Operator Algebras And Quantum Statistical Mechanics Equilibrium States Models In Quantum Statistical Mechanics Theoretical And Mathematical Physics

Like the first Abel Symposium, held in 2004, the Abel Symposium 2015 focused on operator algebras. It is interesting to see the remarkable advances that have been made in operator algebras over these years, which strikingly illustrate the vitality of the field. A total of 26 talks were given at the symposium on a variety of themes, all highlighting the richness of the subject. The field of operator algebras was created in the 1930s and was motivated by problems of quantum mechanics. It has subsequently developed well beyond its initial intended realm of applications and expanded into such diverse areas of mathematics as representation theory, dynamical systems, differential geometry, number theory and quantum algebra. One branch, known as “noncommutative geometry”, has become a powerful tool for studying phenomena that are beyond the reach of classical analysis. This volume includes research papers that present new results, surveys that discuss the development of a specific line of research, and articles that offer a combination of survey and research. These contributions

provide a multifaceted portrait of beautiful mathematics that both newcomers to the field of operator algebras and seasoned researchers alike will appreciate.
This collection of papers by leading researchers provides a broad picture of current research directions in index theory. Based on lectures presented at the NSF-CBMS Regional Conference on K-Homology and Index Theory, held in August 1991 at the University of Colorado at Boulder, the book provides both a careful exposition of new perspectives in classical index theory and an introduction to currently active areas of the field. Presented here are two new proofs of the classical Atiyah-Singer Index Theorem, as well as index theorems for manifolds with boundary and open manifolds. Index theory for semi-simple p-adic groups and the geometry of discrete groups are also discussed. Through-out the book, the application of operator algebras emerges as a central theme. Aimed at graduate students and researchers, this book would be suitable as a text for an advanced graduate topics course on index theory.
In the last 20 years, the study of operator algebras has developed from a branch of functional analysis to a central field of mathematics with applications and connections with different areas in both pure mathematics (foliations, index theory, K-theory, cyclic homology, affine Kac--Moodyalgebras, quantum groups, low dimensional topology) and mathematical physics (integrable theories,

statistical mechanics, conformal field theories and the string theories of elementary particles). The theory of operator algebras was initiated by von Neumann and Murray as a tool for studying grouprepresentations and as a framework for quantum mechanics, and has since kept in touch with its roots in physics as a framework for quantum statistical mechanics and the formalism of algebraic quantum field theory. However, in 1981, the study of operator algebras took a new turn with theintroduction by Vaughan Jones of subfactor theory and remarkable connections were found with knot theory, 3-manifolds, quantum groups and integrable systems in statistical mechanics and conformal field theory. The purpose of this book, one of the first in the area, is to look at thesecombinatorial-algebraic developments from the perspective of operator algebras; to bring the reader to the frontline of research with the minimum of prerequisites from classical theory.

This book is concerned with the theory of unbounded derivations in C*-algebras, a subject whose study was motivated by questions in quantum physics and statistical mechanics, and to which the author has made considerable contributions. This is an active area of research, and one of the most ambitious aims of the theory is to develop quantum statistical mechanics within the framework of C*-theory. The presentation concentrates on topics involving

quantum statistical mechanics and differentiations on manifolds. One of the goals is to formulate the absence theorem of phase transitions in its most general form within the C* setting. For the first time, the author globally constructs, within that setting, derivations for a fairly wide class of interacting models, and presents a new axiomatic treatment of the construction of time evolutions and KMS states. Based on presentations given at the NordForsk Network Closing Conference “Operator Algebra and Dynamics,” held in Gjáargarður, Faroe Islands, in May 2012, this book features high quality research contributions and review articles by researchers associated with the NordForsk network and leading experts that explore the fundamental role of operator algebras and dynamical systems in mathematics with possible applications to physics, engineering and computer science. It covers the following topics: von Neumann algebras arising from discrete measured groupoids, purely infinite Cuntz-Krieger algebras, filtered K-theory over finite topological spaces, C*-algebras associated to shift spaces (or subshifts), graph C*-algebras, irrational extended rotation algebras that are shown to be C*-alloys, free probability, renewal systems, the Grothendieck Theorem for jointly completely bounded bilinear forms on C*-algebras, Cuntz-Li algebras associated with the a-adic numbers, crossed products of injective endomorphisms (the so-called Stacey crossed products), the interplay between

dynamical systems, operator algebras and wavelets on fractals, C*-completions of the Hecke algebra of a Hecke pair, semiprojective C*-algebras, and the topological dimension of type I C*-algebras. Operator Algebra and Dynamics will serve as a useful resource for a broad spectrum of researchers and students in mathematics, physics, and engineering.

In this book we describe the elementary theory of operator algebras and parts of the advanced theory which are of relevance, or potentially of relevance, to mathematical physics. Subsequently we describe various applications to quantum statistical mechanics. At the outset of this project we intended to cover this material in one volume but in the course of develop ment it was realized that this would entail the omission of various interesting topics or details. Consequently the book was split into two volumes, the first devoted to the general theory of operator algebras and the second to the applications. This splitting into theory and applications is conventional but somewhat arbitrary. In the last 15-20 years mathematical physicists have realized the importance of operator algebras and their states and automorphisms for problems offield theory and statistical mechanics. But the theory of 20 years ago was largely developed for the analysis of group representations and it was inadequate for many physical applications. Thus after a short honey moon period in which the new found tools of the extant theory were applied to the most amenable problems a longer and more interesting period ensued in which mathematical physicists were forced to

redevelop the theory in relevant directions. New concepts were introduced, e. g. asymptotic abelian ness and KMS states, new techniques applied, e. g. the Choquet theory of barycentric decomposition for states, and new structural results obtained, e. g. the existence of a continuum of nonisomorphic type-three factors.

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asymptotic abelian ness and KMS states, new techniques applied, e. g. the Choquet theory of barycentric decomposition for states, and new structural results obtained, e. g. the existence of a continuum of nonisomorphic type-three factors.

Three-part treatment covers background material on definitions, terminology, operators in Hilbert space domains of representations, operators in the enveloping algebra, spectral theory; and covariant representation and connections. 2017 edition.

This concise and readable book addresses primarily readers with a background in classical statistical physics and introduces quantum mechanical notions as required. Conceived as a primer to bridge the gap between statistical physics and quantum information, it emphasizes concepts and thorough discussions of the fundamental notions and prepares the reader for deeper studies, not least through a selection of well chosen exercises.

This book offers peer-reviewed articles from the 19th International Conference on Operator Theory, Summer 2002. It contains recent developments in a broad range of topics from operator theory, operator algebras and their applications, particularly to differential analysis, complex functions, ergodic theory, mathematical physics, matrix analysis, and systems theory. The book covers a large variety of topics including single operator theory, C*-algebras, diffrential operators, integral transforms, stochastic processes and operators, and more.

This book introduces a variety of statistical tools for characterising and designing the

dynamical features of complex quantum systems. These tools are applied in the contexts of energy transfer in photosynthesis, and boson sampling. In dynamical quantum systems, complexity typically manifests itself via the interference of a rapidly growing number of paths that connect the initial and final states. The book presents the language of graphs and networks, providing a useful framework to discuss such scenarios and explore the rich phenomenology of transport phenomena. As the complexity increases, deterministic approaches rapidly become intractable, which leaves statistics as a viable alternative.
Professor Gerard G. Emch has been one of the pioneers of the C-algebraic approach to quantum and classical statistical mechanics. In a prolific scientific career, spanning nearly five decades, Professor Emch has been one of the creative influences in the general area of mathematical physics. The present volume is a collection of tributes, from former students, colleagues and friends of Professor Emch, on the occasion of his 70th birthday. The articles featured here are a small yet representative sample of the breadth and reach of some of the ideas from mathematical physics.It is also a testimony to the impact that Professor Emch's work has had on several generations of mathematical physicists as well as to the diversity of mathematical methods used to understand them.
This volume contains the proceedings of the eighteenth International Workshop on Operator Theory and Applications (IWOTA), hosted by the Unit for Business Mathematics and Informatics of North-West University, Potchefstroom, South Africa from July 3 to 6, 2007. The conference (as well as these proceedings) was dedicated to Professors Joseph A. Ball and Marinus M. Kaashoek on the occasion of their 60th and 70th birthdays, respectively. This conference had a particular focus on Von Neumann algebras at the interface of operator theory

with functional analysis and on applications of operator theory to differential equations.
This volume consists of articles contributed by participants at the fourth Ja pan-U.S. Joint Seminar on Operator Algebras. The seminar took place at the University of Pennsylvania from May 23 through May 27, 1988 under the auspices of the Mathematics Department. It was sponsored and supported by the Japan Society for the Promotion of Science and the National Science Foundation (USA). This sponsorship and support is acknowledged with gratitude. The seminar was devoted to discussions and lectures on results and prob lems concerning mappings of operator algebras (C*-and von Neumann alge bras). Among the articles contained in these proceedings, there are papers dealing with actions of groups on C* algebras, completely bounded mappings, index and subfactor theory, and derivations of operator algebras. The seminar was held in honor of the sixtieth birthday of Sh6ichir6 Sakai, one of the great leaders of Functional Analysis for many decades. This vol ume is dedicated to Professor Sakai, on the occasion of that birthday, with the respect and admiration of all the contributors and the participants at the seminar. H. Araki Kyoto, Japan R. Kadison Philadelphia, Pennsylvania, USA Contents Preface.... .... vii On Convex Combinations of Unitary Operators in C*-Algebras UFFE HAAGERUP ..... .

The idea of writing this book appeared when I was working on some problems related to representations of physically relevant infinite - mensional groups of operators on physically relevant Hilbert spaces. The considerations were local, reducing the subject to dealing with representations of infinite-dimensional Lie algebras associated with the associated groups. There is a large number of specialized articles and books on parts of this subject, but to our

suprise only a few represent the point of view given in this book. Moreover, none of the written material was self-contained. At present, the subject has not reached its final form and active research is still being undertaken. I present this subject of growing importance in a unified manner and by a fairly simple approach. I present a route by which students can absorb and understand the subject, only assuming that the reader is familliar with functional analysis, especially bounded and unbounded operators on Hilbert spaces. Moreover, I assume a little basic knowledge of algebras , Lie algebras, Lie groups, and manifolds- at least the definitions. The contents are presented in detail in the introduction in Chap. The manuscript of this book has been succesfully used by some advanced graduate students at Aarhus University, Denmark, in their "A-exame'. I thank them for comments.

For almost two decades, this has been the classical textbook on applications of operator algebra theory to quantum statistical physics. Major changes in the new edition relate to Bose-Einstein condensation, the dynamics of the X-Y model and questions on phase transitions.

This book contains papers presented at the NSF/CBMS Regional Conference on Coordinates in Operator Algebras, held at Texas Christian University in Fort Worth in May 1990. During the conference, in addition to a series of ten lectures by Paul S. Muhly (which will be published in a CBMS Regional Conference Series volume), twenty-eight lectures were delivered by conference participants on a broad range of topics of current interest in operator algebras and operator theory. This volume contains slightly expanded versions of most of those lectures. Participants were encouraged to bring open problems to the conference, and, as a result, over one hundred problems and questions are scattered throughout this volume. Readers will appreciate this book for the overview it provides of current topics and methods of operator

algebras and operator theory.

This volume contains survey papers on the theory of operator algebras based on lectures given at the ``Lluis Santalo'' Summer School of the Real Sociedad Matematica Espanola, held in July 2008 at the Universidad Internacional Menendez Pelayo, in Santander (Spain). Topics in this volume cover current fundamental aspects of the theory of operator algebras, which have important applications such as: K-Theory, the Cuntz semigroup, and Classification for C^*-algebras Modular Theory for von Neumann algebras and applications to Quantum Field Theory Amenability, Hyperbolic Groups, and Operator Algebras. The theory of operator algebras, introduced in the thirties by J. von Neumann and F. J. Murray, was developed in close relationship with fundamental aspects of functional analysis, ergodic theory, harmonic analysis, and quantum physics. More recently, this field has shown many other fruitful interrelations with several areas of mathematics and mathematical physics. This book is published in cooperation with Real Sociedad Matematica Espanola.

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From the reviews: "These three bulky volumes [EMS 124, 125, 127] [...] provide an introduction to this rapidly developing theory. [...] These books can be warmly recommended to every graduate student who wants to become acquainted with this exciting branch of mathematics. Furthermore, they should be on the bookshelf of every researcher of the area." Acta Scientiarum Mathematicarum

During the last few years, the theory of operator algebras, particularly non-self-adjoint operator algebras, has evolved dramatically, experiencing both international growth and interfacing with

other important areas. The present volume presents a survey of some of the latest developments in the field in a form that is detailed enough to be accessible to advanced graduate students as well as researchers in the field. Among the topics treated are: operator spaces, Hilbert modules, limit algebras, reflexive algebras and subspaces, relations to basis theory, C* algebraic quantum groups, endomorphisms of operator algebras, conditional expectations and projection maps, and applications, particularly to wavelet theory. The volume also features an historical paper offering a new approach to the Pythagoreans' discovery of irrational numbers.