Series on Advances in Quantum Many-Body Theory – Vol. 11

Proceedings of the 14th International Conference

RECENT PROGRESS *in* MANY-BODY THEORIES

Editors

Jordi Boronat

Gregory E. Astrakharchik

Ferran Mazzanti

World Scientific

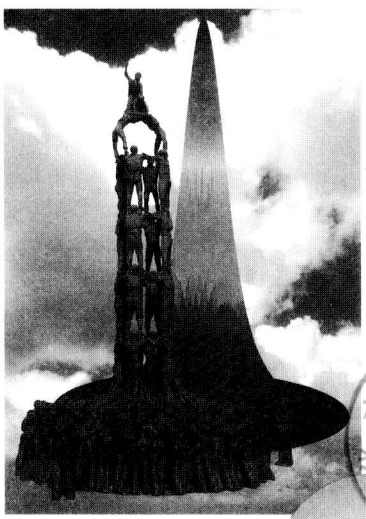
0413.3-53
R295
2007

Series on Advances in Quantum Many-Body Theory – Vol. 11

Proceedings of the 14th International Conference

RECENT PROGRESS *in* MANY-BODY THEORIES

Barcelona, Spain 16 – 20 July 2007



Editors

Jordi Boronat
Gregory E. Astrakharchik
Ferran Mazzanti

Universitat Politècnica de Catalunya
Spain

南理工大学 图书馆藏书

E2009002684

World Scientific

NEW JERSEY • LONDON • SINGAPORE • BEIJING • SHANGHAI • HONG KONG • TAIPEI • CHENNAI

Published by

World Scientific Publishing Co. Pte. Ltd.

5 Toh Tuck Link, Singapore 596224

USA office: 27 Warren Street, Suite 401-402, Hackensack, NJ 07601

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Series on Advances in Quantum Many-Body Theories
RECENT PROGRESS IN MANY-BODY THEORIES
Proceedings of the 14th International Conference

Copyright © 2008 by World Scientific Publishing Co. Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. In this case permission to photocopy is not required from the publisher.

ISBN-13 978-981-277-987-8
ISBN-10 981-277-987-6

Printed in Singapore by B & JO Enterprise

RECENT PROGRESS
in
MANY-BODY THEORIES

FOREWORD

The Fourteenth International Conference on *Recent Progress in Many-Body Theories* (RPMBT-14) was held at the Technical University of Catalonia (UPC), Barcelona, Spain, 16-20 July 2007. The present volume contains most of the invited talks plus a selection of excellent poster presentations.

This conference series is now firmly established as one of the premier series of international meetings in the field of Many-Body physics. The first official RPMBT meeting was held in Trieste in 1978, in response to several precursor meetings that accentuated the need for a continuing series. The most important of these, which can be regarded as RPMBT-0, is the 1972 conference on *The Nuclear Many-Body Problem* organized by F. Calogero and C. Cioffi degli Atti in Rome. Additionally, there were two very significant workshops held in 1975 and 1977 at the University of Illinois, Urbana, with Vijay Pandharipande as the chief organizer. Later conferences in the series have been the 1981 RPMBT-2 meeting in Oaxtepec, Mexico; the 1983 RMPBT-3 meeting in Altenberg, Germany; the 1985 RPMBT-4 meeting in San Francisco, USA; the 1987 RPMBT-5 meeting in Oulu, Finland; the 1989 RPMBT-6 meeting in Arad, Israel; the 1991 RPMBT-7 meeting in Minneapolis, USA; the 1994 RPMBT-8 meeting in Schloss Seggau, Styria, Austria; the 1997 RPMBT-9 meeting in Sydney, Australia; the 1999 RPMBT-10 meeting in Seattle, USA; the 2001 RPMBT-11 meeting in Manchester, UK; the 2004 RPMBT-12 meeting in Santa Fe, USA; the 2005 RPMBT-13 meeting at Buenos Aires, Argentina, and the present 2007 meeting in Barcelona, Spain. Highlights and a more detailed history of past meetings can be found in earlier volumes of this series.

This conference series is also responsible for awarding the prestigious Eugene Feenberg Memorial Medal in Many-Body Physics. This Medal, first presented in 1985, is designated for work that is firmly established and that can be demonstrated to have significantly advanced the field of many-body physics. The work considered can be accumulative contributions sustained over time, or a single important contribution. In appropriate cases, the award can be shared by as many as three people for a single body of work. More details on the Feenberg Medal and its nomination process can be found in the Conference Series official website *http://www.qmbt.org/Feenberg/index.php?doc=Feenberg.*

Past recipients have included David Pines (1985), John W. Clark (1987), Malvin H. Kalos (1989), Walter Kohn (1991), David M. Ceperley (1994), Lev P. Pitaevskii (1997), Anthony J. Leggett (1999), Philippe Noziéres (2001), Spartak T. Belyaev and Lev P. Gor'kov (2004), and Raymond F. Bishop and Hermann G. Kümmel

此为试读,需要完整PDF请访问: www.ertongbook.com

(2005). Professors Kohn and Leggett received the Nobel Prize in 1998 and 2003 respectively.

We are pleased that the Feenberg Medal was awarded at this conference to Professors Stefano Fantoni and Eckhard Krotscheck, "for their leading role in the development and extensive applications of the correlated basis function method, including the advance of Fermi hypernetted chain theory, thereby providing an accurate, quantitative, microscopic description of strongly-interacting quantum many-body systems, especially for finite atomic nuclei and inhomogeneous quantum fluids". In addition to their outstanding research achievments, both have been inspirational models for a generation of many-body theorists. The presentation was made by Jordi Boronat, Chair of the Feenberg Medal Selection Committee in a special Award Session held in Barcelona's world famous Science Museum CosmoCaixa. The text of the tribute, as well as the responses of the Medal recipients are included in this volume.

Another highlight of this conference is the presentation of the inaugural Hermann Kümmel Early Achievement Award in Many-Body Physics to Dr. Frank Verstraete of Universit Wien, Austria, in recognition of his pioneering work on quantum information and entanglement. This award was established by the International Advisory Committee of the Conference Series to recognize outstanding published work done within six years of receiving the doctorate degree. The award honors Prof. Kümmel's long and distinguished career as a leader in the field of many-body physics and as a mentor of younger generations of many-body physicists. More details on the Kümmel award can again be found at

http://www.qmbt.org/Kuemmel/index.php?doc=KuemmelAward.

The quality of nominees for this award was so outstanding that the Selection Committee recommended that Honorable Mentions be given to Dr. Gregory E. Astrakharchik of the Technical University of Catalonia, Barcelona, Spain, for his calculation of the BEC-BCS crossover in dilute Fermi gases, and to Dr. Robert Zillich of Johannes Kepler Universität, Linz, Austria, for his quantum Monte Carlo simulation of strongly correlated quantum fluids. The presentation was made by Susana Hernandez, Chair of the Kümmel Award Selection Committee, in the special Award Session.

The current conference maintains the tradition of covering the entire spectrum of theoretical tools developed to tackle important and current quantum many-body problems, with the aim of fostering the exchange of ideas and techniques among physicists working in diverse subfields of physics. The highlights of the conference included state-of-the-art contributions on the dynamics and rotation of ultra-cold quantum gases, BEC-BCS cross-over, quantum liquid and solids, correlated electron systems and superconductivity, correlated nuclear systems and nuclear astrophysics, quantum computations and quantum Monte Carlo simulations. The conference continues to demonstrate the vitality and the fundamental importance of many-body theories, techniques, and applications in understanding diverse and novel phenonomena at the cutting-edge of physics.

We thank the Program Advisory Committee for recommending excellent topics and great speakers for the Conference. We are very much indebted to each member of the Local Organizing Committee: Jordi Boronat, Artur Polls, Jesús Navarro, Joaquim Casulleras, Ferran Mazzanti, Muntsa Guilleumas and Gregory Astrakharchik, for their tireless labor and attention to details, which made this meeting productive and memorable. Above all, we are all in awe of Jordi's singular devotion and energy, which made this conference possible.

Siu A. Chin
Chair, International Advisory Committee
for the Series of International Conferences on
Recent Progress in Many-Body Theories
College Station, U.S.A.

ORGANIZING COMMITTEES

SERIES EDITORIAL BOARD

for the Series on Advances in Quantum Many-Body Theory

R. F. Bishop (Chairman)	– UMIST, Manchester, UK
C. E. Campbell	– University of Minnesota, USA
J. W. Clark	– Washington University, St. Louis, USA
S. Fantoni	– SISSA, Trieste, Italy

INTERNATIONAL ADVISORY COMMITTEE

for the Series of International Conferences on Recent Progress in Many-Body Theories

Siu A. Chin (Chairman)	– Texas A & M University, USA
Charles E. Campbell (Treasurer)	– University of Minnesota, USA
Hermann Kümmel (Hon. President)	– Ruhr-Universität Bochum, Germany
Raymond F. Bishop	– University of Manchester , UK
Joe A. Carlson	– Los Alamos National Laboratory, USA
John W. Clark	– Washington University, St. Louis, USA
Peter Fulde	– Max-Planck-Institut für Komplexer Systeme, Dresden, Germany
Susana Hernández	– Universidad de Buenos Aires, Argentina
Eckhard Krotscheck	– Johannes Kepler Universität Linz, Austria
Claire Lhuillier	– Université Pierre et Marie Curie, France
Allan MacDonald	– Indiana University, USA
Efstratios Manousakis	– Florida State University, USA
David Neilson	– University of Camerino, Italy
Gerardo Ortiz	– Indiana University, USA
Artur Polls	– Universitat de Barcelona, Spain
Mikko Saarela	– University of Oulu, Finland
Masahito Ueda	– Tokyo Institute of Technology, Japan

PROGRAMME COMMITTEE FOR THE FOURTEENTH CONFERENCE

Marcello Baldo	– INFN, Italy
Manuel Barranco	– Universitat de Barcelona ,Spain
Raymond Bishop	– University of Manchester, UK
Enrique Buendía	– Universidad de Granada, Spain
Charles E. Campbell	– University of Minessota, USA
Joe Carlson	– LANL, USA
Ignacio Cirac	– MPQ, Germany
John W. Clark	– Washington University, St. Louis, USA
Jorge Dukelsky	– CSIC , Spain
Stefano Giorgini	– University of Trento ,Italy
Susana Hernández	– Universidad de Buenos Aires, Argentina
Morten Hjorth-Jensen	– University of Oslo, Norway
Eckhard Krotscheck	– Johannes Kepler Universität Linz, Austria
David Neilson	– University of Camerino, Italy
Lubos Mitas	– North Carolina State University, USA
Gerardo Ortiz	– Indiana University, USA
Luciano Reatto	– University of Milan, Italy
Mikko Saarela	– University of Oulu, Finland
Kevin Schmidt	– Arizona State University, USA
Masahito Ueda	– Tokyo Institute of Technology, Japan

LOCAL ORGANIZING COMMITTEE FOR THE FOURTEENTH CONFERENCE

Jordi Boronat (Chairman)	– Universitat Politècnica de Catalunya
Gregory E. Astrakharchik	– Universitat Politècnica de Catalunya
Joaquim Casulleras	– Universitat Politècnica de Catalunya
Muntsa Guilleumas	– Universitat de Barcelona
Ferran Mazzanti	– Universitat Politècnica de Catalunya
Jesús Navarro	– Institut de Física Corpuscular (CSIC-UV)
Artur Polls	– Universitat de Barcelona

PREFACE

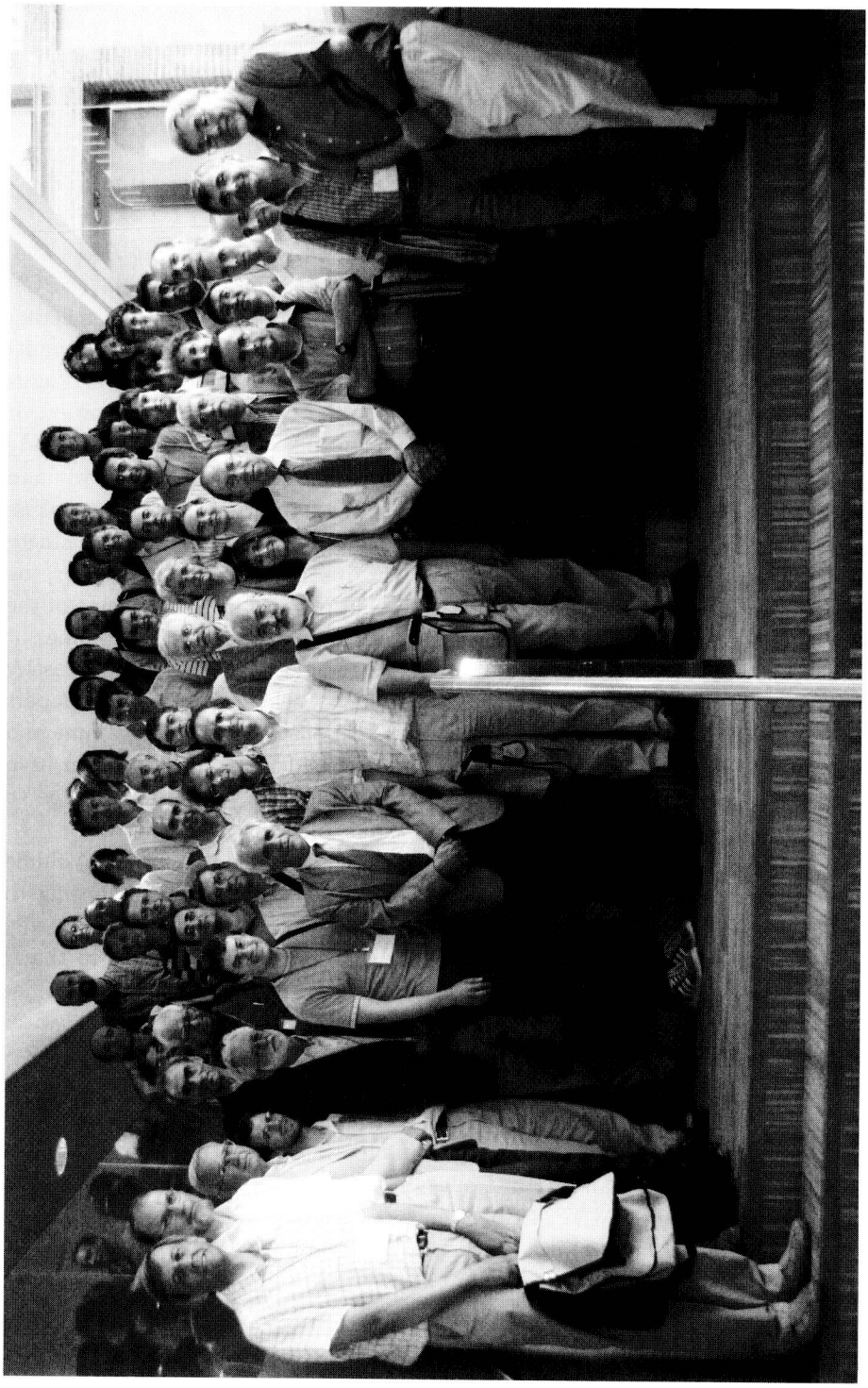
The *Fourteenth International Conference on Recent Progress in Many-Body Theories* (RPMBT14) was held at the Technical University of Catalonia (UPC), Barcelona, Spain over the period 16-20 July, 2007. The sessions of the meeting were organized according to a list of topics proposed by the Programme Committee spanning traditional fields of the Conference Series, such as Quantum Fluids and Solids and Nuclear Physics, and newer fields like Quantum Computation or Cold Quantum Gases, all of them with the common link of Quantum Many-Body Physics. During the Conference, some 45 invited papers were presented orally and approximately 40 contributed papers were presented as posters. All the speakers were requested to submit a paper for this Proceedings Volume and around ninety per cent of them submitted the paper by the tight deadline imposed. Moreover, the Editors made a selection among the poster contributions and offered to some of the authors the opportunity of including their contributions in the present Volume.

Some of the papers are quite interdisciplinary and therefore difficult to classify into a numbered list of topics. Nevertheless, we have decided to group the papers according to the topic session in which they were classified by the Programme and Organizing Committees. The Editors suggest to consider this classification as a guide to the readers, and recommend that they go through the entire Volume to get a deeper insight on the recent progress in the field.

We would like to thank all the people who have made it possible for this Volume to arrive to your hands. First, we warmly thank all the authors contributing to this Volume for their accurate work and close collaboration, and for amending any format problem that emerged during the edition. Second, we would like to thank Siu Chin, Chair of the International Advisory Committee of the Conference Series, for enriching this Volume with a clever preface, to John Clark for his warm remembrance of Eugene Feenberg at the centenary of his birth. We are also grateful to Gerardo Ortiz, Artur Polls and Mikko Saarela for their Laudations of the 2007 Kuemmel Award and Feenberg Medal winners. Finally, we are indebted to the rest of the members of the Organizing Committee, Joaquim Casulleras, Muntsa Guilleumas, Jesús Navarro and Artur Polls, for their invaluable advices and help in the organization of the RPMBT14 Conference.

Jordi Boronat
Gregory E. Astrakharchik
Ferran Mazzanti

Barcelona, Spain
5 January 2008



Group picture

此为试读,需要完整PDF请访问: www.ertongbook.com

CONTENTS

Foreword v

Organizing Committees ix

Preface xi

FEENBERG MEDAL AND KUEMMEL AWARD PRESENTATIONS 1

The legacy of Eugene Feenberg at the centenary of his birth 3
J. W. Clark

Stefano Fantoni: Feenberg Medalist 2007: Microscopic Many-Body Theory of Strongly Correlated Systems 11
A. Polls

Eckhard Krotscheck: Feenberg Medalist 2007: Microscopic Many-Body Theory of Quantum Fluids 16
M. Saarela

Frank Verstraete: Hermann Kuemmel Award 2007 20
G. Ortiz

Quantum Monte Carlo calculations for nuclei and nuclear matter 23
S. Fantoni, S. Gandolfi, F. Pederiva, and K. E. Schmidt

Static and Dynamic Many-Body Correlations 39
E. Krotscheck and C. E. Campbell

Entanglement in many-body quantum physics 53
F. Verstraete

COLD BOSE AND FERMI GASES 63

New states of quantum matter 65
G. Baym

Stationary Josephson effect in the BCS–BEC Crossover 75
A. Spuntarelli, P. Pieri, and G. C. Strinati

Ultra-cold dipolar gases 79
C. Menotti and M. Lewenstein

Crystalline phase of strongly interacting Fermi mixtures 94
D. D. Petrov, G. E. Astrakharchik, D. Papoular, C. Salomon, and G. V. Shlyapnikov

Localization and glassiness of bosonic mixtures in optical lattices 106
T. Roscilde, B. Horstmann, and J. I. Cirac

Scattering of a sound wave on a vortex in Bose–Einstein condensates 111
P. Capuzzi, F. Federici, and M. P. Tosi

Static properties of a system of Bose hard rods in one dimension 116
F. Mazzanti, G. E. Astrakharchik, J. Boronat, and J. Casulleras

A scenario for studying off-axis vortices in Bose–Einstein condensates 120
D. M. Jezek, H. M. Cataldo, and P. Capuzzi

NUCLEAR AND SUBNUCLEAR PHYSICS 125

Strangeness nuclear physics 127
A. Ramos

Many-body methods for nuclear systems at subnuclear densities 138
A. Sedrakian and J. W. Clark

Correlations as a function of nucleon asymmetry: The lure of dripline physics 148
W. H. Dickhoff

Fermi hypernetted chain description of doubly closed shell nuclei 152
F. Arias de Saavedra, C. Bisconti, and G. Co'

Many-body challenges in nuclear-astrophysics 156
G. Martínez-Pinedo

Coupled-cluster approach to an *ab-initio* description of nuclei 168
D. J. Dean, G. Hagen, M. Hjorth-Jensen, and T. Papenbrock

Developing New Many-Body Approaches for No-Core Shell Model Calculations 172
B. R. Barrett, A. F. Lisetskiy, P. Navràtil, I. Stetcu, and J. P. Vary

Applications of in-medium chiral dynamics to nuclear structure 176
P. Finelli

Variational Calculations of the Equation of State of Nuclear Matter 181
M. Takano, H. Kanzawa, K. Oyamatsu, and K. Sumiyoshi

Refinement of the variational method with approximate energy expressions by taking into account 4-body cluster terms 185
K. Tanaka and M. Takano

COMPUTATIONAL QUANTUM MANY-BODY 191

Nodal properties of fermion wave functions 193
L. Mitas and M. Bajdich

Simulating rotating BEC: Vortices formation and over-critical rotations 203
S. A. Chin

Polarizability in quantum dots via correlated quantum Monte Carlo 213
L. Colletti, F. Pederiva, E. Lipparini, and C. J. Umrigar

Progress in Coupled Electron-Ion Monte Carlo Simulations of High-Pressure Hydrogen 217
C. Pierleoni, K. T. Delaney, M. A. Morales, D. M. Ceperley, and M. Holzmann

PHASE TRANSITIONS 233

Quantum phase transitions on percolating lattices 235
T. Vojta and J. A. Hoyos

Ground-state properties of a homogeneous 2D system of Bosons with dipolar interactions 245
G. E. Astrakharchik, J. Boronat, J. Casulleras, I. L. Kurbakov, and Yu. E. Lozovik

Liquid-solid transition in Bose systems at $T = 0$ K: Analytic results about the ground state wave function 251
E. Vitali, D. E. Galli, and L. Reatto

The exact renormalization group and pairing in many-fermion systems 255
N. R. Walet

The spin-1/2 and spin-1 quantum J_1–J_1'–J_2 Heisenberg models on the square lattice 265
R. F. Bishop, P. H. Y. Li, R. Darradi, and J. Richter

Liquid-gas phase transition in nuclear matter within a correlated approach 275
A. Rios, A. Polls, A. Ramos, and H. Müther

QUANTUM LIQUIDS AND SOLIDS 279

Small clusters of para-hydrogen 281
R. Guardiola and J. Navarro

Adhesive forces on helium in nontrivial geometries 291
E. S. Hernández, A. Hernando, R. Mayol, and M. Pi

Rotational Spectra in Helium-4 Clusters and Droplets: Size Dependence and Rotational Linewidth 295
R. E. Zillich and K. B. Whaley

Microscopic studies of solid ^{4}He with path integral projector Monte Carlo 300
M. Rossi, R. Rota, E. Vitali, D. E. Galli, and L. Reatto

Liquid ^{4}He inside (10,10) carbon nanotubes 312
M. C. Gordillo, J. Boronat and J. Casulleras

Spatial microstructure of fcc quantum crystals 316
M. J. Harrison and K. A. Gernoth

STRONGLY CORRELATED ELECTRONS 321

Nucleation of vortices in superconductors in confined geometries 323
W. M. Wu, M. B. Sobnack, and F. V. Kusmartsev

The correlated density and the Bernoulli potential in superconductors 332
K. Morawetz, P. Lipavský, and J. Koláček

Electron Correlations in Solids: From High-Temperature Superconductivity to Half-Metallic Ferromagnetism 336
E. Arrigoni, L. Chioncel, H. Allmaier, M. Aichhorn, and W. Hanke

Excitons and polaritons in an optical lattice for cold-atoms within a cavity 346
H. Zoubi and H. Ritsch

ATOMS AND MOLECULES 351

Fixed-Node Quantum Monte Carlo for Chemistry 353
M. Caffarel and A. Ramírez-Solís

Quantum Monte Carlo for the electronic structure of atomic systems 364
A. Sarsa, E. Buendía, F. J. Gálvez, and P. Maldonado

Hierarchical method for the dynamics of metal clusters in contact with an environment 374
G. Bousquet, P. M. Dinh, J. Messud, E. Suraud, M. Baer, F. Fehrer, and P.-G. Reinhard

Population transfer processes: From atoms to clusters and Bose–Einstein condensate 379
V. O. Nesterenko, F. F. de Souza Cruz, E. L. Lapolli, and P.-G. Reinhard

QUANTUM COMPUTATION 385

Generalized entanglement in static and dynamic quantum phase transitions 387
S. Deng, L. Viola, and G. Ortiz

Entanglement percolation in quantum networks: How to establish large distance quantum correlations? 398
A. Acín, M. Lewenstein, and J. I. Cirac

NEW FRONTIERS 409

Phonon-roton excitations and quantum phase transitions in liquid ^{4}He in nanoporous media 411
H. R. Glyde, J. V. Pearce, J. Bossy, and H. Schober

Topological quantum order: A new paradigm in the physics of matter 423
Z. Nussinov and G. Ortiz

Thermal rectification in one-dimensional chains 431
N. Zeng and J.-S. Wang

Author Index 435

Subject Index 437

此为试读,需要完整PDF请访问: www.ertongbook.com