Spin Waves Theory And Applications

JORDYN AMY

Analysis as a Tool in Mathematical Physics Springer Nature
In the last two decades low-dimensional (low-d) physics has matured into a major branch of science. Quite generally we may define a system with restricted dimensionality d as an object that is infinite only in one or two spatial directions (d = 1 and 2). Such a definition comprises isolated single chains or layers, but also fibres and thin layers (films) of varying but finite thickness. Clearly, a multitude of physical phenomena, notably in solid state physics, fall into these categories. As examples, we may mention: • Magnetic chains or layers (thin-film technology). • Metallic films (homogeneous or heterogeneous, crystalline, amorphous or microcristalline, etc.). • I-d or 2-d conductors and superconductors. • Intercalated systems. • 2-d electron gases (electrons on helium, semiconductor interfaces). • Surface layer problems (2-d melting of monolayers of noble gases on a substrate, surface problems in general). • Superfluid films of ~He or 'He. • Polymer physics. • Organic and inorganic chain conductors, superionic conductors. • I-d or 2-d molecular crystals and liquid crystals. • I-d or 2-d ferro- and antiferro electrics.

Spin wave theory, application to two dimensional systems Morgan & Claypool Publishers
Since the publication of the first edition of Spin-Wave Confinement, the magnetic community’s interest in dynamic excitations in magnetic systems of reduced dimensions has been increasing. Although the concept of spin waves and their quanta (magnons) as propagating excitation of magnetic media was introduced more than 80 years ago, this field has been repeatedly bringing us fascinating new physical phenomena. The successful development of magnonics as an emerging subfield of spintronics, which considers confined spin waves as a basis for smaller, faster, more robust, and more power-efficient electronic devices, inevitably demands reduction in the sizes and dimensions of the magnetic systems being studied. The unique features of magnons, including the possibility of carrying spin information over relatively long distances, the possibility of achieving submicrometer wavelength at microwave frequencies, and controllability by electronic signal via magnetic fields, make magnonic devices distinctively suited for implementation of novel integrated electronic schemes characterized by high speed, low power consumption, and

extended functionalities. Edited by S. O. Demokritov, a prominent magnonics researcher who has successfully collected the results of cutting-edge research by almost all main players in the field, this book is for everyone involved in nanotechnology, spintronics, magnonics, and nanomagnetism.

Chaotic Systems World Scientific

This book presents recent scientific achievements in the investigation of magnetization dynamics in confined magnetic systems. Introduced by Bloch as plane waves of magnetization in unconfined ferromagnets, spin waves currently play an important role for description of very small systems.Spin wave confinement effect was experimentally discovered in

Magnetic Properties of Layered Transition Metal Compounds Springer

Quantum sensing is a vast and emerging field enabling in-situ studies of quantum systems and hence the development of quantum hybrid systems. This work creates the fundament of direct superconducting-magnetic hybrid systems by developing a local microwave sensing scheme and studying the influence of a static magnetic field on a superconducting qubit. Finally, a proof-of-principle hybrid system is demonstrated, which opens the path towards superconducting-magnetic quantum circuits.

Initial Release Spin WavesTheory and Applications

Nanomagnetic Materials: Fabrication, Characterization and Application explores recent studies of conventional nanomagnetic materials in spintronics, data storage, magnetic sensors and biomedical applications. In addition, the book also reviews novel magnetic characteristics induced in two-dimensional materials, diamonds, and those induced by the artificial formation of lattice defect and heterojunction as novel nanomagnetic materials. Nanomagnetic materials are usually based on d- and f-electron systems. They are an important solution to the demand for higher density of information storage, arising from the emergence of novel technologies required for non-volatile memory systems. Advances in the understanding of magnetization dynamics and in the characteristics of nanoparticles or surface of nanomagnetic materials is resulting in greater expansion of applications of nanomagnetic materials, including in biotechnology, sensor devices, energy harvesting, and power generating systems. This book provides a cogent overview of the latest research on novel nanomagnetic materials, including spintronic nanomagnets, molecular nanomagnets, self-assembling magnetic nanomaterials, nanoparticles, multifunctional materials, and heterojunction-induced novel magnetism. Explains manufacturing principles and process for nanomagnetic materials Discusses physical and chemical properties and potential industrial applications, such as magnetic data storage, sensors, oscillator, permanent magnets, power generations, and biomedical applications Assesses the major challenges of using magnetic nanomaterials on a broad scale

Spin Waves Elsevier

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.

Quantum Sensing Experiments with Superconducting Qubits Academic Press

Advances in Quantum Chemistry presents surveys of current topics in this rapidly developing field that has emerged at the cross section of the historically established areas of mathematics, physics, chemistry, and biology. It features detailed reviews written by leading international researchers. This series provides a one-stop resource for following progress in this interdisciplinary area. Publishes articles, invited reviews and proceedings of major international conferences and workshops Written by leading international researchers in quantum and theoretical chemistry Highlights important interdisciplinary developments

Propagating Waves, Second Edition John Wiley & Sons

Boris Pavlov (1936-2016), to whom this volume is dedicated, was a prominent specialist in analysis, operator theory, and mathematical physics. As one of the most influential members of the St. Petersburg Mathematical School, he was one of the founders of the Leningrad School of Non-self-adjoint Operators. This volume collects research papers originating from two conferences that were organized in memory of Boris Pavlov: “Spectral Theory and Applications”, held in Stockholm, Sweden, in March 2016, and “Operator Theory, Analysis and Mathematical Physics – OTAMP2016” held at the Euler Institute in St. Petersburg, Russia, in August 2016. The volume also includes water-color paintings by Boris Pavlov, some personal photographs, as well as tributes from friends and colleagues.

Proceedings of the 6th International School “Synchrotron Radiation and Magnetism”, Mittelwihr (France), 2012 CRC Press

Magnonics, a research field that uses spin waves, collective excitations of ordered magnetic materials, or magnons (their quanta) as a tool for signal processing, communication, and computation, has rapidly grown during the past decade because of the low-energy consumption and potential compatibility with next-generation circuits beyond CMOS electronics. The interest in 3D magnonic nanostructures follows the latest trend in conventional electronics based on expansion from 2D planar to 3D vertically integrated structures. To remain on the same technological level, a similar expansion should be realized in magnonics. Following this trend, this book provides an overview of recent developments in the exploitation of the third dimension in magnonics, with special focus on the propagation of spin waves in layered magnonic crystals, spin textures, curved surfaces, 3D nano-objects, and cavity magnonics.

Spin Wave Confinement Vasant Corporation

This book describes the bottleneck faced soon by designers of traditional CMOS devices, due to device scaling, power and energy consumption, and variability limitations. This book aims at bridging the gap between device technology and architecture/system design. Readers will learn about challenges and opportunities presented by “beyond-CMOS devices” and

gain insight into how these might be leveraged to build energy-efficient electronic systems.

Spin Wave Confinement Frontiers Media SA

A collection of different lectures presented by experts in the field of nonlinear science provides the reader with contemporary, cutting-edge, research works that bridge the gap between theory and device realizations of nonlinear phenomena. Representative examples of topics covered include: chaos gates, social networks, communication, sensors, lasers, molecular motors, biomedical anomalies, stochastic resonance, nano-oscillators for generating microwave signals and related complex systems. A common theme among these and many other related lectures is to model, study, understand, and exploit the rich behavior exhibited by nonlinear systems to design and fabricate novel technologies with superior characteristics. Consider, for instance, the fact that a shark’s sensitivity to electric fields is 400 times more powerful than the most sophisticated electric-field sensor. In spite of significant advances in material properties, in many cases it remains a daunting task to duplicate the superior signal processing capabilities of most animals. Since nonlinear systems tend to be highly sensitive to perturbations when they occur near the onset of a bifurcation, there are also lectures on the general topic of bifurcation theory and on how to exploit such bifurcations for signal enhancements purposes. This manuscript will appeal to researchers interested in both theory and implementations of nonlinear systems.

Problems and Solutions CRC Press

Two of the most powerful tools used to study magnetic materials are inelastic neutron scattering and THz spectroscopy. Because the measured spectra provide a dynamical fingerprint of a magnetic material, those tools enable scientists to unravel the structure of complex magnetic states and to determine the microcscopic interactions that produce them. This book discusses the experimental techniques of inleastic neutron scattering and THz spectroscopy and provides the theoretical tools required to analyze their measurements using spin-wave theory. For most materials, this analysis can resolve the microscopic magnetic interactions such as exchange, anisotropy, and Dzyaloshinskii-Moriya interactions. Assuming a background in elementary statistical mechanics and a familiarity with the quantized harmonic oscillator, this book presents a comprehensive review of spin-wave theory and its applications to both inelastic neutron scattering and THz spectroscopy. Spin-wave theory is used to study several model magnetic systems, including non-collinear magnets such as spirals and cycloids that are produced by geometric frustration, competing exchange interactions, or Dzyaloshinskii-Moriya interactions. Several case studies utilizing spin-wave theory to analyze inelastic neutron-scattering and THz spectroscopy measurements are presented. These include both single crystals and powders and both oxides and molecule-based magnets. In addition to sketching the numerical techniques used to fit dynamical spectra based on microscopic models, this book also contains over 70 exercises that can be performed by beginning graduate students.

Fabrication, Characterization and Application World Scientific

Nanomagnetic and spintronic computing devices are strong contenders for future replacements of CMOS. This is an important and rapidly evolving area with the semiconductor industry investing significantly in the study of nanomagnetic phenomena and in developing strategies to pinpoint and regulate nanomagnetic reliably with a high degree of energy efficiency. This timely book explores the recent and on-going research into nanomagnetic-based technology. Key features: Detailed background material and comprehensive descriptions of the current state-of-the-art research on each topic. Focuses on direct applications to devices that have potential to replace CMOS devices for computing applications such as memory, logic and higher order information processing. Discusses spin-based devices where the spin degree of freedom of charge carriers are exploited for device operation and ultimately information processing. Describes magnet switching methodologies to minimize energy dissipation. Comprehensive bibliographies included for each chapter enabling readers to conduct further research in this field. Written by internationally recognized experts, this book provides an overview of a rapidly burgeoning field for electronic device engineers, field-based applied physicists, material scientists and nanotechnologists. Furthermore, its clear and concise form equips readers with the basic understanding required to comprehend the present stage of development and to be able to contribute to future development. Nanomagnetic and Spintronic Devices for Energy-Efficient Memory and Computing is also an indispensable resource for students and researchers interested in computer hardware, device physics and circuits design.

Nanomagnetic and Spintronic Devices for Energy-Efficient Memory and Computing Springer

Written by two well-known researchers in the field, this useful reference takes an applied approach to high frequency processes including oscillations and waves in ferromagnets, antiferromagnets, and ferrimagnets. Problems evaluated include ferromagnetic and antiferromagnetic resonances, spin waves, nonlinear processes, and high frequency manifestations of interactions between the magnetic system and other systems of magnetically ordered substances as elastic waves and charge carriers. Unlike previous monographs on this subject, which are highly theoretical and written for very advanced readers, this book requires only an average college background in mathematics and experimental physics. It will be a valuable addition to the library of engineers and scientists in research and development for communications applications, and scientists interested in nonlinear magnetic phenomena. It also serves as an excellent introduction to the topic for newcomers in the field. Magnetization Oscillations and Waves not only presents results but also shows readers how to obtain them; most formulas are derived with so many details that readers can reproduce them. The book includes many summaries and tables and detailed references to significant work in the area by European researchers.

From Fundamentals to Applications Springer Science & Business Media

The book is intended for graduate students and researchers who wish to master the main properties of magnetic materials in the bulk state and at the nanometric scale such as for thin films and multilayers. This textbook provides the theories and methods of simulation to study and to understand these properties in an explicit manner.In the first part of the book, the quantum theory of magnetism is presented while the second part of the book is devoted to the application of the theory of magnetism to surface physics. Numerous examples covering typical cases in ferromagnets, antiferromagnets, ferrimagnets, helimagnets, and frustrated spin systems are all illustrated. Fundamental surface effects are shown and discussed. Lastly, the spin transport is described — in which the basic formulation of the Boltzmann's equation is recalled — and the recent methods of Monte Carlo simulation to deal with the spin resistivity are explained.This

book contains a large number of detailed solutions for the problems given in each chapter to help readers discover new related phenomena and applications, as well as an appendix on elements of statistical physics included at the end to make the book self-contained.

Optomagnonic Structures: Novel Architectures For Simultaneous Control Of Light And Spin Waves CRC Press

The main goal of the book is a coherent treatment of the theory of propagation in materials of nonlinearly elastic waves of displacements, which corresponds to one modern line of development of the nonlinear theory of elastic waves. The book is divided on five basic parts: the necessary information on waves and materials; the necessary information on nonlinear theory of elasticity and elastic materials; analysis of one-dimensional nonlinear elastic waves of displacement – longitudinal, vertically and horizontally polarized transverse plane nonlinear elastic waves of displacement; analysis of one-dimensional nonlinear elastic waves of displacement – cylindrical and torsional nonlinear elastic waves of displacement; analysis of two-dimensional nonlinear elastic waves of displacement – Rayleigh and Love nonlinear elastic surface waves. The book is addressed first of all to people working in solid mechanics – from the students at an advanced undergraduate and graduate level to the scientists, professionally interesting in waves. But mechanics is understood in the broad sense, when it includes mechanical and other engineering, material science, applied mathematics and physics and so forth. The genesis of this book can be found in author’s years of research and teaching while a head of department at SP Timoshenko Institute of Mechanics (National Academy of Sciences of Ukraine), a member of Center for Micro and Nanomechanics at Engineering School of University of Aberdeen (Scotland) and a professor at Physical-Mathematical Faculty of National Technical University of Ukraine “KPI”. The book comprises 11 chapters. Each chapter is complemented by exercises, which can be used for the next development of the theory of nonlinear waves.

Magnetization Oscillations and Waves Academic Press

This volume of Solid State Physics provides a broad review on recent advances in the field of magnetic insulators, ranging from new spin effects to thin film growth and high-frequency applications. It covers both theoretical and experimental progress. The topics include the use of magnetic insulators to produce and transfer spin currents, the excitation of spin waves in magnetic insulators by spin transfer torque, interplay between the spin and heat transports in magnetic insulator/normal metal heterostructures, nonlinear spin waves in thin films, development of high-quality nanometer thick films, and applications of magnetic insulators in rf, microwave, and terahertz devices, among others. The volume not only presents introductions and tutorials for those just entering the field, but also provides comprehensive yet timely summaries to specialists in the field. Solid-state physics is the branch of physics primarily devoted to the study of matter in its solid phase, especially at the atomic level. This prestigious series presents timely and state-of-the-art reviews pertaining to all aspects of solid-state physics. Contributions from leading authorities Informs and updates on all the latest developments in the field

Metallic Spintronic Devices Springer Science & Business Media

Two of the most powerful tools used to study magnetic materials are inelastic neutron scattering and THz spectroscopy. Because the measured spectra provide a dynamical fingerprint of a magnetic material, those tools enable scientists to unravel the structure of complex magnetic states and to determine the microcscopic interactions that produce them. This book discusses the experimental techniques of inleastic neutron scattering and THz spectroscopy and provides the theoretical tools required to analyze their measurements using spin-wave theory. For most materials, this analysis can resolve the microscopic magnetic interactions such as exchange, anisotropy, and Dzyalloshinskii-Moriya interactions. Assuming a background in elementary statistical mechanics and a familiarity with the quantized harmonic oscillator, this book presents a comprehensive review of spin-wave theory and its applications to both inelastic neutron scattering and THz spectroscopy. Spin-wave theory is used to study several model magnetic systems, including non-collinear magnets such as spirals and cycloids that are produced by geometric frustration, competing exchange interactions, or Dzyalloshinskii-Moirya interactions. Several case studies utilizing spin-wave theory to analyze inelastic neutron-scattering and THz spectroscopy measurements are presented. These include both single crystals and powders and both oxides and molecule-based magnets. In addition to sketching the numerical techniques used to fit dynamical spectra based on microscopic models, this book also contains over 70 exercises that can be performed by beginning graduate students.

In Memory of Boris Pavlov CRC Press

Spin waves (and their quanta magnons) can effectively carry and process information in magnetic nanostructures. By analogy to photonics, this research field is labelled magnonics. It comprises the study of excitation, detection, and manipulation of magnons. From the practical point of view, the most attractive feature of magnonic devices is the controllability of their functioning by an external magnetic field. This book has been designed for students and researchers working in magnetism. Here the readers will find review articles written by leading experts working on realization of magnonic devices.

Theory and Applications Oxford University Press

Spin WavesTheory and ApplicationsSpringer Science & Business Media

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