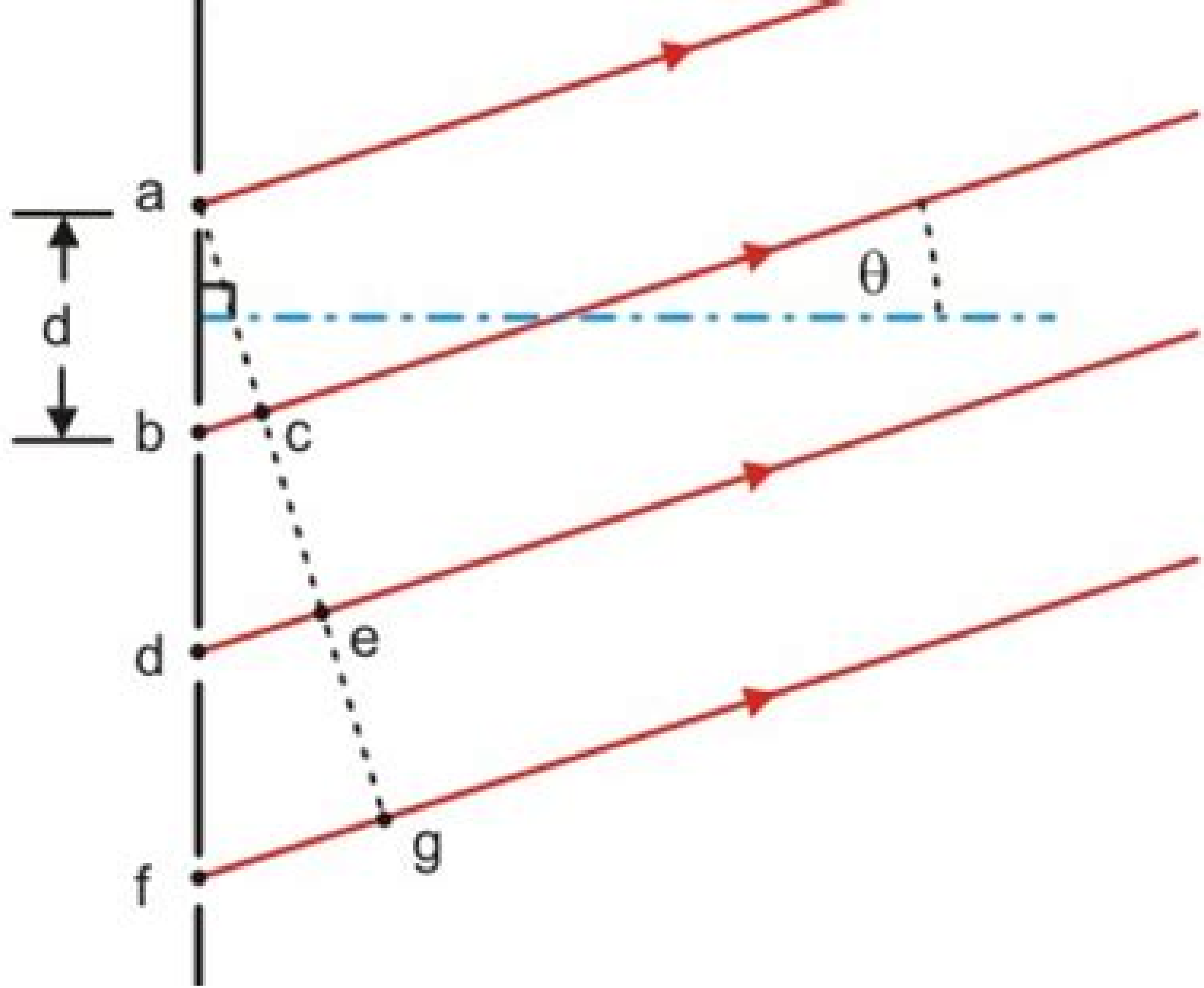

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Scattering Theory For Diffraction Gratings

Yuriy K. Sirenko, Staffan Ström

Scattering Theory For Diffraction Gratings:

Scattering Theory for Diffraction Gratings Calvin H. Wilcox,2012-12-06 The scattering of acoustic and electromagnetic waves by periodic sur faces plays a role in many areas of applied physics and engineering Opti cal diffraction gratings date from the nineteenth century and are still widely used by spectroscopists More recently diffraction gratings have been used as coupling devices for optical waveguides Trains of surface waves on the oceans are natural diffraction gratings which influence the scattering of electromagnetic waves and underwater sound Similarly the surface of a crystal acts as a diffraction grating for the scattering of atomic beams This list of natural and artificial diffraction gratings could easily be extended The purpose of this monograph is to develop from first principles a theory of the scattering of acoustic and electromagnetic waves by periodic surfaces In physical terms the scattering of both time harmonic and transient fields is analyzed The corresponding mathematical model leads to the study of boundary value problems for the Helmholtz and d Alembert wave equations in plane domains bounded by periodic curves In the formal ism adopted here these problems are intimately related to the spectral analysis of the Laplace operator acting in a Hilbert space of functions defined in the domain adjacent to the grating **Mathematical Problems in Image Processing** Gilles Aubert,Pierre Kornprobst,2006-11-30 Partial differential equations PDEs and variational methods were introduced into image processing about fifteen years ago Since then intensive research has been carried out The goals of this book are to present a variety of image analysis applications the precise mathematics involved and how to discretize them Thus this book is intended for two audiences The first is the mathematical community by showing the contribution of mathematics to this domain It is also the occasion to highlight some unsolved theoretical questions The second is the computer vision community by presenting a clear self contained and global overview of the mathematics involved in image procesing problems This work will serve as a useful source of reference and inspiration for fellow researchers in Applied Mathematics and Computer Vision as well as being a basis for advanced courses within these fields During the four years since the publication of the first edition there has been substantial progress in the range of image processing applications covered by the PDE framework The main goals of the second edition are to update the first edition by giving a coherent account of some of the recent challenging applications and to update the existing material In addition this book provides the reader with the opportunity to make his own simulations with a minimal effort To this end programming tools are made available which will allow the reader to implement and test easily some classical approaches *Gratings: Theory and Numeric Applications* , *Modern Theory of Gratings* Yuriy K. Sirenko,Staffan Ström,2010-07-23 The advances in the theory of diffraction gratings and the applications of these results certainly determine the progress in several areas of applied science and engineering The polarization converters phase shifters and filters quantum and solid state oscillators open quasi optical dispersive resonators and power compressors slow wave structures and patter forming systems accelerators and spectrometer that is still far from being a complete list of devices exploiting the amazing ability of periodic structures to perform controlled frequency spatial and polarization selection of signals Diffraction gratings used to be and still are one of the most popular objects of analysis in electromagnetic theory The further development of the theory of diffraction gratings in spite of considerable achievements is still very important presently The requirements of applied optics and microwave engineering present the theory of diffraction gratings with many new problems which force us to search for new methods and tools for their resolution Just in such way there appeared recently new fields connected with the analysis synthesis and definition of equivalent parameters of artificial materials layers and coatings having periodic structure and possessing features which can be found in natural materials only in extraordinary or exceptional situations In this book the authors present results of the electromagnetic theory of diffraction gratings that may constitute the base of further development of this theory which can meet the challenges provided by the most recent requirements of fundamental and applied science The following issues will be considered in the book Authentic methods of analytical regularization that perfectly match the requirements of analysis of resonant scattering of electromagnetic waves by gratings Spectral theory of gratings providing a reliable foundation for the analysis of spatial frequency transformations of electromagnetic fields occurring in open periodic resonators and waveguides Parametric Fourier method and C method that are oriented towards the efficient numerical analysis of transformation properties of fields in the case of arbitrary profile periodic boundary between dielectric media and multilayered conformal arrays Rigorous methods for analysis of transient processes and time spatial transformations of electromagnetic waves in resonant situations based on development and incorporation in standard numerical routines of FDTD of so called explicit absorbing boundary conditions New approaches to the solution of homogenization problems the key problem arising in construction of metamaterials and meta surfaces New physical results about the resonance scattering of pulse and monochromatic waves by periodic structures including structures with chiral or left handed materials Methods and the results of the solutions of several actual applied problems of analysis and synthesis of pattern creating gratings power compressors resonance radiators of high capacity short radio pulses open electromagnetic structures for the systems of resonant quasi optics and absorbing coatings **Progress in Computational Physics (PiCP): Volume 1** Matthias Ehrhardt,2010 Progress in Computational Physics is a new e book series devoted to recent research trends in computational physics It contains chapters contributed by outstanding experts of modeling of physical problems The series focuses on interdisciplinary computat

Direct and Inverse Problems in Wave Propagation and Applications Ivan Graham,Ulrich Langer,Jens Melenk,Mourad Sini,2013-10-14 This book is the third volume of three volume series recording the Radon Special Semester 2011 on Multiscale Simulation Analysis in Energy and the Environment taking place in Linz Austria October 3 7 2011 This book surveys recent developments in the analysis of wave propagation problems The topics covered include aspects of the forward problem and problems in inverse problems as well as applications in the earth sciences Wave propagation problems are ubiquitous in environmental applications such as seismic analysis acoustic and electromagnetic scattering The design of efficient numerical methods for the forward problem in which the scattered field is computed from known geometric configurations is very challenging due to the multiscale nature of the problems Even more challenging are inverse problems where material parameters and configurations have to be determined from measurements in conjunction with the forward problem This book contains review articles covering several state of the art numerical methods for both forward and inverse problems This collection of survey articles focusses on the efficient computation of wave propagation and scattering is a core problem in numerical mathematics which is currently of great research interest and is central to many applications in energy and the environment Two generic applications which resonate strongly with the central aims of the Radon Special Semester 2011 are forward wave propagation in heterogeneous media and seismic inversion for subsurface imaging As an example of the first application modelling of absorption and scattering of radiation by clouds aerosol and precipitation is used as a tool for interpretation of e g solar infrared and radar measurements and as a component in larger weather climate prediction models in numerical weather forecasting As an example of the second application inverse problems in wave propagation in heterogeneous media arise in the problem of imaging the subsurface below land or marine deposits The book records the achievements of Workshop 3 Wave Propagation and Scattering Inverse Problems and Applications in Energy and the Environment It brings together key numerical mathematicians whose interest is in the analysis and computation of wave propagation and scattering problems and in inverse problems together with practitioners from engineering and industry whose interest is in the applications of these core problems *Elements of Applied Bifurcation Theory* Yuri Kuznetsov,2008-01-10 Providing readers with a solid basis in dynamical systems theory as well as explicit procedures for application of general mathematical results to particular problems the focus here is on efficient numerical implementations of the developed techniques The book is designed for advanced undergraduates or graduates in applied mathematics as well as for Ph D students and researchers in physics biology engineering and economics who use dynamical systems as model tools in their studies A moderate mathematical background is assumed and whenever possible only elementary mathematical tools are used This new edition preserves the structure of the first while updating the context to incorporate recent theoretical developments in particular new and improved numerical methods for bifurcation analysis *Algebraic Methods in Nonlinear Perturbation Theory* V.N. Bogaevski,A. Povzner,2012-12-06 Many books have already been written about the perturbation theory of differential equations with a small parameter Therefore we would like to give some reasons why the reader should bother with still another book on this topic Speaking for the present only about ordinary differential equations and their applications we notice that methods of solutions are so numerous and diverse that this part of applied mathematics appears as an aggregate of poorly connected methods The majority of these methods require some previous guessing of a structure of the desired asymptotics The Poincare method of normal forms and the Bogolyubov Krylov Mitropolsky averaging methods well known in the literature should be mentioned specifically in connection with what will follow These methods do not assume an immediate search for solutions in some special form but make use of changes of variables close to the identity transformation which bring the initial system to a certain normal form Applicability of these methods is restricted by special forms of the initial systems **Elements of Applied Bifurcation Theory** Yuri A. Kuznetsov,2013-03-09 During the last few years several good textbooks on nonlinear dynamics have ap peared for graduate students in applied mathematics It seems however that the majority of such books are still too theoretically oriented and leave many practi cal issues unclear for people intending to apply the theory to particular research problems This book is designed for advanced undergraduate or graduate students in mathematics who will participate in applied research It is also addressed to professional researchers in physics biology engineering and economics who use dynamical systems as modeling tools in their studies Therefore only a moderate mathematical background in geometry linear algebra analysis and differential equations is required A brief summary of general mathematical terms and results that are assumed to be known in the main text appears at the end of the book Whenever possible only elementary mathematical tools are used For example we do not try to present normal form theory in full generality instead developing only the portion of the technique sufficient for our purposes The book aims to provide the student or researcher with both a solid basis in dynamical systems theory and the necessary understanding of the approaches methods results and terminology used in the modem applied mathematics litera ture A key theme is that of topological equivalence and codimension or what one may expect to occur in the dynamics with a given number of parameters allowed to vary *An Introduction to the Mathematical Theory of Inverse Problems* Andreas Kirsch,1996-09-26 Following Keller 119 we call two problems inverse to each other if the for mulation of each of them requires full or partial knowledge of the other By this definition it is obviously arbitrary which of the two problems we call the direct and which we call the inverse problem But usually one of the problems has been studied earlier and perhaps in more detail This one is usually called the direct problem whereas the other is the inverse problem However there is often another more important difference between these two problems Hadamard see 91 introduced the concept of a well posed problem originating from the philosophy that the mathematical model of a physical problem has to have the properties of uniqueness existence and stability of the solution If one of the properties fails to hold he called the problem ill posed It turns out that many interesting and important inverse in science lead to ill posed problems while the corresponding di problems rect problems are well posed Often existence and uniqueness can be forced by enlarging or reducing the solution space the space of models For restoring stability however one has to change the topology of the spaces which is in many cases impossible because of the presence of measurement errors At first glance it seems to be impossible to compute the solution of a problem numerically if the solution of the problem does not depend continuously on the data i e for the case of ill posed problems Mathematical Theory of Incompressible Nonviscous Fluids Carlo Marchioro,Mario Pulvirenti,2012-12-06 Fluid dynamics is an ancient science incredibly alive today Modern technol ogy and new needs require a deeper knowledge of the behavior of real fluids and new discoveries or steps forward pose quite often challenging and diffi cult new mathematical oblems In this framework a special role is played by incompressible nonviscous sometimes called perfect flows This is a mathematical model consisting essentially of an evolution equation the Euler equation for the velocity field of fluids Such an equation which is nothing other than the Newton laws plus some additional structural hypo theses was discovered by Euler in 1755 and although it is more than two centuries old many fundamental questions concerning its solutions are still open In particular it is not known whether the solutions for reasonably general initial conditions develop singularities in a finite time and very little is known about the long term behavior of smooth solutions These and other basic problems are still open and this is one of the reasons why the mathe matical theory of perfect flows is far from being completed Incompressible flows have been attached by many distinguished mathe maticians with a large variety of mathematical techniques so that today this field constitutes a very rich and stimulating part of applied mathematics **Maxwell's Equations in Periodic Structures** Gang Bao,Peijun Li,2021-11-22 This book addresses recent developments in mathematical analysis and computational methods for solving direct and inverse problems for Maxwell s equations in periodic structures The fundamental importance of the fields is clear since they are related to technology with significant applications in optics and electromagnetics The book provides both introductory materials and in depth discussion to the areas in diffractive optics that offer rich and challenging mathematical problems It is also intended to convey up to date results to students and researchers in applied and computational mathematics and engineering disciplines as well **The Mathematical Theory of Dilute Gases** Carlo Cercignani,Reinhard Illner,Mario Pulvirenti,2013-12-01 The idea for this book was conceived by the authors some time in 1988 and a first outline of the manuscript was drawn up during a summer school on mathematical physics held in Ravello in September 1988 where all three of us were present as lecturers or organizers The project was in some sense inherited from our friend Marvin Shinbrot who had planned a book about recent progress for the Boltzmann equation but due to his untimely death in 1987 never got to do it When we drew up the first outline we could not anticipate how long the actual writing would stretch out Our ambitions were high We wanted to cover the modern mathematical theory of the Boltzmann equation with rigorous proofs in a complete and readable volume As the years progressed we withdrew to some degree from this first ambition there was just too much material too scattered sometimes incomplete sometimes not rigor ous enough However in the writing process itself the need for the book became ever more apparent The last twenty years have seen an amazing number of significant results in the field many of them published in incom plete form sometimes in obscure places and sometimes without technical details We made it our objective to collect these results classify them and present them as best we could The choice of topics remains of course subjective Introduction to Spectral Theory P.D. Hislop,I.M. Sigal,2012-12-06 The intention of this book is to introduce students to active areas of research in mathematical physics in a rather direct way minimizing the use of abstract mathematics The main features are geometric methods in spectral analysis exponential decay of eigenfunctions semi classical analysis of bound state problems and semi classical analysis of resonance A new geometric point of view along with new techniques are brought out in this book which have both been discovered within the past decade This book is designed to be used as a textbook unlike the competitors which are either too fundamental in their approach or are too abstract in nature to be considered as texts The authors text fills a gap in the marketplace Bifurcation Theory Hansjörg Kielhöfer,2006-04-10 In the past three decades bifurcation theory has matured into a well established and vibrant branch of mathematics This book gives a unified presentation in an abstract setting of the main theorems in bifurcation theory as well as more recent and lesser known results It covers both the local and global theory of one parameter bifurcations for operators acting in infinite dimensional Banach spaces and shows how to apply the theory to problems involving partial differential equations In addition to existence qualitative properties such as stability and nodal structure of bifurcating solutions are treated in depth This volume will serve as an important reference for mathematicians physicists and theoretically inclined engineers working in bifurcation theory and its applications to partial differential equations **Theory and Practice of Finite Elements** Alexandre Ern,Jean-Luc Guermond,2013-03-09 The origins of the finite element method can be traced back to the 1950s when engineers started to solve numerically structural mechanics problems in aeronautics Since then the field of applications has widened steadily and nowadays encompasses nonlinear solid mechanics fluid structure interactions flows in industrial or geophysical settings multicomponent reactive turbulent flows mass transfer in porous media viscoelastic flows in medical sciences electromagnetism wave scattering problems and option pricing to cite a few examples Numerous commercial and academic codes based on the finite element method have been developed over the years The method has been so successful to solve Partial Differential Equations PDEs that the term Finite Element Method nowadays refers not only to the mere interpolation technique it is but also to a fuzzy set of PDEs and approximation techniques The efficiency of the finite element method relies on two distinct ingredi ents the interpolation capability of finite elements referred to as the approx imability property in this book and the ability of the user to approximate his model mostly a set of PDEs in a proper mathematical setting thus guar anteeing continuity stability and consistency properties Experience shows that failure to produce an approximate solution with an acceptable accuracy is almost invariably linked to departure from the mathematical foundations Typical examples include non physical oscillations spurious modes and lock ing effects In most cases a remedy can be designed if the mathematical framework is properly set up **Scientific and Technical Aerospace Reports** ,1992 *Robust Control Theory in Hilbert Space* Avraham Feintuch,2012-12-06 Motivation The latest texts on linear systems for engineering students have begun incorpo rating chapters on robust control using the state space approach to HOC control for linear finite dimensional time invariant systems While the pedagogical and computational advantages of this approach are not to be underestimated there are in my opinion some disadvantages Among these disadvantages is the narrow viewpoint that arises from the amputation of the finite dimensional time invariant case from the much more general theory that had been developed using frequency domain methods The frequency domain which occupied center stage for most of the develop ments of HOC control theory presents a natural context for analysis and controller synthesis for time invariant linear systems whether of finite or infinite dimen sions A fundamental role was played in this theory by operator theoretic methods especially the theory of Toeplitz and skew Toeplitz operators The recent lecture notes of Foias Ozbay and Tannenbaum 3 display the power of this theory by constructing robust controllers for the problem of a flexible beam Although controller synthesis depends heavily on the special computational ad vantages of time invariant systems and the relationship between HOC optimization and classical interpolation methods it turns out that the analysis is possible without the assumption that the systems are time invariant

Scattering, Two-Volume Set E. R. Pike,Pierre C. Sabatier,2002 Part 1 SCATTERING OF WAVES BY MACROSCOPIC TARGET Interdisciplinary aspects of wave scattering Acoustic scattering Acoustic scattering approximate methods Electromagnetic wave scattering theory Electromagnetic wave scattering approximate and numerical methods Electromagnetic wave scattering applications Elastodynamic wave scattering theory Elastodynamic wave scattering Applications Scattering in Oceans Part 2 SCATTERING IN MICROSCOPIC PHYSICS AND CHEMICAL PHYSICS Introduction to direct potential scattering Introduction to Inverse Potential Scattering Visible and Near visible Light Scattering Practical Aspects of Visible and Near visible Light Scattering Nonlinear Light Scattering Atomic and Molecular Scattering Introduction to Scattering in Chemical X ray Scattering Neutron Scattering Electron Diffraction and Scattering Part 3 SCATTERING IN NUCLEAR PHYSICS Nuclear Physics Part 4 PARTICLE SCATTERING State of the Art of Peturbative Methods Scattering Through Electro weak Interactions the Fermi Scale Scattering Through Strong Interactions the Hadronic or QCD Scale Part 5 SCATTERING AT EXTREME PHYSICAL SCALES Scattering at Extreme Physical Scales Part 6 SCATTERING IN MATHEMATICS AND NON PHYSICAL SCIENCES Relations with Other Mathematical Theories Inverse Scattering Transform and Non linear Partial Differenttial Equations Scattering of Mathematical Objects **Critical Point Theory and Hamiltonian Systems** Jean Mawhin,2013-04-17 FACHGEB The last decade has seen a tremendous development in critical point theory in infinite dimensional spaces and its application to nonlinear boundary value problems In particular striking results were obtained in the classical problem of periodic solutions of Hamiltonian systems This book provides a systematic presentation of the most basic tools of critical point theory minimization convex functions and Fenchel transform dual least action principle Ekeland variational principle minimax methods Lusternik Schirelmann theory for Z2 and S1 symmetries Morse theory for possibly degenerate critical points and non degenerate critical manifolds Each technique is illustrated by applications to the discussion of the existence multiplicity and bifurcation of the periodic solutions of Hamiltonian systems Among the treated questions are the periodic solutions with fixed period or fixed energy of autonomous systems the existence of subharmonics in the non autonomous case the asymptotically linear Hamiltonian systems free and forced superlinear problems Application of those results to the equations of mechanical pendulum to Josephson systems of solid state physics and to questions from celestial mechanics are given The aim of the book is to introduce a reader familiar to more classical techniques of ordinary differential equations to the powerful approach of modern critical point theory The style of the exposition has been adapted to this goal The new topological tools are introduced in a progressive but detailed way and immediately applied to differential equation problems The abstract tools can also be applied to partial differential equations and the reader will also find the basic references in this direction in the bibliography of more than 500 items which concludes the book ERSCHEIN

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