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Algebra and Algebraic Geometry

Cohomology for Quantum Groups via the Geometry of the Nullcone

Christopher P. Bendel, University of Wisconsin-Stout, Menomonie, Wisconsin, Daniel K. Nakano, University of Georgia, Athens, Georgia, Brian J. Parshall, University of Virginia, Charlottesville, Virginia, and Cornelius Pillen, University of South Alabama, Mobile, Alabama

Contents: Preliminaries and statement of results; Quantum groups, actions, and cohomology; Computation of $\Phi_0$ and $\mathcal{N}(\Phi_0)$; Combinatorics and the Steinberg Module; The cohomology algebra $H^*(\mathfrak{u}_G(g), \mathbb{C})$; Finite generation; Comparison with positive characteristic; Support varieties over $\mathfrak{u}_G$ for the Modules $\mathcal{V}_G(\lambda)$ and $\Delta_G(\lambda)$; Appendix A; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1077


On the Spectra of Quantum Groups

Milen Yakimov, Louisiana State University, Baton Rouge, Louisiana

Contents: Introduction; Previous results on spectra of quantum function algebras; A description of the centers of Joseph's localizations; Primitive ideals of $R_q[G]$ and a Dixmier map for $R_q[G]$; Separation of variables for the algebras $S^*_W$; A classification of the normal and prime elements of the De Concini-Kac-Procesi algebras; Module structure of $R_w$ over their subalgebras generated by Joseph's normal elements; A classification of maximal ideals of $R_q[G]$ and a question of Goodearl and Zhang; Chain properties and homological applications; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1078


Analysis

Global and Local Regularity of Fourier Integral Operators on Weighted and Unweighted Spaces

David Dos Santos Ferreira, Université Paris 13, Villetteanue, France, and Wolfgang Staubach, Uppsala University, Sweden

Contents: Prolegomena; Global boundedness of Fourier integral operators; Global and local weighted $L^p$ boundedness of Fourier...
New Publications Offered by the AMS

integral operators; Applications in harmonic analysis and partial differential equations; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1074

Operator-Valued Measures, Dilations, and the Theory of Frames
Deguang Han, University of Central Florida, Orlando, Florida, David R. Larson, Texas A&M University, College Station, Texas, Bei Liu, Tianjin University of Technology, China, and Rui Liu, Nankai University, Tianjin, China

Contents: Introduction; Preliminaries; Dilation of operator-valued measures; Framings and dilations; Dillations of maps; Examples; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1075

Differential Equations
Semiclassical Standing Waves with Clustering Peaks for Nonlinear Schrödinger Equations
Jaeyoung Byeon, KAIST, Daejeon, Republic of Korea, and Kazunaga Tanaka, Waseda University, Tokyo, Japan

Contents: Introduction and results; Preliminaries; Local centers of mass; Neighborhood $Q_{\Omega}(\rho, R, \beta)$ and minimization for a tail of $u$ in $\Omega$; A gradient estimate for the energy functional; Translation flow associated to a gradient flow of $V(x)$ on $\mathbb{R}^{N}$; Iteration procedure for the gradient flow and the translation flow; An $N + 1$-d-dimensional initial path and an intersection result; Completion of the proof of Theorem 1.3; Proof of Proposition 8.3; Proof of Lemma 6.1; Generalization to a saddle point setting; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1076

Mathematical Physics

Semiclassical Standing Waves with Clustering Peaks for Nonlinear Schrödinger Equations
Jaeyoung Byeon, KAIST, Daejeon, Republic of Korea, and Kazunaga Tanaka, Waseda University, Tokyo, Japan

Contents: Introduction and results; Preliminaries; Local centers of mass; Neighborhood $Q_{\Omega}(\rho, R, \beta)$ and minimization for a tail of $u$ in $\Omega$; A gradient estimate for the energy functional; Translation flow associated to a gradient flow of $V(x)$ on $\mathbb{R}^{N}$; Iteration procedure for the gradient flow and the translation flow; An $N + 1$-d-dimensional initial path and an intersection result; Completion of the proof of Theorem 1.3; Proof of Proposition 8.3; Proof of Lemma 6.1; Generalization to a saddle point setting; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1076

General Interest
Really Big Numbers
Richard Evan Schwartz, Brown University, Providence, RI

A superb, beautifully illustrated book for kids — and those of us still children at heart — that takes you up (and up, and up, and up, and ...) through the counting numbers, illustrating the power of the different notations mathematicians have invented to talk about VERY BIG NUMBERS. Many of us use words to try to describe the beauty and the power of mathematics. Schwartz does it with captivating, full-color drawings.

– Keith Devlin, NPR Math Guy and author of The Math Instinct and The Math Gene

Open this book and embark on an accelerated tour through the number system, starting with small numbers and building up to really gigantic ones, like a trillion, an octillion, a googol, and even ones too huge for names! Along the way, you'll become familiar with the sizes of big numbers in terms of everyday objects, such as the number of basketballs needed to cover New York City or the number of trampolines needed to cover the earth's surface. Take an unforgettable journey part of the way to infinity!

The expository style of the articles enables non-experts to understand the basic ideas of this wide range of important topics. This item will also be of interest to those working in geometry and topology.

Contents: A. Henriques, Three-tier CFTs from Frobenius algebras; S. Gukov and I. Saberi, Lectures on knot homology and quantum curves; G. Heuts and J. Lurie, Ambidexterity; C. J. Schommer-Pries, Dualizability in low-dimensional higher category theory.

Contemporary Mathematics, Volume 613

New AMS-Distributed Publications

Algebra and Algebraic Geometry

Advances in Representation Theory of Algebras

David J. Benson, University of Aberdeen, United Kingdom, Henning Krause, University of Bielefeld, Germany, and Andrzej Skowroński, Nicolaus Copernicus University, Toruń, Poland, Editors

This volume presents a collection of articles devoted to representations of algebras and related topics. Distinguished experts in this field presented their work at the International Conference on Representations of Algebras, which took place in Bielefeld in 2012. Many of the expository surveys are included here. Researchers of representation theory will find in this volume interesting and stimulating contributions to the development of the subject.

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

Contents: L. A. Hügel, Infinite dimensional tilting theory; D. J. Benson, A survey of modules of constant Jordan type and vector bundles on projective space; K. Bongartz, On representation-finite algebras and beyond; J. Brundan, Quiver Hecke algebras and categorification; T. Brüstle and D. Yang, Ordered exchange graphs; S. Mozgovoy, Introduction to Donaldson–Thomas invariants; H. Nakajima, Cluster algebras and singular supports of perverse sheaves; J. Pevtsova, Representations and cohomology of finite group schemes; M. Prest, Superdecomposable pure-injective modules; J. Šťovíček, Exact model categories, approximation theory, and cohomology of quasi-coherent sheaves; List of Contributors.

EMS Series of Congress Reports, Volume 9

Lecture Notes on Cluster Algebras

Robert J. Marsh, University of Leeds, United Kingdom

Cluster algebras are combinatorially defined commutative algebras which were introduced by S. Fomin and A. Zelevinsky as a tool for studying the dual canonical basis of a quantized enveloping algebra and totally positive matrices. The aim of these notes is to give an introduction to cluster algebras which is accessible to graduate students or researchers interested in learning more about the field while giving a taste of the wide connections between cluster algebras and other areas of mathematics.

The approach taken emphasizes combinatorial and geometric aspects of cluster algebras. Cluster algebras of finite type are classified by the Dynkin diagrams, so a short introduction to reflection groups is given in order to describe this and the corresponding generalized associahedra. A discussion of cluster algebra periodicity, which has a close relationship with discrete integrable systems, is included.

This book ends with a description of the cluster algebras of finite mutation type and the cluster structure of the homogeneous coordinate ring of the Grassmannian, both of which have a beautiful description in terms of combinatorial geometry.

This item will also be of interest to those working in discrete mathematics and combinatorics.

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

Contents: Introduction; Cluster algebras; Exchange pattern cluster algebras; Reflection groups; Cluster algebras of finite type; Generalized associahedra; Periodicity; Quivers of finite mutation type; Grassmannians; Bibliography; Nomenclature; Index.

Zurich Lectures in Advanced Mathematics, Volume 19

March 2014 Notices of the AMS 321
Analysis

This manuscript complements the Hirsch-Pugh-Shub (HPS) theory on persistence of normally hyperbolic laminations and implies several structural stability theorems. The author generalizes the concept of lamination by defining a new object: the stratification of laminations. It is a stratification whose strata are laminations. The main theorem implies the persistence of some stratifications whose strata are normally expanded. The dynamics is a $C^1$-endomorphism of a manifold (which is possibly not invertible and with critical points). The persistence means that any $C^r$-perturbation of the dynamics preserves a $C^r$-close stratification.

If the stratification consists of a single stratum, the main theorem implies the persistence of normally expanded laminations by endomorphisms, and hence implies the HPS theorem. Another application of this theorem is the persistence, as stratifications, of submanifolds with boundary or corners normally expanded. Several examples are also given in product dynamics.

As diffeomorphisms that satisfy axiom A and the strong transversality condition (AS) defines canonically two stratifications of laminations: the stratification whose strata are the (un)stable sets of basic pieces of the spectral decomposition. The main theorem implies the persistence of some “normally AS” laminations which are not normally hyperbolic and other structural stability theorems.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Decomposition of the dynamics; Techniques of perturbation, genericity; Connexions de pseudo-orbites; Connexions globales; Hyperbolicité non uniforme; Réduction de la dimension ambiante; Bifurcations de points périodiques; Points périodiques homocliniquement liés; Dynamique loin des tangences homoclines; modèles centraux; Hyperblicité topologique et uniforme; A. Centralisateurs de difféomorphismes; Bibliographie; Index.

Mémoires de la Société Mathématique de France, Number 134

Mathematics Subject Classification: 37D10, 37F15, 34D30, 37D20, 57N80, AMS members US$36, List US$45, Order code SMFMEM/134
Differential Equations

From Newton to Boltzmann
Hard Spheres and Short-Range Potentials

Isabelle Gallagher, Université Paris Diderot, France, Laure Saint-Raymond, Ecole Normale Supérieure, Paris, France, and Benjamin Texier, Université Paris Diderot, France

The question addressed in this monograph is the relationship between the time-reversible Newton dynamics for a system of particles interacting via elastic collisions and the irreversible Boltzmann dynamics which gives a statistical description of the collision mechanism. Two types of elastic collisions are considered: hard spheres and compactly supported potentials.

Following the steps suggested by Lanford in 1974, the authors describe the transition from Newton to Boltzmann by proving a rigorous convergence result in short time, as the number of particles tends to infinity and their size simultaneously goes to zero, in the Boltzmann-Grad scaling.

Boltzmann’s kinetic theory rests on the assumption that particle independence is statistically recovered in the limit. This assumption is central to the issue of appearance of irreversibility. For finite numbers of particles, correlations are generated by collisions. The convergence proof establishes that for initially independent configurations, independence is statistically recovered in the limit.

This book is intended for mathematicians working in the fields of partial differential equations and mathematical physics and is accessible to graduate students with a background in analysis.

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

Contents: Introduction; Review on sheaves on subanalytic sites; Conic sheaves on subanalytic sites; Fourier-Sato transform for subanalytic sheaves; Specialization of subanalytic sheaves; Microlocalization of subanalytic sheaves; Holomorphic functions with growth conditions; Integral transforms; A. Review on subanalytic sets; Bibliography.

Mémoires de la Société Mathématique de France, Number 135

General Interest

European Congress of Mathematics
Kraków, July 2–7, 2012

Rafal Latala, University of Warsaw, Poland, Andrzej Ruciński, Adam Mickiewicz University, Poznan, Poland, Paweł Strzelecki, University of Warsaw, Poland, Jacek Świątkowski, University of Wrocław, Poland, and Dariusz Wrzosek and Piotr Zakrzewski, University of Warsaw, Poland, Editors

The European Congress of Mathematics, held every four years, has become a well-established major international mathematical event. Following those in Paris (1992), Budapest (1996), Barcelona (2000), Stockholm (2004), and Amsterdam (2008), the Sixth European Congress of Mathematics (6ECM) took place in Kraków, Poland, July 2–7, 2012, with about 1000 participants from all over the world.

Ten plenary, thirty-three invited lectures, and three special lectures formed the core of the program. As at all the previous EMS congresses, ten outstanding young mathematicians received the EMS prizes in recognition of their research achievements. In addition, two more prizes were awarded: the Felix Klein Prize for a remarkable solution of an industrial problem, and—for the first time—the Otto Neugebauer Prize for a highly original and influential piece of work in the history of mathematics. The program was complemented by twenty-four minisymposia with nearly 100 talks that covered all areas of mathematics. Six panel discussions were organized, covering a variety of issues ranging from the financing of mathematical research to gender imbalance in mathematics.

These proceedings, which present extended versions of most of the invited talks delivered during the congress, provide a permanent record of the best of what mathematics offers today.

Contents: Plenary Lectures: A. Constantin, Some mathematical aspects of water waves; C. De Lellis and L. Székelyhidi, Continuous dissipative Euler flows and a conjecture of Onsager; H. Edelsbrunner and D. Morozov, Persistent homology: theory and practice; M. Gromov, In a search for a structure, Part 1: On entropy; C. Hacon, Classification of algebraic varieties; A. Braverman and D. Kazhdan, Representations of affine Kac–Moody groups over local and global fields: A survey of some recent results; S. Serfaty, Emergence of the Abrikosov lattice in several models with two dimensional Coulomb interaction; S. Shelah, Dependent classes, E72; M. Talagrand, Chaining and the geometry of stochastic processes; Invited Lectures: A. Alekseev, Duflo isomorphism, the
Kashiwara–Vergne conjecture and Drinfeld associators; J. Bertoin, Coagulation with limited aggregations; S. Cantat, The Cremona group in two variables; V. Caselles, Variational models for image inpainting; A. Celletti, KAM theory and its applications: From conservative to dissipative systems; P. Colmez, Le programme de Langlands $p$-adique; T. Coates, A. Corti, S. Galkin, V. Golyshev, and A. Kasprzyk, Mirror symmetry and Fano manifolds; H. Esnault, On flat bundles in characteristic 0 and $p > 0$; A. A. Gaifullin, Combinatorial realisation of cycles and small covers; I. Gallagher, Remarks on the global regularity for solutions to the incompressible Navier–Stokes equations; O. Häggström, Why the empirical sciences need statistics so desperately; A. Iserles, Computing the Schrödinger equation with no fear of commutators; A. S. Kechris, Dynamics of non-archimedean Polish groups; B. Keller, Cluster algebras and cluster monomials; S. Kołodziej, Weak solutions to the complex Monge–Ampère equation; G. Kozma, Reinforced random walk; F. Merle, On blow-up curves for semilinear wave equations; A. E. Mironov, Commuting higher rank ordinary differential operators; D. Nualart, Stochastic calculus with respect to the fractional Brownian motion; A. Olevskii, Sampling, interpolation, translates; L.帕诺夫斯基, Multidimensional periodic and almost-periodic spectral problems; B. Schlein, Effective equations for quantum dynamics; P. Śniady, Combinatorics of asymptotic representation theory; H. Jia and V. Sverak, On scale-invariant solutions of the Navier–Stokes equations; S. Todorčević, Ramsey-theoretic analysis of the conditional structure of weakly-null sequences; Prize Winners’ Lectures: S. Brendle, Uniqueness results for minimal surfaces and constant mean curvature surfaces in Riemannian manifolds; A. Figalli, Stability in geometric and functional inequalities; A. Ioana, Classification and rigidity for von Neumann algebras; M. Lewin, A nonlinear variational problem in relativistic quantum mechanics; C. Manolescu, Grid diagrams in Heegaard Floer theory; G. Miermont, Random maps and continuum random 2-dimensional geometries; T. Sanders, Approximate (Abelian) groups; C. Ulcigrai, Shearing and mixing in parabolic flows; E. Trelat, Optimal control theory and some applications to aerospace problems; J. P. Hogendijk, Mathematics and geometric ornamentation in the medieval Islamic world; Special Lectures: J. F. Rodrigues, Some mathematical aspects of the Planet Earth; P. Welch, Turing’s mathematical work; A. Siemaszko and M. P. Wojtkowski, Counting Berg partitions via Sturman words and substitution tilings.


**Lectures on Representations of Surface Groups**

François Labourie, Université Paris Sud, Orsay, France

The subject of these notes is the character variety of representations of a surface group in a Lie group. The author emphasizes the various points of view (combinatorial, differential, and algebraic) and is interested in the description of its smooth points, symplectic structure, volume, and connected components. He also shows how a three manifold bounded by the surface leaves a trace in this character variety.

These notes were originally designed for students with only elementary knowledge of differential geometry and topology. In the first chapters, the author does not focus on the details of the differential geometric constructions and refers to classical textbooks, while in the more advanced chapters proofs occasionally are provided only for special cases where they convey the flavor of the general arguments. These notes might also be used by researchers entering

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**Geometry and Topology**

**Problème de Plateau, Équations Fuchsienes et Problème de Riemann-Hilbert**

Laura Desideri, Université de Lille 1, Villeneuve d’Ascq, France

A note to readers: This book is in French.

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This dissertation is devoted to the resolution of the Plateau problem in the case of a polygonal boundary in the three-dimensional euclidean space. It relies on a method developed by René Garnier and published in 1928 in a paper which seems today to be totally forgotten. Even if Garnier’s method is more geometrical and constructive than the variational one, it is sometimes really complicated, and even obscure or incomplete. The authors rewrite his proof with a modern formalism, fill some gaps, and propose some alternative easier proofs.

This work mainly relies on a systematic use of Fuchsian systems and on the relation that we establish between the reality of such systems and their monodromy. Garnier’s method is based on the following result: using the spinorial Weierstrass representation for minimal surfaces, the authors can associate to each minimal disk with a polygonal boundary a real Fuchsian second order equation defined on the Riemann sphere. The monodromy of the equation is encoded by the oriented directions of the edges of the boundary.

To solve the Plateau problem, the authors are thus led to solve a Riemann–Hilbert problem. Then, they proceed in two steps: first, by means of isomonodromic deformations, they construct the family of all minimal disks with a polygonal boundary with given oriented directions. Then, by studying the edges’ lengths of these polygonal boundaries, they show that every polygon is the boundary of a minimal disk.

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

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Surfaces minimales; Équations fuchsienes et systèmes fuchsiens; Equation associée à un disque minimal à bord polygonal; Déformations isomonodromiques; Rapports de longueurs des côtés; A. Le système de Garnier; B. Démonstrations de résultats utilisés au chapitre 5; Bibliographie.

this fast expanding field as motivation for further studies. The concluding paragraph of every chapter provides suggestions for further research.

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

**Contents:** Introduction; Surfaces; Vector bundles and connections; Twisted cohomology; Moduli spaces; Symplectic structure; 3-manifolds and integrality questions; Bibliography; Index.

**Zurich Lectures in Advanced Mathematics, Volume 17**


**Mathematics Subject Classification:** 53D30, 53C10, 58D27, 32G15, 58J28, AMS members US$30.40, List US$38, Order code EMSZLEC/17

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**Probability and Statistics**

**One-Dimensional General Forest Fire Processes**

**Xavier Bressaud, Université Paul Sabatier, Toulouse, France, and Nicolas Fournier, Université Paris-Est, Créteil, France**

The authors consider the one-dimensional generalized forest fire process: at each site of $\mathbb{Z}$, seeds and matches fall according to i.i.d. stationary renewal processes. When a seed falls on an empty site, a tree grows immediately. When a match falls on an occupied site, a fire starts and destroys immediately the corresponding connected component of occupied sites. Under some quite reasonable assumptions on the renewal processes, we show that when matches become less and less frequent, the process converges, with a correct normalization, to a limit forest fire model.

According to the nature of the renewal processes governing seeds, there are four possible limit forest fire models. The four limit processes can be perfectly simulated. This study generalizes consequently previous results where seeds and matches were assumed to fall according to Poisson processes.

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

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Introduction; Notation and results; Proofs; Numerical simulations; Appendix; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 132


**Mathematics Subject Classification:** 60K35, 82C22, AMS members US$38.40, List US$48, Order code SMFMEM/132

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**Selected Papers of V. S. Varadarajan Volumes 2 and 3**

**Donald G. Babbitt and Ramesh Gangolli, K. R. Parthasarathy, Indian Statistical Institute, New Delhi, India, Enrico G. Beltrameetti and Gianni Cassinelli, University of Genova, Italy, Rita Fioresi, Università di Bologna, Italy, and Anatoly N. Kochubei, National Academy of Sciences of Ukraine, Kiev, Ukraine, Editors**

The current volumes contain the papers on fundamental questions of individual and families of meromorphic differential equations that are treated by a new group theoretic and functional approach; papers on representation theory of Lie groups; papers on foundations of physics, supersymmetry, and P-adic aspects of quantum physical theories; papers on analysis, especially oscillatory integrals, on semi-simple Lie groups, their conjugacy classes, and their flag manifolds; and finally, several review articles, both personal and mathematical, on a number of the above topics.

**Hindustan Book Agency:** 2013; 1366 pages; Hardcover: ISBN: 978-93-80250-54-0; List US$60; AMS members US$48; Order code HIN64

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**Basic Ergodic Theory Third Edition**

**M. G. Nadkarni, University of Mumbai, India**

This is an introductory text on ergodic theory. The presentation has a slow pace, and the book can be read by anyone with a background in basic measure theory and metric topology.

The third edition has, among other improvements, a new chapter on additional topics that include Liousville’s theorem of classical mechanics, the basics of Shannon Entropy and the Kullback-Leibler theorem, and van der Waerden’s theorem on arithmetical progressions.

**Hindustan Book Agency:** 2013; 196 pages; Hardcover: ISBN: 978-93-80250-43-4; List US$48; AMS members US$38.40; Order code HIN58

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**Probability Theory A FOUNDATIONAL COURSE**

**R. P. Pakshirajan, University of Mysore, India**

This book shares the dictum of J. L. Doob in treating probability theory as a branch of measure theory and establishes this relationship early. Probability measures in product spaces are introduced right at the start as a way of laying the groundwork to later claim the existence of stochastic processes with prescribed finite-dimensional distributions.

**Hindustan Book Agency:** 2013; 364 pages; Hardcover: ISBN: 978-93-80250-44-1; List US$68; AMS members US$54.40; Order code HIN60

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**Atiyah-Singer Index Theorem An Introduction**

**Amiya Mukherjee, Indian Statistical Institute, Calcutta, India**

This monograph is a thorough introduction to the Atiyah-Singer index theorem for elliptic operators on compact manifolds without boundary. The main theme is only the classical index theorem and some of its applications, but not the subsequent developments and simplifications of the theory.

**Hindustan Book Agency:** 2013; 276 pages; Hardcover: ISBN: 978-93-80250-53-3; List US$60; AMS members US$48; Order code HIN64