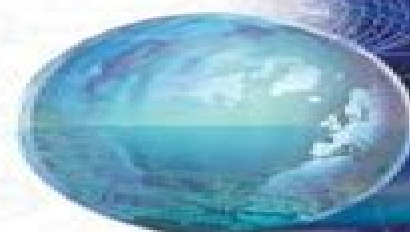


Advanced Series in Mathematical Physics – Volume 18

# **Exactly Solvable Models of Strongly Correlated Electrons**

**Vladimir E. Korepin  
Fabian H. L. Eßler**



# Exactly Solvable Models Of Strongly Correlated Electronics

**Vladimir M. Akulin**



## **Exactly Solvable Models Of Strongly Correlated Electronics:**

**Exactly Solvable Models of Strongly Correlated Electrons** Vladimir E. Korepin, Fabian H. L. Essler, 1994 Systems of strongly correlated electrons are at the heart of recent developments in condensed matter theory They have applications to phenomena like high  $c$  superconductivity and the fractional quantum hall effect Analytical solutions to such models though mainly limited to one spatial dimension provide a complete and unambiguous picture of the dynamics involved This volume is devoted to such solutions obtained using the Bethe Ansatz and concentrates on the most important of such models the Hubbard model The reprints are complemented by reviews at the start of each chapter and an extensive bibliography

**Off-Diagonal Bethe Ansatz for Exactly Solvable Models** Yupeng Wang, Wen-Li Yang, Junpeng Cao, Kangjie Shi, 2015-04-21 This book serves as an introduction of the off diagonal Bethe Ansatz method an analytic theory for the eigenvalue problem of quantum integrable models It also presents some fundamental knowledge about quantum integrability and the algebraic Bethe Ansatz method Based on the intrinsic properties of  $R$  matrix and  $K$  matrices the book introduces a systematic method to construct operator identities of transfer matrix These identities allow one to establish the inhomogeneous  $TQ$  relation formalism to obtain Bethe Ansatz equations and to retrieve corresponding eigenstates Several longstanding models can thus be solved via this method since the lack of obvious reference states is made up Both the exact results and the off diagonal Bethe Ansatz method itself may have important applications in the fields of quantum field theory low dimensional condensed matter physics statistical physics and cold atom systems

**Strongly Correlated Systems, Coherence And Entanglement** J M P Carmelo, J M B Lopes Dos Santos, Vitor Joao Rocha Vieira, Pedro Sacramento, 2007-07-12 This volume presents a collection of review papers on recent work in the connected areas of strongly correlated systems the effects of coherence on macroscopic systems and entanglement in quantum systems These areas have attracted considerable interest due to their complexity and associated unexpected nontrivial phenomena and also due to their potential applications in various fields from materials science to information technology The coverage includes strongly correlated electronic systems such as low dimensional complex materials ordered and disordered spin systems and aspects of the physics of manganites and graphene both in equilibrium and far from equilibrium

**Strongly Correlated Systems** Adolfo Avella, Ferdinando Mancini, 2013-04-05 This volume presents for the very first time an exhaustive collection of those modern numerical methods specifically tailored for the analysis of Strongly Correlated Systems Many novel materials with functional properties emerging from macroscopic quantum behaviors at the frontier of modern research in physics chemistry and material science belong to this class of systems Any technique is presented in great detail by its own inventor or by one of the world wide recognized main contributors The exposition has a clear pedagogical cut and fully reports on the most relevant case study where the specific technique showed to be very successful in describing and enlightening the puzzling physics of a particular strongly correlated system The book is intended for advanced graduate students and post docs in the

field as textbook and or main reference but also for other researchers in the field who appreciate consulting a single but comprehensive source or wishes to get acquainted in a as painless as possible way with the working details of a specific technique

Models of Quantum Matter Hans-Peter Ecker, 2019 The book introduces tools with which models of quantum matter are built The most important technique the Bethe ansatz is developed in detail to perform exact calculations of the physical properties of quantum matter

*Coherent Dynamics of Complex Quantum Systems* Vladimir M. Akulin, 2005-09-13 Coherent Dynamics of Complex Quantum Systems is aimed at senior level undergraduate students in the areas of atomic molecular and laser physics physical chemistry quantum optics and quantum informatics It should help them put particular problems in these fields into a broader scientific context and thereby take advantage of the well elaborated technique of the adjacent fields

**Self-consistent Quantum-Field Theory and Bosonization for Strongly Correlated Electron Systems** Rudolf Haussmann, 2003-07-01 This research monograph offers an introduction to advanced quantum field theoretical techniques for many particle systems beyond perturbation theory Several schemes for resummation of the Feynman diagrams are described The resulting approximations are especially well suited for strongly correlated fermion and boson systems Also considered is the crossover from BCS superconductivity to Bose Einstein condensation in fermion systems with strong attractive interaction In particular a field theoretic formulation of bosonization is presented it is published here for the first time This method is applied to the fractional quantum Hall effect to the Coulomb plasma and to several exactly solvable models

*Strong Coulomb Correlations in Electronic Structure Calculations* Vladimir I Anisimov, 2000-05-30 Materials where electrons show nearly localized rather than itinerant behaviour such as the high temperature superconducting copper oxides or manganate oxides are attracting interest due to their physical properties and potential applications For these materials the interaction between electrons or electron correlation plays an important role

Physics Letters, 1999 General physics atomic physics molecular physics and solid state physics

Quantum Inverse Scattering Method and Correlation Functions V. E. Korepin, Vladimir E. Korepin, N. M. Bogoliubov, A. G. Izergin, 1997-03-06 The quantum inverse scattering method is a means of finding exact solutions of two dimensional models in quantum field theory and statistical physics such as the sine Gordon equation or the quantum non linear Schrödinger equation These models are the subject of much attention amongst physicists and mathematicians The present work is an introduction to this important and exciting area It consists of four parts The first deals with the Bethe ansatz and calculation of physical quantities The authors then tackle the theory of the quantum inverse scattering method before applying it in the second half of the book to the calculation of correlation functions This is one of the most important applications of the method and the authors have made significant contributions to the area Here they describe some of the most recent and general approaches and include some new results The book will be essential reading for all mathematical physicists working in field theory and statistical physics

**Electronic Correlation And Disorder Effects In Metals - Proceedings Of Winter Workshop On**

**Condensed Matter Physics** S N Behera,1991-03-20 The proceedings provide an up to date self contained status report of the developments in the fields of high temperature superconductivity and heavy fermion systems      **New Theoretical**

**Approaches to Strongly Correlated Systems** Alexei M. Tsvelik,2012-12-06 For many years the physics of strongly correlated systems was considered a theorists playground right at the border with pure mathematics where physicists from the real world did not venture The time has come however when healthy physics cannot exist without these techniques and results Lectures on selected topics in the theory of strongly correlated systems are here presented by the leading experts in the field Topics covered include a use of the form factor approach in low dimensional systems applications of quantum field theory to disorder and dynamical mean field theory The main divisions of the book deal with I Quantum Critical Points II Strongly Correlated One Dimensional Systems III Strong Correlations and Disorder and IV Dynamical Mean Field Theory

**Chinese Physics Letters** ,2005      **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  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_x$   $T_c$  40K and  $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$   $T_c$  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  $T_c$  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  $T_c$  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  $T_c$  superconductivity applications and considerable progress has been made This volume brings together new leading edge research in the field      **Two-dimensional Strongly Correlated Electronic**

**Systems** China Center of Advanced Science and Technology,1989 This book addresses present problems and looks towards the future development of new ideas in the field The series of lectures places emphasis on the theoretical development of high  $T_c$  superconducting oxide materials Contributions include an introduction to strongly correlated systems the basic concepts of the Mott insulator the fractional quantum Hall effect and a review of the current thoughts on resonating valence bonds Research techniques such as variational Monte Carlo methods mean field theories and topological excitations are also covered The book will be of general interest and value to graduate students and researchers involved in the study of condensed matter theory      **Statistical Mechanics And The Physics Of Many-particle Model Systems** Alexander

Leonidovich Kuzemsky, 2017-02-24 The book is devoted to the study of the correlation effects in many particle systems It presents the advanced methods of quantum statistical mechanics equilibrium and nonequilibrium and shows their effectiveness and operational ability in applications to problems of quantum solid state theory quantum theory of magnetism and the kinetic theory The book includes description of the fundamental concepts and techniques of analysis following the approach of N N Bogoliubov s school including recent developments It provides an overview that introduces the main notions of quantum many particle physics with the emphasis on concepts and models This book combines the features of textbook and research monograph For many topics the aim is to start from the beginning and to guide the reader to the threshold of advanced researches Many chapters include also additional information and discuss many complex research areas which are not often discussed in other places The book is useful for established researchers to organize and present the advanced material disseminated in the literature The book contains also an extensive bibliography The book serves undergraduate graduate and postgraduate students as well as researchers who have had prior experience with the subject matter at a more elementary level or have used other many particle techniques     The Universality of Physics Ramzi R. Khuri, James T. Liu, Feng Chen, Wenbiao Gan, 2012-12-06

Deng Feng Wang was born February 8 1965 in Chongqing City China and died August 15 1999 while swimming with friends in the Atlantic Ocean off Island Beach State Park New Jersey In his brief life he was to have an influence far beyond his years On August 12th 2000 The Deng Feng Wang Memorial Conference was held at his alma mater Princeton University during which Deng Feng s mentors collaborators and friends presented scientific talks in a testimonial to his tremendous influence on their work and careers The first part of this volume contains proceedings contributions from the conference with plenary talks by Nobel Laureate Professor Phil Anderson of Princeton University and leading Condensed Matter Theorists Professor Piers Coleman of Rutgers University and Professor Christian Gruber of the University of Lausanne Other talks given by collaborators friends and classmates testify to the great breadth of Deng Feng Wang s influence with remarkable connections shown between seemingly unrelated areas in physics such as Condensed Matter Physics Superconductivity One Dimensional Models Statistical Physics Mathematical Physics Quantum Field Theory High Energy Theory Nuclear Magnetic Resonance Supersymmetry M Theory and String Theory in addition to such varied fields outside of physics such as Oil Drilling Mixed Signal Circuits and Neurology The second part of the volume consists of reprints of some of Deng Feng Wang s most important papers in the areas of Condensed Matter Physics Statistical Physics Magnetism Mathematical Physics and Mathematical Finance This volume represents a fascinating synthesis of a wide variety of topics and ultimately points to the universality of physics and of science as a whole As such it represents a fitting tribute to a remarkable individual whose tragic death will never erase his enduring influence     **The Hubbard Model** Dionys

Baeriswyl, David K. Campbell, Jose M.P. Carmelo, Francisco Guinea, Enrique Louis, 2013-11-11 In the slightly more than thirty years since its formulation the Hubbard model has become a central component of modern many body physics It provides a

paradigm for strongly correlated interacting electronic systems and offers insights not only into the general underlying mathematical structure of many body systems but also into the experimental behavior of many novel electronic materials In condensed matter physics the Hubbard model represents the simplest theoretical framework for describing interacting electrons in a crystal lattice Containing only two explicit parameters the ratio  $U/t$  between the Coulomb repulsion and the kinetic energy of the electrons and the filling  $p$  of the available electronic band and one implicit parameter the structure of the underlying lattice it appears nonetheless capable of capturing behavior ranging from metallic to insulating and from magnetism to superconductivity Introduced originally as a model of magnetism of transition metals the Hubbard model has seen a spectacular recent renaissance in connection with possible applications to high  $T_c$  superconductivity for which particular emphasis has been placed on the phase diagram of the two dimensional variant of the model In mathematical physics the Hubbard model has also had an essential role The solution by Lieb and Wu of the one dimensional Hubbard model by Bethe Ansatz provided the stimulus for a broad and continuing effort to study solvable many body models In higher dimensions there have been important but isolated exact results e g Nagaoka's Theorem

**First Principles Approaches to Spectroscopic Properties of Complex Materials** Cristiana Di Valentin, Silvana Botti, Matteo Cococcioni, 2014-09-26 The series Topics in Current Chemistry presents critical reviews of the present and future trends in modern chemical research The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology medicine and materials science The goal of each thematic volume is to give the non specialist reader whether in academia or industry a comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed The coverage is not intended to be an exhaustive summary of the field or include large quantities of data but should rather be conceptual concentrating on the methodological thinking that will allow the non specialist reader to understand the information presented Contributions also offer an outlook on potential future developments in the field Review articles for the individual volumes are invited by the volume editors Readership research chemists at universities or in industry graduate students

**Quantum Physics in One Dimension** Thierry Giamarchi, 2004 This volume presents in a pedagogical yet complete way correlated systems in one dimension After an introduction to the basic concepts of correlated systems it gives a step by step description of the techniques needed to treat one dimension and discusses the resulting physics

The book delves into Exactly Solvable Models Of Strongly Correlated Electronics. Exactly Solvable Models Of Strongly Correlated Electronics is a vital topic that must be grasped by everyone, from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Exactly Solvable Models Of Strongly Correlated Electronics, encompassing both the fundamentals and more intricate discussions.

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