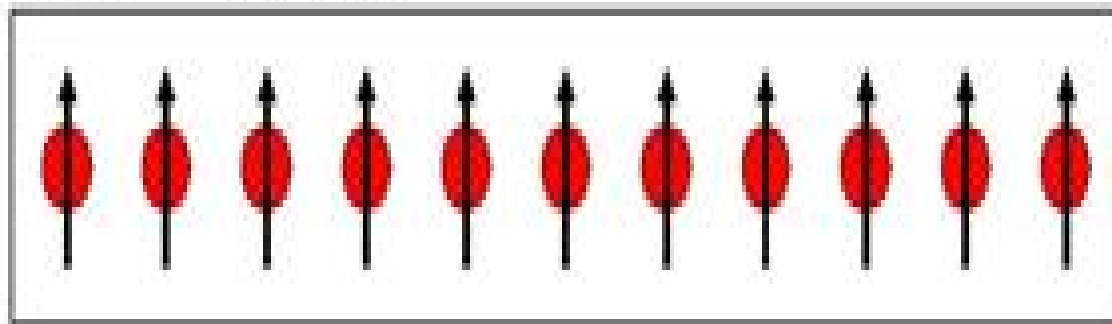
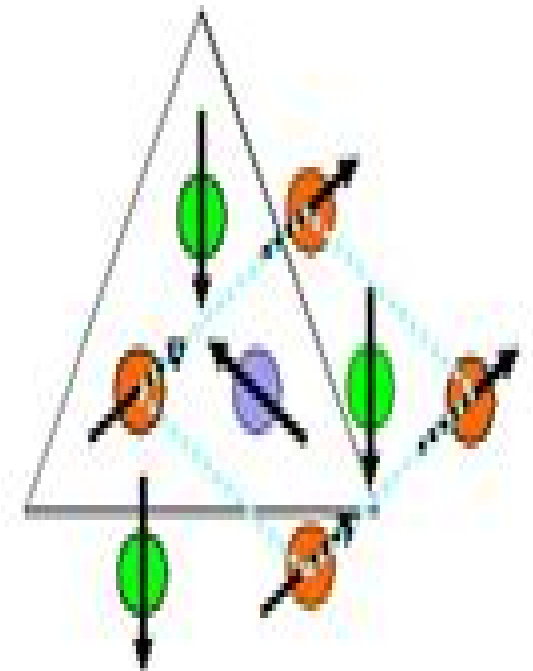
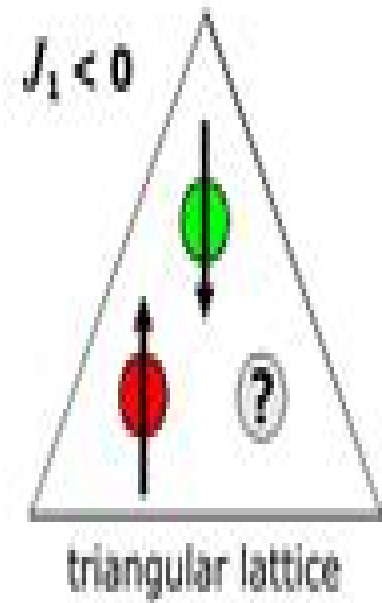
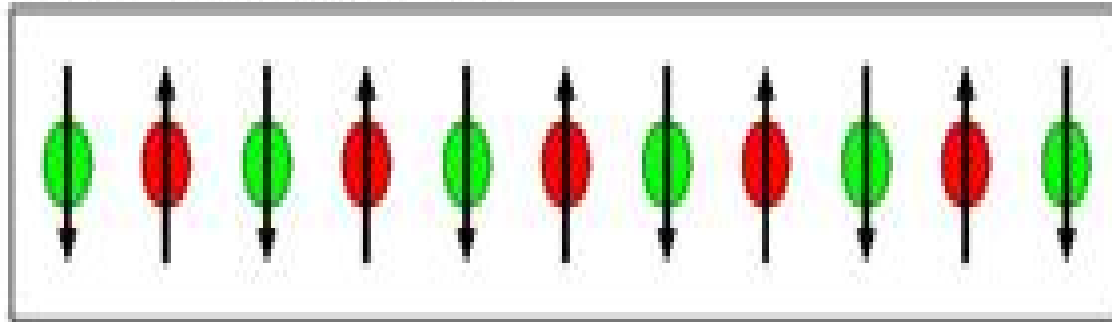


Heisenberg exchange $E_H = -\sum_{i,j} J_{ij} \mathbf{S}_i \cdot \mathbf{S}_j$

$J_1 > 0$ ferromagnetic



$J_1 < 0$ antiferromagnetic



Magnetic Interactions And Spin Transport

**Yongbing Xu, David D.
Awschalom, Junsaku Nitta**



Magnetic Interactions And Spin Transport:

Magnetic Interactions and Spin Transport Almadena Chtchelkanova, Stuart A. Wolf, Yves Idzerda, 2014-01-15

Magnetic Interactions and Spin Transport Almadena Chtchelkanova, Stuart A. Wolf, Yves Idzerda, 2013-11-11 Stuart Wolf This book originated as a series of lectures that were given as part of a Summer School on Spintronics in the end of August 1998 at Lake Tahoe Nevada It has taken some time to get these lectures in a form suitable for this book and so the process has been an iterative one to provide current information on the topics that are covered There are some topics that have developed in the intervening years and we have tried to at least alert the readers to them in the Introduction where a rather complete set of references is provided to the current state of the art The field of magnetism once thought to be dead or dying has seen a remarkable rebirth in the last decade and promises to get even more important as we enter the new millennium This rebirth is due to some very new insight into how the spin degree of freedom of both electrons and nucleons can play a role in a new type of electronics that utilizes the spin in addition to or in place of the charge For this new field to mature and prosper it is important that students and postdoctoral fellows have access to the appropriate literature that can give them a sound basis in the fundamentals of this new field and I hope that this book is a very good start in this direction Magnetic Interactions and Spin Transport Almadena Chtchelkanova, Stuart A. Wolf, Yves Idzerda, 2003-01-31 Stuart Wolf This book originated as a series of lectures that were given as part of a Summer School on Spintronics in the end of August 1998 at Lake Tahoe Nevada It has taken some time to get these lectures in a form suitable for this book and so the process has been an iterative one to provide current information on the topics that are covered There are some topics that have developed in the intervening years and we have tried to at least alert the readers to them in the Introduction where a rather complete set of references is provided to the current state of the art The field of magnetism once thought to be dead or dying has seen a remarkable rebirth in the last decade and promises to get even more important as we enter the new millennium This rebirth is due to some very new insight into how the spin degree of freedom of both electrons and nucleons can play a role in a new type of electronics that utilizes the spin in addition to or in place of the charge For this new field to mature and prosper it is important that students and postdoctoral fellows have access to the appropriate literature that can give them a sound basis in the fundamentals of this new field and I hope that this book is a very good start in this direction *Handbook of Spintronics* Yongbing Xu, David D. Awschalom, Junsaku Nitta, 2015-10-14 Over two volumes and 1500 pages the Handbook of Spintronics will cover all aspects of spintronics science and technology including fundamental physics materials properties and processing established and emerging device technology and applications Comprising 60 chapters from a large international team of leading researchers across academia and industry the Handbook provides readers with an up to date and comprehensive review of this dynamic field of research The opening chapters focus on the fundamental physical principles of spintronics in metals and semiconductors including an introduction to spin quantum computing Materials

systems are then considered with sections on metallic thin films and multilayers magnetic tunnelling structures hybrids magnetic semiconductors and molecular spintronic materials A separate section reviews the various characterisation methods appropriate to spintronics materials including STM spin polarised photoemission x ray diffraction techniques and spin polarised SEM The third part of the Handbook contains chapters on the state of the art in device technology and applications including spin valves GMR and MTJ devices MRAM technology spin transistors and spin logic devices spin torque devices spin pumping and spin dynamics and other topics such as spin caloritronics Each chapter considers the challenges faced by researchers in that area and contains some indications of the direction that future work in the field is likely to take This reference work will be an essential and long standing resource for the spintronics community *Spin Current* Sadamichi Maekawa, Sergio O. Valenzuela, Eiji Saitoh, Takashi Kimura, 2017 In a new branch of physics and technology called spin electronics or spintronics the flow of electrical charge usual current as well as the flow of electron spin the so called spin current are manipulated and controlled together This book is intended to provide an introduction and guide to the new physics and applications of spin current Magnetism Joachim Stöhr, Hans Christoph Siegmann, 2007-01-19 This text book gives a comprehensive account of magnetism one of the oldest yet most vibrant fields of physics It spans the historical development the physical foundations and the continuing research underlying the subject The book covers both the classical and quantum mechanical aspects of magnetism and novel experimental techniques Perhaps uniquely it discusses spin transport and magnetization dynamics phenomena associated with atomically and spin engineered nano structures against the backdrop of spintronics and magnetic storage and memory applications The book is for students and serves as a reference for scientists in academia and research laboratories **Spin Dependent Transport in Magnetic Nanostructures** Sadamichi Maekawa, Teruya Shinjo, 2002-07-11 In magnetic systems of nano meter size the interplay between spin and charge of electrons provides unique transport phenomena In magnetic superlattices magnetic and non magnetic metallic thin films with thickness of the order of one nano meter are piled up alternately Since the discovery of giant magnetoresistance GMR in these superlattices in 1988 spin dependent transport phenomena in magnetic nanostructures have received much attention from both academic and technological points of view Ferromagnetic tunnel junctions made of ferromagnetic metal electrodes and a very thin insulating barrier between them are also of current interest as magnetoresistive devices where the tunneling current depends on the relative orientation of magnetization TMR In addition to magnetic superlattices and magnetic tunnel junctions magnetic granular systems and magnetic dots have been studied extensively as magnetoresistive systems Edited by two of the world s leading authorities Spin Dependent Transport in Magnetic Nanostructures introduces and explains the basic physics and applications of a variety of spin dependent transport phenomena in magnetic nanostructures with particular emphasis on magnetic multilayers and magnetic tunnel junctions Three-Dimensional Magnonics Gianluca Gubbiotti, 2019-07-10 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

Spintronics Handbook, Second Edition: Spin Transport and Magnetism Evgeny Y. Tsymbal, Igor Žutić, 2019-05-09 Spintronics Handbook Second Edition offers an update on the single most comprehensive survey of the two intertwined fields of spintronics and magnetism covering the diverse array of materials and structures including silicon organic semiconductors carbon nanotubes graphene and engineered nanostructures It focuses on seminal pioneering work together with the latest in cutting edge advances notably extended discussion of two dimensional materials beyond graphene topological insulators skyrmions and molecular spintronics The main sections cover physical phenomena spin dependent tunneling control of spin and magnetism in semiconductors and spin based applications Atomic- and Nanoscale Magnetism Roland

Wiesendanger, 2018-11-02 This book provides a comprehensive overview of the fascinating recent developments in atomic and nanoscale magnetism including the physics of individual magnetic adatoms and single spins the synthesis of molecular magnets for spintronic applications and the magnetic properties of small clusters as well as non collinear spin textures such as spin spirals and magnetic skyrmions in ultrathin films and nanostructures Starting from the level of atomic scale magnetic interactions the book addresses the emergence of many body states in quantum magnetism and complex spin states resulting from the competition of such interactions both experimentally and theoretically It also introduces novel microscopic and spectroscopic techniques to reveal the exciting physics of magnetic adatom arrays and nanostructures at ultimate spatial and temporal resolution and demonstrates their applications using various insightful examples The book is intended for researchers and graduate students interested in recent developments of one of the most fascinating fields of condensed matter physics **Handbook of Spin Transport and Magnetism** Evgeny Y. Tsymbal, Igor Zutic, 2016-04-19 In the past

several decades the research on spin transport and magnetism has led to remarkable scientific and technological breakthroughs including Albert Fert and Peter Grunberg s Nobel Prize winning discovery of giant magnetoresistance GMR in magnetic metallic multilayers Handbook of Spin Transport and Magnetism provides a comprehensive bal **Atomistic Spin Dynamics** Olle Eriksson, Anders Bergman, Lars Bergqvist, Johan Hellsvik, 2017-02-10 The purpose of this book is to provide a theoretical foundation and an understanding of atomistic spin dynamics ASD and to give examples of where the atomistic Landau Lifshitz Gilbert equation can and should be used As argued in the text a description of magnetism in an atomistic way

is very natural and allows for an interpretation of experimental results in a clear and deep way This description also allows for calculations from first principles of all parameters needed to perform the spin dynamics simulations without using experimental results as input to the simulations As shown in the book we are now at a very exciting situation where it is possible to perform accurate and efficient atomistic simulations on a length and time scale which is balancing on the edge of what is experimentally possible In this way ASD simulations can both validate and be validated by state of the art experiments and ASD simulations also have the possibility to act as a predictive tool that is able to explain the magnetization dynamics in experimentally inaccessible situations The purpose of this book has been to communicate technically relevant concepts An even larger motivation is to communicate an inspiration to magnetism and magnetization dynamics and the emerging technological fields that one may foresee e g in magnonics solitonics and skyrmionics

Electronic Structure and Magnetism of Complex Materials David J. Singh, Dimitris A. Papaconstantopoulos, 2003-03-06 Recent developments in electronic structure theory have led to a new understanding of magnetic materials at the microscopic level This enables a truly first principles approach to investigations of technologically important magnetic materials Among the advances treated here have been practical schemes for handling non collinear magnetic systems including relativity and an understanding of the origins and role of orbital magnetism within band structure formalisms This book provides deep theoretical insight into magnetism in magnetic materials and magnetic systems It covers these recent developments with review articles by some of the main originators of these developments

Exchange Bias Surender Kumar Sharma, 2017-09-22 This timely book covers basic mechanisms characterization theoretical simulations and applications for exchange bias in granular nanosystems thin films and bulk systems After an overview of the field and key principles the next section covers nanogranular core shell systems followed by chapters on thin films bilayers multilayers nanostructures dilute magnetic semiconductors and multiferroic systems A final section turns to bulk systems such as those consisting of perovskite structures rare earth transition metal intermetallic and ion implantations Readers of this book will obtain A complete modern overview on exchange bias phenomena covering synthesis characterization techniques and applications An introduction to all the important phenomenological models proposed for thin films bulk materials and nanoparticles Detailed discussion of the importance of size shape cooling field and temperature on exchange bias properties Understanding of novel applications of exchange bias systems

Magnetic Interactions in Molecules and Solids Anshul Pandey, 2025-02-20 Magnetic Interactions in Molecules and Solids provides an in depth journey into the captivating world of magnetism perfect for both seasoned researchers and those keen to explore the fundamentals Written by leading experts we illuminate the intricate magnetic forces at play within molecules and solid materials combining foundational theories with advanced insights to appeal to readers of varying expertise We start with core magnetism principles spin magnetic moment and magnetic fields preparing readers to delve into complex molecular magnetic interactions Through clear explanations and examples we

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Introduction to Spintronics Supriyo Bandyopadhyay, Marc Cahay, 2015-09-18 *Introduction to Spintronics* provides an accessible organized and progressive presentation of the quantum mechanical concept of spin and the technology of using it to store process and communicate information Fully updated and expanded to 18 chapters featuring many new drill problems this edition reflects the explosion of study in spin related physics addressing seven important physical phenomena with spintronic device applications It discusses spintronics without magnetism which allows one to manipulate spin currents by purely electrical means It explores lateral spin orbit interaction and its many nuances as well as the possibility to implement spin polarizers and analyzers using quantum point contacts It also introduces the concept of single domain nanomagnet based computing

Introduction to Graphene-Based Nanomaterials Luis E. F. Foa Torres, Stephan Roche, Jean-Christophe Charlier, 2014-01-23 A detailed primer describing the most effective theoretical and computational methods and tools for simulating graphene based systems

Spin Ice Masafumi Udagawa, Ludovic Jaubert, 2021-10-19 This book deals with a new class of magnetic materials spin ice Spin ice has become the canonical example of modern frustrated magnetism where competing interactions between spins set the rules for an emergent magnetostatic gauge field theory Excitations take the form of magnetic monopoles or can condense via a Higgs mechanism Beyond classical spin ice the book describes the new physics emerging when quantum coherence spin liquids photon like excitations and itinerant electrons anomalous Hall effect are included in artificial systems This first book dedicated to spin ice is a review of the current understanding of the field both on the theoretical and experimental levels written by leading experts The book is written in a linear way with very few prerequisites It also contains textbook like descriptions of

theoretical methods to help advanced students and researchers to enter the field

Topological Insulators Gregory Tkachov, 2015-10-14 This book is the result of dynamic developments that have occurred in condensed matter physics after the recent discovery of a new class of electronic materials topological insulators A topological insulator is a material that behaves as a band insulator in its interior while acting as a metallic conductor at its surface The surface current car

Porphyrin-Based Composites Umar Ali Dar, Mohd. Shahnawaz, Puja Gupta, 2025-04-28 Discover the transformative potential of porphyrin based composites in *Porphyrim Based Composites* where readers will learn how these innovative materials enhance industrial sectors by combining multiple porphyrin components to create durable sensitive and efficient

technologies that outperform traditional materials This book highlights the benefits of adopting porphyrin composites and discusses how they are used in different industrial sectors Combining multiple porphyrin components is used to create materials with properties that are not possible with individual components remove restrictions of water insolubility and ultimately lead to the development of durable and more sensitive technological materials Composite materials have been essential to human life for thousands of years beginning with the construction of houses by the first civilizations and advancing to modern technologies Originating in the mid twentieth century composite materials show promise as a class of engineering materials that offer new opportunities for contemporary technology and have been beneficially incorporated into practically every sector due to their ability to choose elements tune them to achieve the desired qualities and efficiently use those features through design Additionally composite materials offer greater strength and modulus to weight ratios than standard engineering materials Materials based on porphyrin composites are used in a wide range of applications including sensors molecular probes electrical gadgets electronic devices construction materials catalysis medicine and environmental and energy applications Readers will find the book Provides an overview of several porphyrin composites as model materials for commercial settings Discusses fundamental experimental and theoretical research on structural and physicochemical properties of porphyrin composites Demonstrates how complementary and alternative material designs that use porphyrin composites have evolved Emphasizes important uses for cutting edge multipurpose materials that might contribute to a more sustainable society Opens new possibilities by examining the role of developing unique hybrid composite and higher order hierarchical materials that may be utilized to make valuable chemicals Audience Researchers academicians chemists industry experts and students working in the fields of materials and environmental sciences engineering textiles biology and medicine

Magnetic Interactions And Spin Transport Book Review: Unveiling the Magic of Language

In an electronic digital era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its capability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Magnetic Interactions And Spin Transport**," compiled by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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