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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 $\nabla_{\lambda}$ and $\Delta_{\lambda}$; Appendix A; Bibliography.

Memoirs of the American Mathematical Society, Volume 229, Number 1077
May 2014, 93 pages, Softcover, ISBN: 978-0-8218-9174-2, LC 201400519, 2010 Mathematics Subject Classification: 16T20, AMS members US$56.80, List US$71, Order code MEMO/229/1077

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 localization; 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
May 2014, 91 pages, Softcover, ISBN: 978-0-8218-9175-9, LC 20100519, 2010 Mathematics Subject Classification: 16T20, 20G42, 17B37, 53D17, AMS members US$56.80, List US$71, Order code MEMO/229/1078

Analysis

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

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

Contents: Prolegomena; Global boundedness of Fourier integral operators; Global and local weighted $L^p$ boundedness of Fourier
integral operators; Applications in harmonic analysis and partial differential equations; Bibliography.

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

May 2014, 65 pages, Softcover, ISBN: 978-0-8218-9119-3, LC 2013051215, 2010 Mathematics Subject Classification: 42B99, AMS members US$55.40, List US$63, Order code MEMO/229/1074

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; Dilations of maps; Examples; Bibliography.

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

May 2014, 84 pages, Softcover, ISBN: 978-0-8218-9172-8, LC 2013051213, 2010 Mathematics Subject Classification: 46G10, 46L07, 46L10, 46L51, 47A20; 42C15, 46B15, 46B25, 47B48, AMS members US$52, List US$65, Order code MEMO/229/1075

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 Ωα(ρ, R, β) and minimization for a tail of u in Ωα; A gradient estimate for the energy functional; Translation flow associated to a gradient flow of V(x) on R^n; Iteration procedure for the gradient flow and the translation flow; An (N + 1)ℓ₀-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

May 2014, 89 pages, Softcover, ISBN: 978-0-8218-9163-6, LC 2013051220, 2010 Mathematics Subject Classification: 35J60; 35B25, AMS members US$56.80, List US$71, Order code MEMO/229/1076

Mathematical Physics

Topology and Field Theories

Stephen Stolz, University of Notre Dame, IN, Editor

This book is a collection of expository articles based on four lecture series presented during the 2012 Notre Dame Summer School in Topology and Field Theories.

The four topics covered in this volume are: Construction of a local conformal field theory associated to a compact Lie group, a level and a Frobenius object in the corresponding fusion category; Field theory interpretation of certain polynomial invariants associated to knots and links; Homotopy theoretic construction of far-reaching generalizations of the topological field theories that Dijkgraf and Witten associated to finite groups; and a discussion of the action of the orthogonal group O(n) on the full subcategory of an n-category consisting of the fully dualizable objects.

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 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!

May 2014, 192 pages, Softcover, ISBN: 978-1-4704-1425-2, 2010 Mathematics Subject Classification: 00-XX, AMS members US$20, List US$25, Order code MBK/84
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
April 2014, approximately 183 pages, Softcover, ISBN: 978-1-4704-1015-5, LC 2013037475, 2010 Mathematics Subject Classification: 57R56, 81T40, 18G99, 55N99, AMS members US$62.40, List US$78, Institutional member US$78.40, Order code CONM/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
December 2013, 378 pages, Hardcover, ISBN: 978-3-03719-125-5, 2010 Mathematics Subject Classification: 16Gxx, 13Dxx, 18Exx, 20Cxx, All Individuals US$78.40, List US$98, Institutional member US$78.40, Order code EMSSCR/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
January 2014, 122 pages, Softcover, ISBN: 978-3-03719-130-9, 2010 Mathematics Subject Classification: 13F60, 05E40, 14M15, 17B22, 17B63, 18E30, 20F55, 51F15, 52B05, 52B11, 57Q15, AMS members US$28.80, List US$36, Order code EMSZLEC/19
Persistence of Stratifications of Normally Expanded Laminations

Pierre Berger, Université Paris 13, Villetaneuse, France

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; Geometry of stratification of laminations; Persistence of stratifications of laminations; Proof of the persistence of stratifications; A. Analysis on laminations and on trellis; B. Adapted metric; C. Plaque-expansiveness; D. Preservation of leaves and of laminations; Bibliography.

Mémoires de la Société Mathématique de France, Number 134

October 2013, 113 pages, Softcover, ISBN: 978-2-85629-764-3, 2010 Mathematics Subject Classification: 37D10, 37F15, 34D30, 37D20, 57N80, AMS members US$36, List US$45, Order code SMFMEM/134

Microlocalization of Subanalytic Sheaves

Luca Prelli, Universita degli Studi di Padova, Italy

The author defines the specialization and microlocalization functors for subanalytic sheaves. Applying these tools to the sheaves of tempered and Whitney holomorphic functions, he generalizes some classical constructions. He also proves that the microlocalizations of tempered and Whitney holomorphic functions have a natural structure of module over the ring of microdifferential operators and are locally invariant under contact transformations.

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.
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. The convergence proof establishes that for initially independent configurations, independence is propagated by the dynamics. This assumption is critical to the issue of appearance of irreversibility. For finite numbers of particles, correlations are generated by collisions. The 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.

The low density limit; The Boltzmann equation; Main results; II. The case of hard spheres: Microscopic dynamics and BBGKY hierarchy; Uniform a priori estimates for the BBGKY and Boltzmann hierarchies; Statement of the convergence result; Strategy of the proof of convergence; III. The case of short-range potentials: Two-particle interactions; Truncated marginals and the BBGKY hierarchy; Cluster estimates and uniform a priori estimates; Convergence result and strategy of proof; IV. Termwise convergence: Elimination of recollisions; Truncated collision integrals; Proof of convergence; Concluding remarks; Bibliography; Index.

Zurich Lectures in Advanced Mathematics, Volume 18

January 2014, 150 pages, Softcover, ISBN: 978-3-03719-129-3, 2010

Mathematics Subject Classification: 35Q20, 35Q70, AMS members US$30.40, List US$38, Order code EMSZLEC/18
Kashiwara–Vergne conjecture and Drinfeld associators; J. Bertoin, Coagulation with limited aggregations; V. Caselles, The Cremona group in two variables; P. Colmez, 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. Gaiffullin, 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. Koldziej, 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. Olevskiǐ, Sampling, interpolation, translates; L. Par探skovskǐǐ, Multidimensional periodic and almost-periodic spectral problems; B. Schlein, Effective equations for quantum dynamics; P. Šniady, Combinatorics of asymptotic representation theory; H. Jia and V. Svešák, On scale-invariant solutions of the Navier–Stokes equations; S. Todorˇcevi´c, 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. Fagalli, 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. Miernost, 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 Sturmian words and substitution tilings.

December 2013, 824 pages, Hardcover, ISBN: 978-3-03719-120-0, 2010 Mathematics Subject Classification: 00Bxx, AMS members US$102.40, List US$128, Order code EMSEM/2012

Geometry and Topology

Problème de Plateau, Équations Fuchsiennes et Problème de Riemann-Hilbert
Laura Desideri, Université de Lille 1, Villeneuve d’Ascq, France

A note to readers: This book is in French.

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 edge’s 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 fuchsiennes et systèmes fuchsiens; Équation 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.

Mémoires de la Société Mathématique de France, Number 133
October 2013, 116 pages, Softcover, ISBN: 978-2-85629-766-7, 2010 Mathematics Subject Classification: 53A10, 34A30, 34M35, 34M50, 34M55, 32G34, AMS members US$38.40, List US$48, Order code SMFMEM/133

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
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

December 2013, 146 pages, Softcover, ISBN: 978-3-03719-127-9, 2010

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

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

October 2013, 138 pages, Softcover, ISBN: 978-2-85629-765-0, 2010

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