	1. Quantisation of the electromagnetic field Quantisation of a single mode Quantum fluctuations of a single mode	1 – 11
2	Quadrature operators of a single-mode field Multi-mode fields	12 – 21
3	Thermal fields Coherent states	22 – 31
4	2. Quasi-probability distributions in phase space Wigner-function (Coherent states)	32 – 42
5	Complex Fourier Transform in 2D Characteristic function Wigner-function (thermal states, Fock states) P – function	43 – 52
6	Q – representation Relationship between Wigner, P and Q functions Equation of motion for quasi-probabilities	53 – 66
7	Non-classicality of radiation fields Mandel parameter	67 – 76

Lecture – Table of contents

8	3. Quantum measurements of the electromagnetic field Beam splitter physics Hong-Ou-Mandel effect Measurement of the Wigner function Homodyne detection	77 – 88
9	Theory of photo-detection Theory of optical coherence Michelson star interferometer Hanbury-Brown-Twiss effect	89 – 102
10	Noise in quantum-optical measurements Introduction to quantum parameter estimation theory Classical parameter estimation theory	103 – 113
11	Quantum parameter estimation theory 4. Light-matter interaction Interaction between an atom and an electromagnetic field	114 – 134
12	Atom driven by classical light field (Rabi model) Atom interacting with a quantised light field (Jaynes-Cummings model)	125 – 137
13	Open system dynamics and decoherence	138 – 148
14	Micromaser theory	149 – 156

Literature

C. Gerry and P. Knight

Introductory Quantum Optics

Cambridge University Press

D. Braun

Quantum Optics Script

I. Lesanovsky

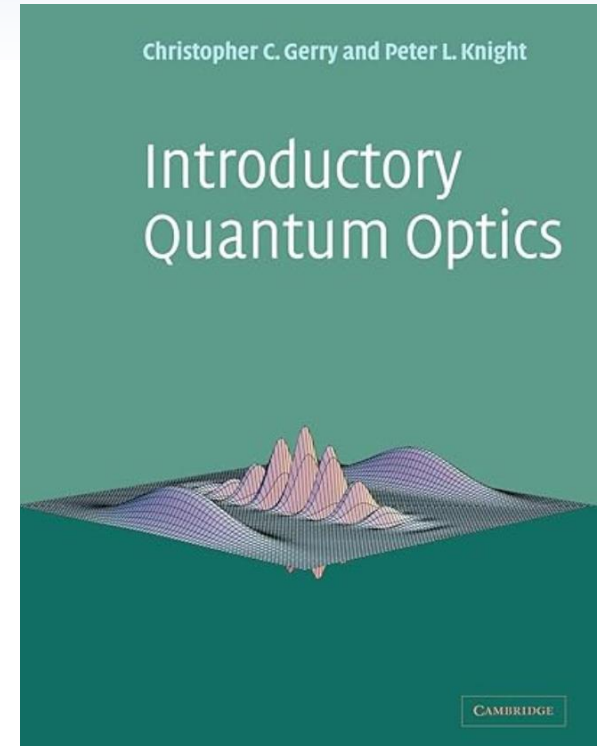
Theoretical Quantum Optics Script

(Download through Ilias)

Berthold-Georg Englert

Elements of Micromaser Physics

arXiv:quant-ph/0203052



...and any other
quantum optics book/script

Lecture plan

Date	
17.10.	Lecture 1
19.10.	Lecture 2
24.10.	Lecture 3
26.10.	Lecture 4
31.10.	Lecture 5
2.11.	Bad Honnef
7.11.	Lecture 6
9.11.	Lecture 7
14.11.	Lecture 8
16.11.	Lecture 9
21.11.	Lecture 10
23.11.	Lecture 11
28.11.	Lecture 12
30.11.	Lecture 13
5.12.	Lecture 14
7.12.	Dresden
12.12.	Lecture 15
14.12.	Lecture 16
19.12.	Lecture 17

Date	
21.12.	School holiday
26.12.	Christmas
28.12.	
2.1.	
4.1.	
9.1.	Lecture 18
11.1.	Lecture 19
16.1.	Lecture 20
18.1.	Munich
23.1.	Lecture 21
25.1.	Lecture 22
30.1.	Lecture 23
1.2.	Lecture 24
6.2.	Lecture 25
8.2.	Lecture 26

Tutorials

- **Venue**
 - Monday 12h00 – 14h00 c.t. D8H33
 - Tuesday 10h00 – 12h00 c.t. C5S06
- **Weekly problem sheet**
 - Hand out online on Thursday
 - Hand in before Thursday lecture
- **Pass criteria**
 - Meaningful attempt to solve of at least 70% of all questions
 - Presentation of solution at least three times during tutorials
 - Attendance of all but one tutorial

