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Generalized optomechanical systems; Bibliography; 2. Theoretical Treatments in Generalized Optomechanical Systems; 2.1 Heisenberg equation of motion; 2.2 Density matrix approach; 2.3 Quantum Heisenberg-Langevin equation; Bibliography; 3. Light Propagation in Cavity Optomechanical System; 3.1 Fast light and slow light; 3.2 All-optically controlled quantum memory; 3.3 Measurement of vacuum Rabi splitting; 3.4 Measurement of resonator's frequency; 3.5 An optomechanical transistor; Bibliography; 4. Cavity Optomechanical System with Bose-Einstein Condensate; 4.1 Slow light; 4.2 All-optical transistor; 4.3 Single photon router; 4.4 Nonlinear all-optical Kerr switch; Bibliography; 5. The Smallest Generalized Optomechanical System - a Single Quantum Dot; 5.1 Two hallmarks of a single quantum dot as generalized optomechanical system; 5.2 Phonon induced coherent optical spectroscopy; 5.3 Measurement the frequency of LO-phonon; 5.4 Slow light and fast light; 5.5 A quantum optical transistor; Bibliography; 6. Nanomechanical Resonator Coupled to a Single Quantum Dot; 6.1 Mechanically induced coherent population oscillation (MICPO); 6.2 Measurement of vibrational frequency of NR; 6.3 Measurement of coupling strength between NR and QD; 6.4 Measurement of lifetime of NR; 6.5 A single photon router; 6.6 All-optical Kerr switch; Bibliography; 7. Nanomechanical Resonator Coupled to a Hybrid Nanostructure; 7.1 Theory; 7.2 Coherent optical spectrum enhancement; 7.3 All-optical Kerr modulator; 7.4 Surface plasmon enhanced optical mass sensing; Bibliography; 8. Optomechanical System with a Carbon Nanotube Resonator; 8.1 Theory; 8.2 Coherent optical spectroscopy; 8.3 Slow light and superluminal light; 8.4 Quantum optical transistor; 8.5 Nonlinear optical Kerr modulator; 8.6 All-optical mass sensor with a carbon nanotube; 8.7 Surface plasmon enhanced optical mass sensor; Bibliography; 9. A Circuit Cavity Electromechanical System; 9.1 Coherent optical spectrum; 9.2 Single-photon router with a cavity electromechanical system; 9.3 Controllable nonlinear responses; 9.4 Mass sensing based on a circuit cavity electromechanical system; Bibliography; 10. A Hybrid Optomechanical System Based on Quantum Dot and DNA Molecules; 10.1 Model and theory; 10.2 Coherent optical spectrum; 10.3 Vibrational frequency measurement of DNA molecule; 10.4 Coupling strength determination between quantum dot and DNA molecule; 10.5 A protocol of tumor discrimination; Bibliography; Index

Sommario/riassunto

A mechanical oscillator coupled to the optical field in a cavity is a typical cavity optomechanical system. In our textbook, we prepare to introduce the quantum optical properties of optomechanical system, i. e. linear and nonlinear effects. Some quantum optical devices based on optomechanical system are also presented in the monograph, such as the Kerr modulator, quantum optical transistor, optomechanical mass sensor, and so on. But most importantly, we extend the idea of typical optomechanical system to coupled mechanical resonator system and demonstrate that the combined two-level structure