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T. Inui Y. Tanabe Y. Onodera

Group Theory and Its Applications in Physics



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Group Theory And Its Applications In Physics Springer Series In Solid State Sciences

Alexander Leonidovich Kuzemsky



Group Theory And Its Applications In Physics Springer Series In Solid State Sciences:

Group Theory and Its Applications in Physics Teturo Inui, Yukito Tanabe, Yositaka Onodera, 2012-12-06 This book has been written to introduce readers to group theory and its applications in atomic physics molecular physics and solid state physics The first Japanese edition was published in 1976 The present English edition has been translated by the authors from the revised and enlarged edition of 1980 In translation slight modifications have been made in Chaps 8 and 14 to update and condense the contents together with some minor additions and improvements throughout the volume The authors cordially thank Professor J L Birman and Professor M Car dona who encouraged them to prepare the English translation Tokyo January 1990 T Inui Y Tanabe Y Onodera Preface to the Japanese Edition As the title shows this book has been prepared as a textbook to introduce readers to the applications of group theory in several fields of physics Group theory is in a nutshell the mathematics of symmetry It has three main areas of application in modern physics The first originates from early studies of crystal morphology and constitutes a framework for classical crystal physics The analysis of the symmetry of tensors representing macroscopic physical properties such as elastic constants belongs to this category The second area was enunciated by E Wigner 1926 as a powerful means of handling quantum mechanical problems and was first applied in this sense to the analysis of atomic spectra Soon H Introduction to Solid-State Theory Otfried Madelung, 1978 This textbook for graduate students of physics and materials science also provides the theoretical background needed by physicists carrying out research in pure solid state physics and its applications to electrical engineering Handbook of Thin Films Hari Singh Nalwa, 2001-11-17 This five volume handbook focuses on processing techniques characterization methods and physical properties of thin films thin layers of insulating conducting or semiconductor material The editor has composed five separate thematic volumes on thin films of metals semimetals glasses ceramics alloys organics diamonds graphites porous materials noncrystalline solids supramolecules polymers copolymers biopolymers composites blends activated carbons intermetallics chalcogenides dyes pigments nanostructured materials biomaterials inorganic polymer composites organoceramics metallocenes disordered systems liquid crystals quasicrystals and layered structures Thin films is a field of the utmost importance in today's materials science electrical engineering and applied solid state physics with both research and industrial applications in microelectronics computer manufacturing and physical devices Advanced high performance computers high definition TV digital camcorders sensitive broadband imaging systems flat panel displays robotic systems and medical electronics and diagnostics are but a few examples of miniaturized device technologies that depend the utilization of thin film materials The Handbook of Thin Films Materials is a comprehensive reference focusing on processing techniques characterization methods and physical properties of these thin film materials **Handbook of Nitride Semiconductors and Devices, Materials Properties, Physics and Growth** Hadis Morkoç, 2009-07-30 The three volumes of this handbook treat the fundamentals technology and nanotechnology of nitride semiconductors with an extraordinary clarity and depth

They present all the necessary basics of semiconductor and device physics and engineering together with an extensive reference section Volume 1 deals with the properties and growth of GaN The deposition methods considered are hydride VPE organometallic CVD MBE and liquid high pressure growth Additionally extended defects and their electrical nature point defects and doping are reviewed

Frustrated Spin Systems (Third Edition) Hung-the Diep, 2020-06-19 Frustrated spin systems have been first investigated five decades ago Well known examples include the Ising model on the antiferromagnetic triangular lattice studied by G H Wannier in 1950 and the Heisenberg helical structure discovered independently by A Yoshimori J Villain and T A Kaplan in 1959 However extensive investigations on frustrated spin systems have really started with the concept of frustration introduced at the same time by G Toulouse and by J Villain in 1977 in the context of spin glasses The frustration is generated by the competition of different kinds of interaction and or by the lattice geometry As a result in the ground state all bonds are not fully satisfied In frustrated Ising spin systems a number of spins behave as free spins In frustrated vector spin systems the ground state configuration is usually non collinear The ground state of frustrated spin systems is therefore highly degenerate and new induced symmetries give rise to unexpected behaviors at finite temperatures Many properties of frustrated systems are still not well understood at present Theoretically recent studies shown in this book reveal that established theories numerical simulations as well as experimental techniques have encountered many difficulties in dealing with frustrated systems In some sense frustrated systems provide an excellent testing ground for approximations and theories Experimentally more and more frustrated materials are discovered with interesting properties for applications

Frustrated Spin Systems (2nd Edition) Hung-the Diep, 2013-03-25 This book covers all principal aspects of currently investigated frustrated systems from exactly solved frustrated models to real experimental frustrated systems going through renormalization group treatment Monte Carlo investigation of frustrated classical Ising and vector spin models low dimensional systems spin ice and quantum spin glass The reader can within a single book obtain a global view of the current research development in the field of frustrated systems This new edition is updated with recent theoretical numerical and experimental developments in the field of frustrated spin systems The first edition of the book appeared in 2005 In this edition more recent works until 2012 are reviewed It contains nine chapters written by researchers who have actively contributed to the field Many results are from recent works of the authors The book is intended for postgraduate students as well as researchers in statistical physics magnetism materials science and various domains where real systems can be described with the spin language Explicit demonstrations of formulas and full arguments leading to important results are given where it is possible to do so

Applications of Finite Groups J. S. Lomont, 2014-05-12 Applications of Finite Groups focuses on the applications of finite groups to problems of physics including representation theory crystals wave equations and nuclear and molecular structures The book first elaborates on matrices groups and representations Topics include abstract properties applications matrix groups key theorem of representation theory

properties of character tables simply reducible groups tensors and invariants and representations generated by functions The text then examines applications and subgroups and representations as well as subduced and induced representations fermion annihilation and creation operators crystallographic point groups proportionality tensors in crystals and nonrelativistic wave equations The publication takes a look at space group representations and energy bands symmetric groups and applications Topics include molecular and nuclear structures multiplet splitting in crystalline electric fields construction of irreducible representations of the symmetric groups and reality of representations The manuscript is a dependable source of data for physicists and researchers interested in the applications of finite groups

Optomagnonic Structures: Novel Architectures For Simultaneous Control Of Light And Spin Waves Evangelos Almpanis, 2021-01-18 Understanding controlling and more importantly enhancing the interaction between light photons and spin waves magnons can be among others a step towards the realization of magnon mediated microwave to optical transducers for quantum computing applications or hybrid solid state spintronic photonic interconnections In this respect the development of novel composite multifunctional micro nanostructures so called optomagnonic which simultaneously control optical and spin waves and enhance their interaction is particularly attractive This book constitutes a collective work comprising seven chapters from leading researchers in the field of optomagnonics and related areas Apart from exciting recent developments it provides the necessary fundamental knowledge in an explanatory manner and therefore it is accessible to non experts It is suitable for PhD students post docs and researchers who are willing to get engaged in optomagnonics while selected parts could also serve as lecture material for advanced courses With increasing demand for miniaturized optomagnonic devices this book will be an important resource to researchers working on optomagnonics magneto optics spintronics as well as on hybrid micro nano devices for information processing

A Course On Many-body Theory Applied To Solid-state Physics Charles P Enz, 1992-10-15 The main aim of this book is to give a self contained and representative cross section through present day research in solid state physics This covers metallic and mesoscopic transport localization by disorder and superconductivity including questions related to high temperature superconductors and to heavy fermion systems An important part of the book is devoted to itinerant electron magnetism discussing paramagnons strong correlation magnetization fluctuations and spin density waves All the formal tools used in these chapters are developed in the first part of the book which contains a thorough discussion of second quantization and of perturbation theory for an arbitrary complex time path and also describes the functional approach to Feynman diagrams including general ward identities Each chapter contains an extensive list of the relevant literature and a series of problems with detailed solutions which complement the main text The book is meant both as a course and a research tool

Soviet Physics, Uspekhi , 1991 , **Statistical Mechanics And The Physics Of Many-particle Model Systems** Alexander Leonidovich Kuzemsky, 2017-02-24 The book is devoted to the study of the correlation effects in many particle systems It presents the advanced methods of quantum statistical mechanics equilibrium and nonequilibrium

and shows their effectiveness and operational ability in applications to problems of quantum solid state theory quantum theory of magnetism and the kinetic theory The book includes description of the fundamental concepts and techniques of analysis following the approach of N N Bogoliubov's school including recent developments It provides an overview that introduces the main notions of quantum many particle physics with the emphasis on concepts and models This book combines the features of textbook and research monograph For many topics the aim is to start from the beginning and to guide the reader to the threshold of advanced researches Many chapters include also additional information and discuss many complex research areas which are not often discussed in other places The book is useful for established researchers to organize and present the advanced material disseminated in the literature The book contains also an extensive bibliography The book serves undergraduate graduate and postgraduate students as well as researchers who have had prior experience with the subject matter at a more elementary level or have used other many particle techniques

Conducting Polymers
Ram K. Gupta, 2022-04-19 Conducting polymers are versatile materials that possess both the unique properties of polymeric materials elastic behavior reversible deformation flexibility etc and the ability to conduct electricity with bulk conductivities comparable to those of metals and semiconductors *Conducting Polymers: Chemistry, Properties and Biomedical Applications* provides current state of the art knowledge of conducting polymers and their composites for biomedical applications This book covers the fundamentals of conducting polymers strategies to modify the structure of conducting polymers to make them biocompatible and their applications in various biomedical areas such as drug gene delivery tissue engineering antimicrobial activities biosensors etc **FEATURES** Covers the state of the art progress on biodegradable conducting polymers for biomedical applications Presents synthesis characterization and applications of conducting polymers for various biomedical research Provides the fundamentals of biodegradation mechanisms and the role of conduction in biomedical devices Offers details of novel methods and advanced technologies used in biomedical applications using conducting polymers Highlights new directions for scientists researchers and students to better understand the chemistry technologies and applications of conducting polymers This book is essential reading for all academic and industrial researchers working in the fields of materials science polymers nanotechnology and biomedical technology

Group Theory in Solid State Physics and Photonics
Wolfram Hergert, R. Matthias Geilhufe, 2018-08-20 While group theory and its application to solid state physics is well established this textbook raises two completely new aspects First it provides a better understanding by focusing on problem solving and making extensive use of Mathematica tools to visualize the concepts Second it offers a new tool for the photonics community by transferring the concepts of group theory and its application to photonic crystals Clearly divided into three parts the first provides the basics of group theory Even at this stage the authors go beyond the widely used standard examples to show the broad field of applications Part II is devoted to applications in condensed matter physics i.e. the electronic structure of materials Combining the application of the computer algebra system Mathematica with pen and

paper derivations leads to a better and faster understanding The exhaustive discussion shows that the basics of group theory can also be applied to a totally different field as seen in Part III Here photonic applications are discussed in parallel to the electronic case with the focus on photonic crystals in two and three dimensions as well as being partially expanded to other problems in the field of photonics The authors have developed Mathematica package GTPack which is available for download from the book's homepage Analytic considerations numerical calculations and visualization are carried out using the same software While the use of the Mathematica tools are demonstrated on elementary examples they can equally be applied to more complicated tasks resulting from the reader's own research

Point Groups, Space Groups, Crystals, Molecules

Ronald Mirman, 1999-05-14 This book is by far the most comprehensive treatment of point and space groups and their meaning and applications Its completeness makes it especially useful as a text since it gives the instructor the flexibility to best fit the class and goals The instructor not the author decides what is in the course And it is the prime book for reference as material is much more likely to be found in it than in any other book it also provides detailed guides to other sources Much of what is taught is folklore things everyone knows are true but almost no one knows why or has seen proofs justifications rationales or explanations Why are there 14 Bravais lattices and why these Are the reasons geometrical conventional or both What determines the Wigner Seitz cells How do they affect the number of Bravais lattices Why are symmetry groups relevant to molecules whose vibrations make them unsymmetrical And so on Here these analyses are given interrelated and in depth The understanding so obtained gives a strong foundation for application and extension Assumptions and restrictions are not merely made explicit but also emphasized In order to provide so much information details and examples and ways of helping readers learn and understand the book contains many topics found nowhere else or only in obscure articles from the distant past The treatment is often completely different from those elsewhere At least in the explanations and usually in many other ways the book is completely new and fresh It is designed to inform educate and make the reader think It strongly emphasizes understanding The book can be used at many levels by many different classes of readers from those who merely want brief explanations perhaps just of terminology who just want to skim to those who wish the most thorough understanding remove

International Tables for Crystallography, Volume B U. Shmueli, 2008-08-25 International Tables for Crystallography is the definitive resource and reference work for crystallography and structural science Volume B presents accounts of the numerous aspects of reciprocal space in crystallographic research This volume is a vital addition to the library of scientists engaged in crystal structure determination crystallographic computing crystal physics and other fields of crystallographic research Graduate students specializing in crystallography will find much material suitable for self study and a rich source of references to the relevant literature New to this edition A new chapter on modern extensions of the Ewald method for Coulomb interactions in crystals Three new sections on electron diffraction and electron microscopy in structure determination describing point group and space group determination by convergent beam electron diffraction

three dimensional reconstruction and single particle reconstruction Substantial revisions to the chapters on space group representations in reciprocal space direct methods Patterson and molecular replacement techniques and disorder diffuse scattering More information on the series can be found at <http://it.iucr.org> *Physics Briefs*, 1990 Topological Insulators Panagiotis Kotetes, 2019-04-24 This book provides an introduction to topological matter with a focus on insulating bulk systems A number of prerequisite concepts and tools are first laid out including the notion of symmetry transformations the band theory of semiconductors and aspects of electronic transport The main part of the book discusses realistic models for both time reversal preserving and violating topological insulators as well as their characteristic responses to external perturbations Special emphasis is given to the study of the anomalous electric thermal and thermoelectric transport properties the theory of orbital magnetisation and the polar Kerr effect The topological models studied throughout this book become unified and generalised by means of the tenfold topological classification framework and the respective systematic construction of topological invariants This approach is further extended to topological superconductors and topological semimetals This book covers a wide range of topics and aims at the transparent presentation of the technical aspects involved For this purpose homework problems are also provided in dedicated Hands on sections Given its structure and the required background level of the reader this book is particularly recommended for graduate students or researchers who are new to the field

Condensed Matter Physics Michael P. Marder, 2010-11-17 Now updated the leading single volume introduction to solid state and soft condensed matter physics This Second Edition of the unified treatment of condensed matter physics keeps the best of the first providing a basic foundation in the subject while addressing many recent discoveries Comprehensive and authoritative it consolidates the critical advances of the past fifty years bringing together an exciting collection of new and classic topics dozens of new figures and new experimental data This updated edition offers a thorough treatment of such basic topics as band theory transport theory and semiconductor physics as well as more modern areas such as quasicrystals dynamics of phase separation granular materials quantum dots Berry phases the quantum Hall effect and Luttinger liquids In addition to careful study of electron dynamics electronics and superconductivity there is much material drawn from soft matter physics including liquid crystals polymers and fluid dynamics Provides frequent comparison of theory and experiment both when they agree and when problems are still unsolved Incorporates many new images from experiments Provides end of chapter problems including computational exercises Includes more than fifty data tables and a detailed forty page index Offers a solutions manual for instructors Featuring 370 figures and more than 1 000 recent and historically significant references this volume serves as a valuable resource for graduate and undergraduate students in physics physics professionals engineers applied mathematicians materials scientists and researchers in other fields who want to learn about the quantum and atomic underpinnings of materials science from a modern point of view

Introduction to Ultrafast Phenomena Guo-ping Zhang, Georgios Lefkidis, Mitsuko Murakami, Wolfgang Hübner, Thomas F.

George,2020-12-08 This book the first of this kind provides a comprehensive introduction to ultrafast phenomena covering the fundamentals of ultrafast spin and charge dynamics femtosecond magnetism all optical spin switching and high harmonic generation It covers the experimental tools including ultrafast pump probe experiments and theoretical methods including quantum chemistry and density functional theory both time independent and time dependent The authors explain in clear language how an ultrafast laser pulse is generated experimentally how it can induce rapid responses in electrons and spins in molecules nanostructures and solids magnetic materials and superconductors and how it can create high harmonic generation from atoms and solids on the attosecond timescale They also show how this field is driving the next generation of magnetic storage devices through femtomagnetism all optical spin switching in ferrimagnets and beyond magnetic logic in magnetic molecules and ultrafast intense light sources incorporating numerous computer programs examples and problems throughout to show how the beautiful research can be done behind the scene Key features Provides a clear introduction to modern ultrafast phenomena and their applications in physics chemistry materials sciences and engineering Presents in detail how high harmonic generation occurs in atoms and solids Explains ultrafast demagnetization and spin switching a new frontier for development of faster magnetic storage devices Includes numerous worked out examples and problems in each chapter with real research codes in density functional theory and quantum chemical calculations provided in the chapters and in the Appendices This book is intended for undergraduate and graduate students researchers in physics chemistry biology materials sciences and engineering

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