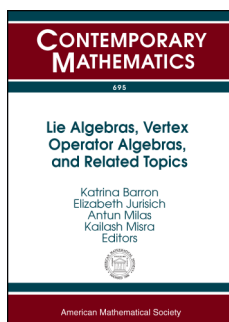# New Publications Offered by the AMS

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Algebra and Algebraic Geometry

Lie Algebras, Vertex Operator Algebras, and Related Topics

Katrina Barron, *University of Notre Dame, IN*, **Elizabeth Jurisich**, *College of Charleston, SC*, **Antun Milas**, *SUNY at Albany, NY*, and **Kailash Misra**, *North Carolina State University, Raleigh, NC*, Editors

This volume contains the proceedings of the conference on Lie Algebras, Vertex Operator Algebras, and Related Topics, celebrating the 70th birthday of James Lepowsky and Robert Wilson, held from August 14–18, 2015, at the University of Notre Dame, Notre Dame, Indiana.

Since their seminal work in the 1970s, Lepowsky and Wilson, their collaborators, their students, and those inspired by their work, have developed an amazing body of work intertwining the fields of Lie algebras, vertex algebras, number theory, theoretical physics, quantum groups, the representation theory of finite simple groups, and more. The papers presented here include recent results and descriptions of ongoing research initiatives representing the broad influence and deep connections brought about by the work of Lepowsky and Wilson and include a contribution by Yi-Zhi Huang summarizing some major open problems in these areas, in particular as they pertain to two-dimensional conformal field theory.
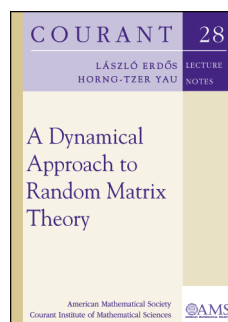
This item will also be of interest to those working in mathematical physics.

Contents: D. **Addabbo** and M. **Bergvelt**, Generalizations of Q-systems and orthogonal polynomials from representation theory; D. **Adamović** and A. **Milas**, Some applications and constructions of intertwining operators in logarithmic conformal field theory; L. **Bao** and L. **Carbone**, Kac-Moody groups and automorphic forms in low dimensional supergravity theories; K. **Bringmann**, K. **Mahlburg**, and A. **Milas**, The Lusztig-Macdonald-Wall polynomial conjectures and q-difference equations; L. **Carbone** and F. **Wagner**, Uniqueness of representation-theoretic hyperbolic Kac-Moody groups over $\mathbb{Z}$; J. **Fuchs** and C. **Schweigert**, Coends in conformal field theory; H. **Li**, Remarks on ϕ-coordinated modules for quantum vertex algebras; A. **Henriques**, The classification of chiral WZW models by $H^4_+(BG, \mathbb{Z})$; Y.-Z. **Huang**, Some open problems in mathematical two-dimensional conformal field theory; N. **Jing**, C. R. **Mangum**, and K. C. **Misra**, On realization of some twisted toroidal Lie algebras; J. **Lepowsky** and J. **Yang**, Twisted generating functions incorporating singular vectors in Verma modules and their localizations, I; Y. **Arike**, K. **Nagatomo**, and Y. **Sakai**, Characterization of the simple Virasoro vertex operator algebras with 2 and 3-dimensional space of characters; D. **Radnell**, E. **Schippers**, and W. **Staubach**, Quasiconformal Teichmüller theory as an analytical foundation for two-dimensional conformal field theory; A. M. **Semikhatov**, Centralizing the centralizers; N. R. **Wallach**, On Neeman's gradient flows.

A Dynamical Approach to Random Matrix Theory

László Erdős, *Institute of Science and Technology Austria, Klosterneuburg, Austria*, and **Horng-Tzer Yau**, *Harvard University, Cambridge, MA*

This book is a concise and self-contained introduction of recent techniques to prove local spectral universality for large random matrices. Random matrix theory is a fast expanding research area, and this book mainly focuses on the methods that the authors participated in developing over the past few years. Many other interesting topics are not included, and neither are several new developments within the framework of these methods. The authors have chosen instead to present key concepts that they believe are the core of these methods and should be relevant for future applications. They keep technicalities to a minimum to make the book accessible

to graduate students. With this in mind, they include in this book the basic notions and tools for high-dimensional analysis, such as large deviation, entropy, Dirichlet form, and the logarithmic Sobolev inequality.

This manuscript has been developed and continuously improved over the last five years. The authors have taught this material in several regular graduate courses at Harvard, Munich, and Vienna, in addition to various summer schools and short courses.

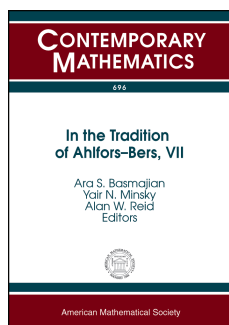*This item will also be of interest to those working in mathematical physics.*

Titles in this series are co-published with the Courant Institute of Mathematical Sciences at New York University.

Contents: Introduction; Wigner matrices and their generalizations; Eigenvalue density; Invariant ensembles; Universality for generalized Wigner matrices; Local semicircle law for universal Wigner matrices; Weak local semicircle law; Proof of the local semicircle law; Sketch of the proof of the local semicircle law using the spectral gap; Fluctuation averaging mechanism; Eigenvalue location: The rigidity phenomenon; Universality for matrices with Gaussian convolutions; Entropy and the logarithmic Sobolev inequality (LSI); Universality of the Dyson Brownian motion; Continuity of local correlation functions under the matrix OU process; Universality of Wigner matrices in small energy windows: GFT; Edge universality; Further results and historical notes; References; Index.

Courant Lecture Notes, Volume 28

September 2017, approximately 226 pages, Softcover, ISBN: 978-1-4704-3648-3, 2010 *Mathematics Subject Classification:* 15B52, 82B44, **AMS members US$34.40**, List US$43, Order code CLN/28

Analysis

In the Tradition of Ahlfors–Bers, VII

Ara S. Basmajian, *The Graduate Center, CUNY, New York, NY*, **Yair N. Minsky**, *Yale University, New Haven, CT*, and **Alan W. Reid**, *University of Texas at Austin, TX*, Editors
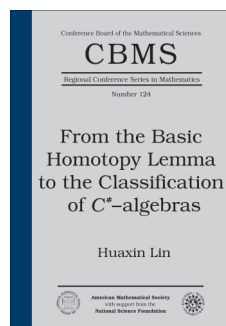
The Ahlfors–Bers Colloquia commemorate the mathematical legacy of Lars Ahlfors and Lipman Bers. The core of this legacy lies in the fields of geometric function theory, Teichmüller theory, hyperbolic geometry, and partial differential equations. Today we see the influence of Ahlfors and Bers on algebraic geometry, mathematical physics, dynamics, probability, geometric group theory, number theory and topology. Recent years have seen a flowering of this legacy with an increased interest in their work.

This current volume contains articles on a wide variety of subjects that are central to this legacy. These include papers in Kleinian groups, classical Riemann surface theory, Teichmüller theory, mapping class groups, geometric group theory, and statistical mechanics.

Contents: S. M. Antonakoudis, The complex geometry of Teichmüller spaces and bounded symmetric domains; **T. Aougab** and **S. J. Taylor**, Pseudo-Anosovs optimizing the ratio of Teichmüller to curve graph translation length; **M. Bestvina** and **K. Fujiwara**, Handlebody subgroups in a mapping class group; **S. Choi**, The convex real projective obifolds with radial or totally geodesic ends: A survey of some partial results; **J. Fan** and **J. Hu**, A gluing theorem and applications in subspaces of the universal Teichmüller space; **F. P. Gardiner**, Extremal length and uniformization; **J. Gilman** and **L. Keen**, Winding and unwinding and essential intersections in $\mathbb{H}^3$; **G. R. Grimmett** and **Z. Li**, The 1-2 model; **S. Gupta** and **M. Wolf**, Meromorphic quadratic differentials with complex residues and spiralling foliations; **P. Haïssinsky**, Quasi-isometric rigidity of the class of convex-cocompact Kleinian groups; **Y. Jiang** and **S. Mitra**, Variation of moduli under continuous motions; **B. Linowitz** and **J. S. Meyer**, Systolic surfaces of arithmetic hyperbolic 3-manifolds; **H. Miyachi**, Extremal length functions are log-plurisubharmonic.

Contemporary Mathematics, Volume 696

September 2017, 250 pages, Softcover, ISBN: 978-1-4704-2651-4, LC 2017015094, 2010 *Mathematics Subject Classification:* 20-XX, 30-XX, 31-XX, 32-XX, 51-XX, 53-XX, 57-XX, 58-XX, 60-XX, **AMS members US$88.80**, List US$111, Order code CONM/696

From the Basic Homotopy Lemma to the Classification of C^*-algebras

Huaxin Lin, *East China Normal University, Shanghai, China, and University of Oregon, Eugene, OR*

This book examines some recent developments in the theory of C^*-algebras, which are algebras of operators on Hilbert spaces. An elementary introduction to the technical part of the theory is given via a basic homotopy lemma concerning a pair of almost commuting unitaries. The book presents an outline of the background as well as some recent results of the classification of simple amenable C^*-algebras, otherwise known as the Elliott program. This includes some stable uniqueness theorems and a revisiting of Bott maps via stable homotopy. Furthermore, KK-theory related rotation maps are introduced. The book is based on lecture notes from the CBMS lecture sequence at the University of Wyoming in the summer of 2015.

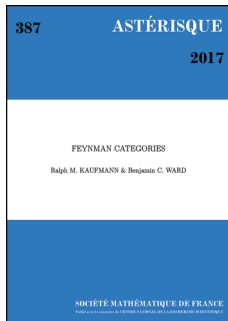A co-publication of the AMS and CBMS.

Contents: An overview of the Elliott program; An introduction to the Basic Homotopy Lemma; Maps to finite dimensional C^*-algebras; Stable homotopy lemmas; The Basic Homotopy Lemma, finite dimensional cases; C^*-algebras of generalized tracial rank one; More Basic Homotopy Lemmas; Asymptotic unitary equivalence; Classification of simple C^*-algebras of finite rank; Bibliography; Index.

CBMS Regional Conference Series in Mathematics, Number 124

October 2017, approximately 240 pages, Softcover, ISBN: 978-1-4704-3490-8, LC 2017014769, 2010 *Mathematics Subject Classification:* 46L35; 46L05, 46L80, **AMS members US$41.60**, List US$52, Order code CBMS/124

New AMS-Distributed Publications

Algebra and Algebraic Geometry

Feynman Categories

Ralph M. Kaufmann, *Purdue University, West Lafayette, IN*, and **Benjamin C. Ward**, *Stockholm University, Sweden*

In this book, the authors give a new foundational, categorical formulation for operations and relations and objects parameterizing them. This generalizes and unifies the theory of operads and all their cousins including but not limited to PROPs, modular operads, twisted (modular) operads, properads, hyperoperads, their colored versions, as well as algebras over operads and an abundance of other related structures, such as crossed simplicial groups, the augmented simplicial category or FI-modules.

The usefulness of this approach is that it allows the authors to handle all the classical as well as more esoteric structures under a common framework and treat all the situations simultaneously. Many of the known constructions simply become Kan extensions. In this common framework, the authors also derive universal operations, such as those underlying Deligne's conjecture, construct Hopf algebras, as well as perform resolutions, (co)bar transforms and Feynman transforms which are related to master equations. For these applications, the authors construct the relevant model category structures. This produces many new examples.

This item will also be of interest to those working in geometry and topology.

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.

Astérisque, Number 387

June 2017, 161 pages, Softcover, ISBN: 978-2-85629-852-7, 2010 *Mathematics Subject Classification:* 18D10, 55U35, 18D99, 55P48, 18D50, 81Q05, 18C15, 18D20, 18D25, 18G55, 55U40, 81T30, 81T18, 16T10, 16T05, **AMS members US$48**, List US$60, Order code AST/387

Représentations des Espaces Tordus sur un Groupe Réductif Connexe p-adique

Bertrand Lemaire, *Aix-Marseille Université, France*, and **Guy Henniart**, *Université Paris-Sud, Orsay, France*

A note to readers: This book is in French.

This volume presents a study of harmonic analysis on a non-connected reductive group over a locally compact non-Archimedean field F of any characteristic. The authors take the point of view of twisted spaces on the connected component and even allow twisting by a character, which is inspired by the notion of twisted endoscopy for automorphic representations.
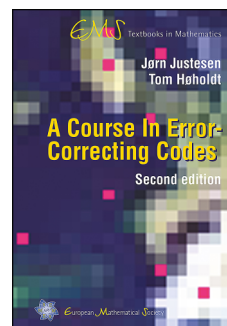
Part I establishes the notion of character functions in this context, and Part II proves the analogues of the scalar Paley–Wiener theorem and the spectral density theorem.

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.

Astérisque, Number 386

May 2017, 376 pages, Softcover, ISBN: 978-2-85629-851-0, 2010 *Mathematics Subject Classification:* 22E50, **AMS members US$65.60**, List US$82, Order code AST/386

Applications

A Course in Error-Correcting Codes

Second Edition

Jørn Justesen, *Technical University of Denmark, Lyngby*, and **Tom Høholdt**, *Technical University of Denmark, Lyngby*

This book, updated and enlarged for the second edition, is written as a text for a course aimed at third or fourth year graduate students in discrete mathematics, computer science, or communication engineering. Only some familiarity with elementary linear algebra and probability is assumed.

The book is also a suitable introduction to coding theory for researchers from related fields or for professionals who want to supplement their theoretical basis. The book gives the coding basics for working on projects in any of the above areas, but material specific to one of these fields has not been included. The chapters cover the codes and decoding methods that are currently of most interest in research, development, and application. They give a relatively brief presentation of the essential results, emphasizing the interrelations between different methods and

proofs of all important results. A sequence of problems at the end of each chapter serves to review the results and give the student an appreciation of the concepts. In addition, some problems and suggestions for projects indicate direction for further work.

The presentation encourages the use of programming tools for studying codes, implementing decoding methods, and simulating performance. Specific examples of programming exercises are provided on the book's homepage.
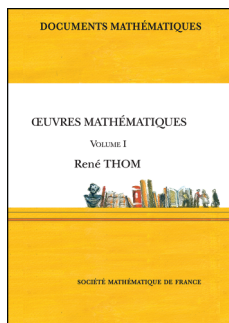
This item will also be of interest to those working in number theory.

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

EMS Textbooks in Mathematics, Volume 20

July 2017, 226 pages, Hardcover, ISBN: 978-3-03719-179-8, 2010 *Mathematics Subject Classification:* 94-01, 12-01, **AMS members US\$36**, List US\$45, Order code EMSTEXT/20

Geometry and Topology

Œuvres Mathématiques
Volume I
René Thom

A note to readers: This book is in French.

This first volume of René Thom's complete mathematical works contains the articles published before 1960, together with fascinating previously unpublished texts and comments that put the whole in perspective.

This volume includes the essentials of Thom's contribution to algebraic and differential topology, born in collaboration with Henri Cartan and Charles Ehresmann, for which Thom was awarded a Fields Medal in 1958. Next come the articles about the founding of singularity theory, which was developed in the sixties and led Thom to invent catastrophe theory.
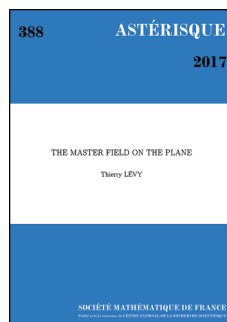
The volume begins with a substantial biographical notice and a bibliography of Thom's mathematical and nonmathematical works.

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.

Documents Mathématiques, Number 15

June 2017, 573 pages, Softcover, ISBN: 978-2-85629-816-9, 2010 *Mathematics Subject Classification:* 55, 57, 14, 32, **AMS members US\$84**, List US\$105, Order code SMFDM/15

Probability and Statistics

The Master Field on the Plane

Thierry Lévy, *Université Pierre et Marie Curie, Paris, France*

The author studies the large N asymptotics of the Brownian motions on the orthogonal, unitary and symplectic groups, extends the convergence in non-commutative distribution originally obtained by Biane for the unitary Brownian motion to the orthogonal and symplectic cases, and derives explicit estimates for the speed of convergence in non-commutative distribution of arbitrary words in independent increments of Brownian motions.

Using these results, the author fulfills part of a program outlined by Singer by constructing and studying the large N limit of the Yang–Mills measure on the Euclidean plane with orthogonal, unitary, and symplectic structure groups. The author proves that each Wilson loop converges in probability towards a deterministic limit and that its expectation converges to the same limit at a speed which is controlled explicitly by the length of the loop. In the course of this study, the author reproves and mildly generalizes a result of Hambly and Lyons on the set of tree-like rectifiable paths.

Finally, the author rigorously establishes, both for finite N and in the large N limit, the Schwinger–Dyson equations for the expectations of Wilson loops, which in this context are called the Makeenko–Migdal equations. The author studies how these equations allow one to compute recursively the expectation of a Wilson loop as a component of the solution of a differential system with respect to the areas of the faces delimited by the loop.

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.

Astérisque, Number 388

May 2017, 201 pages, Softcover, ISBN: 978-2-85629-853-4, 2010 *Mathematics Subject Classification:* 60B20, 81T13, 46L54, **AMS members US\$53.60**, List US\$67, Order code AST/388