Semiconductor Quantum Optics

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A Guide to Experiments in Quantum Optics Springer
Covering a number of important subjects in quantum optics, this textbook is an excellent introduction for advanced undergraduate and beginning graduate students, familiarizing readers with the basic concepts and formalism as well as the most recent advances. The first part of the textbook covers the semi-classical approach where matter is quantized, but light is not. It describes significant phenomena in quantum optics, including the principles of lasers. The second part is devoted to the full quantum description of light and its interaction with matter, covering topics such as spontaneous emission, and classical and non-classical states of light. An overview of photon entanglement and applications to quantum information is also given. In the third part, non-linear optics and laser cooling of atoms are presented, where using both approaches allows for a comprehensive description. Each chapter describes basic concepts in detail, and more specific concepts and phenomena are presented in 'complements'.

Quantum Theory of the Optical and Electronic Properties of Semiconductors Cambridge University Press
This book takes the reader from the very basics of III-V semiconductors (some preparation in quantum mechanics and electromagnetism is helpful) and shows how seemingly obscure results such as detailed forms of the Hamiltonian, optical transition strengths, and recombination mechanisms follow.

Quantum Optics with Semiconductor Nanostructures Springer
The state-of-the-art of quantum transport and quantum kinetics in semiconductors, plus the latest applications, are covered in this monograph. Since the publishing of the first edition in 1996, the nonequilibrium Green function technique has been applied to a large number of new research topics, and the revised edition introduces the reader to many of these areas. This book is both a reference work for researchers and a self-tutorial for graduate students.

Quantum Photonics Academic Press
This revised and updated edition of the well-received book by C. Klingshirn provides an introduction to and an overview of all aspects of semiconductor optics, from IR to visible and UV. It has been split into two volumes and rearranged to offer a clearer structure of the course content. Inserts on important experimental techniques as well as sections on topical research have been added to support research-oriented teaching and learning. Volume 1 provides an introduction to the linear optical properties of semiconductors. The mathematical treatment has been kept as elementary as possible to allow an intuitive approach to the understanding of results of semiconductor spectroscopy. Building on the phenomenological model of the Lorentz oscillator, the book describes the interaction of light with fundamental optical excitations in semiconductors (phonons, free carriers, excitons). It also offers a broad review of seminal research results augmented by concise descriptions of the relevant experimental techniques, e.g., Fourier transform IR spectroscopy, ellipsometry, modulation spectroscopy and spatially resolved methods, to name a few. Further, it picks up on hot topics in current research, like quantum structures, mono-layer semiconductors or Perovskites. The experimental aspects of semiconductor optics are complemented by an in-depth discussion of group theory in solid-state optics. Covering subjects ranging from physics to materials science and optoelectronics, this book provides a lively and comprehensive introduction to semiconductor optics. With over 120 problems, more than 480 figures, abstracts to each chapter, as well as boxed inserts and a detailed index, it is intended for use in graduate courses in physics and neighboring sciences like material science and electrical engineering. It is also a valuable reference resource for doctoral and advanced researchers.

Optical Generation and Control of Quantum Coherence in Semiconductor Nanostructures Cambridge University Press
Of the variety of nonlinear dynamical systems that exhibit deterministic chaos optical systems both lasers and passive devices provide nearly ideal systems for quantitative investigation due to their simplicity both in construction and in the mathematics that describes them. In view of their growing technical application the understanding, control and possible exploitation of sources of instability in these systems has considerable practical importance. The aim of this volume is to provide a comprehensive coverage of the current understanding of optical instabilities through a series of reviews by leading researchers in the field. The book comprises nine chapters, five on active (laser) systems and four on passive optically bistable systems. Instabilities and chaos in single- (and multi-) mode lasers with homogeneously and broadened gain media are presented and the influence of an injected signal, loss modulation and also feedback of laser output on this behaviour is treated. Both electrically excited and optically pumped gas lasers are considered, and an analysis of dynamical instabilities in the emission from free electron lasers are presented. Instabilities in passive optically bistable systems include a detailed analysis of the global bifurcations and chaos in which transverse effects are accounted for. Experimental verification of degenerative pulsations and chaos in intrinsic bistable systems is described for various optical feedback systems in which atomic and molecular gases and semiconductors are used as the nonlinear media. Results for a hybrid bistable optical system are significant in providing an important test of current understanding of the dynamical behaviour of passive bistable systems.

Optical Properties of Semiconductor Nanocrystals Woodhead Pub Limited
This book combines new physics and the latest device developments in low dimensional semiconductors. The development and application of low dimensional semiconductors has been rapid and spectacular during the past decade. Ever improving epitaxial growth and device fabrication techniques have allowed access to some remarkable new physics in quantum confined structures, while in parallel, a plethora of new devices have emerged. The field of optoelectronics in particular has benefited from these advances both in terms of improved performance and the invention of fundamentally new types of device, at a time when the use of optics and lasers in telecommunications, broadcasting, the internet, signal processing and computing has been rapidly expanding. An appreciation of the physics of quantum and dynamical electronic processes in confined structures in key to the understanding of many of the latest devices and involvement in their continued development. This book allows those who already have somefamiliarity with semiconductor physics and devices, to broaden and expand their knowledge into new and expanding topics in low dimensional semic

Semiconductor Quantum Dots Taylor & Francis
Photonics is the discipline of electrons and photons working in tandem to create new physics, new devices and new applications. This textbook employs a pedagogical approach that facilitates access to the fundamentals of quantum photonics. Beginning with a review of the quantum properties of photons and electrons, the book then introduces the concept of their non-locality at the quantum level. It presents a determination of electronic band structure using the pseudopotential method, enabling the student to directly compute the band structures of most group IV, group III-V, and group II-VI semiconductors. The book devotes further in-depth discussion of second quantization of the electromagnetic field that describes spontaneous and stimulated emission of photons, quantum entanglement and introduces the topic of quantum cascade lasers, showing how electrons and photons interact in a quantum environment to create a practical photonic device. This extended second edition includes a detailed description of the link between quantum photon states and the macroscopic electric field. It describes the particle qualities of quantum electrons via their unique operator algebra and distinguishable behavior from photons, and employs these fundamentals to describe the quantum point contact, which is the quantum analogue of a transistor and the basic building block of all nanoscopic circuits, such as electron interferometers. Pearsall's Quantum Photonics is supported by numerous numerical calculations that can be repeated by the reader, and every chapter features a reference list of state-of-the art research and a set of exercises. This textbook is an essential part of any graduate-level course dealing with the theory of nanophotonic devices or computational physics of solid-state quantum devices based on nanoscopic structures.

Optical Properties of Semiconductor Quantum Dots Springer Nature
This book introduces the wider field of functional nanomaterials sciences, with a strong emphasis on semiconductor photonics. Whether you are studying photonic quantum devices or just interested in semiconductor nanomaterials and their benefits for optoelectronic applications, this book offers you a pedagogical overview of the relevant subjects along with topical reviews. The book discusses different yet complementary studies in the context of ongoing international research efforts, delivering examples from both fundamental and applied research to a broad readership. In addition, a hand-full of useful optical techniques for the characterization of semiconductor quantum structures and materials are addressed. Moreover, nanostructuring methods for the production of low-dimensional systems, which exhibit advantageous properties predominantly due to quantum effects, are summarized. Science and engineering professionals in the interdisciplinary domains of nanotechnology, photonics, materials sciences, and quantum physics can familiarize themselves with selected highlights with eyes towards photonic applications in the fields of two-dimensional materials research, light–matter interactions, and quantum technologies.

Bands and Photons in III-V Semiconductor Quantum Structures Springer Science & Business Media
A comprehensive review of cutting-edge solid state research, focusing on quantum dot nanostructures, for graduate students and researchers.

Quantum Optics Cambridge University Press
Ultrafast spectroscopy of semiconductors and semiconductor nanostructures is currently one of the most exciting areas of research in condensed-matter physics. Remarkable recent progress in the generation of tunable femtosecond pulses has allowed direct investigation of the most fundamental dynamical processes in semiconductors. This second edition presents the most striking recent advances in the techniques of ultrashort pulse generation and ultrafast spectroscopy; it discusses the physics of relaxation, tunneling and transport dynamics in semiconductors and semiconductor nanostructures following excitation by femtosecond laser pulses.

Semiconductor Quantum Science and Technology Springer Nature
Examines the optical properties of low-dimensional semiconductor structures, a hot research area - for graduate students and researchers.

Quantum Dot Devices World Scientific
The fundamental concept of quantum coherence plays a central role in quantum physics, cutting across disciplines of quantum optics, atomic and condensed matter physics. Quantum coherence represents a universal property of the quantum s- tems that applies both to light and matter thereby tying together materials and p- nomena. Moreover, the optical coherence can be transferred to the medium through the light-matter interactions. Since the early days of quantum mechanics there has been a desire to control dynamics of quantum systems. The generation and c- trol of quantum coherence in matter by optical means, in particular, represents a viable way to achieve this longstanding goal and semiconductor nanostructures are the most promising candidates for controllable quantum systems. Optical generation and control of coherent light-matter states in semiconductor quantum nanostructures is precisely the scope of the present book. Recently, there has been a great deal of interest in the subject of quantum coh- ence. We are currently witnessing parallel growth of activities in different physical systems that are all built around the central concept of manipulation of quantum coherence. The burgeoning activities in solid-state systems, and semiconductors in particular, have been strongly driven by the unprecedented control of coherence that previously has been demonstrated in quantum optics of atoms and molecules, and is now taking advantage of the remarkable advances in semiconductor fabrication technologies. A recent impetus to exploit the coherent quantum phenomena comes from the emergence of the quantum information paradigm.

Quantum Coherence Correlation and Decoherence in Semiconductor Nanostructures Pan Stanford Publishing
This textbook presents the basic elements needed to understand and engage in research in semiconductor physics. It deals with elementary excitations in bulk and low-dimensional semiconductors, including quantum wells, quantum wires and quantum dots. The basic principles underlying optical nonlinearities are developed, including excitonic and many-body plasma effects. The fundamentals of optical bistability, semiconductor lasers, femtosecond excitation, optical Stark effect, semiconductor photon echo, magneto-optic effects, as well as bulk and quantum-confined Franz-Keldysh effects are covered. The material is presented in sufficient detail for graduate students and researchers who have a general background in quantum mechanics. Request Inspection Copy

Optical Coherence and Quantum Optics Cambridge University Press
The emerging field of semiconductor quantum optics combines semiconductor physics and quantum optics, with the aim of developing quantum devices with unprecedented performance. In this book researchers and graduate students alike will reach a new level of understanding to begin conducting state-of-the-art investigations. The book combines theoretical methods from quantum optics and solid-state physics to give a consistent microscopic description of light-matter- and many-body-interaction effects in low-dimensional semiconductor nanostructures. It develops the systematic theory needed to treat semiconductor quantum-optical effects, such as strong light-matter coupling, light-matter entanglement, squeezing, as well as quantum-optical semiconductor spectroscopy. Detailed derivations of key equations help readers learn the techniques and nearly 300 exercises help test their understanding of the materials covered. The book is accompanied by a website hosted by the authors, containing further discussions on topical issues, latest trends and publications on the field. The link can be found at www.cambridge.org/9780521875097.

Semiconductor Optics 1 Springer Nature
The updated and enlarged new edition of this book provides an introduction to and an overview of semiconductor optics from the IR through the visible to the UV. It includes coverage of linear and nonlinear optical properties, dynamics, magneto- and electrooptics, high-excitation effects, some applications, experimental techniques and group theory. The mathematics is kept as elementary as possible. The subjects covered extend from physics to materials science and optoelectronics. New or updated chapters add coverage of current topics, while the chapters on bulk materials have been revised and updated.

Electrically Driven Quantum Dot Based Single-Photon Sources Springer Science & Business Media
Well-balanced and up-to-date introduction to the field of semiconductor optics, including transport phenomena in semiconductors. Starting with the theoretical fundamentals of this field the book develops, assuming a basic knowledge of solid-state physics. The application areas of the theory covered include semiconductor lasers, detectors, electro-optic modulators, single-electron transistors, microcavities and double-barrier resonant tunneling diodes. One hundred problems with hints for solution help the readers to deepen their knowledge.

Ultrafast Spectroscopy of Semiconductors and Semiconductor Nanostructures Oxford University Press, USA

This book introduces the basic theoretical concepts required for the analysis of the optical response of semiconductor systems in the coherent regime. It is the most instructive textbook on the theory and optical effects of semiconductors. The entire presentation is based on a one-dimensional tight-binding model. Starting with discrete-level systems, increasing complexity is added gradually to the model by including band-structure and many-particle interaction. Various linear and nonlinear optical spectra and temporal phenomena are studied. The analysis of many-body effects in nonlinear optical phenomena covers a major part of the book.

Semiconductor Quantum Optics Elsevier

An understanding of the interaction between light and matter on a quantum level is of fundamental interest and has many applications in optical technologies. The quantum nature of the interaction has recently attracted great attention for applications of semiconductor nanostructures in quantum information processing. Quantum optics with semiconductor nanostructures is a key guide to the theory, experimental realisation, and future potential of semiconductor nanostructures in the exploration of quantum optics. Part one provides a comprehensive overview of single quantum dot systems, beginning with a look at resonance fluorescence emission. Quantum optics with single quantum dots in photonic crystal and micro cavities are explored in detail, before part two goes on to review nanolasers with quantum dot emitters. Light-matter interaction in semiconductor nanostructures, including photon statistics and photoluminescence, is the focus of part three, whilst part four explores all-solid-state quantum optics, crystal nanobeam cavities and quantum-dot microcavity systems. Finally, part five investigates ultrafast phenomena, including femtosecond quantum optics and coherent optoelectronics with quantum dots. With its distinguished editor and international team of expert contributors, Quantum optics with semiconductor nanostructures is an essential guide for all those involved with the research, development, manufacture and use of semiconductors nanodevices, lasers and optical components, as well as scientists, researchers and students. A key guide to the theory, experimental realisation, and future potential of semiconductor nanostructures in the exploration of quantum optics Chapters provide a comprehensive overview of single quantum dot systems, nanolasers with quantum dot emitters, and light-matter interaction in semiconductor nanostructures Explores all-solid-state quantum optics, crystal nanobeam cavities and quantum-dot microcavity systems, and investigates ultrafast phenomena

Quantum Kinetics in Transport and Optics of Semiconductors Springer Science & Business Media

This book presents a systematic account of optical coherence theory within the framework of classical optics, as applied to such topics as radiation from sources of different states of coherence, foundations of radiometry, effects of source coherence on the spectra of radiated fields, coherence theory of laser modes, and scattering of partially coherent light by random media.

Quantum Optics and Nanophotonics Springer Science & Business Media

The 7th International Workshop on Nonlinear Optics and Excitation Kinetics in Semiconductors (NOEKS 7) was held at University Karlsruhe (TH) from 24-28 February 2003. Topics of NOEKS 7 were: Ultrafast dynamics (coherent effects, coherent controls, quantum kinetics, THz-experiments), photonic crystals (2D and 3D photonic band gap materials), quantum dot physics (quantum dots, quantum wires), spin effects (spin dephasing, spin transport), disorder-related effects, organic semiconductors, semiconductor quantum optics (luminescence, photon statistics), device physics (quantum cascade lasers, superlattices, interband lasers), and Bose-Einstein condensation of excitions. physica status solidi (c) - conferences and critical reviews publishes conference proceedings, ranging from large international meetings to specialized topical workshops as well as collections of topical reviews on various areas of current solid state physics research.