Two-Dimensional Electron Systems - E.Y. Andrei 2012-12-06 Recent studies on two-dimensional systems have led to new insights into the fascinating interplay between physical properties and dimensionality. Many of these ideas have emerged from work on electrons bound to the surface of a weakly polarizable substrate such as liquid helium or solid hydrogen. The research on this subject continues to be at the forefront of modern condensed matter physics because of its fundamental simplicity as well as its connection to technologically useful devices. This book is the first comprehensive overview of experimental and theoretical research in this exciting field. It is intended to provide a coherent introduction for graduate students and non-experts, while at the same time serving as a reference source for active researchers in the field. The chapters are written by individuals who made significant contributions and cover a variety of specialized topics. These include the origin of the surface states, tunneling and magneto-tunneling out of these states, the phase diagram, collective excitations, transport and magneto-transport.

The Physics of the Two-Dimensional Electron Gas - J.T. Devreese 2012-12-24 The 1986 Advanced Study Institute on "The Physics of the Two-Dimen sional Electron Gas" took place at the Conference Centre i'ITer Helme", close to Oostende (Belgium), from June 2 till 16, 1986. We were motivated to organize this Advanced Study Institute in view of the recent experimental and theoretical progress in the study of the two-dimensional electron gas. An additional motivation was our own theoretical interest in cyclotron resonance in two-dimensional electron systems at our institute. It is my pleasure to thank several instances and people who made this Advanced Study Institute possible. First of all, the sponsor of the Advanced Study Institute, the NATO Scientific Committee. Furthermore, the co-sponsors: Afqa Gevaert, Bell Telephone Mfg. Co. N.V., Burroughs Belgium. Control Data. Digital Equipment Corporation, Esso Belgium. European Research Office (USA). Kredietbank. National Science Foundation (USA). Special thanks are due to the members of the Organizing Committee. I would also like to thank Mrs. H. Evans for typing assistance.

The Physics of the Two-Dimensional Electron Gas - J.T. Devreese 2012-12-06 The 1986 Advanced Study Institute on "The Physics of the Two-Dimensional Electron Gas" took place at the Conference Centre i'ITer Helme", close to Oostende (Belgium), from June 2 till 16, 1986. We were motivated to organize this Advanced Study Institute in view of the recent experimental and theoretical progress in the study of the two-dimensional electron gas. An additional motivation was our own theoretical interest in cyclotron resonance in two-dimensional electron systems at our institute. It is my pleasure to thank several instances and people who made this Advanced Study Institute possible. First of all, the sponsor of the Advanced Study Institute, the NATO Scientific Committee. Furthermore, the co-sponsors: Afqa Gevaert, Bell Telephone Mfg. Co. N.V., Burroughs Belgium. Control Data. Digital Equipment Corporation, Esso Belgium. European Research Office (USA). Kredietbank. National Science Foundation (USA). Special thanks are due to the members of the Program Committee and the members of the Organizing Committee. I would also like to thank Mrs. H. Evans for typing assistance.

Spin-orbit Coupling Effects in Two-Dimensional Electron and Hole Systems - Roland Winkler 2003-10-10 The first part provides a general introduction to the electronic structure of quasi-two-dimensional systems with a particular focus on group-theoretical methods. The main part of the monograph is devoted to spin-orbit coupling phenomena at zero and nonzero magnetic fields. Throughout the book, the main focus is on a thorough discussion of the physical ideas and a detailed interpretation of the results. Accurate numerical calculations are complemented by simple and transparent analytical models that capture the important physics.

Tunneling Between Two Dimensional Electron Systems in a High Magnetic Field and Crystalline Phases of a Two Dimensional Electron System in a Magnetic Field - Filippos Klironomos 2005 We further study the collective states formed by the 2D electrons at low Landau levels by working from a semi-classical and microscopic perspective and evaluating the elastic moduli, normal modes, and zero-point and cohesive energies of the different crystalline structures. The effects of screening from filled Landau levels and finite thickness of the sample are found not to influence the overall interplay of the phases. When probing the internal degrees of the crystalline structures, the energy is lowered considerably (which signifies that these degrees have a prominent physical importance).


Two-Dimensional Electron Systems - E.Y. Andrei 1997-09-30 Recent studies on two-dimensional systems have led to new insights into the fascinating interplay between physical properties and dimensionality. Many of these ideas have emerged from work on electrons bound to the surface of a weakly polarizable substrate such as liquid helium or solid hydrogen. The research on this subject continues to be at the forefront of modern condensed matter physics because of its fundamental simplicity as well as its connection to technologically useful devices. This book is the first comprehensive overview of experimental and theoretical research in this exciting field. It is intended to provide a coherent introduction for graduate students and non-experts, while at the same time serving as a reference source for active researchers in the field. The chapters are written by individuals who made significant contributions and cover a variety of specialized topics. These include the origin of the surface states, tunneling and magneto-tunneling out of these states, the phase diagram, collective excitations, transport and magneto-transport.
Quantum Wells—Alexander Y. Shik 1997-01-01 This invaluable book is devoted to the physics, technology and device applications of semiconductor structures with ultrathin layers where the electronic properties are governed by the quantum-mechanical laws. Such structures called quantum wells or structures with the two-dimensional electron gas, have become one of the most actively investigated objects in modern solid state physics. Electronic properties of quantum wells differ dramatically from those of bulk semiconductors, which allows one to observe new types of physical phenomena, such as the quantum Hall effect and many other so-far-unknown kinetic and optical effects. This, in turn, offers wide opportunities for creating semiconductor devices based on new principles, and it has given birth to the new branch of electronics called nanoelectronics.

Ground States of the Two-Dimensional Electron System at Half-Filling under Hydrostatic Pressure—Katherine A. Schreiber 2019-09-04 This thesis presents the discovery of a surprising phase transition between a topological and a broken symmetry phase. Phase transitions between broken symmetry phases involve a change in symmetry and those between topological phases require a change in topological order; in rare cases, however, transitions may occur between these two broad classes of phases in which the vanishing of the topological order is accompanied by the emergence of a broken symmetry. This thesis describes observations of such a special phase transition in the two-dimensional electron gas confined in the GaAs/AlGaAs structures. When tuned by hydrostatic pressure, the $v = 5/2$ and $v = 7/2$ fractional quantum Hall states, believed to be prototypical non-Abelian topological phases of the Pfaffian universality class, give way to an electronic nematic phase. Remarkably, the fractional quantum Hall states involved are due to pairing of emergent particles called composite fermions. The findings reported here, therefore, provide an interesting example of competition of pairing and nematicity. This thesis provides an introduction to quantum Hall physics of the two-dimensional electron gas, contains details of the high pressure experiments, and offers a discussion of the ramifications and of the origins of the newly reported phase transition.

Magnetocconductivity of Two-dimensional Electron Systems—Frank Oliver Kuehnel 2000

Magnetophotoluminescence and Ultrafast Spectroscopy on High-Mobility Two-Dimensional Electron Systems—Patrick Schröter 2004

Two-dimensional Electron Gas in Monolayer InN Quantum Wells—2014 We report in this letter experimental results that confirm the two-dimensional nature of the electron systems in monolayer InN quantum wells embedded in GaN barriers. The electron density and mobility of the two-dimensional electron system (2DES) in these InN quantum wells are 5×1015 cm-2 and 420 cm2/Vs, respectively. Moreover, the diagonal resistance of the 2DES shows virtually no temperature dependence in a wide temperature range, indicating the topological nature of the 2DES.

Correlation Effects in Low-Dimensional Electron Systems—Ayao Okiji 2012-12-06 Correlation Effects in Low-Dimensional Electron Systems describes recent developments in theoretical condensed-matter physics, emphasizing exact solutions in one dimension including conformal-field theoretical approaches, the application of quantum groups, and numerical diagonalization techniques. Various key properties are presented for two-dimensional, highly correlated electron systems.

Report on DOE Proposal "Electronic Transport in Disordered Two Dimensional Electron Systems"—2004 Under the support of the DOE grant, studied the electronic transport properties in an interacting two-dimensional electron system and the magneto-transport properties, such as giant magneto-resistance (GMR) or colossal magneto-resistance (CMR).

Magnetothermal Effect in Two-Dimensional Electron Systems—A. Ishihara 1984 Adiabatic variation of a strong magnetic field is expected to produce strong temperature oscillations in two-dimensional electron systems at low temperatures. (Author).


Strongly Correlated Electrons in Two Dimensions—Sergey Kravchenko 2017-05-25 The properties of strongly correlated electrons confined in two dimensions are a forefront area of modern condensed matter physics. In the past two or three decades, strongly correlated electron systems have garnered a great deal of scientific interest due to their unique and often unpredictable behavior. Two of many examples are the metallic state and the metal-insulator transition discovered in 2D semiconductors: phenomena that cannot occur in noninteracting systems. Tremendous efforts have been made, in both theory and experiment, to create an adequate understanding of the situation; however, a consensus has still not been reached. Strongly Correlated Electrons in Two Dimensions compiles and details cutting-edge research in experimental and theoretical physics of strongly correlated electron systems by leading scientists in the field. The book covers recent theoretical work exploring the quantum criticality of Mott and Wigner-Mott transitions, experiments on the metal-insulator transition and related phenomena in clean and dilute systems, the effect of spin and isospin degrees of freedom on low-temperature transport in two dimensions, electron transport near the 2D Mott transition, experimentally observed temperature and magnetic field dependencies of resistivity in silicon-based systems with different levels of disorder, and microscopic theory of the interacting electrons in two dimensions. Edited by Sergey Kravchenko, a prominent experimentalist, this book will appeal to advanced graduate-level students and researchers specializing in condensed matter physics, nanophysics, and low-temperature physics, especially those involved in the science of strongly correlated, 2D semiconductors, and conductor-insulator transitions.

High-frequency Measurements of Two-dimensional Electron Systems on 4 He-films—Johannes Voss 2003

Memory Function for Cyclotron Resonance of Two-dimensional Electron Systems—A. Ishihara 1985 Coulomb effects on cyclotron resonance in two-dimensional electron systems are investigated based on a self-consistent approach which improves the random-phase approximation. The memory function in the dynamic magnetocconductivity depends on the electron density not only through the filling factor $v$ but also on its combination with the dimensionless density parameter $r$ sub $s$ in the form $r$ sub $s$ $v$ to the 3/2 power. The memory function reproduces the data of Wilson, Allen and Tsui for intermediate densities.

Electron-electron Interactions in 12g Two-dimensional Electron Gases—John Robert Tolksma 2017 In this thesis I discuss the effects of electron-electron interactions on the properties of recently created two-dimensional conducting layers which form near the surface or interface of transition-metal oxides, most commonly SrTiO3. Although these systems typically contain far fewer than one conduction band electron per unit cell, and are therefore most appropriately described using two-dimensional electron gas (2DEG) models, they are distinct from previous 2DEGs in that unique single-particle characteristics (e.g multiple occupied bands at the Fermi energy, strong band-anisotropy, varying band-edge energy differences) are inherited from the $d$ (subscript $d$) d-orbitals which form the low-energy bands. The interplay of the long-range Coulomb interaction with these unique single-particle characteristics leads to many novel results and is the central theme of this thesis. The contents of this dissertation are separated into two complimentary parts. In the first part I propose a model intended to qualitatively capture the electron-electron interaction physics of two-dimensional electron gases formed near transition-metal oxide heterojunctions containing $d$ (subscript $d$) electrons with a density much smaller than one electron per metal atom. Two-dimensional electron systems of this type can be described perturbatively using a GW approximation which predicts that Coulomb interactions enhance quasiparticle effective masses more strongly than in simple two-dimensional electron gases, and that they reshape the Fermi surface, reducing its anisotropy. In the second part of this thesis I describe a variational theory of multi-band two-dimensional electron gases that captures the interplay between electrostatic confining potentials, orbital-dependent interlayer electronic hopping and electron-electron interactions, and apply it to the d-band two-dimensional electron gases.
that form near perovskite oxide surfaces and heterojunctions. These multi-band two-dimensional electron gases are prone to the formation of Coulomb-interaction-driven orbitally-ordered nematic ground-states. I find that as the electron density is lowered and interaction effects strengthen, spontaneous orbital order occurs first, followed by spin order. I compare my results with known properties of single-component two-dimensional electron gas systems and comment on closely related physics in semiconductor quantum wells and van der Waals heterostructures.

**Peculiarities in Equilibrium Tunneling Between Disordered Two-Dimensional Electron Systems: From Fermi Edge Singularity to Linear Gap in High Magnetic Field**

Yu V. Dubrovska 2001 We have investigated equilibrium tunneling between disordered two-dimensional electron systems at temperature below 0.3 K and in a wide range of magnetic field normal to the electron layers. Observed transformation of a narrow conductance peak of about 1 mV width at zero bias into the narrow dip with magnetic field is discussed in the frame of many-electron interaction effects in tunnel phenomena.

**Thermopower in Two Dimensional Electron Systems**

John Paul Oxley 1991

**Lateral Tunneling in Two-dimensional Electron Systems**

A. J. Peck 1994

**Aspects of Critical Behavior of Two Dimensional Electron Systems**

Maxim A. Metlitski 2011

**Scanning Probe Study of a Two-dimensional Electron System and Donor Layer Charging in Heterostructured Semiconductors**

Irma Kuljanishvili 2005

**Investigation of Electron-nuclear Spin Interactions in Two-dimensional Electron Systems Via Magnetoresistively Detected Magnetic Resonance**

Joshua D. Caldwell 2004 ABSTRACT: The polarization of the electron spins and their interactions with the local nuclei are of considerable interest within two-dimensional electron systems (2DES) within the regime of the quantum Hall effect (QHE). Electron spin resonance (ESR) is an ideal experimental technique to probe both of these features. Unfortunately, due to the low electron densities, it is not usually possible to detect the ESR spectra via typical absorption techniques.

**Magnetotransport in GaN and GaAs Two-dimensional Electron Systems**

Lucas Steinke 2004

**Quantum Hall Effect in Perpendicular Two-dimensional Electron Systems**

Lucia Steinke 2004

**Magnetotransport in Multi-component Two-dimensional Electron Systems**

Tsong-Sheng Lay 1996

**Magnetisation Measurements of Two-dimensional Electron Systems**

Russell A. Shepherd 1996

**Multi-valley Physics of Two-dimensional Electron Systems on Hydrogen-terminated Silicon (111) Surfaces**

Robert Nicholas McFarland 2010

**Studies of Two-dimensional Electron Systems in Semiconductors at High Magnetic Fields**

David F. Howell 1989

**Terahertz Magneto-Optical Spectroscopy of Two-Dimensional Hole and Electron Systems**

2015 Two-dimensional hole gases (2DHGs) have attracted recent attention for their unique quantum physics and potential applications in areas including spintronics and quantum computing. However, their properties remain relatively unexplored, motivating the use of different techniques to study them. We used terahertz magneto-optical spectroscopy to investigate the cyclotron resonance frequency in a high mobility 2DHG, revealing a nonlinear dependence on the applied magnetic field. This is also shown to be due to the complex non-parabolic valence band structure of the 2DHG, as verified by multiband Landau level calculations. We also find that impurity scattering dominates cyclotron resonance decay in the 2DHG, in contrast with the dominance of superradiant damping in two-dimensional electron gases. These results shed light on the properties of 2DHGs, motivating further studies of these unique 2D nanosystems.

**Lateral Tunneling in Two-dimensional Electron Systems**

Andrew John Peck 1994

**Charge Accumulation Imaging of a Two-dimensional Electron System**

Subhasish Chakraborty 2003

**Heterostructure Design of Si/SiGe Two-dimensional Electron Systems for Field-effect Devices**

Michael Schmalzhauser 2015-04-22 2D-confined carrier systems have given access to the exploration of manifold quantum effects in fundamental research and also led to numerous device concepts for commercial electronic applications. Additionally, the possibility to control the 2D carrier density via gate voltages through the electric field-effect offers a great advantage of external manipulation of the system. With the optimization of lithography on a nanometre scale, gated 2D systems in semiconductor heterostructures are currently intensively studied as platforms for few to single-carrier devices. In this context, a precise control of the heterostructure layout including the doping, as well as an understanding of charge reconfiguration effects within the device, are important challenges. This thesis, addresses the heterostructure optimization and focuses on a precise field-effect control of Schottky top-gated modulation doped Si/SiGe heterostructures. For the optimization of the heterostructure design, several parameters which affect the strain, the band offset and the doping degree in Si/SiGe two-dimensional electron systems are precisely studied. In parallel, the field-effect influence on Si/SiGe heterostructures is used to identify the origin of disorder and possible sources of charge noise. In this connection, finally a modified charge transfer model including a polarizability of neutral phosphorous atoms inside the doping layer is developed.

**Fractionally Quantized Hall Effect in Two-Dimensional Systems of Extreme Electron Concentration**

E. E. Mendez 1984 We report magnetotransport measurements, down to 0.050 K and up to 20 T, in two-dimensional systems with dilute and dense electron densities. The emphasis is on the latter regime, where the Hall resistance shows quantization for level filling factors at v=4/3 and 3/3, and the magnetoresistance presents well-defined structures at v=7/3 and 8/3. These results indicate that the fractional quantum Hall effect is a general phenomenon not restricted to the lowest-orbital Landau level. Keywords include: Fractional quantum hall effect, Two-dimensional electron systems, Magnetotransport, Semiconductor heterostructures.

**Unconventional Magnetoresistance of Two-dimensional and Three-dimensional Electron Systems**

Peter Daniel Scheuninger 1995

**Resonant Spin Hall Effect in Two-dimensional Electron Systems**

2006