

QUANTUM OPTICS AND INFORMATION

[Gonzalo Muga]

Introduction: History.

Field quantization: Quantization and quantum fluctuation of single mode field; Quadrature operators; Multimode fields; Thermal fields; Vacuum fluctuations and zero-point energy; The quantum phase.

Coherent states: Eigenstates of the annihilation operator and minimum uncertainty states; Displaced vacuum states; Wave packets and time evolution; Generation of coherent states; More on the properties of coherent states; Phase-space pictures of coherent states; Density operators and phase-space probability distributions; Characteristic functions.

Emission and absorption of radiation by atoms: Atom–field interactions; Interaction of an atom with a classical field; Interaction of an atom with a quantized field; The Rabi model; Fully quantum-mechanical model; the Jaynes–Cummings model; The dressed states; Density-operator approach: application to thermal states; The JC model with large detuning; Extensions of the Jaynes–Cummings model; Schmidt decomposition and von Neumann entropy for the JC model. Realization of the JC model with trapped ions.

Quantum coherence functions: Classical coherence functions; Young’s interference; Higher-order coherence functions.

Beam splitters and interferometers: Experiments with single photons; Quantum mechanics of beam splitters; Interferometry with a single photon; Interaction-free measurement; Interferometry with coherent states of light.

Non-classical light: Quadrature squeezing; Generation of quadrature squeezed light; Detection of quadrature squeezed light; Amplitude (or number) squeezed states; Photon antibunching; Schrödinger cat states; Two-mode squeezed vacuum states; Higher-order squeezing; Broadband squeezed light.