

# Slow light in Photonic Crystals

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Jana Jagerska, IPEQ-LOEQ

# Slow Light

**S Ben Porath**



## **Slow Light:**

*Slow Light* Jacob B. Khurgin, Rodney S. Tucker, 2009      Photonics, Volume 1 David L. Andrews, 2015-01-16 Covers modern photonics accessibly and discusses the basic physical principles underlying all the applications and technology of photonics This volume covers the basic physical principles underlying the technology and all applications of photonics from statistical optics to quantum optics The topics discussed in this volume are Photons in perspective Coherence and Statistical Optics Complex Light and Singular Optics Electrodynamics of Dielectric Media Fast and slow Light Holography Multiphoton Processes Optical Angular Momentum Optical Forces Trapping and Manipulation Polarization States Quantum Electrodynamics Quantum Information and Computing Quantum Optics Resonance Energy Transfer Surface Optics Ultrafast Pulse Phenomena Comprehensive and accessible coverage of the whole of modern photonics Emphasizes processes and applications that specifically exploit photon attributes of light Deals with the rapidly advancing area of modern optics Chapters are written by top scientists in their field Written for the graduate level student in physical sciences Industrial and academic researchers in photonics graduate students in the area College lecturers educators policymakers consultants Scientific and technical libraries government laboratories NIH      *Slow Light* Sidney Perkowitz, 2011 *Slow Light* is a popular treatment of today's astonishing breakthroughs in the science of light Even though we don't understand light's quantum mysteries we can slow it to a stop and speed it up beyond its Einsteinian speed limit 186 000 miles/sec use it for quantum telecommunications teleport it manipulate it to create invisibility and perhaps generate hydrogen fusion power with it All this is lucidly presented for non scientists who wonder about teleportation Harry Potter invisibility cloaks and other fantastic outcomes *Slow Light* shows how the real science and the fantasy inspire each other and projects light's incredible future Emory physicist Sidney Perkowitz discusses how we are harnessing the mysteries of light into technologies like lasers and fiber optics that are transforming our daily lives Science fiction fantasies like Harry Potter's invisibility cloak are turning into real possibilities      **Essentials of Nonlinear Optics** Y. V. G. S. Murti, C. Vijayan, 2014-07-02 Current literature on Nonlinear Optics varies widely in terms of content style and coverage of specific topics relative emphasis of areas and the depth of treatment While most of these books are excellent resources for the researchers there is a strong need for books appropriate for presenting the subject at the undergraduate or postgraduate levels in Universities The need for such a book to serve as a textbook at the level of the bachelors and masters courses was felt by the authors while teaching courses on nonlinear optics to students of both science and engineering during the past two decades This book has emerged from an attempt to address the requirement of presenting the subject at college level A one semester course covering the essentials can effectively be designed based on this      Introduction to Nanophotonics Henri Benisty, Jean-Jacques Greffet, Philippe Lalanne, 2022 This book provides an introduction to nanophotonics a newly emerged and rapidly evolving field combining optics quantum physics material sciences and electrical engineering It illustrates the theoretical foundations as well as the

major advances in the field based on artificial metallic and dielectric nanostructures      **Photonics, Volume 3** David L. Andrews, 2015-03-23 Discusses the basic physical principles underlying the technology instrumentation of photonics This volume discusses photonics technology and instrumentation The topics discussed in this volume are Communication Networks Data Buffers Defense and Security Applications Detectors Fiber Optics and Amplifiers Green Photonics Instrumentation and Metrology Interferometers Light Harvesting Materials Logic Devices Optical Communications Remote Sensing Solar Energy Solid State Lighting Wavelength Conversion Comprehensive and accessible coverage of the whole of modern photonics Emphasizes processes and applications that specifically exploit photon attributes of light Deals with the rapidly advancing area of modern optics Chapters are written by top scientists in their field Written for the graduate level student in physical sciences Industrial and academic researchers in photonics graduate students in the area College lecturers educators policymakers consultants Scientific and technical libraries government laboratories NIH      Nonlinear Optics and Photonics Guangsheng He, 2015 This book provides a comprehensive presentation on most of the major topics in nonlinear optics and photonics with equal emphasis on principles experiments techniques and applications It covers many major new topics including optical solitons multi photon effects nonlinear photoelectric effects fast and slow light and Terahertz photonics Chapters 1 10 present the fundamentals of modern nonlinear optics and could be used as a textbook with problems provided at the end of each chapter Chapters 11 17 cover the more advanced topics of techniques and applications of nonlinear optics and photonics serving as a highly informative reference for researchers and experts working in related areas There are also 16 pages of color photographs to illustrate the visual appearances of some typical nonlinear optical effects and phenomena The book could be adopted as a textbook for both undergraduates and graduate students and serve as a useful reference work for researchers and experts in the fields of physics quantum electronics and laser technology To request a copy of the Solutions Manual visit [global.oup.com/uk/academic/physics/admin/solutions](http://global.oup.com/uk/academic/physics/admin/solutions)      **Optical MEMS, Nanophotonics, and Their Applications** Guangya Zhou, Chengkuo Lee, 2017-12-14 This book covers device design fundamentals and system applications in optical MEMS and nanophotonics Expert authors showcase examples of how fusion of nanoelectromechanical NEMS with nanophotonic elements is creating powerful new photonic devices and systems including MEMS micromirrors MEMS tunable filters MEMS based adjustable lenses and apertures NEMS driven variable silicon nanowire waveguide couplers and NEMS tunable photonic crystal nanocavities The book also addresses system applications in laser scanning displays endoscopic systems space telescopes optical telecommunication systems and biomedical implantable systems Presents efforts to scale down mechanical and photonic elements into the nano regime for enhanced performance faster operational speed greater bandwidth and higher level of integration Showcases the integration of MEMS and optical photonic devices into real commercial products Addresses applications in optical telecommunication sensing imaging and biomedical systems Prof Vincent C Lee is Associate Professor in the Department of Electrical and

Computer Engineering National University of Singapore Prof Guangya Zhou is Associate Professor in the Department of Mechanical Engineering at National University of Singapore

*Nonlinearities in Periodic Structures and Metamaterials* Cornelia Denz, Sergej Flach, Yuri S. Kivshar, 2010-03-11 Optical information processing of the future is associated with a new generation of compact nanoscale optical devices operating entirely with light Moreover adaptive features such as self guiding reconfiguration and switching become more and more important Nonlinear devices offer an enormous potential for these applications Consequently innovative concepts for all optical communication and information technologies based on nonlinear effects in photonic crystal physics and nanoscale devices as metamaterials are of high interest This book focuses on nonlinear optical phenomena in periodic media such as photonic crystals optically induced adaptive lattices atomic lattices or metamaterials The main purpose is to describe and overview new physical phenomena that result from the interplay between nonlinearities and structural periodicities and is a guide to actual and future developments for the expert reader in optical information processing as well as in the physics of cold atoms in optical lattices

*Advanced Photonic Sciences* Mohamed Fadhal, 2012-03-21 The new emerging field of photonics has significantly attracted the interest of many societies professionals and researchers around the world The great importance of this field is due to its applicability and possible utilization in almost all scientific and industrial areas This book presents some advanced research topics in photonics It consists of 16 chapters organized into three sections Integrated Photonics Photonic Materials and Photonic Applications It can be said that this book is a good contribution for paving the way for further innovations in photonic technology The chapters have been written and reviewed by well experienced researchers in their fields In their contributions they demonstrated the most profound knowledge and expertise for interested individuals in this expanding field The book will be a good reference for experienced professionals academics and researchers as well as young researchers only starting their carrier in this field

Plasmonics Tatjana Gric, 2018-11-21 Plasmonics gives researchers in universities and industries and designers an overview of phenomena enabled by artificially designed metamaterials and their application for plasmonic devices The purpose of this book is to provide a detailed introduction to the basic modeling approaches and an overview of enabled innovative phenomena The main research agenda of this book is aimed at the study of modeling techniques and novel functionalities such as plasmonic enhancement of solar cell efficiency plasmonics in sensing etc The topics addressed in this book cover the major strands theory modeling and design applications in practical devices fabrication characterization and measurement It is worthwhile mentioning that the strategic objectives of developing new artificial functional materials require close cooperation of the research in each subarea

*Frontiers in Guided Wave Optics and Optoelectronics* Bishnu Pal, 2010-02-01 As the editor I feel extremely happy to present to the readers such a rich collection of chapters authored co authored by a large number of experts from around the world covering the broad field of guided wave optics and optoelectronics Most of the chapters are state of the art on respective topics or areas that are emerging Several authors

narrated technological challenges in a lucid manner which was possible because of individual expertise of the authors in their own subject specialties I have no doubt that this book will be useful to graduate students teachers researchers and practicing engineers and technologists and that they would love to have it on their book shelves for ready reference at any time

*Reviews in Plasmonics 2016* Chris D. Geddes, 2017-02-28 *Reviews in Plasmonics 2016* the third volume of the new book series from Springer serves as a comprehensive collection of current trends and emerging hot topics in the field of Plasmonics and closely related disciplines It summarizes the year's progress in surface plasmon phenomena and its applications with authoritative analytical reviews in sufficient detail to be attractive to professional researchers yet also appealing to the wider audience of scientists in related disciplines of Plasmonics *Reviews in Plasmonics* offers an essential source of reference material for any lab working in the Plasmonics field and related areas All academics bench scientists and industry professionals wishing to take advantage of the latest and greatest in the continuously emerging field of Plasmonics will find it an invaluable resource

**New Horizon of Plasmonics and Metamaterials** Masafumi Kimata, Shinpei Ogawa, 2020-06-25 Plasmonics and metamaterials are growing fields that consistently produce new technologies for controlling electromagnetic waves Many important advances in both fundamental knowledge and practical applications have been achieved in conjunction with a wide range of materials structures and wavelengths from the ultraviolet to the microwave regions of the spectrum In addition to this remarkable progress across many different fields much of this research shares many of the same underlying principles and therefore significant synergy is expected This Special Issue introduces the recent advances in plasmonics and metamaterials and discusses various applications while addressing a wide range of topics in order to explore the new horizons emerging for such research

**Photonics, Plasmonics and Information Optics** Arpan Deyasi, Pampa Debnath, Asit Kumar Datta, Siddhartha Bhattacharyya, 2021-04-18 This edited volume covers technological developments and current research trends in the field of photonics plasmonics and optics focusing on photonic crystals semiconductor optical devices optical communications and optical sensors with an emphasis on practical sectors It broadly contains the latest research domains contributed by experts and researchers in their respective fields with a major focus on the basic physics Works in the area of electromagnetic bandgap structures EBG and metasurfaces are included for applications in different aspects of communications systems Further it covers research phenomena of microwave photonic devices to develop miniaturized high frequency devices

**FEATURES** Reviews nonlinear optical phenomena related with materials and crystals and plasmonic effects on device fabrications Contains a detailed analysis on photonic crystals with their applications in making all optical passive components Focusses on nonlinear optics more precisely on crystals and materials and computational aspects on evaluating their properties from Maxwell's equations Presents an extensive study on the physics of EBG structures for application in antenna and high frequency communications Includes metamaterials and metasurfaces for applications in photonics as well as in microwave engineering for high frequency communication systems

Photonics Plasmonics and Information Optics Research and Technological Advances is aimed at researchers professionals and graduate students in optical communication silicon photonics photonic crystals semiconductor optical devices metamaterials and metasurfaces and microwave photonics

**Brillouin Scattering Part 2**, 2022-08-27 Brillouin Scattering Part Two Volume 110 in the Semiconductors and Semimetal series marks the centenary of Leon Brillouin's seminal 1922 paper which provided a detailed theory on the effect that now bears his name Sections in this new release include Optical Fiber Sensors Based on Stimulated Brillouin scattering Brillouin based RF frequency sources SBS for Microwave Photonics MWP Engineerable Brillouin processes for integrated photonics SBS in optical communication systems the good the bad and the ugly Slow light dynamic gratings and light storage Non reciprocity in Brillouin scattering Electromechanical Brillouin Scattering and Brillouin light scattering for studying mechanics of biological systems Stimulated Brillouin Scattering SBS is the strongest third order nonlinearity and plays an important role in contemporary science and applications particularly lasers communications fiber optics and basic physics This volume provides different perspectives on current technological contexts of SBS in a range of different application areas including sensing communications radar imaging and information storage Presented by the leading researchers in the field Covers both scientific and technological perspectives Provides different perspectives on current technological contexts of SBS in a range of different application areas including sensing communications radar imaging and information storage

**Optical and Wireless Technologies** Vijay Janyani, Manish Tiwari, Ghanshyam Singh, Paolo Minzioni, 2018-02-12 This book presents selected papers from 1st International Conference on Optical and Wireless Technologies providing insights into the analytical experimental and developmental aspects of systems techniques and devices in these spheres It explores the combined use of various optical and wireless technologies in next generation networking applications and discusses the latest developments in applications such as photonics high speed communication systems and networks visible light communication nanophotonics and wireless and multiple input multiple output MIMO systems The book will serve as a valuable reference resource for academics and researchers across the globe

**Silicon-Based Photonics** Erich Kasper, Jinzhong Yu, 2020-07-24 Silicon photonics has evolved rapidly as a research topic with enormous application potential The high refractive index contrast of silicon on insulator SOI shows great promise for submicron waveguide structures suited for integration on the chip scale in the near infrared region Ge and GeSn Si heterostructures with different elastic strain levels already provide expansion of the spectral range high speed operation efficient modulation and switching of optical signals and enhanced light emission and lasing This book focuses on the integration of heterostructure devices with silicon photonics The authors have attempted to merge a concise treatment of classical silicon photonics with a description of principles prospects challenges and technical solution paths of adding silicon based heterostructures The book discusses the basics of heterostructure based silicon photonics system layouts and key device components keeping in mind the application background Special focus is placed on SOI based waveguide

configurations and Ge and GeSn Si heterostructure devices for light detection modulation and light emission and lasing The book also provides an overview of the technological and materials science challenges connected with integration on silicon The first half of the book is mainly for readers who are interested in the topic because of its increasing importance in different fields while the latter half covers different device structures for light emission detection modulation extension of the wavelength beyond 1.6  $\mu\text{m}$  and lasing as well as future challenges

**Optics in Our Time** Mohammad D. Al-Amri, Mohamed El-Gomati, M. Suhail Zubairy, 2016-12-12 Light and light based technologies have played an important role in transforming our lives via scientific contributions spanned over thousands of years In this book we present a vast collection of articles on various aspects of light and its applications in the contemporary world at a popular or semi popular level These articles are written by the world authorities in their respective fields This is therefore a rare volume where the world experts have come together to present the developments in this most important field of science in an almost pedagogical manner This volume covers five aspects related to light The first presents two articles one on the history of the nature of light and the other on the scientific achievements of Ibn Haitham Alhazen who is broadly considered the father of modern optics These are then followed by an article on ultrafast phenomena and the invisible world The third part includes papers on specific sources of light the discoveries of which have revolutionized optical technologies in our lifetime They discuss the nature and the characteristics of lasers Solid state lighting based on the Light Emitting Diode LED technology and finally modern electron optics and its relationship to the Muslim golden age in science The book's fourth part discusses various applications of optics and light in today's world including biophotonics art optical communication nanotechnology the eye as an optical instrument remote sensing and optics in medicine In turn the last part focuses on quantum optics a modern field that grew out of the interaction of light and matter Topics addressed include atom optics slow stored and stationary light optical tests of the foundation of physics quantum mechanical properties of light fields carrying orbital angular momentum quantum communication and Wave Particle dualism in action

**Handbook of Silicon Photonics** Laurent Vivien, Lorenzo Pavesi, 2016-04-19 The development of integrated silicon photonic circuits has recently been driven by the Internet and the push for high bandwidth as well as the need to reduce power dissipation induced by high data rate signal transmission To reach these goals efficient passive and active silicon photonic devices including waveguide modulators photodetectors



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