

Quantum Hall Effect

Zyun Francis Ezawa

Quantum Hall Effect:

The Quantum Hall Effect Richard E. Prange, Steven M. Girvin, 2012-12-06 After a foreword by Klaus von Klitzing the first chapters of this book discuss the prehistory and the theoretical basis as well as the implications of the discovery of the Quantum Hall effect on superconductivity superfluidity and metrology including experimentation The second half of this volume is concerned with the theory of and experiments on the many body problem posed by fractional effect Specific unsolved problems are mentioned throughout the book and a summary is made in the final chapter The quantum Hall effect was discovered on about the hundredth anniversary of Hall's original work and the finding was announced in 1980 by von Klitzing Dorda and Pepper Klaus von Klitzing was awarded the 1985 Nobel prize in physics for this discovery Hall Effect Michael Stone, 1992 This book is a compilation of major reprint articles on one of the most intriguing phenomena in modern physics the quantum Hall effect Together with a detailed introduction by the editor this volume serves as a stimulating and valuable reference for students and research workers in condensed matter physics and for those with a particle physics background The papers have been chosen with the intention of emphasizing the topological aspects of the quantum Hall effect and its connections with other branches of theoretical physics such as topological quantum field theories and string theory The contents include sections on integer effect fractional effect effect of global topology effective theories edge states and non Abelian statistics **Quantum Hall Effect** Giuseppe Morandi, 1988 **Ouantum Hall Effects: Recent** Theoretical And Experimental Developments (3rd Edition) Zyun Francis Ezawa, 2013-03-21 Enthusiasm for research on the quantum Hall effect QHE is unbounded The QHE is one of the most fascinating and beautiful phenomena in all branches of physics Tremendous theoretical and experimental developments are still being made in this sphere Composite bosons composite fermions and anyons were among distinguishing ideas in the original edition In the 2nd edition fantastic phenomena associated with the interlayer phase coherence in the bilayer system were extensively described The microscopic theory of the QHE was formulated based on the noncommutative geometry Furthermore the unconventional QHE in graphene was reviewed where the electron dynamics can be treated as relativistic Dirac fermions and even the supersymmetric quantum mechanics plays a key role In this 3rd edition all chapters are carefully reexamined and updated A highlight is the new chapter on topological insulators Indeed the concept of topological insulator stems from the QHE Other new topics are recent prominent experimental discoveries in the QHE provided by the experimentalists themselves in Part V This new edition presents an instructive and comprehensive overview of the QHE It is also suitable for an introduction to quantum field theory with vividly described applications Only knowledge of quantum mechanics is assumed This book is ideal for students and researchers in condensed matter physics particle physics theoretical physics and mathematical physics

The Quantum Hall Effect Richard E. Prange, Steven M. Girvin, 2012-12-06 analyze the Hall effect in the plateau region relative to the fundamental value 2 h e i expected in the simple one electron picture for integer filling factors of Landau

levels Subsequent work in my laboratory in Wiirzburg using a super conducting solenoid confirmed the constancy of the Hall resistance both in Dorda's samples and in samples supplied by M Pepper of the Cavendish Laboratory With technical assistance from the Physikalisch Technische Bundesanstalt in Braunschweig an absolute measurement of the Hall resistance confirmed the 2 fundamental quantization relation RIJ h ei to an accuracy of about 1 part in 05 Recalling the practical applications of the Josephson effect my initial thinking was oriented toward the idea of a resistance standard but various groups at national laboratories which are involved in high precision measurements of fun damental constants pointed out that in addition the quantized Hall resistance yields a new fundamental measure of the fine structure constant Ci These then were the initial events which led to the remarkable surge of interest within both the metrology and condensed matter physics communities in quantum transport in inversion layer systems Subsequent developments have been many and varied and are described in detail in this volume The Quantum Hall Effects Tapash Chakraborty, Pekka Pietiläinen, 2013-03-12 The experimental discovery of the fractional quantum Hall effect FQHE at the end of 1981 by Tsui Stormer and Gossard was absolutely unexpected since at this time no theoretical work existed that could predict new struc tures in the magnetotransport coefficients under conditions representing the extreme quantum limit It is more than thirty years since investigations of bulk semiconductors in very strong magnetic fields were begun Under these conditions only the lowest Landau level is occupied and the theory predicted a monotonic variation of the resistivity with increasing magnetic field depending sensitively on the scattering mechanism However the ex perimental data could not be analyzed accurately since magnetic freeze out effects and the transitions from a degenerate to a nondegenerate system complicated the interpretation of the data For a two dimensional electron the positive background charge is well separated from the two gas where dimensional system magnetic freeze out effects are barely visible and an analysis of the data in the extreme quantum limit seems to be easier First measurements in this magnetic field region on silicon field effect transistors were not successful because the disorder in these devices was so large that all electrons in the lowest Landau level were localized Consequently models of a spin glass and finally of a Wigner solid were developed and much effort was put into developing the technology for improving the quality of semi conductor materials and devices especially in the field of two dimensional electron systems

Perspectives in Quantum Hall Effects Sankar Das Sarma, Aron Pinczuk, 2008-07-11 The discovery of the quantized and fractional Quantum Hall Effect phenomena is among the most important physics findings in the latter half of this century The precise quantization of the electrical resistance involved in the quantized Hall effect phenomena has led to the new definition of the resistance standard and has metrologically affected all of science and technology This resource consists of contributions from the top researchers in the field who present recent experimental and theoretical developments Each chapter is self-contained and includes its own set of references guiding readers to original papers and further reading on the topic **The Fractional Quantum Hall Effect** Tapash Chakraborty, Pekka Pietiläinen, 2012-12-06 The experimental

discovery of the fractional quantum Hall effect FQHE at the end of 1981 by Tsui Stormer and Gossard was absolutely unexpected since at this time no theoretical work existed that could predict new struc tures in the magnetotransport coefficients under conditions representing the extreme quantum limit It is more than thirty years since investigations of bulk semiconductors in very strong magnetic fields were begun Under these conditions only the lowest Landau level is occupied and the theory predicted a monotonic variation of the resistivity with increasing magnetic field depending sensitively on the scattering mechanism However the ex perimental data could not be analyzed accurately since magnetic freeze out effects and the transitions from a degenerate to a nondegenerate system complicated the interpretation of the data For a two dimensional electron gas where the positive background charge is well separated from the two dimensional system magnetic freeze out effects are barely visible and an analysis of the data in the extreme quantum limit seems to be easier First measurements in this magnetic field region on silicon field effect transistors were not successful because the disorder in these devices was so large that all electrons in the lowest Landau level were localized Consequently models of a spin glass and finally of a Wigner solid were developed and much effort was put into developing the technology for improving the quality of semi conductor materials and devices especially in the field of two dimensional electron systems to the Theory of the Integer Quantum Hall Effect Martin Janßen, 1994-08-09 This book has been conceived as a multipurpose introduction and comprises three parts that can be viewed as independent units The reader can start at any level The first part chapters 2 3 A is intended to convey physical insight into the subject The next part chapters 4 8 presents linear response theory as a basic tool and gives various applications of the theory. The final part chapters 9 12 develops modern aspects such as localization transition as a critical phenomenon and the methods of finite size scaling and multifractal analysis Experimental and theoretical physicists graduate students as well as experts in transport theory will discover new aspects and interesting perspectives on magneto transport The Quantum Hall Effects Tapash Chakraborty, Pekka Pietiläinen, 1995-07-12 The experimental discovery of the fractional quantum Hall effect FQHE at the end of 1981 by Tsui Stormer and Gossard was absolutely unexpected since at this time no theoretical work existed that could predict new struc tures in the magnetotransport coefficients under conditions representing the extreme quantum limit It is more than thirty years since investigations of bulk semiconductors in very strong magnetic fields were begun Under these conditions only the lowest Landau level is occupied and the theory predicted a monotonic variation of the resistivity with increasing magnetic field depending sensitively on the scattering mechanism However the ex perimental data could not be analyzed accurately since magnetic freeze out effects and the transitions from a degenerate to a nondegenerate system complicated the interpretation of the data For a two dimensional electron the positive background charge is well separated from the two gas where dimensional system magnetic freeze out effects are barely visible and an analysis of the data in the extreme quantum limit seems to be easier First measurements in this magnetic field region on silicon field effect transistors were not

successful because the disorder in these devices was so large that all electrons in the lowest Landau level were localized Consequently models of a spin glass and finally of a Wigner solid were developed and much effort was put into developing the technology for improving the quality of semi conductor materials and devices especially in the field of two dimensional Theory of the Integer and Fractional Quantum Hall Effects Shosuke Sasaki, 2016 This book aims to describe the physics of the integer and fractional quantum Hall effects OHE from a theoretical side In the classical Hall effect the Hall resistance is proportional to the applied magnetic field strength and varies continuously So the discovery of a stepwise change of the Hall resistance by von Klitzing in an ultra thin layer of a MOSFET was a big surprise The QHE is a macroscopic phenomenon and shows the exact quantum structure which is one of the most fundamental phenomena in physics The fractional quantum Hall effect has been explained assuming quasi particles with fractional charges or Jain s composite fermions the existence of which has not been verified experimentally. The author has been developing a theory based on a standard treatment of an interacting electron system without assuming any quasi particle This book will be easily understood by undergraduate students in physics Knowledge of quantum field theory is needed to study Chapter 9 Quantum Hall Effect Daijiro Yoshioka, 2002-02-26 The fractional quantum Hall effect has opened up a new paradigm in the study of strongly correlated electrons and it has been shown that new concepts such as fractional statistics anyon chiral Luttinger liquid and composite particles are realized in two dimensional electron systems. This book explains the quantum Hall effects together with these new concepts starting from elementary quantum mechanics Fractional Quantum Hall Effects: New Developments Bertrand I Halperin, Jainendra K Jain, 2020-06-09 The fractional quantum Hall effect has been one of the most active areas of research in quantum condensed matter physics for nearly four decades serving as a paradigm for unexpected and exotic emergent behavior arising from interactions This book featuring a collection of articles written by experts and a Foreword by Klaus von Klitzing the discoverer of quantum Hall effect and winner of 1985 Nobel Prize in physics aims to provide a coherent account of the exciting new developments and the current status of the field

Introduction to Quantum Hall Effect Keshav Narin Shrivastava,2002 NMR in quantum Hall effect is described and electronic polarization at half filled Landau levels is given Important appendices are provided BOOK JACKET The Quantum Hall Effect Richard E. Prange, Marvin E. Cage, Steven M. Girvin, 1990 The Quantum Hall Effect Benoît Douçot, Vincent Pasquier, Vincent Rivasseau, 2005-07-19 The Poincar Seminar is held twice a year at the Institut Henri Poincar in Paris The goal of this seminar is to provide up to date information about general topics of great interest in physics Both the theoretical and experimental results are covered with some historical background Particular care is devoted to the pedagogical nature of the presentation This volume is devoted to the quantum Hall effect After a historical and general presentation by Nobel prize winner Klaus von Klitzing discoverer of this effect the volume proceeds with reviews on the mathematics and physics of both the integer and fractional case It includes up to date presentations of the tunneling and

metrology experiments related to the quantum Hall effect It will serve the community of physicists and mathematicians at professional or graduate student level **Quantum Hall Effect** A. H. MacDonald,1989 **Mesoscopic Quantum Hall Effect** Ivan Levkivskyi,2012-08-18 In recent years remarkable progress in the fabrication of novel mesoscopic devices has produced a revival of interest in quantum Hall physics New types of measurements more precise and efficient than ever have made it possible to focus closely on the electronic properties of quantum Hall edge states This is achieved by applying charge and heat currents at mesoscopic length scales attaching metallic gates and Ohmic contacts and splitting edge channels with the help of quantum point contacts The experiments reveal fascinating new phenomena such as the interference statistics and topological phase shifts of fractionally charged quasi particles strong interaction and correlation effects and phase transitions induced by non Gaussian fluctuations The thesis discusses some puzzling results of these experiments and presents a coherent picture of mesoscopic effects in quantum Hall systems which accounts for integer and fractional filling factors and ranges from microscopic theory to effective models and covers both equilibrium and non equilibrium phenomena

Excitations in the Fractional Quantum Hall Effect Pekka Pietiläinen,1988 Quantum Hall Effect Keshav Narin Shrivastava,2005 This book explains the calculations of Laughlin and Schrieffer and shows how they are modified when the magnetic length is treated properly The attachment of flux quanta to the electron has been discussed at length and experimental reports are re examined in the light of variable magnetic length The angular momentum theory of the Quantum Hall Effect explains the experimental data as is well based on theoretical grounds An effort is made to compromise the flux attached electron theory with the angular momentum theory which shows that some of the composite fermions become bosons The Quantum Hall effect is explained on the basis of angular momentum theory The importance of the negative spin has been discussed The considerable amount of literature is reviewed

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