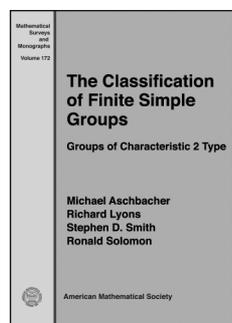


# New Publications Offered by the AMS

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## Algebra and Algebraic Geometry



### The Classification of Finite Simple Groups

Groups of Characteristic 2  
Type

**Michael Aschbacher**, *California Institute of Technology, Pasadena, CA*, **Richard Lyons**, *Rutgers University, Piscataway, NJ*, **Stephen D. Smith**, *University of Illinois at Chicago, IL*, and **Ronald Solomon**, *The Ohio State University, Columbus, OH*

The book provides an outline and modern overview of the classification of the finite simple groups. It primarily covers the “even case”, where the main groups arising are Lie-type (matrix) groups over a field of characteristic 2. The book thus completes a project begun by Daniel Gorenstein’s 1983 book, which outlined the classification of groups of “noncharacteristic 2 type”.

However, this book provides much more. Chapter 0 is a modern overview of the logical structure of the entire classification. Chapter 1 is a concise but complete outline of the “odd case” with updated references, while Chapter 2 sets the stage for the remainder of the book with a similar outline of the “even case”. The remaining six chapters describe in detail the fundamental results whose union completes the proof of the classification theorem. Several important subsidiary results are also discussed. In addition, there is a comprehensive listing of the large number of papers referenced from the literature. Appendices provide a brief but valuable modern introduction to many key ideas and techniques of the proof. Some improved arguments are developed, along with indications of new approaches to the entire classification—such as the second and third generation projects—although there is no attempt to cover them comprehensively.

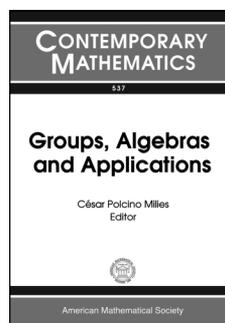
The work should appeal to a broad range of mathematicians—from those who just want an overview of the main ideas of the classification, to those who want a reader’s guide to help navigate

some of the major papers, and to those who may wish to improve the existing proofs.

**Contents:** *Background and overview:* Introduction; Overview: The classification of groups of Gorenstein-Walter type; Overview: The classification of groups of characteristic 2 type; *Outline of the classification of groups of characteristic 2 type:*  $e(G) \leq 2$ : The classification of quasithin groups;  $e(G) = 3$ : The classification of rank 3 groups;  $e(G) \geq 4$ : The pretrichotomy and trichotomy theorems; The classification of groups of standard type; The classification of groups of  $GF(2)$  type; The final contradiction: Eliminating the Uniqueness Case; *Appendices:* Some background material related to simple groups; Overview of some techniques used in the classification; *References and index:* References used for both  $GW$  type and characteristic 2 type; References mainly for  $GW$  type; References used primarily for characteristic 2 type; Expository references mentioned; Index.

**Mathematical Surveys and Monographs**, Volume 172

March 2011, 347 pages, Hardcover, ISBN: 978-0-8218-5336-8, LC 2010048011, 2010 *Mathematics Subject Classification*: 20D05; 20C20, **AMS members US\$75.20**, List US\$94, Order code SURV/172



### Groups, Algebras and Applications

**César Polcino Milies**, *University of São Paulo, Brazil*, Editor

This book contains the proceedings of the XVIII Latin American Algebra Colloquium, held from August 3–8, 2009, in São Paulo, Brazil.

It includes research articles as well as up-to-date surveys covering several directions of current research in algebra, such as Asymptotic Codimension Growth, Hopf Algebras, Structure Theory of both Associative and Non-Associative Algebras, Partial Actions of Groups on Rings, and contributions to Coding Theory.

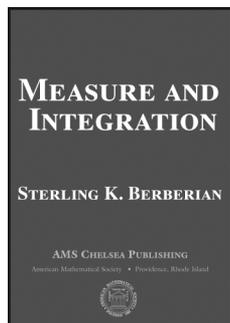
**Contents:** **R. Alfaro**, Linear codes over  $\mathbb{F}_q[u]/(u^t)$ ; **M. M. S. Alves** and **E. Batista**, Globalization theorems for partial Hopf (co)actions, and some of their applications; **N. Andruskiewitsch**, **F. Fantino**, **G. A. García**, and **L. Vendramin**, On Nichols algebras associated to simple racks; **I. Angiono** and **A. G. Iglesias**, Pointed Hopf algebras with standard braiding are generated in degree one; **A. Berele** and **A. Regev**, Asymptotics of Young tableaux in the  $(k, \ell)$

hook; **C. Boyallian** and **J. I. Liberati**, Classification of irreducible representations over finite simple Lie conformal superalgebras; **C. Carvalho**, Pure gaps and bounds for the generalized Hamming weights of Goppa codes; **F. N. Castro**, **L. A. Medina**, and **I. M. Rubio**, Exact divisibility of exponential sums over the binary field via the covering method; **W. Cortes**, **V. Rodrigues**, and **A. Sant'Ana**, All hereditary torsion theories are higher differential; **A. Davydov** and **A. Molev**, A categorical approach to classical and quantum Schur-Weyl duality; **M. Dokuchaev**, Partial actions: A survey; **V. O. Ferreira** and **L. S. I. Murakami**, On free associative algebras linearly graded by finite groups; **V. Futorny**, **S. Ovsienko**, and **M. Saorin**, Gelfand-Tsetlin categories; **A. Giambruno** and **E. Zelmanov**, On growth of codimensions of Jordan algebras; **L. Gutiérrez-Frez**, **J. Pantoja**, and **J. Soto-Andrade**, Geometric Weil representations for star-analogues of  $SL(2, k)$ ; **K. Igusa**, Exceptional sequences, braid groups and clusters; **F. Levstein** and **L. Saal**, Spherical distributions of some generalized Gelfand pairs attached to the Heisenberg group; **C. A. López-Andrade** and **H. Tapia-Recillas**, On the linearity and quasi-cyclicity of the Gray image of codes over a Galois ring; **M. Lorenz**, Some applications of Frobenius algebras to Hopf algebras; **J. Tiraó**, The algebra of differential operators associated to a weight matrix: A first example.

**Contemporary Mathematics**, Volume 537

April 2011, 324 pages, Softcover, ISBN: 978-0-8218-5239-2, LC 2010045183, 2010 *Mathematics Subject Classification*: 05A16, 11T71, 16D90, 16T05, 16S34, 17B69, 20C15; 16L60, 20C33, 20F36, **AMS members US\$84**, List US\$105, Order code CONM/537

## Analysis



### Measure and Integration

**Sterling K. Berberian**

This highly flexible text is organized into two parts: Part I is suitable for a one-semester course at the first-year graduate level, and the book as a whole is suitable for a full-year course.

Part I treats the theory of measure and integration over abstract measure spaces.

Prerequisites are a familiarity with epsilon-delta arguments and with the language of naive set theory (union, intersection, function). The fundamental theorems of the subject are derived from first principles, with details in full. Highlights include convergence theorems (monotone, dominated), completeness of classical function spaces (Riesz-Fischer theorem), product measures (Fubini's theorem), and signed measures (Radon-Nikodym theorem).

Part II is more specialized; it includes regular measures on locally compact spaces, the Riesz-Markoff theorem on the measure-theoretic representation of positive linear forms, and Haar measure on a locally compact group. The group algebra of a locally compact group is constructed in the last chapter, by an especially transparent method that minimizes measure-theoretic difficulties. Prerequisites for Part II include Part I plus a course in general topology.

To quote from the Preface:

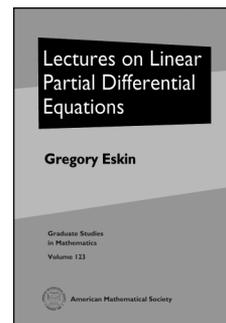
"Finally, I am under no illusions as to originality, for the subject of measure theory is an old one which has been worked over by many experts. My contribution can only be in selection, arrangement, and emphasis. I am deeply indebted to Paul R. Halmos, from whose textbook I first studied measure theory; I hope that these pages may reflect their debt to his book without seeming to be almost everywhere equal to it."

**Contents:** Measures; Measurable functions; Sequences of measurable functions; Integrable functions; Convergence theorems; Product measures; Finite signed measures; Integration over locally compact spaces; Integration over locally compact groups; References and notes; Bibliography; Index.

**AMS Chelsea Publishing**, Volume 241

April 2011, 312 pages, Hardcover, ISBN: 978-0-8218-5328-3, LC 74-128871, 2010 *Mathematics Subject Classification*: 28-01, **AMS members US\$45.90**, List US\$51, Order code CHEL/241.H

## Differential Equations



### Lectures on Linear Partial Differential Equations

**Gregory Eskin**, *University of California, Los Angeles, CA*

This book is a reader-friendly, relatively short introduction to the modern theory of linear partial differential equations. An effort has been made to present complete proofs in an accessible and self-contained form.

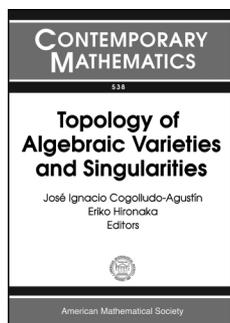
The first three chapters are on elementary distribution theory and Sobolev spaces with many examples and applications to equations with constant coefficients. The following chapters study the Cauchy problem for parabolic and hyperbolic equations, boundary value problems for elliptic equations, heat trace asymptotics, and scattering theory. The book also covers microlocal analysis, including the theory of pseudodifferential and Fourier integral operators, and the propagation of singularities for operators of real principal type. Among the more advanced topics are the global theory of Fourier integral operators and the geometric optics construction in the large, the Atiyah-Singer index theorem in  $\mathbb{R}^n$ , and the oblique derivative problem.

**Contents:** Theory of distributions; Fourier transforms; Applications of distributions to partial differential equations; Second order elliptic equations in bounded domains; The scattering theory; Pseudodifferential operators; Elliptic boundary value problems and parametrices; Fourier integral operators; Index.

**Graduate Studies in Mathematics**, Volume 123

May 2011, approximately 411 pages, Hardcover, ISBN: 978-0-8218-5284-2, 2010 *Mathematics Subject Classification*: 35J25, 35L40, 35K30, 35L05, 35L30, 35P20, 35P25, 35S05, 35S30, **AMS members US\$59.20**, List US\$74, Order code GSM/123

# Geometry and Topology



## Topology of Algebraic Varieties and Singularities

José Ignacio Cogolludo-Agustín,  
*Universidad de Zaragoza, Spain,*  
and Eriko Hironaka, *Florida State University, Tallahassee, FL,*  
Editors

This volume contains invited expository and research papers from the conference *Topology of Algebraic Varieties*, in honor of Anatoly Libgober's 60th birthday, held June 22–26, 2009, in Jaca, Spain.

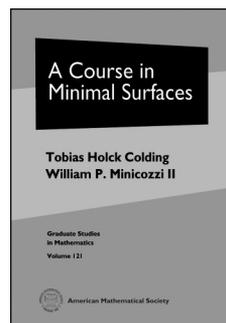
This volume contains four parts corresponding to the four main focal points of the conference: algebraic geometry and fundamental groups, braids and knots, hyperplane arrangements, and singularities. Together, the papers provide an overview of the current status of a broad range of topological questions in Algebraic Geometry.

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

**Contents:** *A historical note:* A. Libgober, Development of the theory of Alexander invariants in algebraic geometry; *Algebraic geometry and fundamental groups:* P. Aluffi and M. Marcolli, Feynman motives and deletion-contraction relations; M. Amram, R. Lehman, R. Shwartz, and M. Teicher, Classification of fundamental groups of Galois covers of surfaces of small degree degenerating to nice plane arrangements; D. Arapura, Homomorphisms between Kähler groups; E. A. Artal-Bartolo, J. I. Cogolludo-Agustín, and D. Matei, Quasi-projectivity, Artin-Tits groups, and pencil maps; A. Degtyarev, Topology of plane algebraic curves: The algebraic approach; L. Maxim and J. Schürmann, Hirzebruch invariants of symmetric products; A. I. Suciu, Fundamental groups, Alexander invariants, and cohomology jumping loci; *Braids and knots:* J. González-Meneses, On reduction curves and Garside properties of braids; L. H. Kauffman, Topological quantum information, Khovanov homology and the Jones polynomial; L. Paris, HOMFLYPT skein module of singular links; *Hyperplane arrangements:* N. Budur, A. Dimca, and M. Saito, First Milnor cohomology of hyperplane arrangements; G. Gaiffi, F. Mori, and M. Salvetti, Minimal CW-complexes for complements to line arrangements via discrete Morse theory; R. Randell, The topology of hyperplane arrangements; *Singularities:* E. Artal-Bartolo, P. Cassou-Noguès, I. Luengo, and A. M. Melle-Hernández, On  $v$ -quasi-ordinary power series: Factorization, Newton trees and resultants; J. L. Cisneros-Molina, J. Seade, and J. Snoussi, Milnor fibrations for real and complex singularities; J. F. de Bobadilla, On homotopy types of complements of analytic sets and Milnor fibres; D. Kerner and A. Némethi, The Milnor fibre signature is not semi-continuous; A. Némethi, W. D. Neumann, and A. Pichon, Principal analytic link theory in homology sphere links; M. Oka, On mixed Brieskorn variety; P. Popescu-Pampu, Introduction to Jung's method of resolution of singularities; S. S.-T. Yau, L. Zhao, and H. Zuo, Biggest sharp polynomial estimate of integral points in right-angled simplices.

Contemporary Mathematics, Volume 538

April 2011, approximately 484 pages, Softcover, ISBN: 978-0-8218-4890-6, LC 2010047841, 2010 *Mathematics Subject Classification:* 00B99, 14B05, 32S99, 57M99, 14-02, 32-02, 51-02, 53-02, 55-02, 57-02, **AMS members US\$108**, List US\$135, Order code CONM/538



## A Course in Minimal Surfaces

Tobias Holck Colding,  
*Massachusetts Institute of Technology, Cambridge, MA,* and  
William P. Minicozzi II,  
*Johns Hopkins University, Baltimore, MD*

Minimal surfaces date back to Euler and Lagrange and the beginning of the calculus

of variations. Many of the techniques developed have played key roles in geometry and partial differential equations. Examples include monotonicity and tangent cone analysis originating in the regularity theory for minimal surfaces, estimates for nonlinear equations based on the maximum principle arising in Bernstein's classical work, and even Lebesgue's definition of the integral that he developed in his thesis on the Plateau problem for minimal surfaces.

This book starts with the classical theory of minimal surfaces and ends up with current research topics. Of the various ways of approaching minimal surfaces (from complex analysis, PDE, or geometric measure theory), the authors have chosen to focus on the PDE aspects of the theory. The book also contains some of the applications of minimal surfaces to other fields including low dimensional topology, general relativity, and materials science.

The only prerequisites needed for this book are a basic knowledge of Riemannian geometry and some familiarity with the maximum principle.

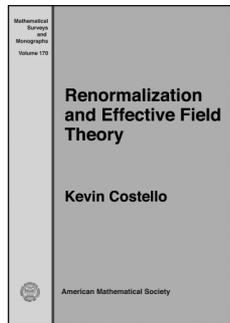
*This item will also be of interest to those working in differential equations.*

**Contents:** The variation formulas and some consequences; Curvature estimates and consequences; Weak Bernstein-type theorems; Existence results; Min-max constructions; Embedded solutions of the Plateau problem; Minimal surfaces in three-manifolds; The structure of embedded minimal surfaces; Exercises; Bibliography; Index.

Graduate Studies in Mathematics, Volume 121

April 2011, approximately 320 pages, Hardcover, ISBN: 978-0-8218-5323-8, LC 2010044373, 2010 *Mathematics Subject Classification:* 49Q05, 53A10, 53C42, 58E12, 57M50, 57N10, 35J15, 35J60, 83C57, **AMS members US\$50.40**, List US\$63, Order code GSM/121

## Mathematical Physics



### Renormalization and Effective Field Theory

Kevin Costello, *Northwestern University, Evanston, IL*

*This book tells mathematicians about an amazing subject invented by physicists and it tells physicists how a master mathematician must proceed in order to understand it. Physicists who know quantum field theory can learn the powerful methodology of mathematical*

*structure, while mathematicians can position themselves to use the magical ideas of quantum field theory in "mathematics" itself. The retelling of the tale mathematically by Kevin Costello is a beautiful tour de force.*

—Dennis Sullivan

*This book is quite a remarkable contribution. It should make perturbative quantum field theory accessible to mathematicians. There is a lot of insight in the way the author uses the renormalization group and effective field theory to analyze perturbative renormalization; this may serve as a springboard to a wider use of those topics, hopefully to an eventual nonperturbative understanding.*

—Edward Witten

Quantum field theory has had a profound influence on mathematics, and on geometry in particular. However, the notorious difficulties of renormalization have made quantum field theory very inaccessible for mathematicians. This book provides complete mathematical foundations for the theory of perturbative quantum field theory, based on Wilson's ideas of low-energy effective field theory and on the Batalin-Vilkovisky formalism. As an example, a cohomological proof of perturbative renormalizability of Yang-Mills theory is presented.

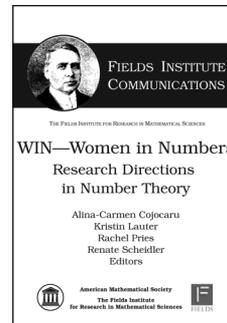
An effort has been made to make the book accessible to mathematicians who have had no prior exposure to quantum field theory. Graduate students who have taken classes in basic functional analysis and homological algebra should be able to read this book.

**Contents:** Introduction; Theories, Lagrangians and counterterms; Field theories on  $\mathbb{R}^n$ ; Renormalizability; Gauge symmetry and the Batalin-Vilkovisky formalism; Renormalizability of Yang-Mills theory; Asymptotics of graph integrals; Nuclear spaces; Bibliography.

Mathematical Surveys and Monographs, Volume 170

March 2011, 251 pages, Hardcover, ISBN: 978-0-8218-5288-0, LC 2010047463, 2010 *Mathematics Subject Classification*: 81T13, 81T15, 81T17, 81T18, 81T20, 81T70, **AMS members US\$67.20**, List US\$84, Order code SURV/170

## Number Theory



### WIN—Women in Numbers

Research Directions in Number Theory

Alina-Carmen Cojocaru, *University of Illinois at Chicago, IL, and Institute of Mathematics "Simion Stoilow" of the Romanian Academy, Bucharest, Romania*, Kristin Lauter, *Microsoft Research, Redmond, WA*, Rachel Pries, *Colorado State University, Fort Collins, CO*, and Renate Scheidler, *University of Calgary, AB, Canada*, Editors

This volume is a collection of papers on number theory which evolved out of the workshop *WIN—Women In Numbers*, held November 2–7, 2008, at the Banff International Research Station (BIRS) in Banff, Alberta, Canada. It includes articles showcasing outcomes from collaborative research initiated during the workshop as well as survey papers aimed at introducing graduate students and recent PhDs to important research topics in number theory.

The contributions in this volume span a wide range of topics in arithmetic geometry and algebraic, algorithmic, and analytic number theory. Clusters of papers center around the four topics of moduli spaces and Shimura curves, curves and Jacobians over finite fields, Galois covers of function fields in positive characteristic, and zeta functions of graphs, with a fifth group of three individual articles on modular forms, Iwasawa theory, and Galois representations, respectively.

The workshop and this volume are part of a broader WIN initiative, whose goals are to highlight and increase the research activities of women in number theory and to train female graduate students in number theory and related fields.

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

Titles in this series are co-published with the Fields Institute for Research in Mathematical Sciences (Toronto, Ontario, Canada).

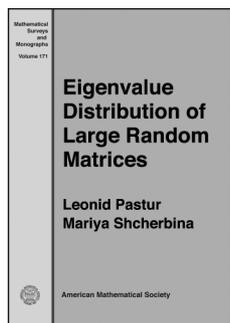
**Contents:** Part I. *Moduli spaces and Shimura curves*: H. Grundman, Hilbert modular variety compositions; P. Bayer, Contributions to Shimura curves; H. Grundman, J. Johnson-Leung, K. Lauter, A. Salerno, B. Viray, and E. Wittenborn, Igusa class polynomials, embeddings of quartic CM fields, and arithmetic intersection theory; E. Mantovan,  $l$ -adic étale cohomology of PEL type Shimura varieties with non-trivial coefficients; Part II. *Curves and Jacobians over finite fields*: J. Balakrishnan, J. Belding, S. Chisholm, K. Eisenträger, K. E. Stange, and E. Teske, Pairings on hyperelliptic curves; A. Bucur, C. David, B. Feigon, and M. Lalin, Biased statistics for traces of cyclic  $p$ -fold covers over finite fields; L. Berger, J. L. Hoelscher, Y. Lee, J. Paulhus, and R. Scheidler, The  $\ell$ -rank structure of a global function field; Part III. *Galois covers of function fields in positive characteristic*: R. Pries and K. Stevenson, A survey of Galois theory of curves in characteristic  $p$ ; I. I. Bouw, Covers of

the affine line in positive characteristic with prescribed ramification; **L. Gruendken, L. Hall-Seelig, B.-H. Im, E. Ozman, R. Pries, and K. Stevenson**, Semi-direct Galois covers of the affine line; Part IV. *Zeta functions of graphs*: **A. Terras**, Looking into a graph theory mirror of number theoretic zetas; **W.-C. W. Li**, Zeta functions of group based graphs and complexes; **B. Malmskog and M. Manes**, Ramified covers of graphs and the Ihara zeta functions of certain ramified covers; Part V. *Other topics*: **S. A. Garthwaite, L. Long, H. Swisher, and S. Treneer**, Zeros of classical Eisenstein series and recent developments; **S. Ramdorai**, On the  $\mu$ -invariant in Iwasawa theory; **S. Arias-de-Reyna and N. Vila**, Galois representations and the tame inverse Galois problem.

**Fields Institute Communications**, Volume 60

March 2011, 288 pages, Hardcover, ISBN: 978-0-8218-5226-2, 2010 *Mathematics Subject Classification*: 11-06, 11-02, 14-06, 11Gxx, 11Mxx, 11Rxx, 11Yxx, 14Hxx, 14Kxx, 14Qxx, **AMS members US\$85.60**, List US\$107, Order code FIC/60

## Probability and Statistics



### Eigenvalue Distribution of Large Random Matrices

**Leonid Pastur and Mariya Shcherbina**, *Ukrainian National Academy of Sciences, Kharkov, Ukraine*

Random matrix theory is a wide and growing field with a variety of concepts, results, and techniques and a vast range of applications in mathematics and the related sciences. The book, written by well-known experts, offers beginners a fairly balanced collection of basic facts and methods (Part 1 on classical ensembles) and presents experts with an exposition of recent advances in the subject (Parts 2 and 3 on invariant ensembles and ensembles with independent entries).

The text includes many of the authors' results and methods on several main aspects of the theory, thus allowing them to present a unique and personal perspective on the subject and to cover many topics using a unified approach essentially based on the Stieltjes transform and orthogonal polynomials. The exposition is supplemented by numerous comments, remarks, and problems. This results in a book that presents a detailed and self-contained treatment of the basic random matrix ensembles and asymptotic regimes.

This book will be an important reference for researchers in a variety of areas of mathematics and mathematical physics. Various chapters of the book can be used for graduate courses; the main prerequisite is a basic knowledge of calculus, linear algebra, and probability theory.

**Contents:** Introduction; *Classical ensembles*: Gaussian ensembles: Semicircle law; Gaussian ensembles: Central limit theorem for linear eigenvalue statistics; Gaussian ensembles: Joint eigenvalue distribution and related results; Gaussian unitary ensemble; Gaussian orthogonal ensemble; Wishart and Laguerre ensembles; Classical compact groups ensembles: Global regime; Classical

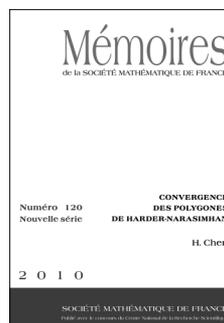
compact groups ensembles: Local regime; Law of addition of random matrices; *Matrix models*: Matrix models: Global regime; Bulk universality for hermitian matrix models; Universality for special points of hermitian matrix models; Jacobi matrices and limiting laws for linear eigenvalue statistics; Universality for real symmetric matrix models; Unitary matrix models; *Ensembles with independent and weakly dependent entries*: Matrices with Gaussian correlated entries; Wigner ensembles; Sample covariance and related matrices; Bibliography; Index.

**Mathematical Surveys and Monographs**, Volume 171

May 2011, approximately 634 pages, Hardcover, ISBN: 978-0-8218-5285-9, LC 2010047315, 2010 *Mathematics Subject Classification*: 60F05, 60B20, 15B52, 15B57, **AMS members US\$84**, List US\$105, Order code SURV/171

## New AMS-Distributed Publications

### Algebra and Algebraic Geometry



### Convergence des Polygones de Harder-Narasimhan

**Huayi Chen**, *Université Paris Diderot, France*

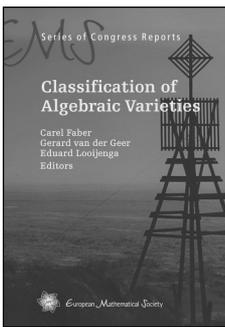
The author interprets the theory of Harder-Narasimhan polygons by the language of  $\mathbb{R}$ -filtrations. By using a variant version of Fekete's lemma and a combinatoric argument on monomials, he establishes the uniform convergence of polygons associated to a graded algebra equipped with filtrations. This leads to the existence of several arithmetic invariants, a very particular case of which is the sectional capacity. Two applications in Arakelov geometry are developed: the arithmetic Hilbert-Samuel theorem and the existence and the geometric interpretation of the asymptotic maximal slope.

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; Rappels et préliminaires; Filtrations de Harder-Narasimhan; Convergence des polygones; Applications; Bibliographie.

**Mémoires de la Société Mathématique de France**, Number 120

October 2010, 120 pages, Softcover, ISBN: 978-2-85629-296-9, 2010 *Mathematics Subject Classification*: 14G40, 14F05, **Individual member US\$37.80**, List US\$42, Order code SMFMEM/120



## Classification of Algebraic Varieties

**Carel Faber**, *Royal Institute of Technology, Stockholm, Sweden*,  
**Gerard van der Geer**, *University of Amsterdam, The Netherlands*,  
 and **Eduard Looijenga**, *Utrecht University, The Netherlands*,  
 Editors

Fascinating and surprising developments are taking place in the classification of algebraic varieties. The work of Hacon and McKernan and many others is causing a wave of breakthroughs in the minimal model program: we now know that for a smooth projective variety the canonical ring is finitely generated. These new results and methods are reshaping the field.

Inspired by this exciting progress, the editors organized a meeting at Schiermonnikoog and invited leading experts to write papers about the recent developments. The result is the present volume, a lively testimony to the sudden advances that originate from these new ideas.

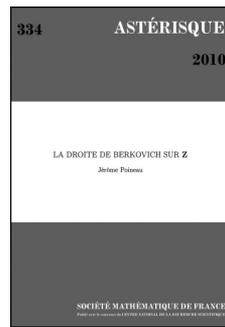
This volume will be of interest to a wide range of pure mathematicians, but will appeal especially to algebraic and analytic geometers.

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

**Contents:** **D. Abramovich** and **B. Hassett**, Stable varieties with a twist; **F. Ambro**, Basic properties of log canonical centers; **I. Bauer** and **F. Catanese**, Burniat surfaces I: Fundamental groups of moduli of primary Burniat surfaces; **C. Birkar** and **M. Păun**, Minimal models, flip and finite generation: A tribute to V. V. Shokurov and Y.-T. Siu; **F. Campana**, Remarks on an example of K. Ueno; **F. Campana**, Special orbifolds and birational classification: A survey; **J. A. Chen**, Birational geometry of threefolds; **C. Ciliberto**, **O. Dumitrescu**, **R. Miranda**, and **J. Roé**, Emptiness of homogeneous linear systems with ten general base points; **A. Corti**, Finite generation of adjoint rings after Lazić: An introduction; **T. de Fernex**, **L. Ein**, and **M. Mustață**, Log canonical thresholds on varieties with bounded singularities; **G. Farkas**, Brill-Noether geometry on moduli spaces of spin curves; **K. Frantzen** and **T. Peternell**, On the bimeromorphic geometry of compact complex contact threefolds; **O. Fujino**, Introduction to the theory of quasi-log varieties; **O. Fujino**, On Kawamata's theorem; **Y. Kawamata**, Remarks on the cone of divisors; **Y. Prokhorov**,  $p$ -elementary subgroups of the Cremona group of rank 3.

EMS Series of Congress Reports, Volume 3

January 2011, 346 pages, Hardcover, ISBN: 978-3-03719-007-4, 2010 *Mathematics Subject Classification*: 14Exx, 14E30, 14Dxx, 14J10, **AMS members US\$78.40**, List US\$98, Order code EMSSCR/3



## La Droite de Berkovich Sur Z

**Jérôme Poineau**, *Institut de Recherche Mathématique Avancée, Strasbourg, France*

This text is devoted to the study of the Berkovich line over the ring of integers of a number field. It is a geometric object which naturally contains complex analytic lines (or their quotient by conjugation),

associated to the infinite places, and classical Berkovich lines over complete valued fields, associated to the finite places. The authors prove that it satisfies nice properties, both from the topological and algebraic points of view. They also provide a few examples of Stein spaces that are contained in this line. The authors explain how this theory may be used to address various questions about convergent arithmetic power series: prescribing zeroes and poles, proving that global rings are Noetherian or constructing Galois groups over them. Typical examples of such series are given by holomorphic functions on the complex open unit disc whose Taylor developments in 0 have integer coefficients.

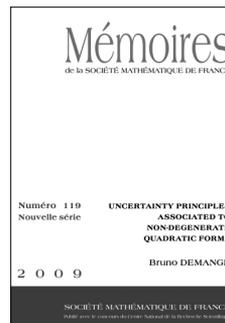
A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Espaces analytiques sur un anneau de Banach; Algèbres de séries convergentes; Espace affine analytique au-dessus d'un anneau d'entiers de corps de nombres; Droite affine analytique au-dessus d'un anneau d'entiers de corps de nombres; Morphismes finis; Espaces de Stein; Applications; Bibliographie; Glossaire des notations; Index.

*Astérisque*, Number 334

November 2010, 284 pages, Softcover, ISBN: 978-2-85629-294-5, 2010 *Mathematics Subject Classification*: 14G22, 14G25, 30B10, 13E05, 12F12, **Individual member US\$94.50**, List US\$105, Order code AST/334

## Analysis



## Uncertainty Principles Associated to Non-Degenerate Quadratic Forms

**Bruno Demange**, *Institut Fourier, St. Martin d'Heres, France*

This volume is devoted to several generalizations of the classical Hardy uncertainty principle on Euclidean spaces.

Instead of comparing functions and their Fourier transforms to a Gaussian, the author compares them to the exponential of general nondegenerate quadratic forms like the Lorentz form, for example. Using the Bargmann transform, he translates the problem into the description of several classes of analytic functions of several

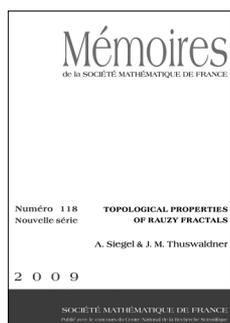
variables and at the same time simplifies and unifies proofs of results presented in several previous papers.

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; Hardy's uncertainty principle and its generalizations; Further results; Critical and non critical pairs; Critical pairs; Lorentz quadratic form; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 119

October 2010, 102 pages, Softcover, ISBN: 978-2-85629-297-6, 2010 *Mathematics Subject Classification:* 30H99, 32A15, 42B10, **Individual member US\$37.80**, List US\$42, Order code SMFMEM/119



## Topological Properties of Rauzy Fractals

Anne Siegel, *Université de Rennes, France*, and Jörg M. Thuswaldner, *University of Leoben, Austria*

Substitutions are combinatorial objects (one replaces a letter by a word), which produce sequences by iteration. They occur in many mathematical fields,

roughly as soon as a repetitive process appears. In this monograph the authors deal with topological and geometric properties of substitutions; in particular, they study properties of the *Rauzy fractals* associated to substitutions.

To be more precise, let  $\sigma$  be a substitution over the finite alphabet  $\mathcal{A}$ . The authors assume that the incidence matrix of  $\sigma$  is primitive and that its dominant eigenvalue is a unit Pisot number (*i.e.*, an algebraic integer greater than one whose norm is equal to one and all of whose Galois conjugates are of modulus strictly smaller than one). It is well known that one can attach to  $\sigma$  a set  $\mathcal{T}$  which is called *central tile* or *Rauzy fractal* of  $\sigma$ . Such a central tile is a compact set that is the closure of its interior and decomposes in a natural way in  $n = |\mathcal{A}|$  subtiles  $\mathcal{T}(1), \dots, \mathcal{T}(n)$ . The central tile, as well as its subtiles, are graph directed self-affine sets that often have fractal boundary.

Pisot substitutions and central tiles are of high relevance in several branches of mathematics such as tiling theory, spectral theory, Diophantine approximation, the construction of discrete planes and quasicrystals as well as in connection with numeration like generalized continued fractions and radix representations. The questions raised in all these domains can often be reformulated in terms of questions related to the topology and the geometry of the underlying central tile.

After a thorough survey of important properties of unit Pisot substitutions and their associated Rauzy fractals, the authors investigate a variety of topological properties of  $\mathcal{T}$  and its subtiles. Their approach is an algorithmic one. In particular, they address the question whether  $\mathcal{T}$  and its subtiles induce a tiling, calculate the Hausdorff dimension of their boundary, give criteria for their connectivity and homeomorphy to a closed disk, and derive properties of their fundamental group.

The basic tools for the authors' criteria are several classes of graphs built from the description of the tiles  $\mathcal{T}(i)$  ( $1 \leq i \leq n$ ) as the

solution of a graph directed iterated function system and from the structure of the tilings induced by these tiles. These graphs are of interest in their own right. For instance, they can be used to construct the boundaries  $\partial\mathcal{T}$  as well as  $\partial\mathcal{T}(i)$  ( $1 \leq i \leq n$ ) and all points where two, three, or four different tiles of the induced tilings meet.

When working with central tiles in one of the above-mentioned contexts it is often useful to know such intersection properties of tiles. In this sense this monograph aims to provide tools for "everyday life" when dealing with topological and geometric properties of substitutions.

Throughout the text, the authors give many examples to illustrate their results and also offer suggestions for further research.

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

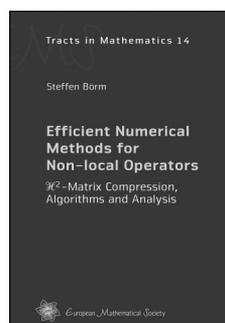
A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Introduction; Substitutions, central tiles and beta-numeration; Multiple tilings induced by the central tile and its subtiles; Statement of the main results: Topological properties of central tiles; Graphs that contain topological information on the central tile; Exact statements and proofs of the main results; Technical proofs and definitions; Perspectives; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 118

November 2010, 144 pages, Softcover, ISBN: 978-2-85629-290-7, 2010 *Mathematics Subject Classification:* 28A80, 11A63, 54F65, **Individual member US\$37.80**, List US\$42, Order code SMFMEM/118

## Applications



## Efficient Numerical Methods for Non-local Operators

$\mathcal{H}^2$ -Matrix Compression, Algorithms and Analysis

Steffen Börm, *Kiel University, Germany*

Hierarchical matrices present an efficient way of treating dense matrices that arise

in the context of integral equations, elliptic partial differential equations, and control theory.

While a dense  $n \times n$  matrix in standard representation requires  $n^2$  units of storage, a hierarchical matrix can approximate the matrix in a compact representation requiring only  $O(nk \log n)$  units of storage, where  $k$  is a parameter controlling the accuracy. Hierarchical matrices have been successfully applied to approximate matrices arising in the context of boundary integral methods, to construct preconditioners for partial differential equations, to evaluate matrix functions, and to solve matrix equations used in control theory.  $\mathcal{H}^2$ -matrices offer a refinement of hierarchical matrices: Using a multilevel representation

of submatrices, the efficiency can be significantly improved, particularly for large problems.

This book gives an introduction to the basic concepts and presents a general framework that can be used to analyze the complexity and accuracy of  $\mathcal{H}^2$ -matrix techniques. Starting from basic ideas of numerical linear algebra and numerical analysis, the theory is developed in a straightforward and systematic way, accessible to advanced students and researchers in numerical mathematics and scientific computing. Special techniques are required only in isolated sections, e.g., for certain classes of model problems.

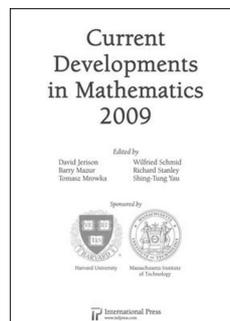
A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

**Contents:** Introduction; Model problem; Hierarchical matrices; Application to integral operators; Orthogonal cluster bases and matrix projections; Compression; A priori matrix arithmetic; A posteriori matrix arithmetic; Application to elliptic partial differential operators; Applications; Bibliography; Algorithm index; Subject index.

**EMS Tracts in Mathematics, Volume 14**

December 2010, 441 pages, Hardcover, ISBN: 978-3-03719-091-3, 2010 *Mathematics Subject Classification*: 65-02, 65F05, 65F30, 65N22, 65N38, 65R20, **AMS members US\$62.40**, List US\$78, Order code EMSTM/14

## General Interest



### Current Developments in Mathematics, 2009

**Barry Mazur, Wilfried Schmid, and Shing-Tung Yau, Harvard University, Cambridge, MA, and David Jerison, Tomasz Mrowka, and Richard Stanley, Massachusetts Institute of Technology, Cambridge, MA, Editors**

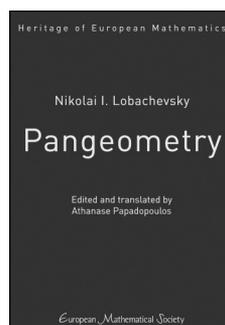
The papers in this volume are based on selected lectures given at the Current Development Mathematics Conference held in November 2009 at Harvard University.

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

**Contents:** N. B. Ch au, Survey on the fundamental lemma; M. A. Hill, M. J. Hopkins, and D. C. Ravenel, The Arf-Kervaire problem in algebraic topology: An introduction; O. Savin, Phase transitions, minimal surfaces, and a conjecture of de Giorgi; S. Zelditch, Recent developments in mathematical quantum chaos.

**International Press**

November 2010, 204 pages, Hardcover, ISBN: 978-1-57146-146-9, 2010 *Mathematics Subject Classification*: 53C44, **AMS members US\$46.80**, List US\$58.50, Order code INPR/94



### Nikolai I. Lobachevsky, Pangeometry

**Athanase Papadopoulos, Universit  de Strasbourg, France, Editor**  
Translated by Athanase Papadopoulos

Lobachevsky wrote *Pangeometry* in 1855, the year before his death. This memoir is a r sum  of his work on non-Euclidean

geometry and its applications and can be considered his clearest account on the subject. It is also the conclusion of his life's work and the last attempt he made to acquire recognition. The treatise contains basic ideas of hyperbolic geometry, including the trigonometric formulae, the techniques of computation of arc length, of area and of volume, with concrete examples. It also deals with the applications of hyperbolic geometry to the computation of new definite integrals. The techniques are different from those found in most modern books on hyperbolic geometry since they do not use models.

Besides its historical importance, Lobachevsky's *Pangeometry* is a beautiful work, written in a simple and condensed style. The material that it contains is still very alive, and reading this book will be most useful for researchers and for students in geometry and in the history of science. It can be used as a textbook, as a sourcebook, and as a repository of inspiration.

The present edition provides the first complete English translation of *Pangeometry* available in print. It contains facsimiles of both the Russian and the French original versions. The translation is accompanied by notes, followed by a biography of Lobachevsky and an extensive commentary.

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

**Contents:** I. Pangeometry; II. Lobachevsky's biography; III. A commentary on Lobachevsky's *Pangeometry*; Bibliography.

**Heritage of European Mathematics, Volume 4**

November 2010, 322 pages, Hardcover, ISBN: 978-3-03719-087-6, 2010 *Mathematics Subject Classification*: 01-02, 51-02, 01A55, 51-01, 51-03, 53-02, 53-01, 53-03, 53A35, **AMS members US\$78.40**, List US\$98, Order code EMSHEM/4