New Publications Offered by the AMS

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Algebra and Algebraic Geometry

Tropical Geometry and Integrable Systems

Chris Athorne, University of Glasgow, United Kingdom, Diane Maclagan, University of Warwick, United Kingdom, and Ian Strachan, University of Glasgow, United Kingdom, Editors

This volume contains the proceedings of the conference on tropical geometry and integrable systems, held July 3–8, 2011, at the University of Glasgow, United Kingdom.

One of the aims of this conference was to bring together researchers in the field of tropical geometry and its applications, from apparently disparate ends of the spectrum, to foster a mutual understanding and establish a common language which will encourage further developments of the area. This aim is reflected in these articles, which cover areas from automata, through cluster algebras, to enumerative geometry. In addition, two survey articles are included which introduce ideas from researchers on one end of this spectrum to researchers on the other.

This book is intended for graduate students and researchers interested in tropical geometry and integrable systems and the developing links between these two areas.

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


Contemporary Mathematics, Volume 580

Vector Bundles on Degenerations of Elliptic Curves and Yang-Baxter Equations

Igor Burban, Universität Bonn, Germany, and Bernd Kreussler, Mary Immaculate College, Limerick, Ireland

Contents: Introduction; Yang-Baxter equations; Massey products and AYBE—a single curve; Massey products and AYBE—families of curves; Explicit calculations—smooth curves; Explicit calculations—singular curves; Summary; Bibliography.

Memoirs of the American Mathematical Society, Volume 220, Number 1035

Modular Branching Rules for Projective Representations of Symmetric Groups and Lowering Operators for the Supergroup $Q(n)$

Alexander Kleshchev, University of Oregon, Eugene, OR, and Vladimir Shchigolev, Lomonosov Moscow State University, Russia

Contents: Preliminaries; Lowering operators; Some polynomials; Raising coefficients; Combinatorics of signature sequences;
Constructing \( U(n - 1) \)-primitive vectors; Main results on \( U(n) \); Main results on projective representations of symmetric groups; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 220, Number 1034


**Mathematics Subject Classification:** 20C30, 20C25, 20C20, 17B10, **Individual member US$42.60**, List US$71, Institutional member US$56.80, Order code MEMO/220/1034

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**Deformation Theory of Algebras and Their Diagrams**

**Martin Markl**, *Academy of Sciences of the Czech Republic, Praha, Czech Republic*

This book brings together both the classical and current aspects of deformation theory. The presentation is mostly self-contained, assuming only basic knowledge of commutative algebra, homological algebra and category theory. In the interest of readability, some technically complicated proofs have been omitted when a suitable reference was available. The relation between the uniform continuity of algebraic maps and topologized tensor products is explained in detail, however, as this subject does not seem to be commonly known and the literature is scarce.

The exposition begins by recalling Gerstenhaber’s classical theory for associative algebras. The focus then shifts to a homotopy-invariant setup of Maurer–Cartan moduli spaces. As an application, Kontsevich’s approach to deformation quantization of Poisson manifolds is reviewed. Then, after a brief introduction to operads, a strongly homotopy Lie algebra governing deformations of (diagrams of) algebras of a given type is described, followed by examples and generalizations.

**Contents:** Basic notions; Deformations and cohomology; Finner structures of cohomology; The gauge group; The simplicial Maurer–Cartan space; Strongly homotopy Lie algebras; Homotopy invariance and quantization; Brief introduction to operads; \( L_{\infty} \)-algebras governing deformations; Examples; Index; Bibliography.

**CBMS Regional Conference Series in Mathematics**, Number 116


**Mathematics Subject Classification:** 13D10, 14D15, 53D55, 55N35, **AMS members US$28, All Individuals US$28**, List US$35, Order code CBMS/116

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### Analysis

**The Reflective Lorentzian Lattices of Rank 3**

**Daniel Allcock**, *University of Texas at Austin, TX*

**Contents:** Background; The classification theorem; The reflective lattices; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 220, Number 1033


**Mathematics Subject Classification:** 11H56, 20F55, 22E40, **Individual member US$42**, List US$70, Institutional member US$56, Order code MEMO/220/1033

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**Spectral Geometry**

**Alex H. Barnett**, *Dartmouth College, Hanover, NH*, **Carolyn S. Gordon**, *Dartmouth College, NH*, **Peter A. Perry**, *University of Kentucky, Lexington, KY*, and **Alejandro Uribe**, *University of Michigan, Ann Arbor, MI, Editors*


Eigenvalue problems involving the Laplace operator on manifolds have proven to be a consistently fertile area of geometric analysis with deep connections to number theory, physics, and applied mathematics. Key questions include the measures to which eigenfunctions of the Laplacian on a Riemannian manifold condense in the limit of large eigenvalue, and the extent to which the eigenvalues and eigenfunctions of a manifold encode its geometry.

In this volume, research and expository articles, including those of the plenary speakers Peter Sarnak and Victor Guillemin, address the flurry of recent progress in such areas as quantum unique ergodicity, isospectrality, semiclassical measures, the geometry of nodal lines of eigenfunctions, methods of numerical computation, and spectra of quantum graphs. This volume also contains mini-courses on spectral theory for hyperbolic surfaces, semiclassical analysis, and orbifold spectral geometry that prepared the participants, especially graduate students and young researchers, for conference lectures.

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

**Contents:** Expository lectures: **D. Borthwick**, Introduction to spectral theory on hyperbolic surfaces; **C. Gordon**, Orbifolds and their spectra; **A. Uribe** and **Z. Wang**, A brief introduction to semiclassical analysis; **Invited papers:** **N. Anantharaman** and **F. Macià**, The dynamics of the Schrödinger flow from the point of view of semiclassical measures; **G. Berkolaiko** and **P. Kuchment**, Dependence of the spectrum of a quantum graph on vertex conditions and edge lengths;
Higher Order Fourier Analysis

Terence Tao, University of California, Los Angeles, CA

Traditional Fourier analysis, which has been remarkably effective in many contexts, uses linear phase functions to study functions. Some questions, such as problems involving arithmetic progressions, naturally lead to the use of quadratic or higher order phases.

Higher order Fourier analysis is a subject that has become very active only recently. Gowers, in groundbreaking work, developed many of the basic concepts of this theory in order to give a new, quantitative proof of Szemerédi’s theorem on arithmetic progressions. However, there are also precursors to this theory in Weyl’s classical theory of equidistribution, as well as in Furstenberg’s structural theory of dynamical systems.

This book, which is the first monograph in this area, aims to cover all of these topics in a unified manner, as well as to survey some of the most recent developments, such as the application of the theory to count linear patterns in primes. The book serves as an introduction to the field, giving the beginning graduate student in the subject a high-level overview of the field. The text focuses on the simplest illustrative examples of key results, serving as a companion to the existing literature on the subject. There are numerous exercises with which to test one's knowledge.

Contents: Higher order Fourier analysis; Related articles; Bibliography; Index.

Graduate Studies in Mathematics, Volume 142


Foundations of Analysis

Joseph L. Taylor, University of Utah, Salt Lake City, UT

Analysis plays a crucial role in the undergraduate curriculum. Building upon the familiar notions of calculus, analysis introduces the depth and rigor characteristic of higher mathematics courses. Foundations of Analysis has two main goals. The first is to develop in students the mathematical maturity and sophistication they will need as they move through the upper division curriculum. The second is to present a rigorous development of both single and several variable calculus, beginning with a study of the properties of the real number system.

The presentation is both thorough and concise, with simple, straightforward explanations. The exercises differ widely in level of abstraction and level of difficulty. They vary from the simple to the quite difficult and from the computational to the theoretical. Each section contains a number of examples designed to illustrate the material in the section and to teach students how to approach the exercises for that section.

The list of topics covered is rather standard, although the treatment of some of them is not. The several variable material makes full use of the power of linear algebra, particularly in the treatment of the differential of a function as the best affine approximation to the function at a given point. The text includes a review of several linear algebra topics in preparation for this material. In the final chapter, vector calculus is presented from a modern point of view, using differential forms to give a unified treatment of the major theorems relating derivatives and integrals: Green’s, Gauss’s, and Stokes’s Theorems.

At appropriate points, abstract metric spaces, topological spaces, inner product spaces, and normed linear spaces are introduced, but only as aside. That is, the course is grounded in the concrete world of Euclidean space, but the students are made aware that there are more exotic worlds in which the concepts they are learning may be studied.

Contents: The real numbers; Sequences; Continuous functions; The derivative; The integral; Infinite series; Convergence in Euclidean space; Functions on Euclidean space; Differentiation in several variables; Integration in several variables; Vector calculus; Degrees of infinity; Bibliography; Index.

Pure and Applied Undergraduate Texts, Volume 18


New Publications Offered by the AMS
Discrete Mathematics and Combinatorics

Rudiments of Ramsey Theory
Ronald L. Graham

The survey is not only very readable in terms of mathematical exposition, it is highly entertaining.
—N. Hindman, Mathematical Reviews

This book is back in print from the AMS:

It is no exaggeration to say that over the past several decades there has been a veritable explosion of activity in the general field of combinatorics. Ramsey theory, in particular, has shown remarkable growth. This book gives a picture of the state of the art of Ramsey theory at the time of Graham’s CBMS lectures. In keeping with the style of the lectures, the exposition is informal. However, complete proofs are given for most of the basic results presented. In addition, many useful results may be found in the exercises and problems.

Loosely speaking, Ramsey theory is the branch of combinatorics that deals with structures that are preserved under partitions. Typically, one looks at the following kind of question: If a particular structure (e.g., algebraic, combinatorial or geometric) is arbitrarily partitioned into finitely many classes, what kinds of substructures must always remain intact in at least one of the classes?

At the time of these lectures, a number of spectacular advances had been made in the field of Ramsey theory. These include: the work of Szemerédi and Furstenberg settling the venerable conjecture of Erdős and Turán, the Nesetril-Rödl theorems on induced Ramsey properties, the results of Paris and Harrington on “large” Ramsey numbers and undecidability in first-order Peano arithmetic, Deuber’s solution to the old partition regularity conjecture of Rado, Hindman’s surprising generalization of Schur’s theorem, and the resolution of Rota’s conjecture on Ramsey’s theorem for vector spaces by Graham, Leeb and Rothschild. It has also become apparent that the ideas and techniques of Ramsey theory span a rather broad range of mathematical areas, interacting in essential ways with parts of set theory, graph theory, combinatorial number theory, probability theory, analysis and even theoretical computer science. These lecture notes lay out the foundation on which much of this work is based.

Relatively little specialized mathematical background is required for this book. It should be accessible to upper division students.

Contents: Three views of Ramsey theory; Ramsey’s theorem; van der Waerden’s theorem; The Hales-Jewett theorem; Szemerédi’s theorem; Graph Ramsey theory; Euclidean Ramsey theory; A general Ramsey product theorem; The theorems of Schur, Folkman, and Hindman; Rado’s theorem; Current trends; References.

CBMS Regional Conference Series in Mathematics, Number 45


Geometry and Topology

Connes-Chern Character for Manifolds with Boundary and Eta Cochains
Matthias Lesch, Universität Bonn, Germany, Henri Moscovici, Ohio State University, Columbus, OH, and Markus J. Pflaum, University of Colorado, Boulder, CO

Contents: Introduction; Preliminaries; The b-analogue of the entire Chern character; Heat kernel and resolvent estimates; The main results; Bibliography; Subject index; Notation index.

Memoirs of the American Mathematical Society, Volume 220, Number 1036

A Survey on Classical Minimal Surface Theory
William H. Meeks III, University of Massachusetts, Amherst, MA, and Joaquin Pérez, Universidad de Granada, Spain

Meeks and Pérez present a survey of recent spectacular successes in classical minimal surface theory. The classification of minimal planar domains in three-dimensional Euclidean space provides the focus of the account. The proof of the classification depends on the work of many currently active leading mathematicians, thus making contact with much of the most important results in the field. Through the telling of the story of the classification of minimal planar domains, the general mathematician may catch a glimpse of the intrinsic beauty of this theory and the authors’ perspective of what is happening at this historical moment in a very classical subject.

This book includes an updated tour through some of the recent advances in the theory, such as Colding–Minicozzi theory, minimal laminations, the ordering theorem for the space of ends, conformal structure of minimal surfaces, minimal annular ends with infinite total curvature, the embedded Calabi–Yau problem, local pictures on the scale of curvature and topology, the local removable singularity theorem, embedded minimal surfaces of finite genus, topological classification of minimal surfaces, uniqueness of Scherk
singly periodic minimal surfaces, and outstanding problems and conjectures.

Contents: Introduction; Basic results in classical minimal surface theory; Minimal surfaces with finite topology and more than one end; Limits of embedded minimal surfaces without local area or curvature bounds; The structure of minimal laminations of $\mathbb{R}^3$; The Ordering Theorem for the space of ends; Conformal structure of minimal surfaces; Uniqueness of the helicoid I: proper case; Embedded minimal annular ends with infinite total curvature; The embedded Calabi–Yau problem; Local pictures, local removable singularities and dynamics; Embedded minimal surfaces of finite genus; Topological aspects of minimal surfaces; Partial results on the Liouville conjecture; The Scherk uniqueness theorem; Calabi–Yau problems; Outstanding problems and conjectures; Bibliography.

University Lecture Series, Volume 60


New AMS-Distributed Publications

Differential Equations

Boundary Value Problems for the Stokes System in Arbitrary Lipschitz Domains

Marius Mitrea, University of Missouri at Columbia, MO, and Matthew Wright, Missouri State University, Springfield, MO

The goal of this work is to treat the following main boundary value problems for the Stokes system: (1) the Dirichlet problem with $L^p$-data and nontangential maximal function estimates, (2) the Neumann problem with $L^p$-data and nontangential maximal function estimates, (3) the Regularity problem with $L^p$-data and nontangential maximal function estimates, (4) the transmission problem with $L^p$-data and nontangential maximal function estimates, (5) the Poisson problem with Dirichlet condition in Besov-Triebel-Lizorkin spaces, and (6) the Poisson problem with Neumann condition in Besov-Triebel-Lizorkin spaces, in Lipschitz domains of arbitrary topology in $\mathbb{R}^n$, for each $n \geq 2$.

The authors’ approach relies on boundary integral methods and yields constructive solutions to the aforementioned problems.

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

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; Smoothness spaces and Lipschitz domains; Rellich identities for divergence form, second-order systems; The Stokes system and hydrostatic potentials; The $L^p$ transmission problem with $p$ near 2; Local $L^2$ estimates; The transmission problem in two and three dimensions; Higher dimensions; Boundary value problems in bounded Lipschitz domains; The Poisson problem for the Stokes system; Appendix; Bibliography.

Astérisque, Number 344


Geometry and Topology

Deformation Quantization Modules

Masaki Kashiwara, Kyoto University, Japan, and Pierre Schapira, Université Paris VI, France

On a complex manifold $(X,O_X)$, a DQ-module is a module (in the derived sense) over an algebroid stack locally equivalent to the sheaf $O_X[[\hbar]]$ endowed with a star-product. The book treats relative finiteness, duality and index theorems for DQ-modules, showing in particular the functoriality of the Hochschild class in this framework and studying in detail holonomic modules in the symplectic case.

Hence, these notes could be considered both as an introduction to noncommutative complex analytic geometry and to the study of microdifferential systems on complex Poisson manifolds.

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: Modules over formal deformations; DQ-algebroids; Kernels; Hochschild classes; The commutative case; Symplectic case and $D$-modules; Holonomic DQ-modules; Notation index; Terminological index; Bibliography.

Astérisque, Number 345

Topics on Hyperbolic Polynomials in One Variable

Vladimir Petrov Kostov,
Université de Nice, France

This book exposes recent results about hyperbolic polynomials in one real variable, i.e. having all their roots real. It contains a study of the stratification and the geometric properties of the domain in $\mathbb{R}^n$ of the values of the coefficients $a_j$ for which the polynomial $P := x^n + a_1 x^{n-1} + \cdots + a_n$ is hyperbolic. Similar studies are performed w.r.t. very hyperbolic polynomials, i.e. hyperbolic and having hyperbolic primitives of any order, and w.r.t. stably hyperbolic ones, i.e. real polynomials of degree $n$ which become hyperbolic after multiplication by $x^k$ and addition of a suitable polynomial of degree $k - 1$.

New results are presented concerning the Schur-Szegő composition of polynomials, in particular of hyperbolic ones, and of certain entire functions. The question about the arrangement of the $n(n + 1)/2$ roots of the polynomials $P, P^{(1)}, \ldots, P^{(n-1)}$ is studied for $n \leq 5$ with the help of the discriminant sets $\text{Res}(P^{(i)}, P^{(j)}) = 0$.

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

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; The hyperbolicity domain; Very hyperbolic and stably hyperbolic polynomials; The Schur–Szegő composition and the mapping $\Phi$; Root arrangements and the Rolle theorem; Testing hyperbolicity; Bibliography.

Panoramas et Synthèses, Number 33


The MSC invites applications for the above positions in the full spectrum of mathematical sciences: ranging from pure mathematics, applied PDE, computational mathematics to statistics. The current annual salary range is between 0.15-1.0 million RMB. Salary will be determined by applicants’ qualification. Strong promise/track record in research and teaching are required. Completed applications must be electronically submitted, and must contain curriculum vitae, research statement, teaching statement, selected reprints and/or preprints, three reference letters on academic research. And one reference letter on teaching, sent electronically to msc-recruitment@math.tsinghua.edu.cn

The review process starts in December 2012, and closes by April 30, 2013. Applicants are encouraged to submit their applications before December 15, 2012.

Positions: post-doctorate fellowship

Mathematical Sciences Center (MSC) will hire a substantial number of post-doctorate fellows in the full spectrum of mathematical sciences. New and recent PhDs are encouraged for this position.

A typical appointment for post-doctorate fellowship of MSC is for three-years. Salary and compensation package are determined by qualification, accomplishment, and experience. MSC offers very competitive packages.

Completed applications must contain curriculum vitae, research statement, teaching statement, selected reprints and/or preprints, three reference letters, sent electronically to msc-recruitment@math.tsinghua.edu.cn

The review process starts in December 2012, and closes by April 30, 2013. Applicants are encouraged to submit their applications before December 15, 2012.