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Force-Free Magnetic Fields: Solutions, Topology and Applications National Academies Press
The physics of strongly interacting matter in an external magnetic field is presently emerging as a topic of great cross-disciplinary interest for particle, nuclear, astro- and condensed matter physicists. It is known that strong magnetic fields are created in heavy ion collisions, an insight that has made it possible to study a variety of surprising and intriguing phenomena that emerge from the interplay of quantum anomalies, the topology of non-Abelian gauge fields, and the magnetic field. In particular, the non-trivial topological configurations of the gluon field induce a non-dissipative electric current in the presence of a magnetic field. These phenomena have led to an extended formulation of relativistic hydrodynamics, called chiral magnetohydrodynamics. Hitherto unexpected applications in condensed matter physics include graphene and topological insulators. Other fields of application include astrophysics, where strong magnetic fields exist in magnetars and pulsars. Last but not least, an important new theoretical tool that will be revisited and which made much of the progress surveyed in this book possible is the holographic principle - the correspondence between quantum field theory and gravity in extra dimensions. Edited and authored by the pioneers and leading experts in this newly emerging field, this book offers a valuable resource for a broad community of physicists and graduate students.
Essentials of Paleomagnetism Univ of California Press
This book deals with electromagnetic theory and its applications at the level of a senior-level undergraduate course for science and engineering. The basic concepts and mathematical analysis are clearly developed and the important applications are analyzed. Each chapter

contains numerous problems ranging in difficulty from simple applications to challenging. The answers for the problems are given at the end of the book. Some chapters which open doors to more advanced topics, such as wave theory, special relativity, emission of radiation by charges and antennas, are included. The material of this book allows flexibility in the choice of the topics covered. Knowledge of basic calculus (vectors, differential equations and integration) and general physics is assumed. The required mathematical techniques are gradually introduced. After a detailed revision of time-independent phenomena in electrostatics and magnetism in vacuum, the electric and magnetic properties of matter are discussed. Induction, Maxwell equations and electromagnetic waves, their reflection, refraction, interference and diffraction are also studied in some detail. Four additional topics are introduced: guided waves, relativistic electrodynamics, particles in an electromagnetic field and emission of radiation. A useful appendix on mathematics, units and physical constants is included. Contents 1. Prologue. 2. Electrostatics in Vacuum. 3. Conductors and Currents. 4. Dielectrics. 5. Special Techniques and Approximation Methods. 6. Magnetic Field in Vacuum. 7. Magnetism in Matter. 8. Induction. 9. Maxwell's Equations. 10. Electromagnetic Waves. 11. Reflection, Interference, Diffraction and Diffusion. 12. Guided Waves. 13. Special Relativity and Electrodynamics. 14. Motion of Charged Particles in an Electromagnetic Field. 15. Emission of Radiation.

Maxwell Equations, Wave Propagation and Emission DIANE Publishing

Remnants of massive stars, neutron stars (Nss), are valuable laboratories to study matter under extreme densities and provide a unique environment with extreme temperature, magnetic and gravitational fields. Up to now almost 2500 NSs have been discovered and show different behaviours, leading astrophysicists to establish several classes. This thesis presents new results on isolated NSs. We investigate the possible manifestations of NS magnetic fields in order to find evidence for high-magnetic-field structures and analyze how these strong magnetic fields affect the star properties. Chapters 2 and 3 report the discovery of a phase-variable absorption feature in the spectra of two X-ray dim isolated NSs. If interpreted as being due to proton cyclotron resonant scattering in a magnetized bundle close to the surface, this feature provides the first indication for the existence of localized structures in these neutron stars. In Chapters 4 and 5, we study the source 1E 161348-5055. With its long periodicity (6.67 hours) and flux variability on a month/year timescale, it defied any classification until a new outburst was detected in 2016. The characteristics of the outburst and the following decay are consistent with 1E 161348-5055 being a magnetar. The emission of magnetars is powered by the instabilities and decay of their strong magnetic fields (up to 10^15 Gauss). The case of the magnetar CXOU J164710.2-455216 is discussed in Chapter 6. This object was revealed to be prolific, since two outbursts were detected in 2006 and 2011, with a third outburst triggered in May 2017.

Achievements in Magnetism CRC Press

This book is an introduction to astrophysical hydrodynamics for both astronomy and physics students. It

provides a comprehensive and unified view of the general problems associated with fluids in a cosmic context, with a discussion of fluid dynamics and plasma physics. It is the only book on hydrodynamics that addresses the astrophysical context. Researchers and students will find this work to be an exceptional reference. Contents include chapters on irrotational and rotational flows, turbulence, magnetohydrodynamics, and instabilities.
Single Crystal Growth of Semiconductors from Metallic Solutions Springer
University Physics is designed for the two- or three-semester calculus-based physics course. The text has been developed to meet the scope and sequence of most university physics courses and provides a foundation for a career in mathematics, science, or engineering. The book provides an important opportunity for students to learn the core concepts of physics and understand how those concepts apply to their lives and to the world around them. Due to the comprehensive nature of the material, we are offering the book in three volumes for flexibility and efficiency. Coverage and Scope Our University Physics textbook adheres to the scope and sequence of most two- and three-semester physics courses nationwide. We have worked to make physics interesting and accessible to students while maintaining the mathematical rigor inherent in the subject. With this objective in mind, the content of this textbook has been developed and arranged to provide a logical progression from fundamental to more advanced concepts, building upon what students have already learned and emphasizing connections between topics and between theory and applications. The goal of each section is to enable students not just to recognize concepts, but to work with them in ways that will be useful in later courses and future careers. The organization and pedagogical features were developed and vetted with feedback from science educators dedicated to the project. VOLUME II Unit 1: Thermodynamics Chapter 1: Temperature and Heat Chapter 2: The Kinetic Theory of Gases Chapter 3: The First Law of Thermodynamics Chapter 4: The Second Law of Thermodynamics Unit 2: Electricity and Magnetism Chapter 5: Electric Charges and Fields Chapter 6: Gauss's Law Chapter 7: Electric Potential Chapter 8: Capacitance Chapter 9: Current and Resistance Chapter 10: Direct-Current Circuits Chapter 11: Magnetic Forces and Fields Chapter 12: Sources of Magnetic Fields Chapter 13: Electromagnetic Induction Chapter 14: Inductance Chapter 15: Alternating-Current Circuits Chapter 16: Electromagnetic Waves
Magnetic Nanomaterials Cambridge University Press
"This book by Lisa Tauxe and others is a marvelous tool for education and research in Paleomagnetism. Many students in the U.S. and around the world will welcome this publication, which was previously only available via the Internet. Professor Tauxe has performed a service for teaching and research that is utterly unique."—Neil D. Opdyke, University of Florida
Magnetic Field Effects on Chemical and Biochemical Reactions Elsevier
This volume deals with the theory of electromagnetism using a descriptive and geometrical approach. It also contains biological topics which can serve as applications of the theory for students of chemistry or biology.
Conversations on Electric and Magnetic

Fields in the Cosmos Elsevier
Provides information about Electric & Magnetic Fields (EMF) exposure in the workplace. Describes what researchers have learned (& have yet to learn) about EMFs & identifies come sources of EMFs in various industries. This information should help workers & employers understand the scientific basis for the concerns & the uncertainties about EMF exposure. Contents: EMF basics; human health studies; biological studies; summaries & opinions; ongoing research; your EMF environment; sources of additional information. Extensive references.
The Foundations of Electric Circuit Theory Cambridge University Press
New edition of a classic textbook, introducing students to electricity and magnetism, featuring SI units and additional examples and problems.
Plasma Physics of the Local Cosmos Springer Science & Business Media
Magnetic nanomaterials have undergone a significant evolution during the past decade, with supramolecular nanoparticle organization reaching unprecedented levels of complexity and the materials providing new approaches to treating cancer. Magnetic Nanomaterials will provide a comprehensive overview of the latest research in the area of magnetic nanoparticles and their broad applications in synthesis, catalysis and theranostics. The book starts with an introduction to magnetism in nanomaterials and magnetic nanoparticle design followed by individual chapters which focus on specific uses. Applications covered include drug delivery, theranostic agents for cancer treatment as well as catalysis, biomass conversion and catalytic enhancement of NMR sensitivity. The reader will have the opportunity to learn about the frontier of magnetic nanotechnology from scientists that have shaped this unique and highly collaborative field of research. Written and edited by experts working within the field across the world, this book will appeal to students and researched interested in nanotechnology, engineering and physical sciences.
Electricity, Magnetism, and Light Academic Press
DIVDetailed theoretical study and a practical survey for solid-state physicists, engineers, graduate students. Ferromagnetism and ferrimagnetism, magnetization and domain structure, much more. 227 figures. /div
Advanced Magnetic Nanostructures Springer Science & Business Media
This 1994 book examines how reversals of the Earth's magnetic field have played a major role in establishing plate tectonics and a geological time scale.
Pulsed Electromagnetic Fields for Clinical Applications Morgan & Claypool Publishers
Pulsed Electromagnetic Fields for Clinical Applications presents the historical development, the state of art, and the future of the application of pulsed electromagnetic fields (PEMFs) for the treatment of various medical problems, including initiating various healing processes from delayed fractures and pain relief to multiple sclerosis and Parkinson’s disease. The emphasis is on the development of scientific methods to be implemented in clinical application. In perspective, this modality provides a practical, exogenous method for inducing cell and tissue modification attempted to the injured tissues to their normal physiological status. The book reviews the current state of equipment for PEMFs and

highlights worldwide therapeutic achievements. It explores the past, present, and future of PEMF therapies. It presents the development of theory and laboratory research during the last 70 years. It reviews the available equipment for PEMF. It reviews the state of the art of worldwide therapeutic achievements. It includes recent achievements and applications of electroporation modalities. *Introduction to Functional Magnetic Resonance Imaging* Frontiers Media SA A unique resource for physicists and engineers working with magnetic fields An understanding of magnetic phenomena is essential for anyone working on the practical application of electromagnetic theory. Magnetic Fields: A Comprehensive Theoretical Treatise for Practical Use provides physicists and engineers with a thorough treatment of the magnetic aspects of classical electromagnetic theory, focusing on key issues and problems arising in the generation and application of magnetic fields. From magnetic potentials and diffusion phenomena to magnetohydrodynamics and properties of matter-topics are carefully selected for their relevance to the theoretical framework as well as current technologies. Outstanding in its organization, clarity, and scope, Magnetic Fields: * Examines a wide range of practical problems, from magnetomechanical devices to magnetic acceleration mechanisms * Opens each chapter with reference to pertinent engineering examples * Provides sufficient detail enabling readers to follow the derivation of the results * Discusses solution methods and their application to different problems * Includes more than 300 graphs, 40 tables, 2,000 numbered formulas, and extensive references to the professional literature * Reviews the essential mathematics in the appendices **Introduction to Dynamic Spin Chemistry** John Wiley & Sons Today's standard textbooks treat the theoretical structure of electric and magnetic fields, but their emphasis is on electromagnetic radiation and static-electric and magnetic fields. In this book, Eugene Parker provides advanced graduate students and researchers with a much-needed complement to existing texts, one that discusses the dynamic electromagnetism of the cosmos--that is, the vast magnetic fields that are carried bodily in the swirling ionized gases of stars and galaxies and throughout intergalactic space. Parker is arguably the world's leading authority on solar wind and the effects of magnetic fields in the heliosphere, and his originality of thought and distinctive approach to physics are very much in evidence here. Seeking to enrich discussions in standard texts and correct misconceptions about the dynamics of these large-scale fields, Parker engages readers in a series of "conversations" that are at times anecdotal and even entertaining without ever sacrificing theoretical rigor. The dynamics he describes represents the Maxwell stresses of the magnetic field working against the pressure and inertia of the bulk motion of ionized gases, characterized in terms of the magnetic field and gas velocity. Parker shows how this dynamic interaction cannot be fully expressed in terms of the electric current and electric field. Conversations on Electric and Magnetic Fields in the Cosmos goes back to basics to explain why classical hydrodynamics and magnetohydrodynamics are inescapable,

even in the deepest reaches of space.
Electricity and Magnetism World Scientific
Neutron Scattering from Magnetic Materials is a comprehensive account of the present state of the art in the use of the neutron scattering for the study of magnetic materials. The chapters have been written by well-known researchers who are at the forefront of this field and have contributed directly to the development of the techniques described. Neutron scattering probes magnetic phenomena directly. The generalized magnetic susceptibility, which can be expressed as a function of wave vector and energy, contains all the information there is to know about the statics and dynamics of a magnetic system and this quantity is directly related to the neutron scattering cross section. Polarized neutron scattering techniques raise the sophistication of measurements to even greater levels and gives additional information in many cases. The present book is largely devoted to the application of polarized neutron scattering to the study of magnetic materials. It will be of particular interest to graduate students and researchers who plan to investigate magnetic materials using neutron scattering. · Written by a group of scientist who have contributed directly in developing the techniques described. · A complete treatment of the polarized neutron scattering not available in literature. · Gives practical hits to solve magnetic structure and determine exchange interactions in magnetic solids. · Application of neutron scattering to the study of the novel electronic materials.
Fabrication, Characterization and Application Springer
Electromagnetism: Problems and solutions is an ideal companion book for the undergraduate student—sophomore, junior, or senior—who may want to work on more problems and receive immediate feedback while studying. Each chapter contains brief theoretical notes followed by the problem text with the solution and ends with a brief bibliography. Also presented are problems more general in nature, which may be a bit more challenging.
Encyclopedia of the Solar System Elsevier
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

Magnetic Fields, Special Relativity and Potential Theory Elsevier

After an introductory chapter concerned with the history of force-free magnetic fields, and the relation of such fields to hydrodynamics and astrophysics, the book examines the limits imposed by the virial theorem for finite force-free configurations. Various techniques are then used to find solutions to the field equations. The fact that the field lines corresponding to these solutions have the common feature of being “twisted”, and may be knotted, motivates a discussion of field line topology and the concept of helicity. The topics of field topology, helicity, and magnetic energy in multiply connected domains make the book of interest to a rather wide audience. Applications to solar prominence models, type-II superconductors, and force-reduced magnets are also discussed. The book contains many figures and a wealth of material not readily available elsewhere. Contents:IntroductionThe Virial TheoremSolutions to the Force-Free Field EquationsField TopologyMagnetic Energy in Multiply Connected DomainsApplicationsForce-Free Fields and Electromagnetic WavesProof of the Jacobi Polynomial IdentitiesSeparation of the Wave Equation, Cyclides, and Boundary Conditions Readership: Students and researchers working in physics, astrophysics, hydrodynamics, plasma physics and energy research. keywords:Force-Free;Magnetic Filed Topology;Helicity (Twist, Kink, Link);Magnetic Energy in Multiply-Connected Domains;Magnetic Knots

Current Status and Future Directions World Scientific Publishing Company

The Committee to Assess the Current Status and Future Direction of High Magnetic Field Science in the United States was convened by the National Research Council in response to a request by the National Science Foundation. This report answers three questions: (1) What is the current state of high-field magnet science, engineering, and technology in the United States, and are there any conspicuous needs to be addressed? (2) What are the current science drivers and which scientific opportunities and challenges can be anticipated over the next ten years? (3) What are the principal existing and planned high magnetic field facilities outside of the United States, what roles have U.S. high field magnet development efforts played in developing those facilities, and what potentials exist for further international collaboration in this area? A magnetic field is produced by an electrical current in a metal coil. This current exerts an expansive force on the coil, and a magnetic field is "high" if it challenges the strength and current-carrying capacity of the materials that create the field. Although lower magnetic fields can be achieved using commercially available magnets, research in the highest achievable fields has been, and will continue to be, most often performed in

large research centers that possess the materials and systems know-how for forefront research. Only a few high field centers exist around the world; in the United States, the principal center is the National High Magnetic Field Laboratory (NHMFL). High Magnetic Field Science and Its Application in the United States considers continued support for a centralized high-field facility such as NHFML to be the highest priority. This report contains a recommendation for the funding and siting of several new high field nuclear magnetic resonance magnets at user facilities in different regions of the United States. Continued advancement in high-magnetic field science requires substantial investments in magnets with enhanced capabilities. High Magnetic Field Science and Its Application in the United States contains recommendations for the further development of all-superconducting, hybrid, and higher field pulsed magnets that meet ambitious but achievable goals.