



# Fluctuation Phenomena in High Temperature Superconductors

Edited by

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# Fluctuation Phenomena In High Temperature Superconductors

**S.-L. Drechsler, T. Mishonov**



## **Fluctuation Phenomena In High Temperature Superconductors:**

*Fluctuation Phenomena in High Temperature Superconductors* M. Ausloos, Andrei A. Varlamov, 2012-12-06 These Proceedings of a NATO ARW HTECH ARW 96 00 52 held at the International Center for Theoretical Physics Trieste Italy from Aug 5 till Aug 9 1996 resulted from many discussions between various workers concerning the need for a gathering of all if possible who were concerned about the subject of superconductivity fluctuations in High critical Temperature Superconductors HTS It appeared to many that the Skocpol Tinkham work of 1975 had to be revitalized in view of the discovery of the new superconducting ceramics and the enormous amount of work having already taken place The study of HTS is one of the most prominent research subject in solid state sciences The understanding of the role of fluctuations is also thought to be necessary before technological applications since the fluctuations may destroy the superconducting state The workshop discussions have touched upon i Superconducting fluctuations in the vicinity of the critical transition ii Superconductivity fluctuations near the percolation transition and iii Fluctuations of the vortex lattice at the lattice melting temperature These topics served as initiators for a very great amount of discussions with many comments from the audience More than forty long lectures and two poster sessions were held Private discussions going unrecorded but obviously took place at many locations lecture halls staircases cafeteria bedrooms bars beach

*Theory of High Temperature Superconductivity* T. Mishonov, Evgeni S. Penev, 2011 Key discoveries concerning the different biological functions of microglia in health and disease have attracted scientists from various fields In *Microglia Methods and Protocols* expert researchers in the field detail methods for selection of the key cellular molecular and biochemical techniques that are used in studying the many and varied functions of this fascinating cell These methods and techniques include microglia cell culture for studying microglia activation and functions as well as their interaction with other cell types both in vitro and in vivo Written in the highly successful *Methods in Molecular Biology* series format chapters include introductions to their respective topics lists of the necessary materials and reagents step by step readily reproducible laboratory protocols and key tips on troubleshooting and avoiding known pitfalls Authoritative and practical *Microglia Methods and Protocols* is a useful resource for cell biologists molecular biologists immunologists oncologist and neuroscientists

**Theory of Fluctuations in Superconductors** Anatoly Larkin, Andrei Varlamov, 2005-01-13 This book presents a complete encyclopedia of superconducting fluctuations summarising the last thirty five years of work in the field The first part of the book is devoted to an extended discussion of the Ginzburg Landau phenomenology of fluctuations in its thermodynamical and time dependent versions and its various applications The second part deals with microscopic justification of the Ginzburg Landau approach and presents the diagrammatic theory of fluctuations The third part is devoted to a less detailed review of the manifestation of fluctuations in observables diamagnetism magnetoconductivity various tunneling characteristics thermoelectricity and NMR relaxation The final chapters turn to the manifestation of fluctuations in unconventional superconducting systems

nanodrops nanorings Berezinsky Kosterlitz Thouless state quantum phase transition between superconductor and insulator and thermal and quantum fluctuations in weak superconducting systems The book ends with a brief discussion on theories of high temperature superconductivity where fluctuations appear as the possible protagonist of this exciting phenomenon

**Handbook of High-Temperature Superconductor** Neeraj Khare, 2003-05-06 Devoted to the preparation characterization and evaluation of HTS electronic devices this reference provides information on using high  $T_c$  thin films and junctions to increase speed lessen noise lower power consumption and enhance upper frequency limits in superconductor electronics

*Symmetry and Pairing in Superconductors* M. Ausloos, Sergei Kruchinin, 2012-12-06 These Proceedings of a NATO ARW HTECH ARW 97 1843 held at the Oreanda Hotel Yalta Ukraine from April 29 till May 2 1998 resulted from many discussions between various workers concerning the need for a gathering of all if possible who were concerned with the subject of symmetry of the order parameter and pairing states for superconductivity We applied ourselves in particular to High critical Temperature Superconductors HTS but also studied other unconventional superconductors The study of HTS is one of the most prominent research subjects in solid state sciences The understanding of the role of symmetry and pairing conditions are also thought to be necessary before technological applications since these features may be influenced by external fields The workshop discussions have touched upon theoretical and experimental aspects but also on related topics These served as initiators for a very great amount of discussions with many comments from the audience More than thirty long lectures and one on going poster session were held Private discussions went unrecorded but obviously took place at many locations lecture halls staircases cafes bedrooms bars beach bus plane Arguments openly reported for the first time were often quite sharp ones and this is an understatement

Physical Properties Of High Temperature Superconductors Iv Donald M Ginsberg, 1994-04-13 This volume contains two chapters of direct interest for applications The magnetic vortex states and transformations and the effects of c axis coupling on the transport properties In addition the isotope effect is reviewed since reliable data on ultra pure samples are now available The lattice vibrations phonons have been explored extensively by inelastic neutron scattering and infrared absorption and these types of data are reviewed as well The interesting properties of the superconducting doped fullerenes are described some of their most fundamental properties are shared by the superconducting cuprates This book with its subject index like the earlier three volumes in this series will be found useful both by people entering the field and by workers who are already active in it

**High-Temperature Superconductors** X G Qiu, 2011-03-28 High temperature superconductors have received a great deal of attention in recent years due to their potential in device and power applications This book summarises the materials science and physics of all the most important high temperature superconductors as well as discussing material growth properties and applications Part one covers fundamental characteristics of high temperature superconductors and high  $TC$  films such as deposition technologies growth transport properties and optical conductivity Part two is concerned with growth techniques and

properties of high temperature superconductors including YBCO BSCCO and HTSC high TC films and electron doped cuprates Finally part three describes the various applications of high temperature superconductors from Josephson junctions and dc superconductive quantum interference devices dc SQUIDS to microwave filters With its distinguished editor and international team of contributors this book is an invaluable resource for those researching high temperature superconductors in industry and academia In light of the many recent advances in high temperature superconductors it will benefit physicists materials scientists and engineers working in this field as well as in areas of industrial application such as electronic devices and power transmission Summarises the materials science and physics of all the most important high temperature superconductors Discusses material growth properties and applications Outlines fundamental characteristics of high temperature superconductors and high TC films

**Shortcut to Superconductivity** Armen Gulian, 2020-07-11 This accessible textbook offers a novel concept led approach to superconducting electronics using the COMSOL Multiphysics software to help describe fundamental principles in an intuitive manner Based on a course taught by the author and aimed primarily at engineering students the book explains concepts effectively and efficiently uncovering the shortcut to understanding each topic enabling readers to quickly grasp the underlying essence The book is divided into two main parts the first part provides a general introduction to key topics encountered in superconductivity illustrated using COMSOL simulations based on time dependent Ginzburg Landau equations and avoiding any deeply mathematical derivations It includes numerous worked examples and problem sets with tips and solutions The second part of the book is more conventional in nature providing detailed derivations of the basic equations from first principles This part covers more advanced topics including the BCS Gor'kov Eliashberg approach to equilibrium properties of superconductors the derivation of kinetic equations for nonequilibrium superconductors and the derivation of time dependent Ginzburg Landau equations used as the basis for COMSOL modeling in the first part Supported throughout by an extensive library of COMSOL Multiphysics animations the book serves as a uniquely accessible introduction to the field for engineers and others with a less rigorous background in physics and mathematics However it also features more detailed mathematical background for those wishing to delve further into the subject

**Handbook of Superconducting Materials** David A. Cardwell, David S. Ginley, 2003

**Superconductivity** A. Bissar, 1999 This book consists of over 600 selected descriptions and abstracts of books book chapters patents and journal articles from throughout the world dealing with this high profile topic Each citation contains complete bibliographic data plus key words The entries are grouped under the headings of Theory of Superconductivity Superconducting Devices Superconducting Properties of Materials Applications of Superconductors Author Index Subject Index

**Dynamics of Magnetic Fluctuations in High-Temperature Superconductors** George Reiter, Peter Horsch, Gregory C. Psaltakis, 2012-12-06 This NATO Advanced Research Workshop was held at a time when there was little consensus as to the mechanism for high temperature superconductivity in the context of a world undergoing

major changes in its political alignments and sense of the possibility for the future. It was characterized by generosity in the sharing of our uncertainties and speculations as was appropriate for both the subject matter and the context. The workshop was organized of necessity around the experimental work as is this volume. Where the theoretical work is directly relevant to particular experiments it is included in the appropriate sections with them. Most of the participants felt strongly that magnetic fluctuations played an important role in the mechanism for high  $T_c$  although with the exception of the ILS R work reported by Luke showing results inconsistent with the anyon picture and the work on flux phases by Lederer the mechanism remained an issue in the background. A major focus was the phenomenological interpretation of the NMR data.

**Supermaterials** Rudi Cloots, M. Ausloos, Marek Pekala, Alan J. Hurd, Gilbert Vacquier, 2012-12-06. What is a supermaterial? A concise definition is by no means obvious but a clue can be obtained from the topics discussed here. In addition to superconductors the reader will encounter magnetic effects of many kinds including giant and even colossal ones, organic conductors, photoconductors and even 400 year old Japanese ceramics. Processing is a prominent pursuit in supermaterials research especially but not exclusively of the superconductors. The papers on characterisation and theory break new ground particularly in pursuit of new optoelectronic phenomena. The parade of new materials recently synthesised often containing four or more elements is surprising. But it is in its reporting of new applications that the book stands out from circuits to sensors, supermaterials are making their impact on society.

**Advances in Superconductivity XII** T. Yamashita, K. Tanabe, 2013-11-11. The 12th International Symposium on Superconductivity was held in Morioka, Japan, October 17-19, 1999. Convened annually since 1988, the symposium covers the whole field of superconductivity from fundamental physics and chemistry to a variety of applications. At the 12th Symposium a mini symposium focusing on the two dimensionality of high temperature superconductors or the  $c$  axis transport and a session on vortex physics were organized. There were also many reports on the recent developments of YBCO based coated conductors both in the United States and in Japan, AC losses of wires and tapes, developments of bulk materials with strong flux pinning, the recent progress in thin film and junction technologies and the demonstration of various electronics applications using SQUIDs, microwave devices and single flux quantum SFQ digital devices. This volume is a valuable resource for all those working in the field of superconductivity.

**The Physics of Superconductors** Karl-Heinz Bennemann, John B. Ketterson, 2012-12-06. Superconductivity has undergone tremendous advances in recent years. Most notable of course was the discovery of high temperature superconductivity in the cuprates. This discovery resulted in an enormous influx of new workers to the field representing a host of experimental and theoretical disciplines. When we combine this with the discovery of superconductivity in other materials such as heavy fermion metals,  $MgB_2$ , various organics, fullerenes, field effect devices, magnetic metals under pressure and presumably non  $s$  symmetry triplet Cooper pairing in ruthenates e.g.  $Sr_2RuO_4$  we have an enrichment of the phenomena of superconductivity. This resulted in an explosion of interest in the field. Many of the new superconductors are

being called unconventional either with respect to the pairing mechanism or the symmetry of the underlying order parameter. Yet in spite of these new materials and directions continuing studies of conventional electron phonon based superconductivity remain interesting. With the aid of historical hindsight we expect the field to continue to advance in unexpected directions. Nonetheless it is our view that a state of the art treatise on superconductivity is justified at this time not only to summarize the present understanding but also to introduce newcomers to the field as was the case with the two justly famous 1968 bibles of superconductivity by our former colleague R D Parks for an earlier generation. Hopefully the present books might help to point the way for future workers research and discoveries. Nuclear Science Abstracts, 1975

**Physics and Materials Science of Vortex States, Flux Pinning and Dynamics** R. Kossowsky, Shyamalendu Bose, Zafer Durusoy, Vladimir Pan, 1999-04-30 A discussion by an assembly of expert physicists and materials scientists embracing the specific features of vortex pin interactions the modes of different kinds of vortex motion under the action of Lorenz force and the mechanisms of dissipation. The effects of transport and screening currents superimposed AC magnetic fields and the microwave electromagnetic irradiation on vortex behaviour define the electromagnetic properties of a high T<sub>c</sub> superconducting material. The mechanisms driving the depinning of vortices and the dynamics of their motion determine the critical current density and its field dependence the mechanisms of energy dissipation and linear and nonlinear resistivity AC losses and noise in electronic circuitry. The book therefore has direct implications for the development of new devices and components in electrical engineering modern electronics computer technology and microwave communication. *Physics of High-Temperature Superconductors* Sadamichi Maekawa, Masatoshi Sato, 2012-12-06 Advances through carefully conducted quantitative work on well designed high quality materials characterize the present state of high temperature superconductivity research. The contributions to this volume present a theoretical and experimental overview of electronic structure and physical properties including anisotropic features of high temperature materials with a focus on cuprates. In order to enhance the understanding of the mechanisms of superconductivity at high temperatures this volume is divided into theoretical and experimental parts. The contributions to the two parts correspond to each other giving readers involved in either area of research activity a reference to findings of the other. On the other hand this book gives young physicists high level information on the present state of research enhanced by tutorial contributions of leading physicists in the field.

Physical Properties of High Temperature Superconductors V Donald M. Ginsberg, 1996 The publication of Volume V of *Physical Properties of High Temperature Superconductors* is expected in March 1996. It will have chapters of interest for both fundamental studies and applied research. The topics discussed are expected to include the electromagnetic response penetration depth and surface resistance local lattice distortions the influence of vortex fluctuations on macroscopic behavior the properties of superlattices and the symmetry of the superconducting order parameter. High-T<sub>c</sub> Superconductors and Related Materials S.-L. Drechsler, T. Mishonov, 2012-12-06 A broad introduction to high T<sub>c</sub> superconductors their parent

compounds and related novel materials covering both fundamental questions of modern solid state physics such as correlation effects fluctuations unconventional symmetry of superconducting order parameter and applied problems related to short coherence length grain boundaries and thin films The information that can be derived from electron spectroscopy and optical measurements is illustrated and explained in detail Descriptions widely employ the clear relatively simple phenomenological Ginzburg Landau model of complex phenomena such as vortex physics vortex charge determination plasmons in superconductors Cooper pair mass and wetting of surfaces The first comprehensive reviews of several novel classes of materials are presented including borocarbides and chain cuprates

**The Impact of Selling the Federal Helium Reserve** National Research Council, Commission on Engineering and Technical Systems, National Materials Advisory Board, Commission on Physical Sciences, Mathematics, and Applications, Board on Physics and Astronomy, Committee on the Impact of Selling the Federal Helium Reserve, 2000-06-18 The Helium Privatization Act of 1996 P L 104 273 directs the Department of the Interior to begin liquidating the U S Federal Helium Reserve by 2005 in a manner consistent with minimum market disruption and at a price given by a formula specified in the act It also mandates that the Department of the Interior enter into appropriate arrangements with the National Academy of Sciences to study and report on whether such disposal of helium reserves will have a substantial adverse effect on U S scientific technical biomedical or national security interests This report is the product of that mandate To provide context the committee has examined the helium market and the helium industry as a whole to determine how helium users would be affected under various scenarios for selling the reserve within the act s constraints The Federal Helium Reserve the Bush Dome reservoir and the Cliffside facility are mentioned throughout this report It is important to recognize that they are distinct entities The Federal Helium Reserve is federally owned crude helium gas that currently resides in the Bush Dome reservoir The Cliffside facility includes the storage facility on the Bush Dome reservoir and the associated buildings pipeline



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## **Table of Contents Fluctuation Phenomena In High Temperature Superconductors**

1. Understanding the eBook Fluctuation Phenomena In High Temperature Superconductors
  - The Rise of Digital Reading Fluctuation Phenomena In High Temperature Superconductors
  - Advantages of eBooks Over Traditional Books
2. Identifying Fluctuation Phenomena In High Temperature Superconductors
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Fluctuation Phenomena In High Temperature Superconductors
  - User-Friendly Interface
4. Exploring eBook Recommendations from Fluctuation Phenomena In High Temperature Superconductors
  - Personalized Recommendations
  - Fluctuation Phenomena In High Temperature Superconductors User Reviews and Ratings

- Fluctuation Phenomena In High Temperature Superconductors and Bestseller Lists
- 5. Accessing Fluctuation Phenomena In High Temperature Superconductors Free and Paid eBooks
  - Fluctuation Phenomena In High Temperature Superconductors Public Domain eBooks
  - Fluctuation Phenomena In High Temperature Superconductors eBook Subscription Services
  - Fluctuation Phenomena In High Temperature Superconductors Budget-Friendly Options
- 6. Navigating Fluctuation Phenomena In High Temperature Superconductors eBook Formats
  - ePub, PDF, MOBI, and More
  - Fluctuation Phenomena In High Temperature Superconductors Compatibility with Devices
  - Fluctuation Phenomena In High Temperature Superconductors Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Fluctuation Phenomena In High Temperature Superconductors
  - Highlighting and Note-Taking Fluctuation Phenomena In High Temperature Superconductors
  - Interactive Elements Fluctuation Phenomena In High Temperature Superconductors
- 8. Staying Engaged with Fluctuation Phenomena In High Temperature Superconductors
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Fluctuation Phenomena In High Temperature Superconductors
- 9. Balancing eBooks and Physical Books Fluctuation Phenomena In High Temperature Superconductors
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Fluctuation Phenomena In High Temperature Superconductors
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Fluctuation Phenomena In High Temperature Superconductors
  - Setting Reading Goals Fluctuation Phenomena In High Temperature Superconductors
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Fluctuation Phenomena In High Temperature Superconductors
  - Fact-Checking eBook Content of Fluctuation Phenomena In High Temperature Superconductors
  - Distinguishing Credible Sources

13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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