



Optical Solitons

*From Fibers
to Photonic
Crystals*

YURI S. KIVSHAR
GOVIND P. AGRAWAL



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Yuri S. Kivshar, Govind P. Agrawal



Optical Solitons:

Optical Solitons Kuppuswamy Porsezian, Valakkattil Chako Kuriakose, 2008-01-11 Optical Solitons represent one of the most exciting and fascinating concepts in modern communications arousing special interest due to their potential applications in optical fibre communication This volume focuses on the explicit integration of analytical and experimental methods in nonlinear fibre optics and integrated optics It covers all important recent technical issues in optical soliton communication For example individual chapters are devoted to topics such as dispersion management and fibre Bragg grating All authors are leading authorities in their fields

Optical Solitons Yuri S. Kivshar, Govind P. Agrawal, 2003-06-12 The current research into solitons and their use in fiber optic communications is very important to the future of communications Since the advent of computer networking and high speed data transmission technology people have been striving to develop faster and more reliable communications media Optical pulses tend to broaden over relatively short distances due to dispersion but solitons on the other hand are not as susceptible to the effects of dispersion and although they are subject to losses due to attenuation they can be amplified without being received and re transmitted This book is the first to provide a thorough overview of optical solitons The main purpose of this book is to present the rapidly developing field of Spatial Optical Solitons starting from the basic concepts of light self focusing and self trapping It will introduce the fundamental concepts of the theory of nonlinear waves and solitons in non integrated but physically realistic models of nonlinear optics including their stability and dynamics Also it will summarize a number of important experimental verification of the basic theoretical predictions and concepts covering the observation of self focusing in the earlier days of nonlinear optics and the most recent experimental results on spatial solitons vortex solitons and soliton interaction spiraling Introduces the fundamental concepts of the theory of nonlinear waves and solitons through realistic models Material is based on authors years of experience actively working in and researching the field Summarizes the most important experimental verification of the basic theories predictions and concepts of this ever evolving field from the earliest studies to the most recent

Optical Solitons Kuppuswamy Porsezian, Valakkattil Chako Kuriakose, 2003-01-22 Optical Solitons represent one of the most exciting and fascinating concepts in modern communications arousing special interest due to their potential applications in optical fibre communication This volume focuses on the explicit integration of analytical and experimental methods in nonlinear fibre optics and integrated optics It covers all important recent technical issues in optical soliton communication For example individual chapters are devoted to topics such as dispersion management and fibre Bragg grating All authors are leading authorities in their fields

Optical Solitons Fatkhulla Abdullaev, Sergei Darmanyan, Pulat Khabibullaev, 2014-04-17 The investigation of nonlinear wave phenomena has been one of the main directions of research in optics for the last few decades Soliton concepts applied to the description of intense electromagnetic beams and ultrashort pulse propagation in various media have contributed much to this field The notion of solitons has proved to be very useful in describing wave processes in

hydrodynamics plasma physics and condensed matter physics Moreover it is also of great importance in optics for ultrafast information transmission and storage radiation propagation in resonant media etc In 1973 Hasegawa and Tappert made a significant contribution to optical soliton physics when they predicted the existence of an envelope soliton in the regime of short pulses in optical fibres In 1980 Mollenauer et al conducted experiments to elucidate this phenomenon Since then the theory of optical solitons as well as their experimental investigation has progressed rapidly The effects of inhomogeneities of the medium and energy pumping on optical solitons the interaction between optical solitons and their generation in fibres etc have all been investigated and reported Logical devices using optical solitons have been developed new types of optical solitons in media with Kerr type nonlinearity and in resonant media have been described **Optical Solitons** J. R. Taylor, 1992-04-23 Provides an overview of our current understanding of optical soliton properties introducing the subject for students and reviewing the most recent research *Introduction to non-Kerr Law Optical Solitons* Anjan Biswas, Swapan Konar, 2006-11-10 Despite remarkable developments in the field a detailed treatment of non Kerr law media has not been published *Introduction to non Kerr Law Optical Solitons* is the first book devoted exclusively to optical soliton propagation in media that possesses non Kerr law nonlinearities After an introduction to the basic features of fiber optic com

Introduction to non-Kerr Law Optical Solitons Anjan Biswas, Swapan Konar, 2006-11-10 Despite remarkable developments in the field a detailed treatment of non Kerr law media has not been published *Introduction to non Kerr Law Optical Solitons* is the first book devoted exclusively to optical soliton propagation in media that possesses non Kerr law nonlinearities After an introduction to the basic features of fiber optic com **Solitons in Optical Fibers** Linn F. Mollenauer, James P. Gordon, 2006-03-08 Solitons are waves that retain their form through obstacle and distance Solitons can be found in hydrodynamics nonlinear optics plasma physics and biology Optical solitons are solitary light waves that hold their form over an expansive interval Conservation of this form creates an effective model for long distance voice and data transmission The application of this principle is essential to the technology of wired communications Optical solitons produce crystal clear phone calls cross country and internationally It is because of these that someone on the other end of the phone sounds in the next room It is also pertinent to high speed network information transmittal Mollenauer and Gordon have written the only text that an engineer or graduate student will need to understand this foundation subject in optics Written by Linn Mollenauer and James Gordon who are celebrated for applying optical solitons to telecommunications Combines mathematical developments with well chosen practical examples and design formulas Extensive material on the basic physics of fiber optic transmission and its practical applications *Physics and Applications of Optical Solitons in Fibres '95* Akira Hasegawa, 2012-12-06 This book summarizes the proceedings of the invited talks presented at the International Symposium of Physics and Application of Optical Solitons in Fibers held in Kyoto during November 14 to 17 1995 As a result of worldwide demand for ultra high bitrate transmissions and increased scientific interests from the soliton community research

on optical solitons in fibers has made a remarkable progress in recent years. In view of these trends and with the support of the Japanese Ministry of Posts and Telecommunications the Research Group for Optical Soliton Communications ROSC chaired by Akira Hasegawa was established in Japan in April 1995 to promote collaboration and information exchange among communication service companies, industries and academic circles in the theory and application of optical solitons. This symposium was organized as a part of the ROSC activities. The symposium attracted enthusiastic response by worldwide researchers involved in this subject which has led to the most intensive meeting that the editor ever attended. The reader will find the contents to be well balanced among theory, experiment and technology. Although the evaluation of the contents shall naturally depend on the particular area of interest of the reader, the symposium has confirmed that the soliton based light wave transmission has achieved the best result in one channel both in distance of transmission and in bitrate although in wavelength division multiplexed WDM systems NRZ transmission has yet better result.

Optical Solitons in Fibers Akira Hasegawa, 2013-03-09. Already after six months high demand made a new edition of this textbook necessary. The most recent developments associated with two topical and very important theoretical and practical subjects are combined: Solitons as analytical solutions of nonlinear partial differential equations and as lossless signals in dielectric fibers. The practical implications point towards technological advances allowing for an economic and undistorted propagation of signals revolutionizing telecommunications. Starting from an elementary level readily accessible to undergraduates, this pioneer in the field provides a clear and up to date exposition of the prominent aspects of the theoretical background and most recent experimental results in this new and rapidly evolving branch of science. This well written book makes not just easy reading for the researcher but also for the interested physicist, mathematician and engineer. It is well suited for undergraduate or graduate lecture courses.

Optical Solitons: Theoretical Challenges and Industrial Perspectives Vladimir E. Zakharov, Stefan Wabnitz, 2013-04-17. 1. V. E. Zakharov and S. Wabnitz. 1. L. D. Landau Institute for Theoretical Physics, 2. Kosygin Str. 117334 Moscow, Russia. 2. Laboratoire de Physique, University of Bourgogne, 9 avenue A. Savary, 21078 Dijon, France. After about a quarter of a century since the first theoretical predictions of optical solitons, the industrial application of the optical soliton concept is near to reality in the booming field of modern telecommunications where the demand for high speed data transmission and routing is of ever growing. This book contains a set of lectures that were presented at a Les Houches school on optical solitons in September 1998. The school was successful in gathering among the lecturers most of the well recognized world leaders in the field of optical solitons. A variety of different aspects of research into optical solitons was exposed in the lectures ranging from the mathematical foundations of integrability theory to the rapidly evolving technological advances of fiber soliton based telecommunication systems. The overall impression that the participants and the students received from the school is that this field of research is an excellent example of the rapid transfer that occurs nowadays from basic science to the technological implementations of the first principles. The subjects that were covered by

the lectures can be broadly grouped into four main categories optical soliton theory fiber soliton telecommunications optical soliton generation methods and all optical information processing via spatial solitons

Dissipative Optical Solitons

Mário F. S. Ferreira, 2022-09-23 This book introduces the basic concept of a dissipative soliton before going to explore recent theoretical and experimental results for various classes of dissipative optical solitons high energy dissipative solitons and their applications and mode locked fiber lasers A soliton is a concept which describes various physical phenomena ranging from solitary waves forming on water to ultrashort optical pulses propagating in an optical fiber While solitons are usually attributed to integrability in recent years the notion of a soliton has been extended to various systems which are not necessarily integrable Until now the main emphasis has been given to well known conservative soliton systems but new avenues of inquiry were opened when physicists realized that solitary waves did indeed exist in a wide range of non integrable and non conservative systems leading to the concept of so called dissipative optical solitons Dissipative optical solitons have many unique properties which differ from those of their conservative counterparts For example except for very few cases they form zero parameter families and their properties are completely determined by the external parameters of the optical system They can exist indefinitely in time as long as these parameters stay constant These features of dissipative solitons are highly desirable for several applications such as in line regeneration of optical data streams and generation of stable trains of laser pulses by mode locked cavities

Mathematical Theory of Dispersion-Managed Optical Solitons

Anjan Biswas, Daniela Milovic, Matthew Edwards, 2010-07-07 Mathematical Theory of Dispersion Managed Optical Solitons discusses recent advances covering optical solitons soliton perturbation optical cross talk Gabitov Turitsyn Equations quasi linear pulses and higher order Gabitov Turitsyn Equations Focusing on a mathematical perspective the book bridges the gap between concepts in engineering and mathematics and gives an outlook to many new topics for further research The book is intended for researchers and graduate students in applied mathematics physics and engineering and also it will be of interest to those who are conducting research in nonlinear fiber optics Dr Anjan Biswas is an Associate Professor at the Department of Applied Mathematics Dr Daniela Milovic is an Associate Professor at the Department of Telecommunications Faculty of Electronic Engineering University of Nis Serbia Dr Matthew Edwards is the Dean of the School of Arts and Sciences at Alabama A M University in Huntsville AL USA

Optical Soliton Control and its Management Dr. N. Prathap , 2021-08-11

INTRODUCTION TO OPTICAL FIBER Recent inventions and discoveries have revolutionized the telecommunication industry but the future enhancement will be based on the transmission and reception of multimedia in an efficient and effective way In present optical fibers are used instead of copper cables which is very helpful to transform plenty of information with high speed and high range The optical fiber cable gives infinite bandwidth for media transmission with low loss The optical fiber is a cylindrical in shape and made up of low loss dielectric material such as silica glass An optical or light signal communication is a system which uses light pulse as the carrier for transmission and reception of signals The silica glass fiber has low loss

higher bandwidth and high speed compare to normal copper cable communication Nowadays the copper coaxial cables are replaced by optical fiber due to low loss in fiber and offers infinite bandwidth with low latency Thus the fiber plays a major role in today s global application such as Telecommunication defence medical networking industrial etc **New Trends in Optical Soliton Transmission Systems** Akira Hasegawa,2012-12-06 This book summarizes the proceedings of the invited talks presented at the International Symposium on New Trends in Optical Soliton Transmission Systems held in Kyoto during November 18 21 1997 As a result of worldwide demand for ultra high bitrate transmissions and increased scientific interest from the soliton community research on optical solitons in fibres has made remarkable progress in recent years In view of these trends the Research Group for Optical Soliton Communications ROSC chaired by Akira Hasegawa was established in Japan in April 1995 to promote collaboration and information exchange among communication service companies industries and academic circles in the theory and application of optical solitons This symposium was organized as a part of the ROSC activities As with the 1 st ROSC symposium this symposium attracted enthusiastic response from worldwide researchers involved in the subject of soliton based communications and intensive discussions were held throughout the symposium Particular emphases were made to dispersion managements of soliton transmission I would like to note that in the t symposium the adiabatic dispersion managements just began to appear in reducing radiation at amplifiers and reducing collision effects in WDM system These have become standard this time but in addition new non adiabatic dispersion managements have been introduced independently by various scientists all over the world Simulation of Optical Soliton Control in Micro- and Nanoring Resonator Systems Suzairi Daud,Sevia Mahdaliza Idrus,Jalil Ali,2015-03-17 This book introduces optical soliton control in micro and nanoring resonator systems It describes how the ring resonator systems can be optimized as optical tweezers for photodetection by controlling the input power ring radii and coupling coefficients of the systems Numerous arrangements and configurations of micro and nanoring resonator systems are explained The analytical formulation and optical transfer function for each model and the interaction of the optical signals in the systems are discussed This book shows that the models designed are able to control the dynamical behaviour of generated signals

Spatial Solitons Stefano Trillo,2001-09-11 Soliton based concepts open the road for newly designed laser sources new frequency converters and high intensity laser material interactions Optical solitons as stable spatial patterns of complex nonlinear systems allow for the control of the diffraction of optical beams Solitons also prevent unwanted chaotic behavior Thus solitary wave physics plays a significant role from modern optical physics to optical communication optical switching and optical storage The book gives an updated overview of optical solitons and can serve as a reference and guide for advanced students and scientists working in the field and related areas of science where solitons are observed *Optical Soliton Communication Using Ultra-Short Pulses* Iraj Sadegh Amiri,Harith Ahmad,2015-05-07 This brief analyzes the characteristics of a microring resonator MRR to perform communication using ultra short soliton pulses The raising of

nonlinear refractive indices coupling coefficients and radius of the single microring resonator leads to decrease in input power and round trips wherein the bifurcation occurs As a result bifurcation or chaos behaviors are seen at lower input power of 44 W where the nonlinear refractive index is $n_2 = 3.2 \times 10^{-20} \text{ m}^2/\text{W}$ Using a decimal convertor system these ultra short signals can be converted into quantum information Results show that multi solitons with FWHM and FSR of 10 pm and 600 pm can be generated respectively The multi optical soliton with FWHM and FSR of 325 pm and 880 nm can be incorporated with a time division multiple access TDMA system wherein the transportation of quantum information is performed

Advances in Nonlinear Optics Xianfeng Chen,Guoquan Zhang,Heping Zeng,Qi Guo,Weilong She,2014-12-16 This book presents an overview of the state of the art of the developing topic of nonlinear optics with contributions from leading experts in the field in China ranging from weak light nonlinear optics ultrafast nonlinear optics to electro optical theory and applications In the past decade nonlinear optics has evolved into many different branches depending on the form of the material used for studying the nonlinear phenomena The growth of research in nonlinear optics is closely linked to the rapid technological advances that have occurred in related fields such as ultra fast phenomena and optical communications Nonlinear optics activities range from the fundamental studies of the interaction between matter and radiation to the development of devices components and systems of tremendous commercial interest for widespread applications in optical telecommunications medicine and biotechnology This book reviews the development of some nonlinear optics researches in China not only the discovery of new principles but also potential applications of nonlinear optics for various industries

Solitons in Optical Communications Akira Hasegawa,Yuji Kodama,1995 Written by the world s leading researchers in the field this is a clear account of the theory and mathematics of solitons travelling in optical fibres

Decoding **Optical Solitons**: Revealing the Captivating Potential of Verbal Expression

In a period characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its ability to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Optical Solitons**," a mesmerizing literary creation penned with a celebrated wordsmith, readers embark on an enlightening odyssey, unraveling the intricate significance of language and its enduring impact on our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

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