



ELECTROMAGNETIC WAVES SERIES 34

# **ELECTRODYNAMIC THEORY of SUPERCONDUCTORS**

**by Shu-Ang Zhou**

# Electrodynamic Theory Of Superconductors

**BM King**



## **Electrodynamic Theory Of Superconductors:**

**Electrodynamic Theory of Superconductors** Shu-Ang Zhou, 1991 This book presents a unified and comprehensive theoretical treatment of electromagnetic thermal and mechanical phenomena in superconductors Introduces basic concepts and principles with particular emphasis on general methodology *Electrodynamics of Superconductors* Vladimir Kozhevnikov, 2024-12-23 Superconductivity is a remarkable on the verge of miraculous macroscopic quantum phenomenon with a boundless potential for a wide variety of applications Over the last century the physics of superconductivity constitutes a major part of research in condensed matter and yet the electrodynamics of superconductors appears as only a minor part in textbooks on electrodynamics and superconductivity The book offers a fresh look at electrodynamics of continuous media with detailed description of thermal and electromagnetic properties of superconductors emphasising physical meaning of concepts and principles without excessive mathematics To facilitate understanding it is accompanied by problems and worked solutions The book will be of interest to senior undergraduate and graduate students of physics and chemistry who have taken a calculus based course in general physics It is a valuable reference for researchers involved in studies of superconductivity the physics of metals and condensed matter physics Key Features The first book in terms of semi classical physics addressing both equilibrium and nonequilibrium thermal and transport properties of superconducting materials Presents an accessible overview without excessive mathematics Accompanied by problems with solutions to aid understanding **Electrodynamics of High-temperature Superconductors** Alan M. Portis, 1993 These lectures are concerned with the application of high temperature superconductors to both passive and active high frequency devices The central issue addressed is the electrodynamics of granular superconductors particularly where grain boundaries either natural or synthetic act as Josephson weak links Grain boundaries are responsible for residual dissipation and for unwanted dependence of the electromagnetic properties on ambient magnetic fields and on elevated power level Properly controlled similar weak links are the key to high sensitivity dc and rf SQUIDS at readily accessible temperatures and to modulators mixers and detectors Such structures may conveniently lead to superconductive electronic devices as well as coherent sources of radiation in the very far infrared **Electrodynamics of Solids and Microwave Superconductivity** Shu-Ang Zhou, 1999-07-23 Die Elektrodynamik von Festkörpern ist ein interdisziplinäres angelegtes Thema zu dem elektromagnetische Phänomene mechanische Bewegungen und Verformungen sowie Wärmeleitungen in festen Stoffen gleichermaßen beitragen Dieses einführende und dennoch umfassende Lehrbuch zur Theorie der Elektrodynamik und Halbleitertechnik richtet sich an Physiker ebenso wie an Elektrotechniker Maschinenbauer und Studenten der einschlägigen Fachrichtungen 08 99 *Remark on Lehnert's Revised Quantum Electrodynamics (RQED) as an Alternative to Francesco Celani's et al.* *Maxwell-Clifford Equations: With an Outline of Chiral Cosmology Model and its Role to CMNS* Victor Christianto, Florentin Smarandache, Yunita Umniyati, In a recent paper published in JCMNS in 2017 Francesco Celani Di Tommaso and Vassalo

argued that Maxwell equations rewritten in Clifford algebra are sufficient to describe the electron and also ultra dense deuterium reaction process proposed by Homlid et al Apparently Celani et al believed that their Maxwell Clifford equations are an excellent candidate to surpass both Classical Electromagnetic and Zitterbewegung QM Meanwhile in a series of papers Bo Lehnert proposed a novel and revised version of Quantum Electrodynamics RQED based on Proca equations

*Non-linear Electromagnetic Systems* Paolo Di Barba,A. Savini,2000 This text is a collection of contributions covering a wide range of topics of interdisciplinary character from materials to systems from microdevices to large equipment with special emphasis on emerging subjects and particular attention to advanced computational methods in order to model both devices and systems The book provides the solution to challenging problems of research on non linear electromagnetic systems and is expected to help researchers working in this broad area

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*Electrodynamics of Quantum-Critical Conductors and Superconductors* Uwe Santiago Pracht,2017-12-14 This thesis presents and discusses recent optical low temperature experiments on disordered NbN granular Al thin films and the heavy fermion compound CeCoIn5 offering a unified picture of quantum critical superconductivity It provides a concise introduction to the respective theoretical models employed to interpret the experimental results and guides readers through in depth calculations supplemented with supportive figures in order to both retrace the interpretations and span the bridge between experiment and state of the art theory

*Superconductivity* Philippe Mangin,Rémi Kahn,2016-12-20 This book proposes a thorough introduction for a varied audience The reader will master London theory and the Pippard equations and go on to understand type I and type II superconductors their thermodynamics magnetic properties vortex dynamics current transport Cooper pairs and the results of BCS theory By studying coherence and flux quantization he or she will be lead to the Josephson effect which with the SQUID is a good example of the applications The reader can make up for any gaps in his knowledge with the use of the appendices follow the logic behind each model and assimilate completely the underlying concepts Approximately 250 illustrations help in developing a thorough understanding This volume is aimed towards masters and doctoral students as well as advanced

undergraduates teachers and researchers at all levels coming from a broad range of subjects chemistry physics mechanical and electrical engineering materials science Engineers working in industry will have a useful introduction to other more applied or specialized material Philippe Mangin is emeritus professor of physics at Mines Nancy Graduate School of Science Engineering and Management of the University of Lorraine and researcher at the Jean Lamour Institute in France He is the former director of both the French neutron scattering facility L on Brillouin Laboratory in Orsay and the Material Physics Laboratory in Nancy and has taught superconductivity to a broad audience in particular to engineering students R mi Kahn is a retired senior research scientist of the French Alternative Energies and Atomic Energy Commission CEA Saclay He worked at the L on Brillouin Laboratory and was in charge of the experimental areas of INB 101 the Orph e research reactor This work responded to the need to bring an accessible account suitable for a wide spectrum of scientists and engineers

**Advances in High Temperature Superconductors and their applications** S. MOHAN, 2019-06-20 Prof Heike Kamerlingh Onnes discovered superconductivity while measuring resistivity of mercury Surprisingly the resistivity of mercury ceased at 4.2 K and this phenomenon was known as superconductivity He realized the importance of this discovery in producing large magnetic fields spl delate It was realized that superconductivity is in a new thermodynamic state with peculiar electric and magnetic properties This paved the way to discover more superconductors Simple elements such as Tin Indium or lead showed the highest critical temperature  $T_c$  7.2 K They were called as Type I superconductors Niobium nitride was found to superconduct at 16 K at 1941 and Vanadium silicon showed superconductive properties at 17.5 K at 1953 Nb alloys and binary or more complex compounds such as Nb<sub>3</sub>Sn  $T_c$  18 K Nb Ti  $T_c$  9 K Ga V with  $T_c$  23 K became type II superconductors Thereafter there was not much improvement in the development of superconductor although wonderful applications were expected from superconductors After three decades Fullerenes like ceramic superconductors are discovered A decade ago MgB<sub>2</sub> was discovered with  $T_c$  39 K These superconductors were routinely produced into form of wires for producing larger magnetic fields In all these cases cooling was effectively done by liquid Helium A comprehensive microscopic theory of superconductivity in metals was proposed in 1957 by John Bardeen Leon Cooper and Robert Schrieffer the so called BCS theory for which they received the Nobel Prize in Physics In a major breakthrough George Bednorz and Karl Mueller discovered a brittle ceramic superconductivity in the family of cuprates at 30 K in 1986 and a new era began Inspired by the work of Bednorz and Mueller on high temperature superconductivity HTS Paul Chu and his associates at the University of Houston discovered in 1987 123 compounds That is YBCO Yttrium<sup>1</sup> Barium<sup>2</sup> Copper<sup>3</sup> Oxygen<sup>7</sup> and iso structural RBCO Rare earth<sup>1</sup> Barium<sup>2</sup> Copper<sup>3</sup> Oxygen<sup>7</sup> have a  $T_c$  of 93 K Prior to 1987 all superconducting materials had lower critical temperatures  $T_c$  s and therefore functioned only at temperatures near the boiling point of liquid helium 4.2 K or liquid hydrogen 20.28 K with the highest being Nb<sub>3</sub>Ge at 23 K They were known as low temperature superconductors YBCO was the first material to become superconducting above 77 K boiling point of liquid nitrogen and subsequently a series

of high temperature superconducting materials were discovered These superconducting materials are widely known as High temperature superconductors as these  $T_c$  s exceeded the limit prescribed by BCS theory HTSCs are potentially valuable as liquid nitrogen is cheaper than liquid helium YBCO possesses superior superconducting and physical properties YBCO receiver coils in NMR spectrometers have improved the resolution NMR spectrometers by a factor of 3 compared to that achievable with conventional coils Paul Chu s group holds the current  $T_c$  record of 164 K in the mercury barium based cuprate superconductor under pressure Their work led to a rapid succession of new high temperature superconducting materials ushering in a new era in material science chemistry and technology Added to this the structure of  $\text{Bi}_2\text{Sr}_2\text{Ca}_2\text{Cu}_2\text{O}_{10}$  BiSCCO high temperature superconductive compound having  $T_c$  110 K was reported In 1993 mercuric cuprates perovskite ceramic superconductors with the transition temperatures  $T_c$  138 K was also reported

*Electrodynamics of Solids* Martin Dressel, George Grüner, 2002-01-17 The authors of this book present a thorough discussion of the optical properties of solids with a focus on electron states and their response to electrodynamic fields A review of the fundamental aspects of the propagation of electromagnetic fields and their interaction with condensed matter is given This is followed by a discussion of the optical properties of metals semiconductors and collective states of solids such as superconductors Theoretical concepts measurement techniques and experimental results are covered in three interrelated sections Well established mature fields are discussed for example classical metals and semiconductors together with modern topics at the focus of current interest The substantial reference list included will also prove to be a valuable resource for those interested in the electronic properties of solids The book is intended for use by advanced undergraduate and graduate students and researchers active in the fields of condensed matter physics materials science and optical engineering

*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

**Foundations of Classical Electrodynamics** Friedrich W Hehl, Yuri N. Obukhov, 2012-12-06 In this book we display the fundamental structure underlying classical electro dynamics i e the phenomenological theory of electric and magnetic effects The book can be used as a textbook for an advanced course in

theoretical electrodynamics for physics and mathematics students and perhaps for some highly motivated electrical engineering students We expect from our readers that they know elementary electrodynamics in the conventional 1 3 dimensional form including Maxwell's equations More over they should be familiar with linear algebra and elementary analysis including vector analysis Some knowledge of differential geometry would help Our approach rests on the metric free integral formulation of the conservation laws of electrodynamics in the tradition of F Kottler 1922 E Cartan 1923 and D van Dantzig 1934 and we stress in particular the axiomatic point of view In this manner we are led to an understanding of why the Maxwell equations have their specific form We hope that our book can be seen in the classical tradition of the book by E J Post 1962 on the Formal Structure of Electromagnetics and of the chapter Charge and Magnetic Flux of the encyclopedia article on classical field theories by C Truesdell and R A Toupin 1960 including R A Toupin's Bressanone lectures 1965 for the exact references see the end of the introduction on page 11 *Electrodynamics of Continuous Media* L D Landau, J. S. Bell, M. J. Kearsley, L. P. Pitaevskii, E.M. Lifshitz, J. B. Sykes, 2013-10-22 Covers the theory of electromagnetic fields in matter and the theory of the macroscopic electric and magnetic properties of matter There is a considerable amount of new material particularly on the theory of the magnetic properties of matter and the theory of optical phenomena with new chapters on spatial dispersion and non linear optics The chapters on ferromagnetism and antiferromagnetism and on magnetohydrodynamics have been substantially enlarged and eight other chapters have additional sections

**Intermediate Electromagnetic Theory** Joseph V Stewart, 2001-02-22 This invaluable text has been developed to provide students with more background for the applications of electricity and magnetism particularly in optics and topics related to research instrumentation For example waveguides both conducting and dielectric are discussed more thoroughly than in most texts because they are an important laboratory tool and important components of modern communications The text therefore modernizes the topics covered in a typical electricity and magnetism text Because this approach requires an understanding of the mathematics relevant to the topics the text includes a much more thorough discussion of the mathematics of electricity and magnetism than found in current texts It provides a solid background for students who need knowledge of electricity and magnetism particularly physics majors a *Collected Papers. Volume XI* Florentin Smarandache, 2022-08-01 This eleventh volume of Collected Papers includes 90 papers comprising 988 pages on Physics Artificial Intelligence Health Issues Decision Making Economics Statistics written between 2001 2022 by the author alone or in collaboration with the following 84 co authors alphabetically ordered from 19 countries Abhijit Saha Abu Su an Jack Allen Shahbaz Ali Ali Safaa Sadiq Aliya Fahmi Atiqa Fakhar Atiqa Firdous Sukanto Bhattacharya Robert N Boyd Victor Chang Victor Christianto V Christy Dao The Son Debjit Dutta Azeddine Elhassouny Fazal Ghani Fazli Amin Anirudha Ghosha Nasruddin Hassan Hoang Viet Long Jhulaneswar Baidya Jin Kim Jun Ye Darjan Karaba evi Vasilios N Katsikis Ieva Meidut Kavaliauskien F Kaymarm Nour Eldeen M Khalifa Madad Khan Qaisar Khan M Khoshnevisan Kifayat Ullah Volodymyr

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**Fundamentals of Electromagnetism** Arturo Lopez Davalos, Damian Zanette, 1999-07-05 This textbook is a revised and enlarged version of notes for a one semester course on electromagnetism It covers the theory of electromagnetic phenomena in vacuum and in material media The book includes a CD ROM with didactic software to solve boundary value problems in electrostatics and magnetostatics

**On the Properties of Novel Superconductors** Heshmatollah Yavari, 2020-07-29 Since the discovery of superconductivity a great number of theoretical and experimental efforts have been made to describe this new phase of matter that emerged in many body systems In this regard theoretical models have been presented the most famous of which was the BCS theory that can only describe conventional superconductors With the discovery of new class superconductors the superconducting mechanism became a new challenge in the field of condensed matter physics This unexpected discovery opened a new area in the history of superconductivity and experimental researchers started trying to find new compounds in this class of superconductors These superconductors are often characterized by the anisotropic character in the superconducting gap function with nodes along a certain direction in the momentum space Since the pairing interaction has an important role in the superconducting gap structure its determination is very important to explain the basic pairing mechanism In this regard this book includes valuable theoretical and experimental discussions about the properties of superconductors Here you will find valuable research describing the properties of unconventional superconductors

**Thermodynamics and Electrodynamics of Superconductors** Vitalii Lazarevich Ginzburg, 1988

**New Foundation in the Sciences** V. Christianto, F. Smarandache, R.N. Boyd, It is widely known among the Frontiers of physics that sweeping under the rug practice has been quite the norm rather than exception In other words the leading paradigms have strong tendency to be hailed as the only game in town



## Adopting the Tune of Phrase: An Emotional Symphony within **Electrodynamic Theory Of Superconductors**

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