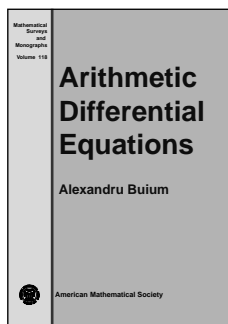


# New Publications Offered by the AMS

## Algebra and Algebraic Geometry



### Arithmetic Differential Equations

Alexandru Buium, *University of New Mexico, Albuquerque*

This monograph contains exciting original mathematics that will inspire new directions of research in algebraic geometry. Developed here is an arithmetic analog of the theory of ordinary differential equations, where

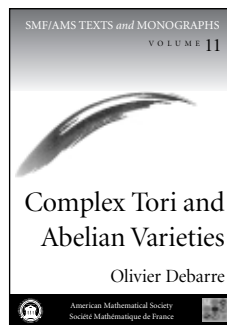
functions are replaced by integer numbers, the derivative operator is replaced by a “Fermat quotient operator”, and differential equations (viewed as functions on jet spaces) are replaced by “arithmetic differential equations”. The main application of this theory concerns the construction and study of quotients of algebraic curves by correspondence with infinite orbits. Any such quotient usually reduces to a point in algebraic geometry. But many of the above quotients cease to be trivial (and become quite interesting) if one enlarges algebraic geometry by using arithmetic differential equations in place of algebraic equations.

This book, in part, follows a series of papers written by the author. However, a substantial amount of the material has never been published before. For most of the book, the only prerequisites are the basic facts of algebraic geometry and algebraic number theory. It is suitable for graduate students and researchers interested in algebraic geometry.

**Contents:** *Main concepts and results:* Preliminaries from algebraic geometry; Outline of  $\delta$ -geometry; *General theory:* Global theory; Local theory; Birational theory; *Applications:* Spherical correspondences; Flat correspondences; Hyperbolic correspondences; List of results; Bibliography; Index.

**Mathematical Surveys and Monographs**, Volume 118

September 2005, approximately 360 pages, Hardcover, ISBN 0-8218-3862-8, 2000 *Mathematics Subject Classification:* 14G20, 14G35, 30F10; 53A55, 37F05, 14L24, **All AMS members US\$68**, List US\$85, Order code SURV/118



### Complex Tori and Abelian Varieties

Olivier Debarre, *Université Louis Pasteur, Strasbourg, France*

This graduate-level textbook introduces the classical theory of complex tori and abelian varieties, while presenting in parallel more modern aspects of complex algebraic and analytic geometry. Beginning with

complex elliptic curves, the book moves on to the higher-dimensional case, giving characterizations from different points of view of those complex tori which are abelian varieties, i.e., those that can be holomorphically embedded in a projective space. This allows, on the one hand, for illuminating the computations of nineteenth-century mathematicians, and on the other, familiarizing readers with more recent theories. Complex tori are ideal in this respect: One can perform “hands-on” computations without the theory being totally trivial.

Standard theorems about abelian varieties are proved, and moduli spaces are discussed. Recent results on the geometry and topology of some subvarieties of a complex torus are also included.

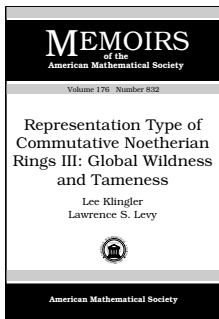
The book contains numerous examples and exercises. It is a very good starting point for studying algebraic geometry, suitable for graduate students and researchers interested in algebra and algebraic geometry.

SMF members are entitled to AMS member discounts.

**Contents:** Preface to the French edition; Preface to the English edition; Lattices and complex tori; Elliptic curves; Differential forms and de Rham cohomology; Theta functions and divisors; Line bundles, sheaf cohomology, and first Chern class; Abelian varieties; Moduli spaces; Subvarieties of a complex torus; Bibliography; Index.

**SMF/AMS Texts and Monographs**, Volume 11

August 2005, 109 pages, Softcover, ISBN 0-8218-3165-8, 2000 *Mathematics Subject Classification:* 14-01, 14K20, 14K25, **All AMS members US\$31**, List US\$39, Order code SMFAMS/11



## Representation Type of Commutative Noetherian Rings III: Global Wildness and Tameness

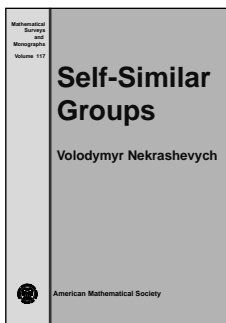
Lee Klingler and Lawrence S. Levy

**Contents:** Introduction; Preliminaries; Dedekind-like rings; Wildness;

Structure of a genus; Substitute for conductor squares; Isomorphism classes in a genus, idèle group action; Web of class groups; Direct sums; Finite normalization; Appendix A; Appendix B; Bibliography.

*Memoirs of the American Mathematical Society*, Volume 176, Number 832

June 2005, 170 pages, Softcover, ISBN 0-8218-3738-9, LC 2005044092, 2000 *Mathematics Subject Classification*: 13E05, 16G60, **Individual member US\$38**, List US\$63, Institutional member US\$50, Order code MEMO/176/832



## Self-Similar Groups

Volodymyr Nekrashevych,  
*International University  
Bremen, Germany, and Kyiv  
Taras Shevchenko University,  
Ukraine*

Self-similar groups (groups generated by automata) initially appeared as examples of groups that are easy to define but have exotic properties like nontrivial torsion, intermediate

growth, etc. This book studies the self-similarity phenomenon in group theory and shows its intimate relationship with dynamical systems and more classical self-similar structures, such as fractals, Julia sets, and self-affine tilings. This connection is established through the central topics of the book, which are the notions of the iterated monodromy group and limit space.

A wide variety of examples and different applications of self-similar groups to dynamical systems and vice versa can be discussed. In particular, it is shown that Julia sets can be reconstructed from the respective iterated monodromy groups and that groups with exotic properties can appear not just as isolated examples, but as naturally defined iterated monodromy groups of rational functions.

The book offers important, new mathematics that will open new avenues of research in group theory and dynamical systems. It is intended to be accessible to a wide readership of professional mathematicians.

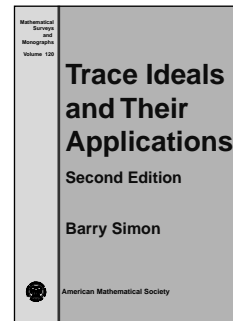
*This item will also be of interest to those working in differential equations.*

**Contents:** Basic definitions and examples; Algebraic theory; Limit spaces; Orbispaces; Iterated monodromy groups; Examples and applications; Bibliography; Index.

*Mathematical Surveys and Monographs*, Volume 117

September 2005, 231 pages, Hardcover, ISBN 0-8218-3831-8, LC 2005048021, 2000 *Mathematics Subject Classification*: 20F65, 37B10; 37F20, 37F15, 20E08, 22A22, **All AMS members US\$47**, List US\$59, Order code SURV/117

## Analysis



## Trace Ideals and Their Applications Second Edition

Barry Simon, *California  
Institute of Technology,  
Pasadena*

*From a review of the first edition:*

*"Beautifully written and well organized ... indispensable for those interested in certain areas of mathematical physics ... for the expert and beginner alike. The author deserves to be congratulated both for his work in unifying a subject and for showing workers in the field new directions for future development."*

—*Zentralblatt MATH*

This is a second edition of a well-known book stemming from the author's lectures on the theory of trace ideals in the algebra of operators in a Hilbert space. Because of the theory's many different applications, the book was widely used and much in demand.

For this edition, the author has added four chapters on the closely related theory of rank one perturbations of self-adjoint operators. He has also included a comprehensive index and an addendum describing some developments since the original notes were published.

This book continues to be a vital source of information for those interested in the theory of trace ideals and in its applications to various areas of mathematical physics.

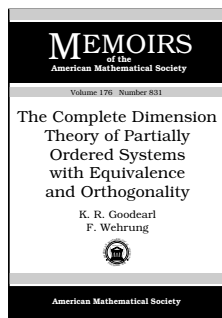
*This item will also be of interest to those working in mathematical physics.*

**Contents:** Preliminaries; Calkin's theory of operator ideals and symmetrically normed ideals; convergence theorems for  $\mathcal{J}_p$ ; Trace, determinant, and Lidskii's theorem;  $f(x)g(-i\nabla)$ ; Fredholm theory; Scattering with a trace condition; Bound state problems; Lots of inequalities; Regularized determinants and renormalization in quantum field theory; An introduction to the theory on a Banach space; Borel transforms, the Krein spectral shift, and all that; Spectral theory of rank one perturbations; Localization in the Anderson model following Aizenman-Molchanov; The Xi function; Addenda; Bibliography; Index.

*Mathematical Surveys and Monographs*, Volume 120

September 2005, 150 pages, Hardcover, ISBN 0-8218-3581-5, LC 2005048059, 2000 *Mathematics Subject Classification*: 47L30; 47A40, 81U99, **All AMS members US\$39**, List US\$49, Order code SURV/120

## Differential Equations



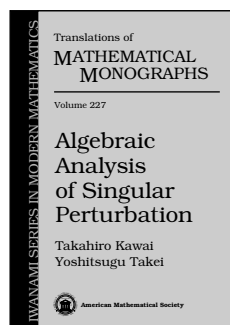
### The Complete Dimension Theory of Partially Ordered Systems with Equivalence and Orthogonality

K. R. Goodearl and F. Wehrung

**Contents:** Introduction; Partial commutative monoids; Continuous dimension scales; Espaliers; Classes of espaliers; Bibliography; Index.

**Memoirs of the American Mathematical Society**, Volume 176, Number 831

June 2005, 117 pages, Softcover, ISBN 0-8218-3716-8, LC 2005044093, 2000 *Mathematics Subject Classification*: 06B15, 06C15, 06B23, 06B30, 06E15, 06C10, 08A55; 06B35, 06C20, 06A05, 16D50, 16D70, 16D90, 16E20, 16E50, 18E10, 19A49, 19K14, 28B10, 28A60, 46L51, **Individual member US\$35**, List US\$58, Institutional member US\$46, Order code MEMO/176/831



### Algebraic Analysis of Singular Perturbation

Takahiro Kawai, *Kyoto University, Japan*, and Yoshitsugu Takei, *Kyoto, Japan*

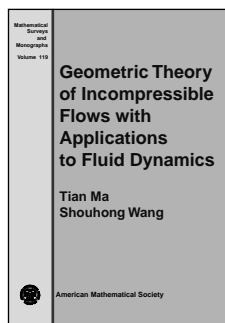
The topic of this book is the study of singular perturbations of ordinary differential equations, i.e., perturbations that represent solutions as asymptotic series rather than as

analytic functions in a perturbation parameter. The main method used is the so-called WKB (Wentzel-Kramers-Brillouin) method, originally invented for the study of quantum-mechanical systems. The authors describe in detail the WKB method and its applications to the study of monodromy problems for Fuchsian differential equations and to the analysis of Painlevé functions. The volume is suitable for graduate students and researchers interested in differential equations and special functions.

**Contents:** Borel resummation; WKB analysis of Schrödinger equations; Applications of WKB analysis to global problems; WKB analysis of the Painlevé function; Future directions and projects; Appendix; Bibliography; Index.

**Translations of Mathematical Monographs (Iwanami Series in Modern Mathematics)**, Volume 227

October 2005, approximately 136 pages, Softcover, ISBN 0-8218-3547-5, 2000 *Mathematics Subject Classification*: 34E15; 34E20, 34M40, **All AMS members US\$23**, List US\$29, Order code MMONO/227



### Geometric Theory of Incompressible Flows with Applications to Fluid Dynamics

Tian Ma, *Sichuan University, Chengdu, China*, and Shouhong Wang, *Indiana University, Bloomington*

This monograph presents a geometric theory for incompressible flow and its applications to fluid dynamics. The main objective is to study the stability and transitions of the structure of incompressible flows and its applications to fluid dynamics and geophysical fluid dynamics. The development of the theory and its applications goes well beyond its original motivation of the study of oceanic dynamics.

The authors present a substantial advance in the use of geometric and topological methods to analyze and classify incompressible fluid flows. The approach introduces genuinely innovative ideas to the study of the partial differential equations of fluid dynamics. One particularly useful development is a rigorous theory for boundary layer separation of incompressible fluids.

The study of incompressible flows has two major interconnected parts. The first is the development of a global geometric theory of divergence-free fields on general two-dimensional compact manifolds. The second is the study of the structure of velocity fields for two-dimensional incompressible fluid flows governed by the Navier-Stokes equations or the Euler equations.

Motivated by the study of problems in geophysical fluid dynamics, the program of research in this book seeks to develop a new mathematical theory, maintaining close links to physics along the way. In return, the theory is applied to physical problems, with more problems yet to be explored.

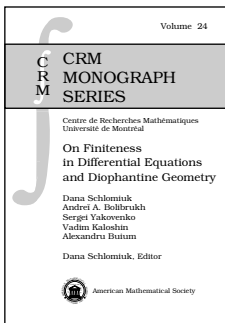
The material is suitable for researchers and advanced graduate students interested in nonlinear PDEs and fluid dynamics.

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

**Contents:** Introduction; Structure classification of divergence-free vector fields; Structural stability of divergence-free vector fields; Block stability of divergence-free vector fields on manifolds with nonzero genus; Structural stability of solutions of Navier-Stokes equations; Structural bifurcation for one-parameter family of divergence-free vector fields; Two examples; Bibliography; Index.

**Mathematical Surveys and Monographs**, Volume 119

October 2005, approximately 288 pages, Hardcover, ISBN 0-8218-3693-5, LC 2005048120, 2000 *Mathematics Subject Classification*: 35Q30, 35Q35, 76D05, 76D10, 37C10, 37C75, 86A10, 86A05; 46E25, 20C20, **All AMS members US\$55**, List US\$69, Order code SURV/119



## On Finiteness in Differential Equations and Diophantine Geometry



Dana Schlomiuk, *Université de Montréal, QC, Canada*, Andrei A. Bolibrukh, *Steklov Institute, Russian Academy of Sciences, Moscow, Russia*, Sergei

Yakovenko, *Weizmann Institute of Science, Rehovot, Israel*, Vadim Kaloshin, *California Institute of Technology, Pasadena, CA*, and Alexandru Buium, *University of New Mexico, Albuquerque, NM*

This book focuses on finiteness conjectures and results in ordinary differential equations (ODEs) and Diophantine geometry. During the past twenty-five years, much progress has been achieved on finiteness conjectures, which are the offspring of the second part of Hilbert's 16th problem. Even in its simplest case, this is one of the very few problems on Hilbert's list which remains unsolved. These results are about existence and estimation of finite bounds for the number of limit cycles occurring in certain families of ODEs. The book describes this progress, the methods used (bifurcation theory, asymptotic expansions, methods of differential algebra, or geometry) and the specific results obtained. The finiteness conjectures on limit cycles are part of a larger picture that also includes finiteness problems in other areas of mathematics, in particular those in Diophantine geometry where remarkable results were proved during the same period of time. There is a chapter devoted to finiteness results in Diophantine geometry obtained by using methods of differential algebra, which is a connecting element between these parallel developments in the book.

The volume can be used as an independent study text for advanced undergraduates and graduate students studying ODEs or applications of differential algebra to differential equations and Diophantine geometry. It is also a good entry point for researchers interested these areas, in particular, in limit cycles of ODEs, and in finiteness problems.

Contributors to the volume include Andrei Bolibrukh and Alexandru Buium. Available from the AMS by A. Buium is *Arithmetic Differential Equations*, as Volume 118 in the Mathematical Surveys and Monographs series.

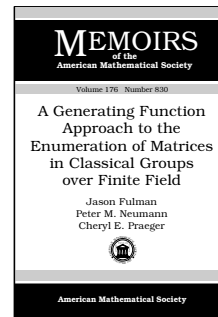
*This item will also be of interest to those working in algebra and algebraic geometry.*

**Contents:** Finiteness problems in differential equations and Diophantine geometry; Linear differential equations, Fuchsian inequalities and multiplicities of zeros; Quantitative theory of ordinary differential equations and tangential Hilbert 16th problem; Around Hilbert-Arnol'd problem; Finiteness results in differential algebraic geometry and Diophantine geometry; o-minimal structures, real analytic geometry, and transseries; List of lectures; List of participants; List of participants II.

CRM Monograph Series, Volume 24

October 2005, approximately 224 pages, Hardcover, ISBN 0-8218-2805-3, 2000 *Mathematics Subject Classification*: 34C07, 34C08, 34M35, 14G25; 11J91, 11J82, 12H05, 32G10, 34C10, 34M10, 34M50, 37C20, 37C27, 58K20, All AMS members US\$47, List US\$59, Order code CRMM/24

## Discrete Mathematics and Combinatorics



## A Generating Function Approach to the Enumeration of Matrices in Classical Groups over Finite Fields

Jason Fulman, Peter M. Neumann, and Cheryl E. Praeger

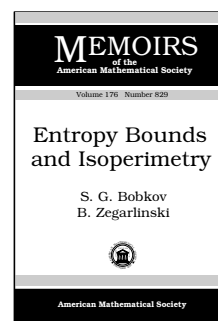
*This item will also be of interest to those working in algebra and algebraic geometry.*

**Contents:** Introduction, tables, and preliminaries; Separable and cyclic matrices in classical groups; Semisimple and regular matrices in classical groups; Bibliography.

Memoirs of the American Mathematical Society, Volume 176, Number 830

June 2005, 90 pages, Softcover, ISBN 0-8218-3706-0, LC 2005044094, 2000 *Mathematics Subject Classification*: 05E15; 20G40, Individual member US\$34, List US\$56, Institutional member US\$45, Order code MEMO/176/830

## Geometry and Topology



## Entropy Bounds and Isoperimetry

S. G. Bobkov and B. Zegarlinski

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

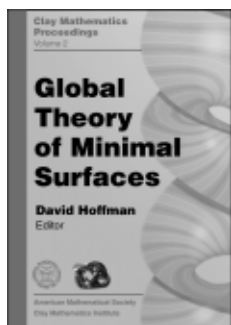
**Contents:** Introduction and notations; Poincaré-type inequalities; Entropy and Orlicz spaces;  $LS_q$  and Hardy-type inequalities on the line; Probability measures satisfying  $LS_q$ -inequalities

on the real line; Exponential integrability and perturbation of measures;  $LS_q$ -inequalities for Gibbs measures with super Gaussian tails;  $LS_q$ -inequalities and Markov semigroups; Isoperimetry; The localization argument; Infinitesimal version;

Proof of Theorem 9.2; Euclidean distance (proof of Theorem 9.1); Uniformly convex bodies; From isoperimetry to  $LS_q$ -inequalities; Isoperimetric functional inequalities; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 176, Number 829

June 2005, 69 pages, Softcover, ISBN 0-8218-3858-X, LC 2005045310, 2000 *Mathematics Subject Classification*: 46-XX; 51-XX, 52-XX, **Individual member US\$32**, List US\$53, Institutional member US\$42, Order code MEMO/176/829



## Global Theory of Minimal Surfaces

David Hoffman, *Mathematical Sciences Research Institute (MSRI), Berkeley, CA*, Editor

In the Summer of 2001, the Mathematical Sciences Research Institute (MSRI) hosted the Clay Mathematics Institute Summer School on the Global Theory of Minimal Surfaces. During that time, MSRI became the world center for the study

of minimal surfaces: 150 mathematicians—undergraduates, post-doctoral students, young researchers, and world experts—participated in the most extensive meeting ever held on the subject in its 250-year history. The unusual nature of the meeting made it possible to put together this collection of expository lectures and specialized reports, giving a panoramic view of a vital subject presented by leading researchers in the field.

The subjects covered include minimal and constant-mean-curvature submanifolds, geometric measure theory and the double-bubble conjecture, Lagrangian geometry, numerical simulation of geometric phenomena, applications of mean curvature to general relativity and Riemannian geometry, the isoperimetric problem, the geometry of fully nonlinear elliptic equations and applications to the topology of three-dimensional manifolds. The wide variety of topics covered make this volume suitable for graduate students and researchers interested in differential geometry.

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

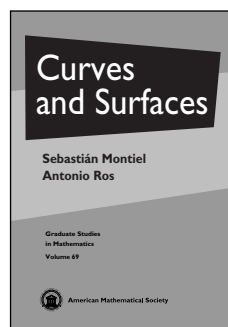
Titles in this series are published by the AMS for the Clay Mathematics Institute (Cambridge, MA).

**Contents:** F. Morgan and M. Ritoré, Geometric measure theory and the proof of the double bubble conjecture; M. Weber, Classical minimal surfaces in Euclidean space by examples: Geometric and computational aspects of the Weierstrass representation; K. Polthier, Computational aspects of discrete minimal surfaces; R. Schoen, Mean curvature in Riemannian geometry and general relativity; H. Karcher, Introduction to conjugate Plateau constructions; J. Pérez and F. J. López, Parabolicity and minimal surfaces; A. Ros, The isoperimetric problem; M. Wolf, Flat structures, Teichmüller theory and handle addition for minimal surfaces; M. Weber, D. Hoffman, and M. Wolf, The genus-one helicoid as a limit of screw-motion invariant helicoids with handles; D. Hoffman, Computing minimal surfaces; J. Spruck, Geometric aspects of the theory of fully nonlinear elliptic equations; H. Karcher,

Hyperbolic surfaces of constant mean curvature one with compact fundamental domains; J. Choe, Isoperimetric inequalities of minimal submanifolds; F. Martín, Complete nonorientable minimal surfaces in  $\mathbb{R}^3$ ; F. J. López, Some Picard-type results for properly immersed minimal surfaces in  $\mathbb{R}^3$ ; M. Ritoré, Optimal isoperimetric inequalities for three-dimensional Cartan-Hadamard manifolds; T. H. Colding and W. P. Minicozzi II, Embedded minimal disks; M. Traizet, Construction of minimal surfaces by gluing Weierstrass representations; W. H. Meeks III, Global problems in classical minimal surface theory; W. H. Meeks III and H. Rosenberg, Minimal surfaces of finite topology; N. Kapouleas, Constructions of minimal surfaces by gluing minimal immersions; R. Mazzeo, F. Pacard, and D. Pollack, The conformal theory of Alexandrov embedded constant mean curvature surfaces in  $\mathbb{R}^3$ ; W. Rossman, M. Umehara, and K. Yamada, Constructing mean curvature 1 surfaces in  $H^3$  with irregular ends; R. Kusner, Conformal structures and necksizes of embedded constant mean curvature surfaces; J. Pérez, W. H. Meeks III, and A. Ros, Uniqueness of the Riemann minimal surfaces; Y. Fang, The mathematical protein folding problem; K. Tenenblat, Minimal and CMC surfaces obtained by Ribaucour transformations; R. Sa Earp and E. Toubiana, Meromorphic data for surfaces of mean curvature one in hyperbolic space, II; R. Schoen, Special Lagrangian submanifolds; D. Joyce, Lectures on special Lagrangian geometry; J. Wolfson, Variational problems in Lagrangian geometry:  $\mathbb{Z}_2$ -currents; J. Hass, Minimal surfaces and the topology of three-manifolds; J. H. Rubinstein, Minimal surfaces in geometric 3-manifolds; K. Große-Brauckmann, Cousins of constant mean curvature surfaces; P. Topping, An approach to the Willmore conjecture; C. Mese, Minimal surfaces and harmonic maps into singular geometry; J. H. Rubinstein, Shortest networks in 2 and 3 dimensions; List of participants.

**Clay Mathematics Proceedings**, Volume 2

September 2005, approximately 816 pages, Softcover, ISBN 0-8218-3587-4, 2000 *Mathematics Subject Classification*: 53A10; 49Q15, 53C25, 53C42, 53C43, 58E35, **All AMS members US\$95**, List US\$119, Order code CMP/2



## Curves and Surfaces



Sebastián Montiel and Antonio Ros, *Universidad de Granada, Spain*

This introductory textbook puts forth a clear and focused point of view on the differential geometry of curves and surfaces, emphasizing the global aspects. The excellent collection of examples and exercises (with hints) will help students in learning the

material. Advanced undergraduates and graduate students will find this a nice entry point to differential geometry.

In order to study the global properties of curves and surfaces, it is necessary to have more sophisticated tools than are usually found in textbooks on the topic. In particular, students must have a firm grasp on certain topological theories. Indeed, this monograph treats the Gauss-Bonnet theorem and

discusses the Euler characteristic. The authors also cover Alexandrov's theorem on embedded compact surfaces in  $\mathbb{R}^3$  with constant mean curvature. The last chapter addresses the global geometry of curves, including periodic space curves and the four vertices theorem for plane curves that are not necessarily convex.

This volume is suitable for advanced undergraduates, graduate students, and researchers interested in the differential geometry of curves and surfaces. It can also be used as an introduction to a more general study of differential geometry.

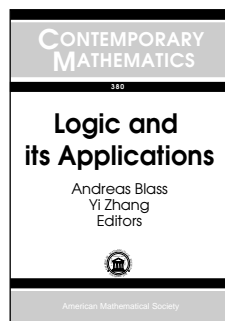
This book is jointly published by the AMS and the Real Sociedad Matemática Española (RSME).

**Contents:** Plane and space curves; Surfaces in Euclidean space; The second fundamental form; Separation and orientability; Integration on surfaces; Global extrinsic geometry; Intrinsic geometry of surfaces; The Gauss-Bonnet theorem; Global geometry of curves; Bibliography; Index.

**Graduate Studies in Mathematics, Volume 69**

October 2005, approximately 384 pages, Hardcover, ISBN 0-8218-3815-6, 2000 *Mathematics Subject Classification:* 53A04, 53A05, 53C40, **All AMS members US\$47**, List US\$59, Order code GSM/69

## Logic and Foundations



### Logic and Its Applications

**Andreas Blass**, *University of Michigan, Ann Arbor*, and **Yi Zhang**, *Sun Yat-Sen University, Guangzhou, China*, Editors

Two conferences, Logic and Its Applications in Algebra and Geometry and Combinatorial Set Theory, Excellent Classes, and Schanuel

Conjecture, were held at the University of Michigan (Ann Arbor). These events brought together model theorists and set theorists working in these areas. This volume is the result of those meetings. It is suitable for graduate students and researchers working in mathematical logic.

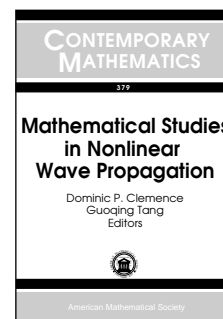
**Contents:** **J. T. Baldwin**, Ehrenfeucht-Mostowski models in abstract elementary classes; **A. Blass**, Unsplit families, dominating families, and ultrafilters; **A. Bovykin**, Several proofs of PA-unprovability; **M. Di Nasso** and **M. Forti**, Ultrafilter semirings and nonstandard submodels of the Stone-Čech compactification of the natural numbers; **S. Gao**, Unitary group actions and Hilbertian polish metric spaces; **R. Grossberg** and **O. Lessmann**, Abstract decomposition theorem and applications; **G. Hjorth**, A dichotomy theorem for being essentially countable; **T. Huuskonen** and **Y. Zhang**, Mad families are small; **T. Hyttinen**, Random logarithm and homogeneity; **J. Iovino**, Definability, semidefinability, and asymptotic structure in analysis; **A. Kolesnikov**, Dependence

relations in non-elementary classes; **O. Lessmann**, An introduction to excellent classes; **D. Mushtari**, Ultrafilters and nuclear spaces; **J. Steprāns**, Many quotient algebras of the integers modulo co-analytic ideals; **V. Tolstikh**, What does the automorphism group of a free abelian group  $A$  know about  $A$ ?; **B. Zilber**, A categoricity theorem for quasi-minimal excellent classes.

**Contemporary Mathematics, Volume 380**

August 2005, 306 pages, Softcover, ISBN 0-8218-3474-6, LC 2005041239, 2000 *Mathematics Subject Classification:* 03-06; 03C35, 03C45, 03C60, 03C95, 03C98, 03E05, 03E15, 03F30, 03H15, **All AMS members US\$63**, List US\$79, Order code CONM/380

## Mathematical Physics



### Mathematical Studies in Nonlinear Wave Propagation

**Dominic P. Clemence** and **Guoqing Tang**, *North Carolina A & T University, Greensboro*, Editors

Lively discussions and stimulating research were part of a five-day conference on Mathematical Methods

in Nonlinear Wave Propagation sponsored by the NSF and CBMS. This volume is a collection of lectures and papers stemming from that event. Leading experts present dynamical systems and chaos, scattering and spectral theory, nonlinear wave equations, optimal control, optical waveguide design, and numerical simulation.

The book is suitable for a diverse audience of mathematical specialists interested in fiber optic communications and other nonlinear phenomena. It is also suitable for engineers and other scientists interested in the mathematics of nonlinear wave propagation.

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

**Contents:** **R. E. Mickens**, An introduction to wave equations; **M. Klaus**, On the Zakharov-Shabat eigenvalue problem; **T. Aktosun**, Solitons and inverse scattering transform; **J. Yang**, A tail-matching method for the linear stability of multi-vector-soliton bound states; **R. H. Goodman**, **R. E. Slusher**, **M. I. Weinstein**, and **M. Klaus**, Trapping light with grating defects; **B. N. Borah**, Thermo-elastic-plastic transition; **A. B. Smirnova**, Regularized quasi-Newton method with continuous inversion of  $F' + \varepsilon I$  for monotone ill-posed operator equations; **W. Huang**, Transition layers for a singularly perturbed neutral delay differential equation; **C. Y. Loh**, Nonlinear aeroacoustics computations by the CE/SE method; **S. C. Chang**, **A. Himansu**, **C. Y. Loh**, **X. Y. Wang**, and **S. T. Yu**, Robust and simple non-reflecting boundary conditions for the Euler equations—A new approach based on

the space-time CE/SE method; **G. Tang, D. Clemence, C. Jackson, Q. Lin, and V. Burbach**, Physical and numerical modeling of seismic wave propagation.

**Contemporary Mathematics**, Volume 379

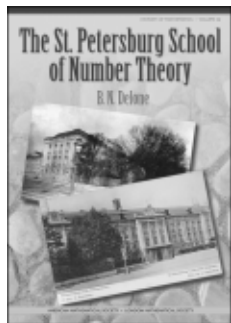
July 2005, 213 pages, Softcover, ISBN 0-8218-3349-9, LC 2005041238, 2000 *Mathematics Subject Classification*: 00B25, 35-06, 65-06, **All AMS members US\$47**, List US\$59, Order code CONM/379

theory of asymptotic functions"; Voronoï's memoirs on quadratic forms; *Ivan Matveevich Vinogradov (1891-1983)*: Ivan Matveevich Vinogradov; Works of Vinogradov from the first period of his mathematical activity; Waring's problem; The Goldbach problem; Estimation of Weyl sums and the problem of the fractional parts of a polynomial; Bibliography.

**History of Mathematics**, Volume 26

September 2005, approximately 296 pages, Hardcover, ISBN 0-8218-3457-6, 2000 *Mathematics Subject Classification*: 01A72, 11-03; 01A55, 01A60, **All AMS members US\$47**, List US\$59, Order code HMATH/26

## Number Theory



### The St. Petersburg School of Number Theory

**B. N. Delone**

For over two centuries, the work of the St. Petersburg mathematicians in number theory has constituted a glorious contribution to mathematics. The Russian book, *The St. Petersburg School of Number Theory*, is about the life and work of prominent members

of this school, such as Chebyshev, Korkin, Zolotarev, Markov, Voronoï, and Vinogradov. These mathematicians are indeed a very distinguished group, and their work in number theory is of the highest quality and continues to have lasting significance.

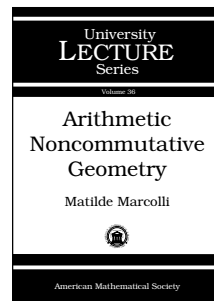
This English translation acquaints the reader with the most important works of these six eminent members of the St. Petersburg school. A short biography is given for each of them, followed by an exposition of some of his most significant contributions. Each contribution features the author's original terminology and notation and is followed by commentary. Certain works receive relatively complete expositions, while others are dealt with more briefly.

With a Foreword written for the English edition, this volume will appeal to a broad mathematical audience, including mathematical historians. It is particularly suitable for graduate students and researchers interested in number theory.

*This item will also be of interest to those working in general and interdisciplinary areas.*

Copublished with the London Mathematical Society. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

**Contents:** *Pafnutii L'vovich Chebyshev (1821-1894)*: Pafnutii L'vovich Chebyshev; Chebyshev's articles on prime numbers; *Aleksandr Nikolaevich Korkin (1837-1908)*: Aleksandr Nikolaevich Korkin; The articles by Korkin and Zolotarev on the minima of positive quadratic forms; *Egor Ivanovich Zolotarev (1847-1878)*: Egor Ivanovich Zolotarev; Zolotarev's memoirs on the theory of ideal numbers; *Andreï Andreevich Markov (1856-1922)*: Andreï Andreevich Markov; On binary quadratic forms of positive determinant; *Georgii Fedoseevich Voronoï (1868-1908)*: Georgii Fedoseevich Voronoï; Voronoï's dissertations on algebraic numbers of the third degree; Voronoï's memoir of 1903: "On a problem from the



### Arithmetic Noncommutative Geometry

**Matilde Marcolli**, *Max-Planck-Institut für Mathematik, Bonn, Germany*

Arithmetic noncommutative geometry uses ideas and tools from noncommutative geometry to address questions in a new way and to

reinterpret results and constructions from number theory and arithmetic algebraic geometry. This general philosophy is applied to the geometry and arithmetic of modular curves and to the fibers at Archimedean places of arithmetic surfaces and varieties.

Noncommutative geometry can be expected to say something about topics of arithmetic interest because it provides the right framework for which the tools of geometry continue to make sense on spaces that are very singular and apparently very far from the world of algebraic varieties. This provides a way of refining the boundary structure of certain classes of spaces that arise in the context of arithmetic geometry.

With a foreword written by Yuri Manin and a brief introduction to noncommutative geometry, this book offers a comprehensive account of the cross fertilization between two important areas, noncommutative geometry and number theory. It is suitable for graduate students and researchers interested in these areas

*This item will also be of interest to those working in algebra and algebraic geometry.*

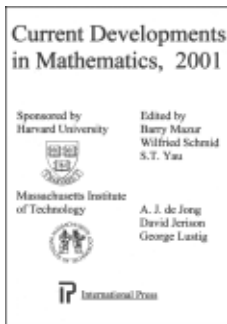
**Contents:** Ouverture; Noncommutative modular curves; Quantum statistical mechanics and Galois theory; Noncommutative geometry at arithmetic infinity; Vistas; Bibliography.

**University Lecture Series**, Volume 36

July 2005, approximately 144 pages, Softcover, ISBN 0-8218-3833-4, 2000 *Mathematics Subject Classification*: 58B34, **All AMS members US\$23**, List US\$29, Order code ULECT/36

# New AMS-Distributed Publications

## Algebra and Algebraic Geometry



### Current Developments in Mathematics, 2001

**Barry Mazur, Wilfried Schmid, and S.-T. Yau, Harvard University, Cambridge, MA, and A. J. de Jong, David Jerison, and George Lustig, Massachusetts Institute of Technology, Cambridge, Editors**

This proceedings volume grew from the joint seminar by MIT and Harvard on the developments in mathematics during the year 2001.

The organizing committee for the seminar consisted of distinguished mathematicians from both institutions: Barry Mazur, Wilfried Schmid, and S.-T. Yau from Harvard, and A. J. de Jong, David Jerison, and George Lustig from MIT.

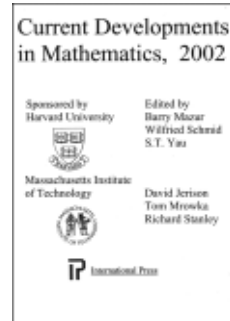
The book is suitable for graduate students and researchers interested in algebra, algebraic geometry, analysis, mathematical physics, number theory, geometry, topology, and probability.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** **G. Carlsson**, Recent developments in algebraic  $K$ -theory; **D. S. Freed**,  $K$ -theory in quantum field theory; **E. H. Lieb** and **J. Yngvason**, The mathematical structure of the second law of thermodynamics; **E. H. Lieb**, **J. P. Solovej**, **R. Seiringer**, and **Y. Yngvason**, The ground state of the Bose gas; **S.-W. Zhang**, Elliptic curves,  $L$ -functions and CM-points.

#### International Press

December 2002, 219 pages, Hardcover, ISBN 1-57146-101-9, All AMS members US\$52, List US\$65, Order code INPR/55



### Current Developments in Mathematics, 2002

**Barry Mazur, Wilfried Schmid, and S.T. Yau, Harvard University, Cambridge, and David Jerison, Tom Mrowka, and Richard Stanley, Massachusetts Institute of Technology, Cambridge, Editors**

These are the proceedings of the joint MIT—Harvard University (Cambridge, MA) seminar on current developments in mathematics held in 2002.

The organizing committee for the seminar consisted of distinguished mathematicians from both institutions: B. Mazur, W. Schmid, and S.T. Yau from Harvard, and D. Jerison, T. Mrowka, and R. Stanley from MIT. This year, the seminar was dedicated to Professor Wilfried Schmid and Professor George Lusztig. The 2002 speakers included Albert Bressan, Mark Haiman, Richard Hain, Stephen Kudla, Yair Minsky, John Morgan, Leslie Saper, Kari Vilonen, and David Vogan.

*This item will also be of interest to those working in mathematical physics, number theory, geometry and topology, and probability.*

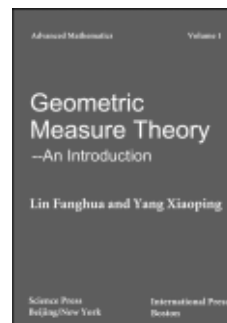
A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** **A. Bressan**, One dimensional hyperbolic systems of conservation laws; **M. Haiman**, Combinatorics, symmetric functions and Hilbert schemes; **R. Hain**, Periods of limit mixed Hodge structures; **S. S. Kudla**, Modular forms and arithmetic geometry; **Y. N. Minsky**, End invariants and the classification of hyperbolic 3-manifolds; **L. Saper**, On the cohomology of locally symmetric spaces and of their compactifications.

#### International Press

December 2003, 289 pages, Hardcover, ISBN 1-57146-102-7, All AMS members US\$52, List US\$65, Order code INPR/57

## Analysis



### Geometric Measure Theory—An Introduction

**Lin Fanghua, New York University, and Yang Xiaoping, Chinese Academy of Sciences, Beijing, China**

In the last three decades since the publication of the seminal work of H. Federer, which gives a rather complete and comprehensive discussion on the subject, geometric measure theory has

developed into an even more cohesive body of basic knowledge with an ample structure of its own, establishing strong ties with many other areas of mathematics and making numerous new striking applications.

The present book is intended for graduate students and researchers in other fields of mathematics as a quick overview on the subject of geometric measure theory, emphasizing various basic ideas, techniques, and their applications in problems arising in the calculus of variations, geometrical analysis and nonlinear partial differential equations. This graduate-level treatment of geometric measure theory illustrates with concrete examples and emphasizes basic ideas and techniques with applications to the calculus of variations, geometrical analysis, and non-linear PDEs. In addition to a full index and bibliography, the book includes eight main chapters. It is co-published by Science Press (Beijing/New York) and International Press (Boston).

The book is suitable for graduate students and researchers interested in analysis.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** Hausdorff measure; Fine properties of functions and sets and their applications; Lipschitz functions and rectifiable sets; The area and co-area formulae; BV functions and sets of finite perimeter; Theory of varifolds; Theory of currents; Mass minimizing currents; Bibliography; Index.

**International Press**

December 2002, 247 pages, Hardcover, ISBN 1-57146-125-6, All AMS members US\$44, List US\$55, Order code INPR/62

hereoclinic orbits of Hamiltonian systems and symplectic geometry.

The book is suitable for graduate students and researchers interested in differential equations.

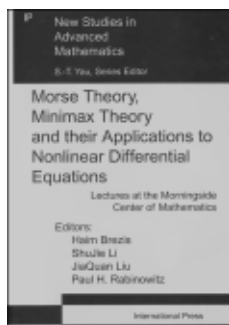
A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** A. Bahri and S. Chanillo, The difference of topology at infinity for the case of two masses in changing sign Yamabe problems on  $S^3$ ; T. Bartsch, Linking, positive invariance and localization of critical points; H. Brezis, Is there failure of the inverse function theorem?; C.-N. Chen, Blow-up of solutions of nonlinear parabolic problems; D. G. Costa, Variational problems which are nonquadratic at infinity; Y. Ding, Homoclinic orbits of Hamiltonian systems; M.-Y. Jiang, Self-adjointness of Hamiltonian operator and some problems in symplectic geometry; G. Li and H.-S. Zhou, Dirichlet problem of  $p$ -Laplacian with nonlinear term  $f(x, u) \sim u^{p-1}$  at infinity; S. Li, Some advances in Morse theory and minimax theory; Y. Li, On a class of elliptic eigenvalue problems with constraint; C. Liu, Iteration theory of Maslov-type index and its applications; Z. Liu and J. Sun, Number of invariant sets of descending flow with applications in critical point theory; Y. Long, The Maslov-type index and its iteration theory and applications to Hamiltonian systems; R. Manasévič and J. Mawhin, The spectrum of  $p$ -Laplacian systems under Dirichlet, Neumann and periodic boundary conditions; P. H. Rabinowitz, A note on Hamiltonian systems of multiple pendulum type; J. Su, Nontrivial critical points for asymptotically quadratic functional at resonance; Z.-Q. Wang, Positive solutions having prescribed symmetry for nonlinear elliptic problems; M. Willem, A decomposition lemma and critical minimization problems; S. Wu, The effect of sublinear term at origin in some elliptic problems; X. Zhang, Positive mass theorem for modified energy condition.

**International Press**

December 2003, 286 pages, Hardcover, ISBN 1-57146-109-4, 2000 *Mathematics Subject Classification:* 49J40, 34B15, 35J20, 35J25, 35J60, 37J45, All AMS members US\$38, List US\$48, Order code INPR/58

## Differential Equations



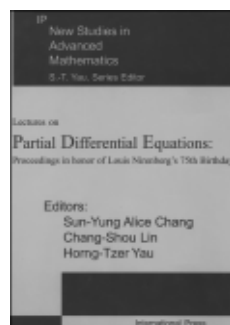
### Morse Theory, Minimax Theory and Their Applications to Nonlinear Differential Equations

Lectures at the Morningside Center of Mathematics

Haim Brezis, *University of Paris VI, France*, ShuJie Li, *Academia Sinica, Beijing, PRC*, JiaQuan Liu, *Peking University, Beijing, PRC*, and Paul H. Rabinowitz, *University of Wisconsin, Madison*, Editors

Based on lectures held at the Morningside Center of Mathematics at the Chinese Academy of Sciences (Beijing), this volume contains both survey and expository papers on Morse theory, minimax theory, iteration theory of Maslov-type index, and critical minimization problems.

The book particularly emphasizes applications to nonlinear differential equations, including semilinear elliptic boundary problems,  $p$ -Laplacian systems, periodic, homoclinic and



### Lectures on Partial Differential Equations

Proceedings in Honor of Louis Nirenberg's 75th Birthday

Sun-Yung Alice Chang, *Princeton University, NJ*, Chang-Shou Lin, *Chung Cheng University, Chia-Yi, Minghsiang, Taiwan*, and Horng-Tzer Yau, *Stanford University, CA*, Editors

Based on lectures held at the Center for Theoretical Sciences (Taiwan) in honor of Louis Nirenberg's 75th birthday, this volume contains research papers dealing with various problems in partial differential equations, such as wave maps, the Navier-Stokes equations, and Lagrangian submanifolds. Professor Nirenberg is particularly appreciated for his

generous encouragement of the development of mathematics in the Asia-Pacific region and the mixture of articles by distinguished mathematicians from Asia and other parts of the world.

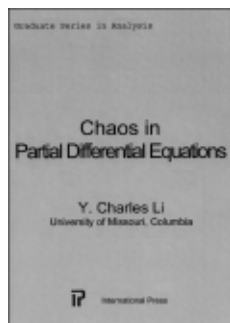
The book is suitable for graduate students and researchers interested in differential equations.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** **A. Bahri**, Recent progress in conformal geometry (with an emphasis on the use of configuration spaces); **H. Brezis**, Homotopy classes in Sobolev spaces; **S.-Y. A. Chang**, **M. J. Gursky**, and **P. C. Yang**, Entire solutions of a fully nonlinear equation; **S.-Y. A. Chang**, **C.-C. Chen**, and **C.-S. Lin**, Extremal functions for a mean field equation in two dimension; **Y. Giga**, Shocks and very strong vertical diffusion; **M. G. Grillakis**, The wave map problem; **Q. Jiu** and **Z. Xin**, Some regularity criteria on suitable weak solutions of the 3-D incompressible axisymmetric Navier-Stokes equations; **J. J. Kohn**, Multiplier ideals and microlocalization; **Y. Li**, Some recent work on elliptic systems from composite material; **F. H. Lin**, Bubbling and quantization in high dimensions; **T.-P. Liu**, **T. Yang**, and **S.-H. Yu**, Entropy pairs for conservation laws and H-theorem for the Boltzmann equation; **Y. Martel** and **F. Merle**, Qualitative results on the generalized critical KdV equation; **R. Schoen** and **J. Wolfson**, The volume functional for Lagrangian submanifolds; **F. Trèves**, An algebraic characterization of the modified Korteweg-De Vries hierarchy; **S. R. Varadhan**, Particle systems and partial differential equations; **S.-T. Yau**, An estimate of the gap of the first two eigenvalues in the Schrödinger operator; Appendix.

#### International Press

December 2003, 238 pages, Hardcover, ISBN 1-57146-111-6, 2000 *Mathematics Subject Classification*: 35J60, 35J50, 35P15, 35Q53, 35L70, 82C22, 53D12, 53A30, 49Q20, 35H20, 46E35, 76P05, **All AMS members US\$52**, List US\$65, Order code INPR/61



## Chaos in Partial Differential Equations

**Y. Charles Li**, *University of Missouri, Columbia*

This book presents a survey on existing results in the rapidly developing area of chaos in partial differential equations (PDEs).

Nonlinear wave equations are the most important class of PDEs in natural sciences. Among these nonlinear wave equations, there is a class of equations called soliton equations that describe a wide spectrum of natural phenomena. The author and his collaborators have established a systematic theory on chaos in nonlinear wave equations. It is a standard program for proving the existence of chaos in perturbed soliton equations, using the following: (1) Darboux transformations for soliton equations, (2) isospectral theory for soliton equations under periodic boundary condition, (3) persistence of invariant manifolds and Fenichel fibers, (4) Melnikov analysis, (5) Smale horseshoes

and symbolic dynamics, and (6) shadowing lemma and symbolic dynamics.

This monograph is suitable for graduate students and researchers interested in differential equations, particularly in chaos in high dimensions.

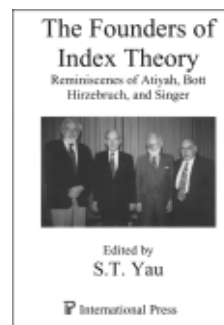
A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** General setup and concepts; Soliton equations as integrable Hamiltonian PDEs; Figure-eight structures; Melnikov vectors; Invariant manifolds; Homoclinic orbits; Existence of chaos; Stabilities of soliton equations in  $\mathbb{R}^n$ ; Lax pairs of Euler equations of inviscid fluids; Linearized 2D Euler equation at a fixed point; Arnold's Liapunov stability theory; Miscellaneous topics; Bibliography; Index.

#### International Press

December 2003, 119 pages, Softcover, ISBN 1-57146-151-5, **All AMS members US\$38**, List US\$48, Order code INPR/60

## General and Interdisciplinary



## The Founders of Index Theory

### Reminiscences of Atiyah, Bott, Hirzebruch, and Singer

**S. T. Yau**, *Harvard University, Cambridge, MA*, Editor

This book tells the story of the four great mathematicians who uncovered index theory, one of the most exciting

discoveries of twentieth-century mathematics. It contains historically important essays by Atiyah, Bott, Hirzebruch, and Singer, as well as articles by Donaldson, Witten, Yau, and others. A large photo section is also included. All combined, these features make this book valuable to everyone interested in understanding mathematics and mathematicians.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** **M. Atiyah**, Personal History; **N. Hitchin**, Sir Michael Atiyah: A brief biography; **P. Goddard**, Sir Michael Atiyah and the early days of the Newton Institute; **R. Bott**, A letter from Raoul Bott; **S. Donaldson**, Geometry in Oxford c.1980-85; **G. Lusztig**, Recollections about my teacher, Michael Atiyah; **L. Nirenberg**, Memories of Sir Michael Atiyah; **G. B. Segal**, Being a graduate student of Michael Atiyah; **E. Witten**, Michael Atiyah and the physics/geometry interface; **M. Atiyah**, Mathematics: Queen and servant of the sciences; **M. Atiyah**, The conscience of science; Interview with Raoul Bott; **L. W. Tu**, The life and works of Raoul Bott; **R. Forman**, Lessons from graduate school; **N. Hingston**, The beautiful vision of Raoul Bott; **P. Landweber**, Some reminiscences about Raoul Bott; **L. W. Tu**, Reminiscences of working with Raoul Bott; **E. Witten**, Lessons from Raoul Bott; Correspondence between J. A. Todd and F. Hirzebruch; **F. Hirzebruch**, Kunihiko Kodaira: Mathematician, friend, and teacher; **A. Jackson**, Bonn's Max Planck Institute: A new building and a new era; **E. Brieskorn**, Singularities in the work of Friedrich Hirzebruch; **K. Hulek**,

Friedrich Hirzebruch and mathematics in post-war Germany; **M. Kreck**, Hirzebruch-Flächen; **I. Singer**, A tribute to Warren Ambrose; **K. Hoffman**, Fifty years of friendship and collaboration with Singer; **C. C. Moore**, Iz Singer and the founding of MSRI; **D. Freed** and **J. Lott**, Singer's Berkeley seminar; **R. V. Kadison**, Which Singer is that?; **H. Rossi**, Reminiscences of a mathematics student, 40 years ago; **D. Stroock**, Is Singer; **F. Warner**, I. M. Singer; **E. Witten**, Is Singer's contributions to geometry and physics; **S. T. Yau**, My friendship with Singer; **M. Atiyah**, Letter to Raoul, Fritz, and Is; **R. Bott**, Letter to Fritz, Is and Michael; **F. Hirzebruch**, Letter to Michael, Raoul, and Iz; **I. M. Singer**, Letters to Michael, Raoul, and Fritz; **R. G. Douglas**, The evolution of modern analysis; **L. Gårding**, A happy collaboration; **A. Weinstein**, Memories of the gang of four; Bibliographies.

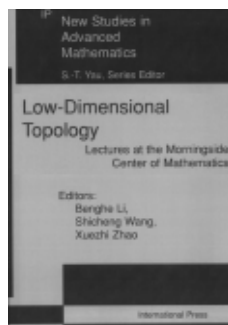
**International Press**

December 2003, 290 pages, Hardcover, ISBN 1-57146-120-5, 2000 *Mathematics Subject Classification*: 51-XX, 54-XX, 58-XX, 34-XX, 46-XX, 14-XX, 47-XX, **All AMS members US\$68**, List US\$85, Order code INPR/54

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## Geometry and Topology

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### Low-Dimensional Topology Lectures at the Morningside Center of Mathematics

**Benghe Li**, *Science Academy, Beijing, China*, **Shicheng Wang**, *Beijing University, China*, and **Xuezhi Zhao**, *Capital Normal University, Beijing, China*, Editors

This volume contains most of the series of lectures presented during the half-year program of low-dimensional topology held at the Morningside Center of Mathematics at the Chinese Academy of Sciences (Beijing). The order of contents is based on the chronological order in which the lectures were presented.

This book is the third volume in the International Press series, *New Studies in Advanced Mathematics*. Each lecture provides a brief introduction to important fields in current research in low-dimensional topology. The volume is suitable for graduate students and researchers interested in geometry and topology.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** **J. W. Morgan**, Definition of the Seiberg-Witten (SW) invariants of 4-manifolds; **J. W. Morgan**, Computation of SW invariants for certain 4-manifolds; **M. Scharlemann**, Heegaard splittings of 3-manifolds; **C. M. Gordon**, Dehn filling; **H. Rubinstein**, Dehn's lemma and the Loop theorem; **H. Rubinstein**, Polyhedral geometry; **H. Rubinstein**, Triangulations of 3-manifolds.

**International Press**

December 2003, 80 pages, Softcover, ISBN 1-57146-112-4, **All AMS members US\$38**, List US\$48, Order code INPR/56