

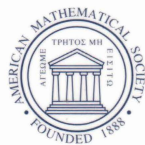
# CONTEMPORARY MATHEMATICS

327

## Advances in Differential Equations and Mathematical Physics

UAB International Conference  
Differential Equations and Mathematical Physics  
March 26–30, 2002  
University of Alabama, Birmingham

Yulia Karpeshina  
Günter Stolz  
Rudi Weikard  
Yanni Zeng  
Editors



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Editors



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**American Mathematical Society**  
Providence, Rhode Island

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## Preface

The 9th International Conference on Differential Equations and Mathematical Physics was held in Birmingham, Alabama, March 26-30, 2002. This conference was part of a series which started in 1981 as a meeting on spectral and scattering theory with 90 participants from North America and Europe, and has since grown, not only in the number of participants and countries, but also by encompassing many other disciplines, such as statistical physics, general relativity, geometric analysis, fluid dynamics, inverse problems and elasticity, among others. The present conference featured 125 talks, and was attended by over 160 participants from 24 countries: Austria (2), Canada (3), Chile (2), China (2), France (6), Germany (15), Israel (3), Japan (4), Mexico (5), Russia (3), South Korea (2), Sweden (6), Switzerland (3), United Kingdom (3), United States (98) and one each from Czech Republic, Denmark, Greece, Hungary, India, Ireland, Kuwait, Turkey, and Venezuela. Previous conferences in the series were held in Birmingham in 1981, 1983, 1986, 1990, 1994, 1999, as well as in Atlanta in 1992 and 1997.

The present proceedings volume features twenty-nine research and survey papers which were contributed by participants of the conference. These contributions were made by invitation of the editors and refereed. In the view of the editors they represent some of the most interesting works which were presented during five days of invited lectures, focus session talks and contributed talks. They are also representative of the major areas of research which were covered at the recent conference, such as spectral theory with applications to non-relativistic and relativistic quantum mechanics, including time-dependent and random potentials, resonances, many body systems, pseudo differential operators and quantum dynamics; inverse spectral and scattering problems; the theory of linear and non-linear partial differential equations with applications in fluid dynamics, conservation laws and numerical simulation; as well as equilibrium and non-equilibrium statistical mechanics.

The main goal of the conference series has been and still is to provide researchers from a broad range of areas encompassing the theory of differential equations and their applications in mathematical physics with a forum to present and discuss their recent results. By now this has brought many leading mathematicians to the conference venues and also given researchers from the southeastern U.S. the opportunity to present their work to an international audience. The present conference was supported through a grant by the US-National Science Foundation (DMS 0120195)<sup>1</sup>. Other financial support was provided by the Alabama Alliance for Minority Participation and by the UAB Department of Mathematics.

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<sup>1</sup>Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The history of the conference is closely linked to the development of the relatively young Mathematics Department at UAB. Organizing a conference of this scale is a truly departmental effort, both from the scientific and the administrative points of view. The editors of this volume acted as organizing committee of the recent conference, but many other faculty and staff members were involved. Almost all graduate and a number of undergraduate students also volunteered their efforts. The decision on whether to run the next conference is never easy. But we feel that by now the significance of the conference series, for UAB as well as for the mathematics community, has grown to the point that we have to keep going. And therefore:

See y'all again in Birmingham!

The Editors  
Birmingham, Alabama  
January 2003

## List of Plenary Speakers

MICHAEL AIZENMAN, Princeton University, USA

*Localization in Schrödinger Dynamics with Random Potentials*

JAMES GLIMM, Stony Brook University, USA

*Predictability and Solution Error Models for Flow in Porous Media*

SVETLANA JITOMIRSKAYA, UC Irvine, USA

*Nonperturbative Localization*

ARI LAPTEV, Royal Institute of Technology in Stockholm, Sweden

*Negative Spectrum of Schrödinger Operators*

JOEL LEBOWITZ, Rutgers University, USA

*Complex Time Evolution of Simple Quantum Systems*

ELLIOTT LIEB, Princeton University, USA

*Stability of a Model of Relativistic Quantum Electrodynamics*

TAI-PING LIU, Stanford University and Academia Sinica, USA and Taiwan

*Boltzmann Equation and Conservation Laws in Gas Dynamics*

CLAUDE-ALAIN PILLET, Université de Toulon, CPT-CNRS/FRUMAM, France

*Spectral Theory of Open Quantum Systems*

JOHANNES SJÖSTRAND, Ecole Polytechnique, Palaiseau, France

*Some Recent Progress on Spectral Asymptotics for Non-Self-Adjoint Operators*

RICARDO WEDER, Universidad Nacional Autónoma de México, Mexico

*The Time-Dependent Approach to Inverse Scattering*



## List of Special Sessions

### **Conservation Laws**

Organizer: GUI-QIANG CHEN, Northwestern University, USA

Speakers: Gui-Qiang Chen, Katarzyna Saxton, Bo Su, Konstantina Trivisa, David Wagner, Robin Young

### **Dynamics and Mathematical Physics**

Organizer: NANDOR SIMANYI, University of Alabama at Birmingham, USA

Speakers: Leonid Bunimovich, Predrag Cvitanovic, Oliver Knill, Marco Lenci, Michael Loss, Thomas J. Murphy, Domokos Szasz

### **Inverse Problems**

Organizer: JOYCE McLAUGHLIN, Rensselaer Polytechnic Institute, USA

Speakers: Gang Bao, Jean-Pierre Fouque, Ji Lin, Liz Rachele, Chris Stolk, Jeong-Rock Yoon

### **Mathematical Fluid Dynamics**

Organizer: SUSAN FRIEDLANDER, University of Illinois at Chicago, USA

Speakers: Radu Cascaval, Susan Friedlander, Yuri Latushkin, Anna Mazzucato, Fedor Nazarov, Natasa Pavlovic, Misha Vishik

### **Quantum Mechanics and Spectral Theory**

Organizer: GIAN-MICHELE GRAF, ETH, Zürich, Switzerland

Speakers: L. Erdos, M. Griesemer, S. Gustafson, G. Hagedorn, P. Hislop, R. Killip, B. Nachtergaele, R. Seiringer

### **Spectral Theory and Wave Propagation**

Organizer: PETER KUCHMENT, Texas A&M University, USA

Speakers: Tuncay Aktosun, Boris Belinskiy, Pavel Exner, Leonid Friedlander, Michael J. Gruber, Peter Kuchment, Vassilis Papanicolaou, Michael Solomyak

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- TUNCAY AKTOSUN, Mississippi State University, USA  
*Wave focusing on the line*
- MARK ASHBAUGH, University of Missouri–Columbia, USA
- GERARD AWANOU, University of Georgia, USA  
*Spline Approximations of the 3D Navier-Stokes Equations*
- GANG BAO, Michigan State, USA
- HORST BEHNCKE, University of Osnabrück, Germany  
*The Spectrum of Differential Operators with Almost Constant Coefficients*
- BORIS BELINSKIY, University of Tennessee at Chattanooga, USA  
*Stability of a general linear mechanical system with a white noise in parameters*
- RAFAEL BENGURIA, P. Universidad Católica de Chile, Chile  
*The Lane-Emden Equation revisited*
- CHRISTER BENNEWITZ, Lund University, Sweden  
*Paley-Wiener methods in inverse spectral theory*
- LYONELL BOULTON, Universidad Simon Bolivar, Caracas, Venezuela  
*D-S projection methods for discrete Schrödinger operators*
- AMIN BOUMENIR, State University of West Georgia, USA  
*Interpolation and Inverse Spectral Theory*
- B. MALCOLM BROWN, Cardiff University, UK  
*Computing the spectrum of the one-dimensional  $p$ -Laplacian*
- LEONID BUNIMOVICH, Georgia Tech, USA  
*Walks in Rigid Environments: Continuous Limits*
- ALMUT BURCHARD, University of Virginia, USA  
*On the Cauchy problem for a dynamical Euler's elastica*
- RADU CASCAVAL, University of Missouri - Columbia, USA  
*Pulse Waves in Elastic Tubes*
- ISABELLE CATTO, CNRS and University of Paris IX-Dauphine, France  
*On a Dirac-Fock type models for crystals*

- GUI-QIANG CHEN, Northwestern University, USA  
*Multidimensional Transonic Shocks and Free Boundary Problems for the Euler Equations for Potential Fluids*
- HONGQIU CHEN, University of Texas, USA
- THOMAS CHEN, Courant Institute, NYU, USA  
*Infrared renormalization and infraparticle states in QED*
- ALEXEI CHEVIAKOV, Queens University, Canada
- PREDRAG CVITANOVIC, Georgia Tech, USA  
*Hopf's last hope: Spatiotemporal chaos in terms of unstable recurrent patterns*
- DAVID DAMANIK, California Institute of Technology, USA  
*Quantum Dynamical Bounds for One-Dimensional Quasicrystals*
- RAFAEL DEL RIO CASTILLO, UNAM, Mexico  
*Coexistence of spectra in rank-one perturbation problems*
- SERGUEI DENISSOV, California Institute of Technology, USA  
*The theory of orthogonal polynomials and spectral analysis of Schrödinger operators*
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- LASZLO ERDOS, Georgia Tech, USA  
*Derivation of the nonlinear Schrödinger equation with Coulomb potential*
- W. DESMOND EVANS, Cardiff University, Wales, UK  
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*Generalized Schrödinger operators of the graph type*
- JEAN-PIERRE FOUQUE, North Carolina State University, USA  
*Time-reversal mirror techniques in the regime of separation of scales*
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*On the spectrum of second order elliptic differential operators with periodic coefficients*
- SUSAN FRIEDLANDER, University of Illinois, Chicago, USA  
*A dyadic model for non-Newtonian fluid equations*
- DAPHNE GILBERT, Dublin Institute of Technology, Ireland  
*An inverse spectral problem for the one-dimensional Schrödinger operator*
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*Lower order terms in Szego type asymptotic formulas*
- JAMES GLIMM, Stony Brook University, USA  
*Predictability and Solution Error Models for Flow in Porous Media*

- GISELE GOLDSTEIN, U. of Memphis, USA  
*The  $n$ -dimensional Heat Equation with Nonlinear Generalized Wentzel Boundary Conditions*
- JERRY GOLDSTEIN, U. of Memphis, USA  
*Instantaneous blow-up for heat equations*
- GIAN-MICHELE GRAF, ETH Zürich, Switzerland
- MARCEL GRIESEMER, University of Alabama at Birmingham, USA  
*Asymptotic Completeness for Compton Scattering*
- MICHAEL J. GRUBER, The University of Arizona, USA  
*Spectral theory of Schrödinger Operators with periodic magnetic field*
- GUDRUN GUDMUNSDOTTIR, Lund University, Sweden
- STEPHEN GUSTAFSON, ETH-Zürich, Switzerland  
*Effective dynamics of magnetic vortices*
- GEORGE HAGEDORN, Virginia Tech, USA  
*A Time-Dependent Born-Oppenheimer Approximation with Exponentially Small Error Estimates*
- CHRISTIAN HAINZL, Universität München, Germany  
*One non-relativistic particle coupled to a photon field*
- EVANS HARRELL, Georgia Tech, USA  
*Gap estimates for Schrödinger operators depending on curvature*
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*On the discrete spectrum of Schrödinger operators with strong magnetic fields of compact support*
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*Exponentially Small Error Estimates of Quasiclassical Eigenvalues*



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