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Quantum Statistics of Linear and Nonlinear Optical Phenomena - Jan Perina 2012-12-06

The quantum statistical properties of radiation represent an important branch of modern physics with rapidly increasing applications in spectroscopy, quantum generators of radiation, optical communication, etc. They have also an increasing role in fields other than pure physics, such as biophysics, psychophysics, biology, etc. Interesting applications have been developed in high energy elementary particle collisions. The present monograph represents an extension and continuation of the previous monograph by this author entitled *Coherence of Light* (Van Nostrand Reinhold Company, London 1972, translated into Russian in the Publishing House Mir, Moscow 1974, second edition published by D. Reidel, Dordrecht-Boston 1985) and of a review chapter in *Progress in Optics*, Vol. 18 (edited by E. Wolf, North-Holland Publishing Company, Amsterdam 1980) as well. It applies the fundamental tools of the coherent-state technique, as described in *Coherence of Light*, to particular studies of the quantum statistical properties of radiation interacting with matter. In particular, nonlinear optical processes are considered, and purely quantum phenomena such as antibunching of photons, their sub-Poisson behaviour and squeezing of vacuum fluctuations are discussed. Compared to the first edition of this book, published in 1984, we have added much more information about squeezing of vacuum fluctuations in nonlinear optical process in this second edition; further we have included the description of experiments and their results performed from that time. Also a new brief chapter on nonlinear dynamics and chaos in quantum statistical optics has been included.

Photoelectron Statistics - B. Saleh 2013-06-05

With the recent great expansion in optics and laser applications, several new areas of research have emerged, among which are: the theory of coherence, photon statistics, speckle phenomenon, statistical optics, atmospheric propagation, optical communications, and light-beating and photon-correlation spectroscopy. A factor common to these overlapping subjects is their basic dependence on the treatment of light as a randomly fluctuating excitation. Moreover, they all necessitate a thorough understanding of the phenomenon of light detection and the additional randomness it introduces. My objective in writing this book is to provide a unified and general presentation of a basic theoretical background central to these areas. This book has a threefold purpose: to present a systematic treatment of the statistical properties of optical fields, to develop methods for determining the statistics of the photoelectron events that are generated when such fields are intercepted by photodetectors, and to examine methods of estimating unknown field parameters from measurements of the photoelectron events. Emphasis is placed on the photoelectron measurements that yield information pertinent to spectroscopy and optical communication. Although some books that treat the theory of coherence and the statistical properties of light are available, the vast body of information central to problems of photoelectron statistics and its applications is scattered in various professional journals and conference proceedings.

Formation and Interactions of Topological Defects - Anne-Christine Davis 2012-12-06

Topological defects have recently become of great interest in condensed matter physics, particle physics and cosmology. They are the unavoidable remnants of many symmetry breaking phase transitions. Topological defects can play an important role in describing the properties of many condensed matter systems (e.g. superfluids and superconductors); they can catalyze many

unusual effects in particle physics models and they may be responsible for seeding the density perturbations in the early Universe which develop into galaxies and the large-scale structure of the Universe. Topological defects are also of great interest in mathematics as nontrivial solutions of nonlinear differential equations stabilized by topological effects. The purpose of the Advanced Study Institute "Formation and Interactions of Topological Defects" was to bring together students and practitioners in condensed matter physics, particle physics and cosmology, to give a detailed exposition of the role of topological defects in these fields; to explore similarities and differences in the approaches; and to provide a common basis for discussion and future collaborative research on common problems.

Demonstrational Optics - Oleg Marchenko 2006-12-06

This book presents a new didactical approach to the study of optics. It emphasizes the importance of elaborate new experimental demonstrations containing pictorial illustrations, computer simulations and models of optical phenomena in order to ensure a deeper understanding of wave and geometric optics. It includes problems focused on the pragmatic needs of students, secondary school teachers, university professors and optical engineers. A substantial part of this volume is devoted to thermal radiation and its properties, especially with partial coherence. The book contains detailed descriptions of demonstrational experiments.

Fourier Optics and Computational Imaging - Kedar Khare 2023-02-03

The book is designed to serve as a textbook for advanced undergraduate and graduate students enrolled in physics and electronics and communication engineering and mathematics. The book provides an introduction to Fourier optics in light of new developments in the area of computational imaging over the last couple of decades. There is an in-depth discussion of mathematical methods such as Fourier analysis, linear systems theory, random processes, and optimization-based image reconstruction techniques. These techniques are very much essential for a better understanding of the working of computational imaging systems. It discusses topics in Fourier optics, e.g., diffraction phenomena, coherent and incoherent imaging systems, and some aspects of coherence theory. These concepts are then used to describe several system ideas that combine optical hardware design and image reconstruction algorithms, such as digital holography, iterative phase retrieval, super-resolution imaging, point spread function engineering for enhanced depth-of-focus, projection-based imaging, single-pixel or ghost imaging, etc. The topics covered in this book can provide an elementary introduction to the exciting area of computational imaging for students who may wish to work with imaging systems in their future careers.

High Resolution Imaging in Microscopy and Ophthalmology - Josef F. Bille 2019-08-13

This open access book provides a comprehensive overview of the application of the newest laser and microscope/ophthalmoscope technology in the field of high resolution imaging in microscopy and ophthalmology. Starting by describing High-Resolution 3D Light Microscopy with STED and RESOLFT, the book goes on to cover retinal and anterior segment imaging and image-guided treatment and also discusses the development of adaptive optics in vision science and ophthalmology. Using an interdisciplinary approach, the reader will learn about the latest developments and most up to date technology in the field and how these translate to a medical setting. High Resolution Imaging in Microscopy and

Ophthalmology - New Frontiers in Biomedical Optics has been written by leading experts in the field and offers insights on engineering, biology, and medicine, thus being a valuable addition for scientists, engineers, and clinicians with technical and medical interest who would like to understand the equipment, the applications and the medical/biological background. Lastly, this book is dedicated to the memory of Dr. Gerhard Zinser, co-founder of Heidelberg Engineering GmbH, a scientist, a husband, a brother, a colleague, and a friend.

Light Scattering and Photon Correlation Spectroscopy - E.R. Pike 2012-12-06

Since their inception more than 2.5 years ago, photon correlation techniques for the spatial, temporal or spectral analysis of fluctuating light fields have found an ever-widening range of applications. Using detectors which respond to single quanta of the radiation field, these methods are intrinsically digital in nature and in many experimental situations offer a unique degree of accuracy and sensitivity, not only for the study of primary light sources themselves, but most particularly in the use of a laser-beam probe to study light scattering from pure fluids, macromolecular suspensions and laminar or turbulent flowing fluids and gases. Following the earliest developments in laser scattering by dilute macromolecular suspensions, in which particle sizing was the main aim, and the use of photon correlation techniques for laser-Doppler studies of flow and turbulence. Both of which areas were the subject of NATO ASIs in Capri, Italy in 1983 and 1986. Significant advances have been made in recent years in many other areas. These were reflected in the topics covered in this NATO Advanced Research Workshop, which took place from August 23rd to 30th, 1986, at the Jagiellonian University, Krakow, Poland. These included experimental techniques, statistics and data reduction, colloids and aggregation, polymers, gels, liquid crystals and mixtures, protein solutions, critical phenomena and dense media.

Phase-Contrast and Dark-Field Imaging - Simon Zabler 2019-01-08

This book is a printed edition of the Special Issue "Phase-Contrast and Dark-Field Imaging" that was published in *J. Imaging*

Principles of Optics - Max Born 2019-12-19

Principles of Optics is one of the most highly cited and most influential physics books ever published, and one of the classic science books of the twentieth century. To celebrate the 60th anniversary of this remarkable book's first publication, the seventh expanded edition has been reprinted with a special foreword by Sir Peter Knight. The seventh edition was the first thorough revision and expansion of this definitive text. Amongst the material introduced in the seventh edition is a section on CAT scans, a chapter on scattering from inhomogeneous media, including an account of the principles of diffraction tomography, an account of scattering from periodic potentials, and a section on the so-called Rayleigh-Sommerfield diffraction theory. This expansive and timeless book continues to be invaluable to advanced undergraduates, graduate students and researchers working in all areas of optics.

General Theory of Light Propagation and Imaging Through the Atmosphere - T. Stewart McKechnie 2022-10-06

This 2nd edition lays out an updated version of the general theory of light propagation and imaging through Earth's turbulent atmosphere initially developed in the late '70s and '80s, with additional applications in the areas of laser communications and high-energy laser beam propagation. New material includes a chapter providing a comprehensive mathematical tool set for precisely characterizing image formation with the anticipated Extremely Large Telescopes (ELTs), enabling a staggering range of star image shapes and sizes; existing chapters rewritten or modified so as to supplement the mathematics with clearer physical insight through written and graphical means; a history of the development of present-day understanding of light propagation and imaging through the atmosphere as represented by the general theory described. Beginning with the rudimentary, geometrical-optics based understanding of a century ago, it describes advances made in the 1960s, including the development of the 'Kolmogorov theory,' the deficiencies of which undermined its credibility, but not before it had done enormous damage, such as construction of a generation of underperforming 'light bucket'

telescopes. The general theory requires no a priori turbulence assumptions. Instead, it provides means for calculating the turbulence properties directly from readily-measurable properties of star images.

Handbook of Optical Metrology - Toru Yoshizawa 2017-07-28
Handbook of Optical Metrology: Principles and Applications begins by discussing key principles and techniques before exploring practical applications of optical metrology. Designed to provide beginners with an introduction to optical metrology without sacrificing academic rigor, this comprehensive text: Covers fundamentals of light sources, lenses, prisms, and mirrors, as well as optoelectronic sensors, optical devices, and optomechanical elements Addresses interferometry, holography, and speckle methods and applications Explains Moiré metrology and the optical heterodyne measurement method Delves into the specifics of diffraction, scattering, polarization, and near-field optics Considers applications for measuring length and size, displacement, straightness and parallelism, flatness, and three-dimensional shapes This new Second Edition is fully revised to reflect the latest developments. It also includes four new chapters—nearly 100 pages—on optical coherence tomography for industrial applications, interference microscopy for surface structure analysis, noncontact dimensional and profile metrology by video measurement, and optical metrology in manufacturing technology.

Testing Quantum Theory with Higher-Order Interference in Many-Particle Correlations - Marc-Oliver Pleinert 2022-05-18

The structure of quantum theory permits interference of indistinguishable paths. At the same time, however, it also limits such interference to certain orders and any higher-order interference is prohibited. This thesis develops and studies concepts to test quantum theory with higher-order interference using many-particle correlations, the latter being generally richer and typically more subtle than single-particle correlations. It is demonstrated that quantum theory in general allows for interference up to order $2M$ in M -particle correlations. Depending on the mutual coherence of the particles, however, the related interference hierarchy can terminate earlier. In this thesis, we show that mutually coherent particles can exhibit interference of the highest orders allowed. We further demonstrate that interference of mutually incoherent particles truncates already at order $M+1$, although interference of the latter is principally more multifaceted than their coherent counterpart. We introduce two families of many-particle Sorkin parameters, whose members are expected to be all zero when quantum mechanics holds. As proof of concept, we demonstrate the disparate vanishing of such higher-order interference terms as a function of coherence in experiments with mutually coherent and incoherent sources. Finally, we investigate the influence of exotic kinked or looped quantum paths, which are permitted by Feynman's path integral approach, in such setups.

Principal Component Analysis - I.T. Jolliffe 2013-03-09

Principal component analysis is probably the oldest and best known of the It was first introduced by Pearson (1901), techniques of multivariate analysis, and developed independently by Hotelling (1933). Like many multivariate methods, it was not widely used until the advent of electronic computers, but it is now well entrenched in virtually every statistical computer package. The central idea of principal component analysis is to reduce the dimensionality of a data set in which there are a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This reduction is achieved by transforming to a new set of variables, the principal components, which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables. Computation of the principal components reduces to the solution of an eigenvalue-eigenvector problem for a positive-semidefinite symmetric matrix. Thus, the definition and computation of principal components are straightforward but, as will be seen, this apparently simple technique has a wide variety of different applications, as well as a number of different derivations. Any feelings that principal component analysis is a narrow subject should soon be dispelled by the present book; indeed some quite broad topics which are related to principal component analysis receive no more than a brief mention in the

final two chapters.

Applications in Energy Finance - Christos Floros 2022-06-15

This textbook investigates the linkages between energy-commodities markets, financial markets and the economy and incorporates different aspects of the energy market, organizing the relevant material in two distinct parts. Part one includes studies that relate to the impact of developments in the various energy-commodities markets (e.g., oil, gas) both on financial markets and economic growth, including studies that consider the impact of energy prices on financial markets or the effect on specific macroeconomic variables, such as interest rates, inflation, GDP. Part two discusses developments in the energy market from a climate change or green financing point of view, further considering issues that relate to climate finance, green investing, as well as policy making relating to GHG Emissions. By introducing a multitude of topics in energy finance, this textbook provides a holistic view of the market and its importance

Optical-Thermal Response of Laser-Irradiated Tissue -

Ashley J. Welch 2011-01-15

The second edition maintains the standard of excellence established in the first edition, while adjusting the content to reflect changes in tissue optics and medical applications since 1995. The material concerning light propagation now contains new chapters devoted to electromagnetic theory for coherent light. The material concerning thermal laser-tissue interactions contains a new chapter on pulse ablation of tissue. The medical applications section now includes several new chapters on Optical Coherent Tomography, acoustic imaging, molecular imaging, forensic optics and nerve stimulation. A detailed overview is provided of the optical and thermal response of tissue to laser irradiation along with diagnostic and therapeutic examples including fiber optics. Sufficient theory is included in the book so that it is suitable for a one or two semester graduate or for senior elective courses. Material covered includes (1) light propagation and diagnostic application; (2) the thermal response of tissue and therapeutic application; (3) denaturation; and (4) ablation. The theory and applications provide researchers with sufficient detail that this volume will become the primary reference for laser-tissue interactions and medical applications.

Introduction to Nanophotonics - Sergey V. Gaponenko

2010-04-08

Nanophotonics is where photonics merges with nanoscience and nanotechnology, and where spatial confinement considerably modifies light propagation and light-matter interaction. Describing the basic phenomena, principles, experimental advances and potential impact of nanophotonics, this graduate-level textbook is ideal for students in physics, optical and electronic engineering and materials science. The textbook highlights practical issues, material properties and device feasibility, and includes the basic optical properties of metals, semiconductors and dielectrics. Mathematics is kept to a minimum and theoretical issues are reduced to a conceptual level. Each chapter ends in problems so readers can monitor their understanding of the material presented. The introductory quantum theory of solids and size effects in semiconductors are considered to give a parallel discussion of wave optics and wave mechanics of nanostructures. The physical and historical interplay of wave optics and quantum mechanics is traced. Nanoplasmonics, an essential part of modern photonics, is also included.

Physics Briefs - 1994

Photon Correlation and Light Beating Spectroscopy - H. Cummins

2013-11-11

This volume contains the invited lectures and seminars and abstracts of the contributed seminars presented at the NATO Advanced Study Institute on Photon Correlation and Light Beating Spectroscopy held at the Centro Caprense Di Vita E Di Studi Ignazio Cerio, Capri, Italy, July 16-27, 1973. The Institute was organized to provide a comprehensive presentation of this new and rapidly developing field for those interested in applying these techniques to problems in many areas including Physics, Biology, Engineering and Chemistry. The lectures were divided into three principal categories: the first Basic Theory (Photon Statistics and Correlation, Scattering Theory), secondly

Instrumentation (Correlation Techniques, Light Beating), and the third Areas of Application (Gas and Liquid Dynamics, Critical Phenomena, Biology). The seminars provided detailed presentations of applications to a number of specific problems. - Although the selection of topics was inevitably limited, it was the hope of the organizing committee that the lectures would provide a broad coverage appropriate for the needs of the interdisciplinary audience represented by the participants, and that this volume would serve for some years to come as a useful introduction for those entering the field. The members of the Organizing Committee were: E.R. Pike, RRE, Malvern U.K. } Co-directors H.Z. Cummins, New York University M. Bertolotti, Universita di Roma - Local Organizer J.M. Vaughan, RRE, Malvern, U.K. Secretary H. Swinney, New York University Treasurer P. Lallemand, Ecole Normale Superieure, Paris H. Haken, Universitat Stuttgart, Germany.

Optical Measurements, Modeling, and Metrology, Volume 5

- Tom Proulx 2011-05-27

Optical Measurements, Modeling, and Metrology represents one of eight volumes of technical papers presented at the Society for Experimental Mechanics Annual Conference on Experimental and Applied Mechanics, held at Uncasville, Connecticut, June 13-16, 2011. The full set of proceedings also includes volumes on Dynamic Behavior of Materials, Mechanics of Biological Systems and Materials, Mechanics of Time-Dependent Materials and Processes in Conventional and Multifunctional Materials; MEMS and Nanotechnology; Experimental and Applied Mechanics, Thermomechanics and Infra-Red Imaging, and Engineering Applications of Residual Stress.

Semiconductor Optics 1 - Heinz Kalt 2019-09-20

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.

Principles of Phase Conjugation - B.Y. Zel'Dovich 2013-06-29

This book has been prompted by our desire to share with others our appreciation of the harmony and beauty in a particular sphere of modern optics known as "optical phase conjugation". Practical applications of the phase conjugated wave are likely to be far-reaching. Optical phase conjugation (OPC) combines in itself aesthetic and pragmatic attractiveness, a synthesis that has made OPC a subject of general attention. The figure presents the approximate rate of publications (number of articles per year) on OPC in the world literature for recent years, the lower curve denoting the work carried out in the USSR. The efforts of a large unofficial international collective have yielded an impressive result. 150 100 50 1975 1980 At present, the physical processes underlying various OPC methods are quite understandable, and it

is the physics of OPC to which our book is devoted. Practical and scientific applications of phase-conjugated waves, which are of no less interest, have been touched upon in short, as major achievements in this sphere are a matter of the future. Today there are two main methods of OPC: i) by backward stimulated light scattering, ii) by four-wave mixing. Naturally, much attention is given to these methods in our book which, after the introductory Chap. 1, can be divided into two almost independent parts - Chaps. 2 - 5, and Chaps. 6 - 8.

Constitutive Models for Rubber IV - Per-Erik Austrell
2017-12-04

The unique properties of elastomeric materials offer numerous advantages in many engineering applications. Elastomeric units are used as couplings or mountings between rigid components, for example in shock absorbers, vibration insulators, flexible joints, seals and suspensions, etc. However, the complicated nature of the behaviour of such material makes it difficult to accurately predict the performance of these units using finite element modelling, for example. It is imperative that constitutive models accurately capture relevant aspects of mechanical behaviour. The latest developments concerning constitutive modelling of rubber is collected in these Proceedings. Topics included in this volume are, Hyperelastic models, Strength, fracture & fatigue, Dynamic properties & the Fletcher-Gent effect, Micro-mechanical & statistical approaches, Stress softening, iscoelasticity, Filler reinforcement, and Tyres, fibre & cord reinforced rubber.

Nucleon Correlations in Nuclei - Anton N. Antonov 2012-12-06

In recent years there has been growing interest in the nucleon-nucleon correlations inside nuclei. In many respects the motions of the nucleons can be very well described by an overall mean field, so that the motion of each nucleon is governed by the mean field due to all the other nucleons. This concept underlies the Fermi-gas, Hartree-Fock and shell models and has enabled a range of nuclear properties to be calculated, often to surprising accuracy. It gradually became clear, however, that these mean-field models are limited by the effects due to the very strong interactions between the nucleons that occur at short distances; these are the short-range correlations. They are responsible for instance for the high-momentum components in the nucleon momentum distribution, and prevent the simultaneous description of the nuclear density and momentum distributions by the same mean field. It thus becomes necessary to develop methods for including the effects of nucleon correlations in nuclei, and these are the main subject of this book. Some related problems of nuclear structure were discussed in an earlier book by the same authors: *Nucleon Momentum and Density Distributions in Nuclei* (Clarendon Press, Oxford, 1988). The main aim of that book was to study the effects of nucleon-nucleon correlations, both short-range and tensor, on the nucleon momentum distribution, which is particularly sensitive to these correlations, and on the nucleon density distribution.

3D Visual Content Creation, Coding and Delivery - Pedro Amado Assunção 2018-07-28

This book covers the different aspects of modern 3D multimedia technologies by addressing several elements of 3D visual communications systems, using diverse content formats, such as stereo video, video-plus-depth and multiview, and coding schemes for delivery over networks. It also presents the latest advances and research results in regards to objective and subjective quality evaluation of 3D visual content, extending the human factors affecting the perception of quality to emotional states. The contributors describe technological developments in 3D visual communications, with particular emphasis on state-of-the-art advances in acquisition of 3D visual scenes and emerging 3D visual representation formats, such as: multi-view plus depth and light field; evolution to freeview and light-field representation; compression methods and robust delivery systems; and coding and delivery over various channels. Simulation tools, testbeds and datasets that are useful for advanced research and experimental studies in the field of 3D multimedia delivery services and applications are covered. The international group of contributors also explore the research problems and challenges in the field of immersive visual communications, in order to identify research directions with substantial economic and social impact. 3D Visual

Content Creation, Coding and Delivery provides valuable information to engineers and computer scientists developing novel products and services with emerging 3D multimedia technologies, by discussing the advantages and current limitations that need to be addressed in order to develop their products further. It will also be of interest to students and researchers in the field of multimedia services and applications, who are particularly interested in advances bringing significant potential impact on future technological developments.

Light Scattering in Solids VI - Manuel Cardona 2006-01-21

This is the sixth volume of a well-established and popular series in which expert practitioners discuss topical aspects of light scattering in solids. This volume discusses recent results of Raman spectroscopy of high T_c superconductors, organic polymers, rare earth compounds, semimagnetic superconductors, and silver halides, as well as developments in the rapidly growing field of time-resolved Raman spectroscopy. Emphasis is placed on obtaining information about elementary excitations, the basic properties of materials, and the use of Raman spectroscopy as an analytical tool. This volume may be regarded as an encyclopedia of condensed matter physics from the viewpoint of the Raman spectroscopist. It will be useful to advanced students and to all researchers who apply Raman spectroscopy in their work.

Quantum Electrodynamics and Quantum Optics - A. O. Barut
2013-11-11

The borderline of quantum electrodynamics and quantum optics offer spectacular results and problems concerning the foundations of radiation theory. Perhaps the major new viewpoint that has emerged from recent investigations is that one can now work inside a time-dependent quantum process, whereas up to now all elementary quantum processes were either stationary, or one worked with asymptotic in-and out-states, i.e. an S-matrix approach. In the first part of this volume, the Quantum Electrodynamics, the present status of the main approaches to this most accurate of all physical theories are discussed: the Hamiltonian approach, the Green's function approach with particular emphasis to bound state problems, and the newer, nonperturbative approach. The latest numerical results on radiative corrections, Lamb shifts and anomalous magnetic moments are reviewed with new results for high Z atoms. Also discussed are different theoretical interpretations of the radiative phenomena as due to quantized field vacuum fluctuations or due to self energy. A small group of contributions are devoted to the physics and mathematical description of decaying or unstable states in quantum theory. This remarkable phenomenon of quantum theory still needs complete clarification, it is a time-dependent phenomenon, which can be described also by asymptotic S-matrix methods, but with complex energies.

Linear Algebra for Economists - Fuad Aleskerov 2011-08-18

This textbook introduces students of economics to the fundamental notions and instruments in linear algebra. Linearity is used as a first approximation to many problems that are studied in different branches of science, including economics and other social sciences. Linear algebra is also the most suitable to teach students what proofs are and how to prove a statement. The proofs that are given in the text are relatively easy to understand and also endow the student with different ways of thinking in making proofs. Theorems for which no proofs are given in the book are illustrated via figures and examples. All notions are illustrated appealing to geometric intuition. The book provides a variety of economic examples using linear algebraic tools. It mainly addresses students in economics who need to build up skills in understanding mathematical reasoning. Students in mathematics and informatics may also be interested in learning about the use of mathematics in economics.

Optochemical Nanosensors - Andrea Cusano 2016-04-19

Nanosized sensors enable the study of chemical and biochemical processes at a level and in dimensions that may not have been envisioned some 20 years ago. Fueled by their inherent small size and the unusual optical, magnetic, catalytic, and mechanical properties of nanoparticles, remarkable progress has been made in recent years in the development

Tropical Forest Plant Ecophysiology - Stephen S. Mulkey
2012-12-06

Taking readers out of the laboratory and into the humid tropical

forests, this comprehensive volume explores the most recent advances occurring in tropical plant ecophysiology. Drawing on the knowledge of leading practitioners in the field, this book synthesizes a broad range of information on the ways in which tropical plants adapt to their environment and demonstrate unique physiological processes. This book is arranged into four sections which cover resource acquisition, species interactions, ecophysiological patterns within and among tropical forest communities, and the ecophysiology of forest regeneration. These sections describe plant function in relation to ecology across a wide spectrum of tropical forest species and growth forms. How do different species harvest and utilize resources from heterogeneous tropical environments? How do patterns of functional diversity reflect the overwhelming taxonomic and morphological diversity of tropical forest plants? Such fundamental questions are examined in rich detail. To illuminate the discussions further, every chapter in this book features an agenda for future research, extensive cross referencing, timely references, and the integration of ecophysiology and the demography of tropical species where the data exist. Tropical Forest Plant Ecophysiology provides plant scientists, botanists, researchers, and graduate students with important insights into the behavior of tropical plants. Biologists and foresters interested in tropical ecology and plant physiological ecologists will also benefit from this authoritative and timely resource.

Handbook of Full-Field Optical Coherence Microscopy - Arnaud Dubois 2016-10-14

Full-field optical coherence microscopy (FF-OCM) is an imaging technique that provides cross-sectional views of the subsurface microstructure of semitransparent objects. The technology is based on low-coherence interference microscopy, which uses an area camera for en face imaging of the full-field illuminated object. FF-OCM benefits from the lateral imaging resolution of optical microscopy along with the capacity of optical axial sectioning at micrometer-scale resolution. The technique can be employed in diverse applications, in particular for non-invasive examination of biological tissues. This handbook is the first to be entirely devoted to FF-OCM. It is organized into four parts with a total of 21 chapters written by recognized experts and major contributors to the field. After a general introduction to FF-OCM, the fundamental characteristics of the technology are analyzed and discussed theoretically. The main technological developments of FF-OCM for improving the image acquisition speed and for endoscopic imaging are presented in part II. Extensions of FF-OCM for image contrast enhancement or functional imaging are reported in part III. The last part of the book provides an overview of possible applications of FF-OCM in medicine, biology, and materials science. A comprehensive compilation of self-contained chapters written by leading experts, this handbook is a definitive guide to the theoretical analyses, technological developments, and applications of FF-OCM. Using the rich information the book is replete with, a wide range of readers, from scientists and physicists to engineers as well as clinicians and biomedical researchers, can get a handle on the latest major advances in FF-OCM.

Colloidal Foundations of Nanoscience - Debora Berti 2014-03-12
Colloidal Foundations of Nanoscience explores the theory and concepts of colloid chemistry and its applications to nanoscience and nanotechnology. It provides the essential conceptual and methodological tools to approach nano-research issues. The authors' expertise in colloid science will contribute to the understanding of basic issues involved in research. Each chapter covers a classical subject of colloid science, in simple and straightforward terms, and addresses its relevance to nanoscience before introducing case studies. Gathers in a single volume the information currently scattered across various sources Straightforward introduction of theoretical concepts and in-depth case studies help you understand molecular mechanisms and master advanced techniques Includes chapter on self-assembly as an alternative to nanostructured phases Includes examples showing applications of classical concepts to real-world cutting-edge research

Light Scattering and Nanoscale Surface Roughness - Alexei A. Maradudin 2010-05-10

This book covers both experimental and theoretical aspects of

nanoscale light scattering and surface roughness. Topics include: spherical particles located on a substrate; surface and buried interface roughness; surface roughness of polymer thin films; magnetic and thermal fluctuations at planar surfaces; speckle patterns; scattering of electromagnetic waves from a metal; multiple wavelength light scattering; nanoroughness standards.

Nonlinear Vision: Determination of Neural Receptive Fields, Function, and Networks - Robert B. Pinter 2018-05-04

This text brings to vision research a treatment different from that often found in books on the subject in its emphasis on nonlinear aspects of vision, from human perception to eye cells of the fly. There is considerable emphasis on mathematics, which forms not only models but the algorithms for processing data.

Cerebral Cortex - Philip S. Ulinski 2012-12-06

This volume is devoted to mathematical models of the cortex. Computational models of individual neurons and ensembles of neurons are increasingly used in research on cortical organization and function. This is, in part, because of the now ubiquitous presence of powerful and affordable computers. The volume begins with a short history of models of cortical neurons and circuitry that introduces the principal modeling styles. An attempt has been made throughout the volume to make it accessible to readers with minimal mathematical backgrounds.

Coherence of Light - Jan Perina 1985-08-31

X-ray Phase-Contrast Imaging Using Near-Field Speckles - Marie-Christine Zdora 2021-02-16

This thesis presents research on novel X-ray imaging methods that improve the study of specimens with small density differences, revealing their inner structure and density distribution. Exploiting the phase shift of X-rays in a material can significantly increase the image contrast compared to conventional absorption imaging. This thesis provides a practical guide to X-ray phase-contrast imaging with a strong focus on X-ray speckle-based imaging, the most recently developed phase-sensitive method. X-ray speckle-based imaging only requires a piece of abrasive paper in addition to the standard X-ray imaging setup. Its simplicity and robustness combined with the compatibility with laboratory X-ray sources, make it an ideal candidate for wide user uptake in a range of fields. An in-depth overview of the state of the art of X-ray speckle-based imaging and its latest developments is given in this thesis. It, furthermore, explores a broad range of applications, from X-ray optics characterisation, to biomedical imaging for 3D virtual histology and geological studies of volcanic rocks, demonstrating is promising potential. Moreover, the speckle-based technique is placed in the context of other phase-sensitive X-ray imaging methods to assist in the choice of a suitable method, hence serving as a guide and reference work for future users.

An Introduction to Statistical Learning - Gareth James 2013-06-24

An Introduction to Statistical Learning provides an accessible overview of the field of statistical learning, an essential toolset for making sense of the vast and complex data sets that have emerged in fields ranging from biology to finance to marketing to astrophysics in the past twenty years. This book presents some of the most important modeling and prediction techniques, along with relevant applications. Topics include linear regression, classification, resampling methods, shrinkage approaches, tree-based methods, support vector machines, clustering, and more. Color graphics and real-world examples are used to illustrate the methods presented. Since the goal of this textbook is to facilitate the use of these statistical learning techniques by practitioners in science, industry, and other fields, each chapter contains a tutorial on implementing the analyses and methods presented in R, an extremely popular open source statistical software platform. Two of the authors co-wrote *The Elements of Statistical Learning* (Hastie, Tibshirani and Friedman, 2nd edition 2009), a popular reference book for statistics and machine learning researchers. An Introduction to Statistical Learning covers many of the same topics, but at a level accessible to a much broader audience. This book is targeted at statisticians and non-statisticians alike who wish to use cutting-edge statistical learning techniques to analyze their data. The text assumes only a previous course in linear regression and no knowledge of matrix algebra.

Journal of the Chemical Society - 1984

Anti-reflection and Light Trapping in c-Si Solar Cells -

Chetan Singh Solanki 2017-06-30

This book offers essential insights into c-Si based solar cells and fundamentals of reflection, refraction, and light trapping. The basic physics and technology for light trapping in c-Si based solar cells are covered, from traditional to advanced light trapping structures. Further, the book discusses the latest developments in plasmonics for c-Si solar cell applications, along with their future scope and the requirements for further research. The book offers a valuable guide for graduate students, researchers and professionals interested in the latest trends in solar cell technologies.

Photorefractive Organic Materials and Applications - Pierre-Alexandre Blanche 2016-06-10

This book provides comprehensive, state-of-the art coverage of photorefractive organic compounds, a class of material with the ability to change their index of refraction upon illumination. The change is both dynamic and reversible. Dynamic because no external processing is required for the index modulation to be revealed, and reversible because the index change can be modified or suppressed by altering the illumination pattern. These properties make photorefractive materials very attractive candidates for many applications such as image restoration, correlation, beam conjugation, non-destructive testing, data storage, imaging through scattering media, holographic imaging and display. The field of photorefractive organic material is also closely related to organic photovoltaic and light emitting diode (OLED), which makes new discoveries in one field applicable to others.