

Spectral Theory of Schrödinger Operators on Euclidean and on Non-Euclidean Spaces

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Introduction

In this paper we shall discuss some problems which arise in the study of spectral properties of Schrödinger type operators. We shall consider problems which are associated with the study of the continuous spectrum. These will involve mathematical objects such as the generalized eigenfunctions and the scattering matrix. Typical problems which will interest us will be the problem of validity of a good eigenfunction expansion theorem and the problem of analytic continuation in the "energy" parameter of the generalized eigenfunctions, resolvent kernel and scattering matrix.

We shall consider the following two classes of operators.

(i) Schrödinger operators on \mathbb{R}^n .

(ii) Laplace Beltrami operators acting on Γ -automorphic functions on the hyperbolic plane, where Γ is a finitely generated Fuchsian group with an unbounded fundamental domain.

The motivation for the study of the spectral properties of the two classes of operators is due to two different sources. In the case of Schrödinger operators it comes from physics whereas in the second case it comes from analytic number theory. In spite of this difference in motivation there are striking similarities between the spectral results obtained for the two classes of operators. The purpose of this paper is to dwell on some of these similarities and show that one can derive the main spectral results for the two classes of operators by a unified method based on a single principle relating the generalized eigenfunctions with the asymptotic behavior of the resolvent kernel.

This paper is a written version of a lecture given at the Courant Institute Jubilee Symposium. For the sake of presentation and for reasons of brevity no proofs were included in the original text. Details of some of the results described in this paper will be published elsewhere.

2. Schrödinger Operators on \mathbb{R}^n

We consider first the class of Schrödinger operators on \mathbb{R}^n . These are partial differential operators P of the form:

$$(1.1) \quad P = -\Delta + V,$$

Spectral Theory Of Schrodinger Operators

**Marius Mantoiu, Georgi Raikov, Rafael
Tiedra de Aldecoa**



Spectral Theory Of Schrodinger Operators:

Spectral Theory of Schrodinger Operators Rafael del Río, Carlos Villegas-Blas, 2004 This volume gathers the articles based on a series of lectures from a workshop held at the Institute of Applied Mathematics of the National University of Mexico The aim of the book is to present to a non specialized audience the basic tools needed to understand and appreciate new trends of research on Schrodinger operator theory Topics discussed include various aspects of the spectral theory of differential operators the theory of self adjoint operators finite rank perturbations spectral properties of random Schrodinger operators and scattering theory for Schrodinger operators The material is suitable for graduate students and research mathematicians interested in differential operators in particular spectral theory of Schrodinger operators

Spectral Theory of Random Schrödinger Operators Reinhard Lang, 2006-11-14 The interplay between the spectral theory of Schrödinger operators and probabilistic considerations forms the main theme of these notes written for the non specialist reader and intended to provide a brief and elementary introduction to this field An attempt is made to show basic ideas in statu nascendi and to follow their evaluation from simple beginnings through to more advanced results The term genetic in the title refers to this procedure The author concentrates on 2 topics which in the history of the subject have been of major conceptual importance on the one hand the Laplacian is a random medium and the left end of its spectrum leading to large deviation problems for Brownian motion and the link to the notion of entropy and on the other Schrödinger operators with general ergodic potentials in one dimensional space Ideas and concepts are explained in the simplest possible setting and by means of a few characteristic problems with heuristic arguments preceding rigorous proofs

Spectral Theory of Random Schrödinger Operators R. Carmona, J. Lacroix, 2012-12-06 Since the seminal work of P Anderson in 1958 localization in disordered systems has been the object of intense investigations Mathematically speaking the phenomenon can be described as follows the self adjoint operators which are used as Hamiltonians for these systems have a tendency to have pure point spectrum especially in low dimension or for large disorder A lot of effort has been devoted to the mathematical study of the random self adjoint operators relevant to the theory of localization for disordered systems It is fair to say that progress has been made and that the understanding of the phenomenon has improved This does not mean that the subject is closed Indeed the number of important problems actually solved is not larger than the number of those remaining Let us mention some of the latter A proof of localization at all energies is still missing for two dimensional systems though it should be within reachable range In the case of the two dimensional lattice this problem has been approached by the investigation of a finite discrete band but the limiting procedure necessary to reach the full two dimensional lattice has never been controlled The smoothness properties of the density of states seem to escape all attempts in dimension larger than one This problem is particularly serious in the continuous case where one does not even know if it is continuous

Introduction to Spectral Theory P.D. Hislop, I.M. Sigal, 2012-12-06 The intention of this book is to introduce students to active areas of research in

mathematical physics in a rather direct way minimizing the use of abstract mathematics The main features are geometric methods in spectral analysis exponential decay of eigenfunctions semi classical analysis of bound state problems and semi classical analysis of resonance A new geometric point of view along with new techniques are brought out in this book which have both been discovered within the past decade This book is designed to be used as a textbook unlike the competitors which are either too fundamental in their approach or are too abstract in nature to be considered as texts The authors text fills a gap in the marketplace *Spectral Theory of Random Schrödinger Operators* René Carmona, Jean Lacroix, 1990

Spectral Theory and Wave Operators for the Schrödinger Equation A. M. Berthier, 1982 **Some Contributions to the Spectral Theory of Schrödinger Operators** Dirk Hundertmark, 2002 **Schrödinger Operators, Spectral Analysis and Number Theory** Sergio Albeverio, Anindita Balslev, Ricardo Weder, 2021-06-03 This book gives its readers a unique opportunity to get acquainted with new aspects of the fruitful interactions between Analysis Geometry Quantum Mechanics and Number Theory The present book contains a number of contributions by specialists in these areas as an homage to the memory of the mathematician Erik Balslev and at the same time advancing a fascinating interdisciplinary area still full of potential Erik Balslev has made original and important contributions to several areas of Mathematics and its applications He belongs to the founders of complex scaling one of the most important methods in the mathematical and physical study of eigenvalues and resonances of Schrödinger operators which has been very essential in advancing the solution of fundamental problems in Quantum Mechanics and related areas He was also a pioneer in making available and developing spectral methods in the study of important problems in Analytic Number Theory Spectral Theory of Random Schrödinger Operators R. Carmona, J. LaCroix, 1990-01-01 **Introduction to Spectral Theory of Schrödinger Operators** A. Pankov, 2018 Lecture Notes of introductory course delivered at the Giessen University during teaching year 1999 2000

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Spectral Theory David Borthwick, 2020-03-12 This textbook offers a concise introduction to spectral theory designed for newcomers to functional analysis Curating the content carefully the author builds to a proof of the spectral theorem in the early part of the book Subsequent chapters illustrate a variety of application areas exploring key examples in detail Readers looking to delve further into specialized topics will find ample references to classic and recent literature Beginning with a brief introduction to functional analysis the text focuses on unbounded operators and separable Hilbert spaces as the essential tools needed for the subsequent theory A thorough discussion of the concepts of spectrum and resolvent follows leading to a complete proof of the spectral theorem for unbounded self adjoint operators Applications of spectral theory to differential operators comprise the remaining four chapters These chapters introduce the Dirichlet Laplacian operator Schrödinger operators operators on graphs and the spectral theory of Riemannian manifolds Spectral Theory offers a uniquely

accessible introduction to ideas that invite further study in any number of different directions A background in real and complex analysis is assumed the author presents the requisite tools from functional analysis within the text This introductory treatment would suit a functional analysis course intended as a pathway to linear PDE theory Independent later chapters allow for flexibility in selecting applications to suit specific interests within a one semester course

Spectral Theory of Schrödinger Operators and the Almost Mathieu Operator, 2015 *Some Problems in Spectral Theory of Schrödinger Operators* Jonathan Breuer, 2007

Spectral Theory and Mathematical Physics Marius Mantoiu, Georgi Raikov, Rafael Tiedra de Aldecoa, 2016-06-30 The present volume contains the Proceedings of the International Conference on Spectral Theory and Mathematical Physics held in Santiago de Chile in November 2014 Main topics are Ergodic Quantum Hamiltonians Magnetic Schrödinger Operators Quantum Field Theory Quantum Integrable Systems Scattering Theory Semiclassical and Microlocal Analysis Spectral Shift Function and Quantum Resonances The book presents survey articles as well as original research papers on these topics It will be of interest to researchers and graduate students in Mathematics and Mathematical Physics

[Spectral Theory of Random Schrödinger Operators](#) Kazuaki Taira, Reinhard Lang, 1964

Differential Operators and Spectral Theory M. Sh Birman, Margarita Solomyak, 1999 This volume contains a collection of original papers in mathematical physics spectral theory and differential equations The papers are dedicated to the outstanding mathematician Professor M Sh Birman on the occasion of his 70th birthday Contributing authors are leading specialists and close professional colleagues of Birman The main topics discussed are spectral and scattering theory of differential operators trace formulas and boundary value problems for PDEs Several papers are devoted to the magnetic Schrödinger operator which is within Birman's current scope of interests and recently has been studied extensively Included is a detailed survey of his mathematical work and an updated list of his publications This book is aimed at graduate students and specialists in the above mentioned branches of mathematics and theoretical physicists The biographical section will be of interest to readers concerned with the scientific activities of Birman and the history of those branches of analysis and spectral theory where his contributions were important and often decisive Features The first detailed survey of Birman's mathematical work includes an updated bibliography New material on the history of some branches of analysis Prominent authors Lieb Agmon Deift Simon Ladyzhenskaya and others All original works containing new results in fields of great current interest

Spectral Theory and Mathematical Physics Fritz Gesztesy, 2007

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