



Nonlinear Optical Waves

Nicolae C. Panoiu



Nonlinear Optical Waves:

Nonlinear Optical Waves A.I. Maimistov, A.M. Basharov, 2013-03-09 A non linear wave is one of the fundamental objects of nature They are inherent to aerodynamics and hydrodynamics solid state physics and plasma physics optics and field theory chemistry reaction kinetics and population dynamics nuclear physics and gravity All non linear waves can be divided into two parts dispersive waves and dissipative ones The history of investigation of these waves has been lasting about two centuries In 1834 J S Russell discovered the extraordinary type of waves without the dispersive broadening In 1965 N J Zabusky and M D Kruskal found that the Korteweg de Vries equation has solutions of the solitary wave form This solitary wave demonstrates the particle like properties i e stability under propagation and the elastic interaction under collision of the solitary waves These waves were named solitons In succeeding years there has been a great deal of progress in understanding of soliton nature Now solitons have become the primary components in many important problems of nonlinear wave dynamics It should be noted that non linear optics is the field where all soliton features are exhibited to a great extent This book had been designed as the tutorial to the theory of non linear waves in optics The first version was projected as the book covering all the problems in this field both analytical and numerical methods and results as well However it became evident in the process of work that this was not a real task

Nonlinear Optics Robert W. Boyd, 2013-10-22 Nonlinear Optics is an advanced textbook for courses dealing with nonlinear optics quantum electronics laser physics contemporary and quantum optics and electrooptics Its pedagogical emphasis is on fundamentals rather than particular transitory applications As a result this textbook will have lasting appeal to a wide audience of electrical engineering physics and optics students as well as those in related fields such as materials science and chemistry Key Features The origin of optical nonlinearities including dependence on the polarization of light A detailed treatment of the quantum theory of the nonlinear susceptibility An explication of dressed atomic states of two level atoms A complete development of spontaneous and stimulated light scattering A clear discussion of the photorefractive effect An introduction to applications including laser frequency modification optical phase conjugation optical bistability and propagation of optical soliton *Physics of Nonlinear Optics* Guangsheng He, Song H. Liu, 1999 Nonlinear optics has been a rapidly growing field in recent decades It is based on the study of effects and phenomena related to the interaction of intense coherent light radiation with matter Physics of Nonlinear Optics describes various major nonlinear optical effects including physical principles experimental techniques up to date research achievements and current or potential applications This book features clear conceptual descriptions concise formulations and emphasizes both theoretical and experimental aspects of nonlinear optics The readability of this book is particularly enhanced by a series of color photographs showing the spectacular appearances of various nonlinear optical effects Both authors of this book are outstanding research scientists renowned in their professional areas Their major research achievements in nonlinear optics include the pioneering studies of two wave coupled refractive index change

Raman enhanced self focusing optical frequency Pockels effect stimulated Kerr scattering optical phase conjugation via backward stimulated emission and two photon absorption based optical limiting stabilization and reshaping Nonlinear Photonics and Novel Optical Phenomena Zhigang Chen,Roberto Morandotti,2012-06-27 Nonlinear Photonics and Novel Optical Phenomena contains contributed chapters from leading experts in nonlinear optics and photonics and provides a comprehensive survey of fundamental concepts as well as hot topics in current research on nonlinear optical waves and related novel phenomena The book covers self accelerating airy beams integrated photonics based on high index doped silica glass linear and nonlinear spatial beam dynamics in photonic lattices and waveguide arrays the theory of polariton solitons in semiconductor microcavities and Terahertz waves Fundamentals of Nonlinear Optics Peter E. Powers,Joseph W. Haus,2017-04-27 Praise for the 1st Edition well written and up to date The problem sets at the end of each chapter reinforce and enhance the material presented and may give students confidence in handling real world problems Optics Photonics News rigorous but simple description of a difficult field keeps the reader s attention throughout serves perfectly for an introductory level course Physics Today This fully revised introduction enables the reader to understand and use the basic principles related to many phenomena in nonlinear optics and provides the mathematical tools necessary to solve application relevant problems The book is a pedagogical guide aimed at a diverse audience including engineers physicists and chemists who want a tiered approach to understanding nonlinear optics The material is augmented by numerous problems with many requiring the reader to perform real world calculations for a range of fields from optical communications to remote sensing and quantum information Analytical solutions of equations are covered in detail and numerical approaches to solving problems are explained and demonstrated The second edition expands the earlier treatment and includes A new chapter on quantum nonlinear optics Thorough treatment of parametric optical processes covering birefringence tolerances and beam optimization to design and build high conversion efficiency devices Treatment of numerical methods to solving sets of complex nonlinear equations Many problems in each chapter to challenge reader comprehension Extended treatment of four wave mixing and solitons Coverage of ultrafast pulse propagation including walk off effects Nonlinear Guided Wave Optics S. Wabnitz,2017-12-24 With introductory material to make the subject area accessible to non specialists such as graduate and PhD students and researchers working in other areas where extreme waves are relevant this book features contributions by prominent scientists in this emerging field and is a comprehensive treatment of optical extreme wave research **Anisotropic and Nonlinear Optical Waveguides** C.G. Someda,G.I. Stegeman,2012-12-02 Dielectric optical waveguides have been investigated for more than two decades In the last ten years they have had the unique position of being simultaneously the backbone of a very practical and fully developed technology as well as an extremely exciting area of basic forefront research Existing waveguides can be divided into two sets one consisting of waveguides which are already in practical use and the second of those which are still at the laboratory stage of their evolution This book is divided into two

separate parts the first dealing with anisotropic waveguides and the second with nonlinear behaviour Nonlinear behaviour in optical waveguides is a topic of current research interest an effect eagerly being sought in waveguides The relative importance of nonlinearity versus anisotropy in theoretical papers changes enormously from problem to problem Many theories can be quite useful and enlightening even though they neglect entirely one of the two aspects Scientists may find their research work leading them in the near future to deal simultaneously with anisotropy and nonlinearity in order to pursue their own investigations This book will be of interest to researchers who first need to understand the individual topics suitably chosen from the two parts of this work thus providing them with the necessary ingredients to pursue their explorations

Guided Wave Nonlinear Optics D.B. Ostrowsky, R. Reinisch, 1992-04-30 The object of this school held at Cargèse Corsica France from August 12th to 24th 1991 was the presentation of the field of guided wave nonlinear optics in a comprehensive coherent and heuristic fashion It seems appropriate that this school began with an historical introduction by Professor Nicolaas Bloembergen of Harvard the acknowledged father of nonlinear optics in general and concluded with a round table discussion headed by Dr Eric Spitz the Scientific Director of a multinational electronics company interested in developing industrial applications of guided wave nonlinear optics The lectures covered both the theoretical framework of the field and applications to basic scientific research optical communications and technical instrumentation Specific topics developed included materials for guided wave nonlinear optics nonlinear interactions using integrated optical guides nonlinear surface waves solitons fiber nonlinear optics ultra fast coupler switching as well as the related topic of fiber and integrated optical lasers and amplifiers Lectures have also been devoted to squeezed states chaos and strange attractors The subjects covered by the school underlines one of the major ways in which this field has evolved over the past thirty some odd years The path from the original experiments with materials requiring mega watt power lasers to the recent developments in guided wave configurations using milliwatt power diode lasers is marked by the conjunction of ever improving fundamental scientific comprehension and continuing technological developments

Nonlinear Optical Crystals: A Complete Survey David N. Nikogosyan, 2006-03-21 Nonlinear optical techniques are now recognized as the most efficient means available to generate laser radiation at wavelengths that are presently inaccessible via conventional sources This technology uses nonlinear optical crystals for the frequency conversion of laser light The book contains the most complete and up to date reference material on properties of nonlinear optical crystals describes their applications both traditional and specific and provides the main mathematical formulas necessary for the calculation of the frequency conversion process It is a vital source of information for scientists and engineers dealing with modern applications of nonlinear optical crystals in quantum electronics optoelectronics and laser physics

Controllable Nonlinear Waves in Graded-Index Waveguides (GRIN) Thokala Soloman Raju, 2024-02-28 This book highlights the dynamical behavior of self similar waves in graded index waveguides in 1 1 dimensions and 2 1 dimensions The mechanism to control these optical similaritons by tailoring the

tapering profile is presented Various nonlinear waves like rogons butterfly shaped and dromion like waves and their controllable behavior are discussed in detail The phenomenon of unbreakable Parity Time symmetry of some of these waves has been delineated for different variety of solvable potentials Compression of these exotic waves has been demonstrated for dispersion decreasing fiber and periodic management of dispersion and nonlinearity parameters Competing cubic quintic nonlinearity scenario and its potential implication on the dynamics of these similaritons has been described in detail Symbiotic self similar rogue waves have been discussed in 2 1 dimensional garded index waveguide The book also includes numerical simulations that complement these analytical insights

Nonlinear Optics Chunfei Li,2016-08-26 This book reflects the latest advances in nonlinear optics Besides the simple strict mathematical deduction it also discusses the experimental verification and possible future applications such as the all optical switches It consistently uses the practical unit system throughout It employs simple physical images such as light waves and photons to systematically explain the main principles of nonlinear optical effects It uses the first order nonlinear wave equation in frequency domain under the condition of slowly varying amplitude approximation and the classical model of the interaction between the light and electric dipole At the same time it also uses the rate equations based on the energy level transition of particle systems excited by photons and the energy and momentum conservation principles to explain the nonlinear optical phenomenon The book is intended for researchers engineers and graduate students in the field of optics optoelectronics fiber communication information technology and materials etc

Handbook of Nonlinear Optics Richard L. Sutherland,2003-04-22 Examining classic theories experimental methods and practical formulas for exploration of the core topics in nonlinear optics the second edition of this acclaimed text was extensively revised to reflect recent advances in the analysis and modification of material properties for application in frequency conversion optical switching and limiting multiphoton absorption and electro optic effects Handbook of Nonlinear Optics Second Edition contains additional chapters on ultrafast characterization techniques laser flash photolysis and the electro optic effect as well as expanded coverage of nonlinear optics in fibers and pulsed two beam coupling

Nonlinear Optics Boris Lembrikov,2019-02-06 Nonlinear optics is a rapidly developing field of modern physics Nonlinear optical phenomena such as self focusing self phase modulation soliton formation and propagation higher harmonic generation different types of stimulated light scattering and four wave mixing have attracted interest from the fundamental point of view of the investigation of light matter interaction and as a basis for applications in contemporary optical communications and optical signal processing Nonlinear Optics Novel Results in Theory and Applications contains novel results concerning the mathematical methods of nonlinear optical phenomena analysis soliton formation and propagation in optical fibers and peculiarities of nonlinear optical phenomena in micro and nanostructures The book may be interesting for researchers and engineers interested in nonlinear optics lasers and optical communications

Rogue and Shock Waves in Nonlinear Dispersive Media Miguel Onorato,Stefania Resitori,Fabio Baronio,2016-09-19 This self contained

set of lectures addresses a gap in the literature by providing a systematic link between the theoretical foundations of the subject matter and cutting edge applications in both geophysical fluid dynamics and nonlinear optics Rogue and shock waves are phenomena that may occur in the propagation of waves in any nonlinear dispersive medium Accordingly they have been observed in disparate settings as ocean waves in nonlinear optics in Bose Einstein condensates and in plasmas Rogue and dispersive shock waves are both characterized by the development of extremes for the former the wave amplitude becomes unusually large while for the latter gradients reach extreme values Both aspects strongly influence the statistical properties of the wave propagation and are thus considered together here in terms of their underlying theoretical treatment This book offers a self contained graduate level text intended as both an introduction and reference guide for a new generation of scientists working on rogue and shock wave phenomena across a broad range of fields in applied physics and geophysics

Shaping Light in Nonlinear Optical Fibers Sonia Boscolo, Christophe Finot, 2017-03-08 This book is a contemporary overview of selected topics in fiber optics It focuses on the latest research results on light wave manipulation using nonlinear optical fibers with the aim of capturing some of the most innovative developments on this topic The book's scope covers both fundamentals and applications from both theoretical and experimental perspectives with topics including linear and nonlinear effects pulse propagation phenomena and pulse shaping solitons and rogue waves novel optical fibers supercontinuum generation polarization management optical signal processing fiber lasers optical wave turbulence light propagation in disordered fiber media and slow and fast light With contributions from leading edge scientists in the field of nonlinear photonics and fiber optics they offer an overview of the latest advances in their own research area The listing of recent research papers at the end of each chapter is useful for researchers using the book as a reference As the book addresses fundamental and practical photonics problems it will also be of interest to and benefit broader academic communities including areas such as nonlinear science applied mathematics and physics and optical engineering It offers the reader a wide and critical overview of the state of the art within this practical as well as fundamentally important and interesting area of modern science providing a useful reference which will encourage further research and advances in the field

Non-diffracting Waves Hugo E. Hernández-Figueroa, Michel Zamboni-Rached, Erasmo Recami, 2013-09-25 This continuation and extension of the successful book Localized Waves by the same editors brings together leading researchers in non diffractive waves to cover the most important results in their field and as such is the first to present the current state The well balanced presentation of theory and experiments guides readers through the background of different types of non diffractive waves their generation propagation and possible applications The authors include a historical account of the development of the field and cover different types of non diffractive waves including Airy waves and realistic finite energy solutions suitable for experimental realization Apart from basic research the concepts explained here have promising applications in a wide range of technologies from wireless communication to acoustics and bio medical imaging

Nonlinearity and Disorder: Theory and Applications Fatkhulla Abdullaev, Ole Bang, Mads Peter Sørensen, 2012-12-06
 Proceedings of the NATO Advanced Research Workshop Tashkent Uzbekistan 26 October 2001 **Nonlinear Optics**
 Robert W. Boyd, 2008-05-13 Nonlinear optics is the study of the interaction of intense laser light with matter The third edition of this textbook has been rewritten to conform to the standard SI system of units and includes comprehensively updated material on the latest developments in the field The book presents an introduction to the entire field of optical physics and specifically the area of nonlinear optics covering fundamental issues and applied aspects of this exciting area Nonlinear Optics will have lasting appeal to a wide audience of physics optics and electrical engineering students as well as to working researchers and engineers Those in related fields such as materials science and chemistry will also find this book of particular interest Presents an introduction to the entire field of optical physics from the perspective of nonlinear optics Combines first rate pedagogy with a treatment of fundamental aspects of nonlinear optics Covers all the latest topics and technology in this ever evolving industry Strong emphasis on the fundamentals Waveguide Nonlinear-Optic Devices
 Toshiaki Suhara, Masatoshi Fujimura, 2003-06-23 The most comprehensive book on waveguide nonlinear optic devices this volume presents a systematic description of the NLO field with an emphasis on devices that use ferroelectric waveguides It ranges from an introduction to the concepts of waveguides to the most recent experimental results **Fundamentals and Applications of Nonlinear Nanophotonics** Nicolae C. Panoiu, 2023-09-07 Fundamentals and Applications of Nonlinear Nanophotonics includes key concepts of nonlinear nanophotonics computational and modeling techniques to design these materials and the latest advances This book addresses the scientific literature on nanophotonics while most existing books focus almost exclusively on the linear aspects of light matter interaction at the nanoscale Sections cover nonlinear optics of sub wavelength photonic nanostructured materials review nonlinear optics of bound states in the continuum nonlinear optics of chiral plasmonic metasurfaces nonlinear hyperbolic nanomaterials nonlinear topological photonics plasmonic lattice solitons and more This book is suitable for academics and industry professionals working in the discipline of materials science engineering and nanotechnology Discusses advances in nonlinear optics research such as plasmonics topological photonics and emerging materials Reviews the latest computational methods to model and design nonlinear photonic materials Introduces key principles of advanced concepts in nonlinear optics of bound states in a continuum and symmetries in nonlinear nano optics

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