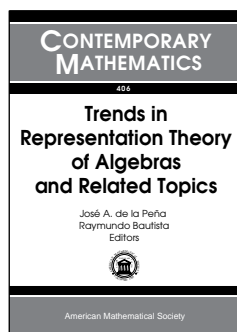


# New Publications Offered by the AMS

## Algebra and Algebraic Geometry



### Trends in Representation Theory of Algebras and Related Topics

José A. de la Peña and Raymundo Bautista, Editors

This book is based on lectures given during a Workshop on Representations of Algebras and Related Topics. Some additional

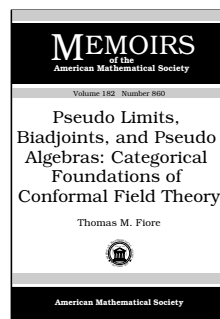
articles are included in order to complete a panoramic view of the main trends of the subject. The volume contains original presentations by leading algebraists addressed to specialists as well as to a broader mathematical audience. The articles include new proofs, examples, and detailed arguments. Topics under discussion include moduli spaces associated to quivers, canonical basis of quantum algebras, categorifications and derived categories,  $A$ -infinity algebras and functor categories, cluster algebras, support varieties for modules and complexes, the Gabriel-Roiter measure for modules, and selfinjective algebras.

**Contents:** A. Bakke Buan and R. Marsh, Cluster-tilting theory; C. Geiß, Introduction to moduli spaces associated to quivers (With an appendix by Lieven Le Bruyn and Markus Reineke); A. Hubery, From triangulated categories to Lie algebras: A theorem of Peng and Xiao; B. Keller,  $A$ -infinity algebras, modules and functor categories; H. Krause and D. Kussin, Rouquier's theorem on representation dimension; C. M. Ringel, Foundation of the representation theory of Artin algebras, using the Gabriel-Roiter measure.; R. Rouquier, Categorification of  $\mathfrak{sl}_2$  and braid groups; A. Skowroński,

Selfinjective algebras: Finite and tame type; Ø. Solberg, Support varieties for modules and complexes.

**Contemporary Mathematics**, Volume 406

August 2006, 270 pages, Softcover, ISBN-10: 0-8218-3818-0, ISBN-13: 978-0-8218-3818-1, LC 2006040706, 2000 *Mathematics Subject Classification:* 16G10, 16G20, 16G50, 16G60, 16G70, 18E30, 16D90, 18G40, 16S99, **All AMS members US\$63**, List US\$79, Order code CONM/406



### Pseudo Limits, Biadjoints, and Pseudo Algebras: Categorical Foundations of Conformal Field Theory

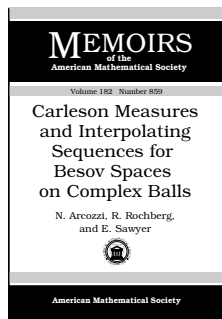
Thomas M. Fiore

**Contents:** Introduction; Some comments on conformal field theory; Weighted pseudo limits in a 2-category; Weighted pseudo colimits in the 2-category of small categories; Weighted pseudo limits in the 2-category of small categories; Theories and algebras; Pseudo  $T$ -algebras; Weighted pseudo limits in the 2-category of pseudo  $T$ -algebras; Biuniversal arrows and biadjoints; Forgetful 2-functors for pseudo algebras; Weighted bicolimits of pseudo  $T$ -algebras; Stacks; 2-Theories, algebras, and weighted pseudo limits; Bibliography; Index.

**Memoirs of the American Mathematical Society**, Volume 182, Number 860

June 2006, 171 pages, Softcover, ISBN-10: 0-8218-3914-4, ISBN-13: 978-0-8218-3914-0, LC 2006042824, 2000 *Mathematics Subject Classification:* 18C10, 18C20; 81T40, 18A30, **Individual member US\$39**, List US\$65, Institutional member US\$52, Order code MEMO/182/860

# Analysis



## Carleson Measures and Interpolating Sequences for Besov Spaces on Complex Balls

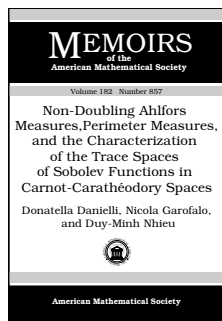
N. Arcozzi, *Università di Bologna, Italy*, R. Rochberg, *Washington University, St. Louis, MO*, and E. Sawyer, *McMaster University, Hamilton, ON, Canada*

*McMaster University, Hamilton, ON, Canada*

**Contents:** Introduction; A tree structure for the unit ball  $\mathbb{B}_n$  in  $\mathbb{C}^n$ ; Carleson measures; Pointwise multipliers; Interpolating sequences; An almost invariant holomorphic derivative; Besov spaces on trees; Holomorphic Besov spaces on Bergman trees; Completing the multiplier interpolation loop; Appendix; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 182, Number 859

June 2006, 163 pages, Softcover, ISBN-10: 0-8218-3917-9, ISBN-13: 978-0-8218-3917-1, LC 2006042823, 2000 *Mathematics Subject Classification*: 46E15; 30H05, 32A25, 32A37, 46E22, 46E35, **Individual member US\$38**, List US\$63, Institutional member US\$50, Order code MEMO/182/859



## Non-Doubling Ahlfors Measures, Perimeter Measures, and the Characterization of the Trace Spaces of Sobolev Functions in Carnot-Carathéodory Spaces

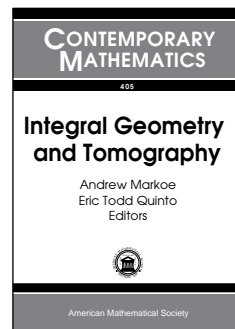
Donatella Danielli, *Purdue University, West Lafayette, IN*, Nicola Garofalo, *Purdue University, West Lafayette, IN*, and Università di Padova, Italy, and Duy-Minh Nhieu, *Georgetown University, Washington, DC*

**Contents:** Introduction; Carnot groups; The characteristic set;  $X$ -variation,  $X$ -perimeter and surface measure; Geometric estimates from above on CC balls for the perimeter measure; Geometric estimates from below on CC balls for the perimeter measure; Fine differentiability properties of Sobolev functions; Embedding a Sobolev space into a Besov space with respect to an upper Ahlfors measure; The extension theorem for a Besov space with respect to a lower Ahlfors measure; Traces on the boundary of  $(\epsilon, \delta)$  domains; The embedding of  $B_\beta^p(\Omega, d\mu)$  into

$L^q(\Omega, d\mu)$ ; Returning to Carnot groups; The Neumann problem; The case of Lipschitz vector fields; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 182, Number 857

June 2006, 119 pages, Softcover, ISBN-10: 0-8218-3911-X, ISBN-13: 978-0-8218-3911-9, LC 2006042821, 2000 *Mathematics Subject Classification*: 43A85, 46E35; 35H20, **Individual member US\$36**, List US\$60, Institutional member US\$48, Order code MEMO/182/857



## Integral Geometry and Tomography

Andrew Markoe, *Rider University, Lawrenceville, NJ*, and Eric Todd Quinto, *Tufts University, Medford, MA*, Editors

This volume consists of a collection of papers that brings together fundamental research in Radon

transforms, integral geometry, and tomography. It grew out of the Special Session at a Sectional Meeting of the American Mathematical Society in 2004. The book contains very recent work of some of the top researchers in the field.

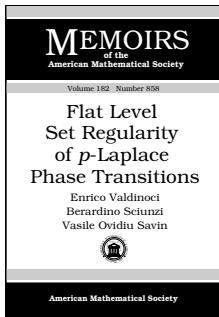
The articles in the book deal with the determination of properties of functions on a manifold by integral theoretic methods, or by determining the geometric structure of subsets of a manifold by analytic methods. Of particular concern are ways of reconstructing an unknown function from some of its projections.

Radon transforms were developed at the beginning of the twentieth century by researchers who were motivated by problems in differential geometry, mathematical physics, and partial differential equations. Later, medical applications of these transforms produced breakthroughs in imaging technology that resulted in the 1979 Nobel Prize in Physiology and Medicine for the development of computerized tomography. Today the subject boasts substantial cross-disciplinary interactions, both in pure and applied mathematics as well as medicine, engineering, biology, physics, geosciences, and industrial testing. Therefore, this volume should be of interest to a wide spectrum of researchers both in mathematics and in other fields.

**Contents:** M. L. Agranovsky and E. T. Quinto, Remarks on stationary sets for the wave equation; C. Berenstein, F. Gavilánez, and J. Baras, Network tomography; J. Boman, On stable inversion of the attenuated Radon transform with half data; M. Dobrescu and G. Ólafsson, Wavelet sets without groups; L. Ehrenpreis, The Radon transform for functions defined on planes; F. B. Gonzalez and J. Zhang, The modified wave equation on the sphere; A. Katsevich and A. Zamyatin, Analysis of a family of exact inversion formulas for cone beam computer tomography; A. Markoe, The  $k$ -plane transform and Riesz potentials; E. Ournycheva and B. Rubin, The composite cosine transform on the Stiefel manifold and generalized zeta integrals; I. Pesenson, Frames for spaces of Paley-Wiener functions on Riemannian manifolds; J. Rennie, Properties of the stationary sets for the wave equation.

**Contemporary Mathematics**, Volume 405

August 2006, 155 pages, Softcover, ISBN-10: 0-8218-3755-9, ISBN-13: 978-0-8218-3755-9, LC 2006040669, 2000 *Mathematics Subject Classification*: 44A12, 92C55; 35B05, 35L05, 35R30, 42B20, 42C40, 43A85, 52A22, 94C12, **All AMS members US\$47**, List US\$59, Order code CONM/405



## Flat Level Set Regularity of $p$ -Laplace Phase Transitions

**Enrico Valdinoci**, *Università di Roma Tor Vergata, Rome, Italy*, **Berardino Sciuuzi**, *Università di Roma Tor Vergata, Rome, Italy*, and **Vasile Ovidiu Savin**,

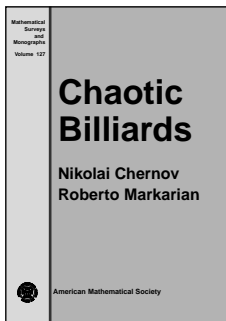
*University of California, Berkeley, CA*

**Contents:** Introduction; Modifications of the potential and of one-dimensional solutions; Geometry of the touching points; Measure theoretic results; Estimates on the measure of the projection of the contact set; Proof of Theorem 1.1; Proof of Theorem 1.2; Proof of Theorem 1.3; Proof of Theorem 1.4; Appendix A. Proof of the measure theoretic results; Appendix B. Summary of elementary lemmata; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 182, Number 858

June 2006, 144 pages, Softcover, ISBN-10: 0-8218-3910-1, ISBN-13: 978-0-8218-3910-2, LC 2006042822, 2000 *Mathematics Subject Classification*: 35J70, 35B65, **Individual member US\$37**, List US\$62, Institutional member US\$50, Order code MEMO/182/858

## Differential Equations



## Chaotic Billiards

**Nikolai Chernov**, *University of Alabama at Birmingham, AL*, and **Roberto Markarian**, *Universidad de la República, Montevideo, Uruguay*

This book covers one of the most exciting but most difficult topics in the modern theory of dynamical systems: chaotic billiards. In physics, billiard models describe various

mechanical processes, molecular dynamics, and optical phenomena.

The theory of chaotic billiards has made remarkable progress in the past thirty-five years, but it remains notoriously difficult for the beginner, with main results scattered in hardly

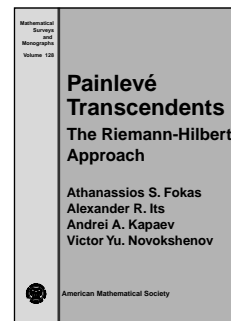
accessible research articles. This is the first and so far only book that covers all the fundamental facts about chaotic billiards in a complete and systematic manner. The book contains all the necessary definitions, full proofs of all the main theorems, and many examples and illustrations that help the reader to understand the material. Hundreds of carefully designed exercises allow the reader not only to become familiar with chaotic billiards but to master the subject.

The book addresses graduate students and young researchers in physics and mathematics. Prerequisites include standard graduate courses in measure theory, probability, Riemannian geometry, topology, and complex analysis. Some of this material is summarized in the appendices to the book.

**Contents:** Simple examples; Basic constructions; Lyapunov exponents and hyperbolicity; Dispersing billiards; Dynamics of unstable manifolds; Ergodic properties; Statistical properties; Bunimovich billiards; General focusing chaotic billiards; Afterword; Measure theory; Probability theory; Ergodic theory; Bibliography; Index.

**Mathematical Surveys and Monographs**, Volume 127

August 2006, 316 pages, Hardcover, ISBN-10: 0-8218-4096-7, ISBN-13: 978-0-8218-4096-2, LC 2006042819, 2000 *Mathematics Subject Classification*: 37D50; 37D25, 37A25, 37N05, 82B99, **All AMS members US\$68**, List US\$85, Order code SURV/127



## Painlevé Transcendents

### The Riemann-Hilbert Approach

**Athanassios S. Fokas**, *Cambridge University, United Kingdom*, **Alexander R. Its**, *Indiana State University, Indianapolis, IN*, **Andrei A. Kapaev**, *Steklov Mathematical*

*Institute, St. Petersburg, Russia*, and **Victor Yu. Novokshenov**, *Russian Academy of Sciences, Ufa, Russia*

At the turn of the twentieth century, the French mathematician Paul Painlevé and his students classified second order nonlinear ordinary differential equations with the property that the location of possible branch points and essential singularities of their solutions does not depend on initial conditions. It turned out that there are only six such equations (up to natural equivalence), which later became known as Painlevé I-VI.

Although these equations were initially obtained answering a strictly mathematical question, they appeared later in an astonishing (and growing) range of applications, including, e.g., statistical physics, fluid mechanics, random matrices, and orthogonal polynomials. Actually, it is now becoming clear that the Painlevé transcendents (i.e., the solutions of the Painlevé equations) play the same role in nonlinear mathematical physics that the classical special functions, such as Airy and Bessel functions, play in linear physics.

The explicit formulas relating the asymptotic behaviour of the classical special functions at different critical points, play a crucial role in the applications of these functions. It is shown in this book, that even though the six Painlevé equations are nonlinear, it is still possible, using a new technique called the Riemann-Hilbert formalism, to obtain analogous explicit formulas for the Painlevé transcendents. This striking fact, apparently unknown to Painlevé and his contemporaries, is the key ingredient for the remarkable applicability of these “nonlinear special functions”.

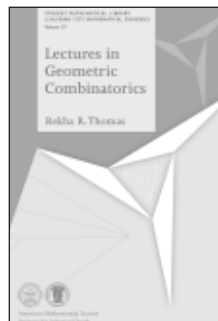
The book describes in detail the Riemann-Hilbert method and emphasizes its close connection to classical monodromy theory of linear equations as well as to modern theory of integrable systems. In addition, the book contains an ample collection of material concerning the asymptotics of the Painlevé functions and their various applications, which makes it a good reference source for everyone working in the theory and applications of Painlevé equations and related areas.

**Contents:** Introduction. Painlevé transcendents as nonlinear special functions; *Part 1. Riemannian-Hilbert problem, isomonodromy method and special functions:* Systems of linear ordinary differential equations with rational coefficients. Elements of the general theory; Monodromy theory and special functions; Inverse monodromy problem and Riemann-Hilbert factorization; Isomonodromy deformations. The Painlevé equations; The isomonodromy method; Bäcklund transformations; *Part 2. Asymptotics of the Painlevé II transcendent. A case study:* Asymptotic solutions of the second Painlevé equation in the complex plane. Direct monodromy problem approach; Asymptotic solutions of the second Painlevé equation in the complex plane. Inverse monodromy problem approach; PII asymptotics on the canonical six-rays. The purely imaginary case; PII asymptotics on the canonical six-rays. Real-valued case; PII quasi-linear Stokes phenomenon; *Part 3. Asymptotics of the third Painlevé transcendent:* PIII equation, an overview; Sine-Gordon reduction of PIII; Canonical four-rays. Real-valued solutions of SG-PIII; Canonical four-rays. Singular solutions of the SG-PIII; Asymptotics in the complex plane of the SG-PIII transcendent; Proof of Theorem 3.4; The Birkhoff-Grothendieck theorem with a parameter; Bibliography; Subject index.

**Mathematical Surveys and Monographs, Volume 128**

August 2006, approximately 560 pages, Hardcover, ISBN-10: 0-8218-3651-X, ISBN-13: 978-0-8218-3651-4, LC 2006042772, 2000 *Mathematics Subject Classification:* 34M55, **All AMS members US\$87**, List US\$109, Order code SURV/128

# Discrete Mathematics and Combinatorics



## Lectures in Geometric Combinatorics

**Rekha R. Thomas, University of Washington, Seattle, WA**

This book presents a course in the geometry of convex polytopes in arbitrary dimension, suitable for an advanced undergraduate or beginning graduate student. The book starts with the basics of polytope theory.

Schlegel and Gale diagrams are introduced as geometric tools to visualize polytopes in high dimension and to unearth bizarre phenomena in polytopes. The heart of the book is a treatment of the secondary polytope of a point configuration and its connections to the state polytope of the toric ideal defined by the configuration. These polytopes are relatively recent constructs with numerous connections to discrete geometry, classical algebraic geometry, symplectic geometry, and combinatorics. The connections rely on Gröbner bases of toric ideals and other methods from commutative algebra.

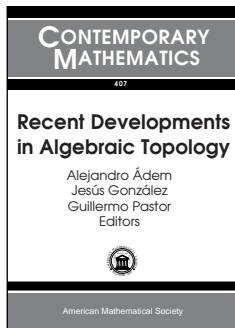
The book is self-contained and does not require any background beyond basic linear algebra. With numerous figures and exercises, it can be used as a textbook for courses on geometric, combinatorial, and computational aspects of the theory of polytopes.

**Contents:** Abstract algebra: Groups, rings and fields; Convex polytopes: Definitions and examples; Faces of polytopes; Schlegel diagrams; Gale diagrams; Bizarre polytopes; Triangulations of point configurations; The secondary polytope; The permutahedron; Abstract algebra: Polynomial rings; Gröbner bases I; Gröbner bases II; Initial complexes of toric ideals; State polytopes of toric ideals; Bibliography; Index.

**Student Mathematical Library, Volume 33**

July 2006, 143 pages, Softcover, ISBN-10: 0-8218-4140-8, ISBN-13: 978-0-8218-4140-2, LC 2006042841, 2000 *Mathematics Subject Classification:* 52-01; 13-01, **All AMS members US\$23**, List US\$29, Order code STML/33

# Geometry and Topology



## Recent Developments in Algebraic Topology

Alejandro Ádem, Jesús González, and Guillermo Pastor, Editors

This book is an excellent illustration of the versatility of Algebraic Topology interacting with other areas in Mathematics and Physics. Topics

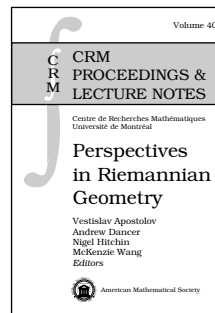
discussed in this volume range from classical Differential Topology and Homotopy Theory (Kervaire invariant one problem) to more recent lines of research such as Topological Quantum Field Theory (string theory). Likewise, alternative viewpoints on classical problems in Global Analysis and Dynamical Systems are developed (a spectral sequence approach to normal form theory).

This collection of papers is based on talks at the conference on the occasion of Sam Gitler's 70th birthday (December, 2003). The variety of topics covered in this book reflects the many areas where Sam Gitler's contributions have had an impact.

**Contents:** D. M. Davis, The mathematical work of Sam Gitler, 1960-2003; N. A. Baas, R. L. Cohen, and A. Ramírez, The topology of the category of open and closed strings; M. Bendersky and R. C. Churchill, A spectral sequence approach to normal forms; F. R. Cohen and I. Johnson, On the degree 2 map for a sphere; C. L. Douglas, On the fibrewise Poincaré-Hopf theorem; T. de Fernex, E. Lupercio, T. Nevins, and B. Uribe, A localization principle for orbifold theories; D. Juan-Pineda and I. J. Leary, On classifying spaces for the family of virtually cyclic subgroups; S. Kallel and P. Salvatore, Symmetric products of two dimensional complexes; K. Y. Lam and D. Randall, Block bundle obstruction to Kervaire invariant one; P. Sankaran and P. Zvengrowski, Upper bounds for the span of projective Stiefel manifolds; M. A. Xicoténcatl, On  $\mathbb{Z}_2$ -equivariant loop spaces.

**Contemporary Mathematics**, Volume 407

August 2006, 191 pages, Softcover, ISBN-10: 0-8218-3676-5, ISBN-13: 978-0-8218-3676-7, LC 2006044458, 2000 *Mathematics Subject Classification*: 55-06, **All AMS members US\$47**, List US\$59, Order code CONM/407



## Perspectives in Riemannian Geometry

Vestislav Apostolov, *Université du Québec à Montréal, QC, Canada*, Andrew Dancer and Nigel Hitchin, *Mathematical Institute, Oxford, England*, and McKenzie Wang, *McMaster University, Hamilton, ON, Canada*, Editors

University, Hamilton, ON, Canada, Editors

Special geometries as well as the relation between curvature and topology have always been of interest to differential geometers. More recently, these topics have turned out to be of use in physical problems related to string theory as well. This volume provides a unique and thorough survey on the latest developments on Riemannian geometry, special geometrical structures on manifolds, and their interactions with other fields such as mathematical physics, complex analysis, and algebraic geometry.

This volume presents ten papers written by participants of the "Short Program on Riemannian Geometry," a workshop held at the CRM in Montréal in 2004. It will be a valuable reference for graduate students and research mathematicians alike.

Titles in this series are copublished with the Centre de Recherches Mathématiques.

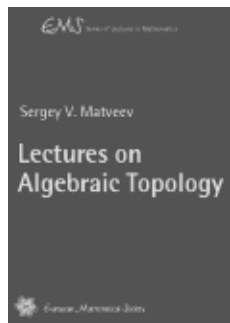
**Contents:** M. T. Anderson, Topics in conformally compact Einstein metrics; O. Biquard, Cauchy-Riemann 3-manifolds and Einstein fillings; C. P. Boyer and K. Galicki, Sasakian geometry and Einstein metrics on spheres; R. L. Bryant, Second order families of special Lagrangian 3-folds; A. Dancer and M. Y. Wang, Einstein equations, superpotentials and convex polytopes; L. David and P. Gauduchon, The Bochner-flat geometry of weighted projective spaces; K. Grove, Aspects of comparison geometry; N. Hitchin, Low-dimensional geometry—A variational approach; C. LeBrun, Twistors, holomorphic disks, and Riemann surfaces with boundary; A. Nabutovsky, Combinatorics of the spaces of Riemannian structures and logic phenomena of Euclidean quantum gravity.

**CRM Proceedings & Lecture Notes**, Volume 40

July 2006, 248 pages, Softcover, ISBN-10: 0-8218-3852-0, ISBN-13: 978-0-8218-3852-5, LC 2006042818, 2000 *Mathematics Subject Classification*: 53Cxx, 53Bxx, 53C26; 53Dxx, 32Qxx, **All AMS members US\$68**, List US\$85, Order code CRMP/40

# New AMS-Distributed Publications

## Geometry and Topology



### Lectures on Algebraic Topology

**Sergey V. Matveev,**  
*Chelyabinsk State University,  
Russia*

Algebraic topology is the study of the global properties of spaces by means of algebra. It is an important branch of modern mathematics with a wide degree of applicability to other fields, including geometric topology,

differential geometry, functional analysis, differential equations, algebraic geometry, number theory, and theoretical physics.

This book provides an introduction to the basic concepts and methods of algebraic topology for the beginner. It presents elements of both homology theory and homotopy theory, and includes various applications.

The author's intention is to rely on the geometric approach by appealing to the reader's own intuition to help understanding. The numerous illustrations in the text also serve this purpose. Two features make the text different from the standard literature: first, special attention is given to providing explicit algorithms for calculating the homology groups and for manipulating the fundamental groups. Second, the book contains many exercises, all of which are supplied with hints or solutions. This makes the book suitable for both classroom use and for independent study.

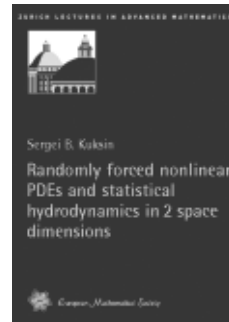
A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

**Contents:** Elements of homology theory; Elements of homotopy theory; Answers, hints, solutions; Bibliography; Index.

#### EMS Series of Lectures in Mathematics

April 2006, 108 pages, Softcover, ISBN-10: 3-03719-023-X, ISBN-13: 978-3-03719-023-4, 2000 *Mathematics Subject Classification*: 55-01, **All AMS members US\$27**, List US\$34, Order code EMSSERLEC/3

## Mathematical Physics



### Randomly Forced Nonlinear PDEs and Statistical Hydrodynamics in 2 Space Dimensions

**Sergei B. Kuksin,** *Heriot-Watt University, Edinburgh, Scotland*

This book gives an account of recent achievements in the mathematical

theory of two-dimensional turbulence, described by the 2D Navier-Stokes equation, perturbed by a random force. The main results presented here were obtained during the last five to ten years and, up to now, have been available only in papers in the primary literature. Their summary and synthesis here, beginning with some preliminaries on partial differential equations and stochastics, make this book a self-contained account that will appeal to readers with a general background in analysis.

After laying the groundwork, the author goes on to recent results on ergodicity of random dynamical systems, which the randomly forced Navier-Stokes equation defines in the function space of divergence-free vector fields, including a Central Limit Theorem. The physical meaning of these results is discussed as well as their relations with the theory of attractors. Next, the author studies the behaviour of solutions when the viscosity goes to zero. In the final section these dynamical methods are used to derive the so-called balance relations—the infinitely many algebraical relations satisfied by the solutions.

*This item will also be of interest to those working in differential equations.*

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

**Contents:** Function spaces; The deterministic 2D Navier-Stokes Equation; Random kick-forces; White-forced equations; Preliminaries from measure theory; Uniqueness of a stationary measure: kick-forces; Uniqueness of a stationary measure: white-forces; Ergodicity and the strong law of large numbers; The martingale approximation and CLT; The Eulerian limit; Balance relations for the white-forced NSE; Comments; Bibliography; Index.

#### Zurich Lectures in Advanced Mathematics

April 2006, 104 pages, Softcover, ISBN-10: 3-03719-021-3, ISBN-13: 978-3-03719-021-0, 2000 *Mathematics Subject Classification*: 35Q30, 76F05, **All AMS members US\$27**, List US\$34, Order code EMSZLEC/3