# Yukikazu Iwasa



# Case Studies in Superconducting Magnets

Design and Operational Issues
Second Edition



**Ian Pickup** 

Case Studies in Superconducting Magnets Yukikazu Iwasa,2009-04-05 The 2nd edition emphasizes two areas not emphasized in the 1st edition 1 high temperature superconductor HTS magnets 2 NMR nuclear magnetic resonance and MRI magnetic resonance imaging magnets Despite nearly 40 years of R and D on superconducting magnet technology most areas notably fusion and electric power applications are still in the R and D stage One exception is in the area of NMR and MRI NMR magnets are very popular among chemists biologists genome scientists and most of all by drug manufacturers for drug discovery and development MRI and NMR magnets have become the most successful application of superconducting magnet technology and this trend should continue The 2nd edition will have new materials never treated formally in any other book of this kind As with the 1st most subjects will be presented through problem format to educate and train the designer

Case Studies in Superconducting Magnets Yukikazu Iwasa,2009-04-01 The 2nd edition emphasizes two areas not emphasized in the 1st edition 1 high temperature superconductor HTS magnets 2 NMR nuclear magnetic resonance and MRI magnetic resonance imaging magnets Despite nearly 40 years of R and D on superconducting magnet technology most areas notably fusion and electric power applications are still in the R and D stage One exception is in the area of NMR and MRI NMR magnets are very popular among chemists biologists genome scientists and most of all by drug manufacturers for drug discovery and development MRI and NMR magnets have become the most successful application of superconducting magnet technology and this trend should continue The 2nd edition will have new materials never treated formally in any other book of this kind As with the 1st most subjects will be presented through problem format to educate and train the designer

Case Studies in Superconducting Magnets Yukikazu Iwasa, 2014-01-15 Superconductivity - Physics and Devices ,2025-03-19 Since Heike Kamerlingh Onnes discovered superconductors in the early 20th century they have profoundly transformed human life Superconductors characterized by zero electrical resistance and perfect diamagnetism allowing them to expel external magnetic fields have enabled groundbreaking advancements in transportation healthcare and security This book offers a comprehensive exploration of superconductors beginning with the fundamental concepts of superconductivity and progressing to advanced principles and practical applications Whether you are new to the subject or an experienced professional this book provides valuable insights for readers at all levels Superconductivity R.G. Sharma, 2015-02-26 This book presents the basics and applications of superconducting magnets It explains the phenomenon of superconductivity theories of superconductivity type II superconductors and high temperature cuprate superconductors The main focus of the book is on the application to superconducting magnets to accelerators and fusion reactors and other applications of superconducting magnets. The thermal and electromagnetic stability criteria of the conductors and the present status of the fabrication techniques for future magnet applications are addressed The book is based on the long experience of the author in studying superconducting materials building magnets and numerous lectures delivered to scholars A researcher and

graduate student will enjoy reading the book to learn various aspects of magnet applications of superconductivity The book provides the knowledge in the field of applied superconductivity in a comprehensive way **Nb3Sn Accelerator Magnets** Daniel Schoerling, Alexander V. Zlobin, 2019-08-30 This open access book is written by world recognized experts in the fields of applied superconductivity and superconducting accelerator magnet technologies It provides a contemporary review and assessment of the experience in research and development of high field accelerator dipole magnets based on Nb3Sn superconductor over the past five decades The reader attains clear insight into the development and the main properties of Nb3Sn composite superconducting wires and Rutherford cables and details of accelerator dipole designs technologies and performance Special attention is given to innovative features of the developed Nb3Sn magnets The book concludes with a discussion of accelerator magnet needs for future circular colliders The Proceedings of 2023 International Conference on Wireless Power Transfer (ICWPT2023) Chunwei Cai, Xiaohui Qu, Ruikun Mai, Pengcheng Zhang, Wenping Chai, Shuai Wu,2024-03-12 This book includes original peer reviewed research papers from the 2023 International Conference on Wireless Power Transfer ICWPT2023 held in Weihai China The topics covered include but are not limited to wireless power transfer technology and systems coupling mechanism and electromagnetic field of wireless power transfer systems latest developments in wireless power transfer system and wide applications. The papers share the latest findings in the field of wireless power transfer making the book a valuable asset for researchers engineers university students etc Simulation for Accelerator Magnets Stephan Russenschuck, 2025-04-16 A comprehensive reference to the theory and practice of accelerator magnet design and measurement Particle accelerators have many fundamental and applied research applications in physics materials science chemistry and life science To accelerate electrons or hadrons to the required energy magnets of highly uniform fields are needed whose design and optimization are some of the most critical aspects of accelerator construction Field Simulation for Accelerator Magnets is a comprehensive two volume reference work on the electromagnetic design of iron and coil dominated accelerator magnets and methods of magnetic field measurements It provides project engineers and beam physicists with the necessary mathematical foundations for their work Students of electrical engineering and physics will likewise find much value in these volumes as the challenges to be met for field quality electrical integrity and robustness of accelerator magnets require an in depth knowledge of electromagnetism Accelerator magnet design provides an excellent opportunity to learn mathematical methods and numerical techniques that have wide ranging applications in industry and science Readers of the two volumes of this work will find Authorship by the leading expert on magnetic fields of accelerator magnets Detailed discussion of topics such as vector algebra and analysis network theory analytical and numerical field computation magnetic measurements elementary beam optics and many more Application of mathematical optimization techniques multiphysics simulation and model based systems engineering Superconductivity, Magnetism and Magnets Lannie K. Tran, 2006 Superconductivity is the ability of certain materials

to conduct electrical current with no resistance and extremely low losses High temperature superconductors such as La2 xSrxCuOx Tc 40K and YBa2Cu3O7 x Tc 90K were discovered in 1987 and have been actively studied since In spite of an intense world wide research effort during this time a complete understanding of the copper oxide cuprate materials is still lacking Many fundamental questions are unanswered particularly the mechanism by which high Tc superconductivity occurs More broadly the cuprates are in a class of solids with strong electron electron interactions An understanding of such strongly correlated solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic High Tc superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics This ability to carry large amounts of current can be applied to electric power devices such as motors and generators and to electricity transmission in power lines For example superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size Many universities research institutes and companies are working to develop high Tc superconductivity applications and considerable progress has been made This volume brings together new leading edge research in the field

Superconductivity Reinhold Kleiner, Werner Buckel, 2016-03-16 Superconductivity The third edition of this proven text has been developed further in both scope and scale to reflect the potential for superconductivity in power engineering to increase efficiency in electricity transmission or engines The landmark reference remains a comprehensive introduction to the field covering every aspect from fundamentals to applications and presenting the latest developments in organic superconductors superconducting interfaces quantum coherence and applications in medicine and industry Due to its precise language and numerous explanatory illustrations it is suitable as an introductory textbook with the level rising smoothly from chapter to chapter such that readers can build on their newly acquired knowledge The authors cover basic properties of superconductors and discuss stability and different material groups with reference to the latest and most promising applications devoting the last third of the book to applications in power engineering medicine and low temperature physics An extensive list of more than 350 references provides an overview of the most important publications on the topic A unique and essential guide for students in physics and engineering as well as a reference for more advanced researchers and young professionals Study of Second Generation High Temperature Superconductors: Electromagnetic Characteristics and AC Loss Analysis Boyang Shen, 2020-08-31 This thesis introduces a systematic study on Second Generation 2G High Temperature Superconductors HTS covering a novel design of an advanced medical imaging device using HTS and an in depth investigation on the losses of HTS The text covers the design and simulation of a superconducting Lorentz Force Electrical Impedance Tomography This is potentially a significant medical device that is more efficient and compact than an MRI and is capable of detecting early cancer as well as other pathologies such stroke and internal haemorrhages It also presents the information regarding the fundamental physics of superconductivity concentrating on the AC losses in superconducting coils

and tapes Overall the thesis signifies an important contribution to the investigation of High Temperature Superconductors This thesis will be beneficial to the development of advanced superconducting applications in healthcare as well as more broadly in electrical and energy systems **Superconductors** Inamuddin, 2022-11-05 The book presents the current status of superconductor science and technology It focuses on the design properties and applications of superconductor materials The superconductor categories covered include type I type II bulk hard soft oxide fermions organic iron Lanthanide based superconductors high temperature superconductors and superconducting metamaterials Keywords Superconductors Large Scale Applications Bulk Superconductors Soft Superconductors Oxide Superconductors Lanthanide based Superconductors High Temperature Superconductors Superconducting Metamaterials Medical Applications Magnetic Imaging Resonance **Engineering Superconductivity** Peter J. Lee, 2001-05-02 Comprehensive coverage of superconductivity **Applications** from the Wiley Encyclopedia of Electrical and Electronics Engineering Engineering Superconductivity features fifty articles selected from the Wiley Encyclopedia of Electrical and Electronics Engineering the one truly indispensable reference for electrical engineers Superconductor technology has made highly advanced experiments possible in chemistry biochemistry particle physics and health sciences and introduced new applications currently in use in fields from medicine to cellular communications Taken together these articles written by acknowledged experts in the field provide the most complete and in depth accounting of superconductivity in existence The book brings together a wealth of information that would not be available to those who do not have access to the full 24 volume encyclopedia This thorough survey looks at the application of superconductors from an engineer's practical perspective rather than a theoretical approach Engineering Superconductivity provides full coverage of the fundamentals of superconducting behavior and explains the properties and fabrication methods of commercially produced superconductors Up to date material on superconductor applications as well as competing technologies is included The fifty articles presented here are divided into three sections Superconductivity and magnetism Superconductors Applications and related technology Engineering Superconductivity is a complete and up to date reference for engineers physicists chemists materials scientists and anyone working with superconductors Advances in Superconductivity X Kozo Osamura, Izumi Hirabayashi, 2013-11-11 The International Symposium on Superconductivity which has been held annu ally since 1988 is a forum for presenting the most up to date information about a broad range of research and development in superconductivity from funda mental aspects to applications More than 10 years have passed since the discovery of oxide superconductors and since various developments of applications began It may be said that the prospects for application of oxide superconductors recently have opened up Great progress has been made toward practical use for example of the flywheel which uses bulk materials and the high performance cryo cooled magnet made of bismuth wire These were the results of persistent efforts to develop materials from the viewpoint of materials science and engineering Also important is the progress in comprehensive understanding of high temperature superconductivity Unique

electronic properties of cuprates such as the non Fermi liquid normal state spin charge separation spin gap and d wave symmetry were discussed at the symposium as were the unique electromagnetic properties resulting from the low dimensionality of cuprates In the field of new superconductors many exotic materials have been discovered since 1986 A decade of work with cuprate superconductors is reviewed in this proceedings and several of the newest materials are presented These papers will be instructive for many researchers and for students who are to enter this field

Superconductivity Research Developments James R. Tobin, 2008 Superconductivity is a phenomenon occurring in certain materials at extremely low temperatures characterized by exactly zero electrical resistance and the exclusion of the interior magnetic field the Meissner effect The electrical resistivity of a metallic conductor decreases gradually as the temperature is lowered However in ordinary conductors such as copper and silver impurities and other defects impose a lower limit Even near absolute zero a real sample of copper shows a non zero resistance. The resistance of a superconductor on the other hand drops abruptly to zero when the material is cooled below its critical temperature typically 20 kelvin or less An electrical current flowing in a loop of superconducting wire can persist indefinitely with no power source Like ferromagnetism and atomic spectral lines superconductivity is a quantum mechanical phenomenon It cannot be understood simply as the idealisation of perfect conductivity in classical physics Superconductivity occurs in a wide variety of materials including simple elements like tin and aluminium various metallic alloys and some heavily doped semiconductors Superconductivity does not occur in noble metals like gold and silver nor in most ferromagnetic metals In 1986 the discovery of a family of cuprate perovskite ceramic materials known as high temperature superconductors with critical temperatures in excess of 90 kelvin spurred renewed interest and research in superconductivity for several reasons As a topic of pure research these materials represented a new phenomenon not explained by the current theory And because the superconducting state persists up to more manageable temperatures more commercial applications are feasible especially if materials with even higher critical temperatures could be discovered This new book presents leading research from around the world in this AC Loss and Macroscopic Theory of Superconductors W.J. Carr, Jr., 2001-07-05 Through the magic of dynamic field averages it is shown that Maxwell's equations can be used in a simple way to describe filamentary composites as well as pure bulk superconductors The second edition of AC Loss and Macroscopic Theory of Superconductors like the first edition is written for both physicists and engineers It starts with a rigorous and partially new derivation of Maxwell's equations as they apply to superconductors and the remainder of the book is devoted to loss approximations for a wide range of applications The chapters on high Tc materials were updated and include a change to SI units and the addition of some historical perspective Particle Physics Reference Library Stephen Myers, Herwig Schopper, 2020-05-27 This third open access volume of the handbook series deals with accelerator physics design technology and operations as well as with beam optics dynamics and diagnostics A joint CERN Springer initiative the Particle Physics Reference Library provides revised and

updated contributions based on previously published material in the well known Landolt Boernstein series on particle physics accelerators and detectors volumes 21A B1 B2 C which took stock of thefield approximately one decade ago Central to this new initiative is publication under full open access Recent Developments in Superconductivity Research Barry P. Martins, 2007 Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses High temperature superconductors such as La2 xSrxCuOx Tc 40K and YBa2Cu3O7 x Tc 90K were discovered in 1987 and have been actively studied since In spite of an intense world wide research effort during this time a complete understanding of the copper oxide cuprate materials is still lacking Many fundamental questions are unanswered particularly the mechanism by which high Tc superconductivity occurs More broadly the cuprates are in a class of solids with strong electron electron interactions An understanding of such strongly correlated solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic High Tc superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics This ability to carry large amounts of current can be applied to electric power devices such as motors and generators and to electricity transmission in power lines For example superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size Many universities research institutes and companies are working to develop high Tc superconductivity applications and considerable progress has been made This volume brings together new leading edge research in the field **Superconductivity** Kristian Fossheim, Asle Sudboe, 2005-09-01 Superconductivity Physics and Applications brings together major developments that have occurred within the field over the past twenty years Taking a truly modern approach to the subject the authors provide an interesting and accessible introduction Brings a fresh approach to the physics of superconductivity based both on the well established and convergent picture for most low Tc superconductors provided by the BCS theory at the microscopic level and London and Ginzburg Landau theories at the phenomenological level as well as on experiences gathered in high Tc research in recent vears Includes end of chapter problems and numerous relevant examples Features brief interviews with key researchers in the field A prominent feature of the book is the use of SI units throughout in contrast to many of the current textbooks on the subject which tend to use cgs units and are considered to be outdated **High Magnetic Fields** Fritz Herlach, Noboru Miura, 2003 This three volume book provides a comprehensive review of experiments in very strong magnetic fields that can only be generated with very special magnets The first volume is entirely devoted to the technology of laboratory magnets permanent superconducting high power water cooled and hybrid pulsed magnets both nondestructive and destructive megagauss fields Volumes 2 and 3 contain reviews of the different areas of research where strong magnetic fields are an essential research tool These volumes deal primarily with solid state physics other research areas covered are biological systems chemistry atomic and molecular physics nuclear resonance plasma physics and astrophysics including

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