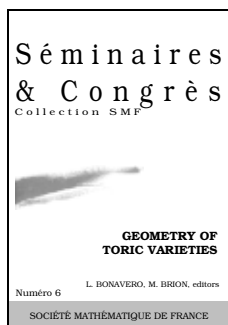


# New Publications Offered by the AMS

## Algebra and Algebraic Geometry



### Geometry of Toric Varieties

**Laurent Bonavero** and **Michel Brion**, *Institut Fourier, Saint-Martin d'Hères, France*, Editors

*A publication of the Société Mathématique de France.*

Toric varieties form a beautiful class of algebraic varieties, which are often used as a testing ground for verifying general conjectures in algebraic geometry, for example, in Hilbert schemes, singularity theory, Mori theory, and so on.

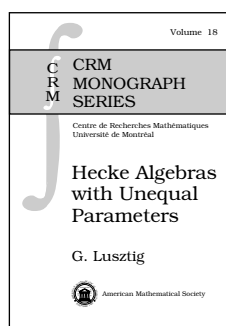
This volume gathers expanded versions of lectures presented during the summer school of "Geometry of Toric Varieties" in Grenoble (France). These lectures were given during the second and third weeks of the school. (The first week was devoted to introductory material.) The paper by D. Cox is an overview of recent work in toric varieties and its applications, putting the other contributions of the volume into perspective.

Distributed by the AMS in North America. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

**Contents:** D. A. Cox, Update on toric geometry; W. Bruns and J. Gubeladze, Semigroup algebras and discrete geometry; A. Craw and M. Reid, How to calculate  $A$ -Hilb  $\mathbb{C}^3$ ; D. I. Dais, Resolving 3-dimensional toric singularities; D. I. Dais, Crepant resolutions of Gorenstein toric singularities and upper bound theorem; J. Hausen, Producing good quotients by embedding into toric varieties; Y. Ito, Special McKay correspondence; Y. Tschinkel, Lectures on height zeta functions of toric varieties; J. A. Wiśniewski, Toric Mori theory and Fano manifolds.

*Séminaires et Congrès*, Number 6

July 2002, 272 pages, Softcover, ISBN 2-85629-122-8, 2000 *Mathematics Subject Classification*: 14M25, List \$78\*, Order code SECO/6N



### Hecke Algebras with Unequal Parameters

**G. Lusztig**, *Massachusetts Institute of Technology, Cambridge*

Hecke algebras arise in representation theory as endomorphism algebras of induced representations. One of the most important classes of Hecke algebras is related to representations of

reductive algebraic groups over  $p$ -adic or finite fields. In 1979, in the simplest (equal parameter) case of such Hecke algebras, Kazhdan and Lusztig discovered a particular basis (the KL-basis) in a Hecke algebra, which is very important in studying relations between representation theory and geometry of the corresponding flag varieties. It turned out that the elements of the KL-basis also possess very interesting combinatorial properties.

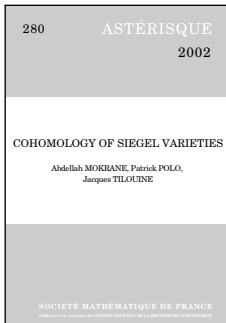
In the present book, the author extends the theory of the KL-basis to a more general class of Hecke algebras, the so-called algebras with unequal parameters. In particular, he formulates conjectures describing the properties of Hecke algebras with unequal parameters and presents examples verifying these conjectures in particular cases.

Written in the author's precise style, the book gives researchers and graduate students working in the theory of algebraic groups and their representations an invaluable insight and a wealth of new and useful information.

**Contents:** Coxeter groups; Partial order on  $W$ ; The algebra  $\mathcal{H}$ ; The bar operator; The elements  $c_w$ ; Left or right multiplication by  $c_s$ ; Dihedral groups; Cells; Cosets of parabolic subgroups; Inversion; The longest element for a finite  $W$ ; Examples of elements  $D_w$ ; The function  $\mathbf{a}$ ; Conjectures; Example: The split case; Example: The quasisplit case; Example: The infinite dihedral case; The ring  $J$ ; Algebras with trace form; The function  $\mathbf{a}_E$ ; Study of a left cell; Constructible representations; Two-sided cells; Virtual cells; Relative Coxeter groups; Representations; A new realization of Hecke algebras; Bibliography; Other titles in this series.

*CRM Monograph Series*, Volume 18

March 2003, 136 pages, Hardcover, ISBN 0-8218-3356-1, 2000 *Mathematics Subject Classification*: 20C08, List \$39\*, Order code CRMM/18N



## Cohomology of Siegel Varieties

A. Mokrane, P. Polo and J. Tilouine, CNRS, *Université de Paris XIII, Villetaneuse, France*

*A publication of the Société Mathématique de France.*

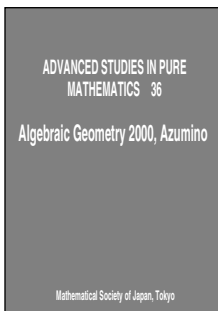
This volume deals with the properties of cohomology of Siegel varieties with coefficients in  $\mathbb{Z}_p$  or in a certain local system of flat  $\mathbb{Z}_p$ -modules. The main result of the book establishes the absence of  $p$ -torsion in certain localizations of this cohomology. Two arithmetic applications are presented: One concerns Hida families of Hecke eigensystems, and the other is a step towards the existence of certain Taylor-Wiles systems for symplectic groups.

Distributed by the AMS in North America. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

**Contents:** A. Mokrane and J. Tilouine, Cohomology of Siegel varieties with  $p$ -adic integral coefficients and applications; P. Polo and J. Tilouine, Bernstein-Gelfand-Gelfand complexes and cohomology of nilpotent groups over  $\mathbb{Z}(p)$  for representations with  $p$ -small weights.

Astérisque, Number 280

October 2002, 135 pages, Softcover, ISBN 2-85629-124-4, 2000 *Mathematics Subject Classification*: 11F46, 11G15, 14F30, 14K22, 17B50, 17B56, 20G30, List \$33\*, Order code AST/280N



## Algebraic Geometry 2000, Azumino

Sampei Usui, *Osaka Univ, Toyonaka, Japan*, Mark Green, *University of California, Los Angeles*, Lue Illusie, *Université de Paris-Sud, Orsay, France*, Kazuya Kato, *Kyoto University, Japan*, Eduard Looijenga, *University of Utrecht, Netherlands*, Siegeru Mukai, *RIMS, Kyoto University, Japan*, and Shuji Saito, *Nagoya University, Japan*, Editors

*A publication of the Mathematical Society of Japan.*

This conference proceedings volume contains survey and research articles on topics of current interest written by leading international experts. The topic of the symposium was "Interactions of Algebraic Geometry, Hodge Theory, and Logarithmic Geometry from the Viewpoint of Degenerations".

The book contains four surveys on 1) pencils of algebraic curves by T. Ashikaga and K. Konno; 2) integral  $p$ -adic Hodge theory by C. Breuil; 3) Hodge-Arakelov theory of elliptic curves by S. Mochizuki; and 4) refined cycle maps by S. Saito. Also included are two results by Gabber on absolute purity theorem written by K. Fujiwara and research articles on the Picard-Lefschetz formula

by L. Illusie, moduli spaces of rational elliptic surfaces by G. Heckman and E. Looijenga, moduli of curves of genus 4 by S. Kondo, and logarithmic Hodge theory by K. Kato, C. Nakayama, and S. Usui and its application to geometry by S. Saito.

The volume is intended for researchers interested in algebraic geometry, particularly in the study of families of algebraic varieties and Hodge structures.

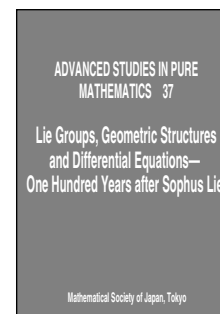
Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

**Contents:** *Survey Articles:* T. Ashikaga and K. Konno, Global and local properties of pencils of algebraic curves; C. Breuil, Integral  $p$ -adic Hodge theory; S. Mochizuki, A survey of the Hodge-Arakelov theory of elliptic curves II; M. Saito, Refined cycle maps; *Research Articles:* K. Fujiwara, Independence of  $\ell$  for intersection cohomology (after Gabber); K. Fujiwara, A proof of the absolute purity conjecture (after Gabber); G. Heckman and E. Looijenga, The moduli space of rational elliptic surfaces; L. Illusie, Sur la formule de Picard-Lefschetz; K. Kato, T. Matsubara, and C. Nakayama, Log  $C^\infty$ -functions and degenerations of Hodge structures; K. Kato and S. Usui, Borel-Serre spaces and spaces of  $SL(2)$ -orbits; S. Kondo, The moduli space of curves of genus 4 and Deligne-Mostow's complex; S. Saito, Infinitesimal logarithmic Torelli problem for degenerating hypersurfaces in  $\mathbb{P}^n$ ; Appendix by Atsushi Ikeda.

**Advanced Studies in Pure Mathematics, Volume 36**

October 2002, 442 pages, Hardcover, ISBN 4-931469-20-5, 2000 *Mathematics Subject Classification*: 11S20; 14D05, List \$104\*, Order code ASPM/36N

## Differential Equations



## Lie Groups, Geometric Structures and Differential Equations—One Hundred Years After Sophus Lie

Tohru Morimoto, *Nara Women's University, Japan*, Hajime Sato, *Science University*

*of Tokyo, Japan*, and Keizo Yamaguchi, *Hokkaido University, Sapporo, Japan*, Editors

*A publication of the Mathematical Society of Japan.*

The blending of algebra, geometry, and differential equations has a long and distinguished history, dating back to the work of Sophus Lie and Élie Cartan. Overviewing the depth of their influence over the past 100 years presents a formidable challenge. A conference was held on the centennial of Lie's death to reflect upon and celebrate his pursuits, later developments, and what the future may hold. This volume showcases the contents, atmosphere, and results of that conference.

Of particular importance are two survey articles: Morimoto develops a synthetic study of Lie groups, geometric structures, and differential equations from a unified viewpoint of nilpotent geometry. Yamaguchi and Yatsui discuss the geometry of higher order differential equations of finite type. Contributed

research articles cover a wide range of disciplines, from geometry of differential equations, CR-geometry, and differential geometry to topics in mathematical physics.

This volume is intended for graduate students studying differential geometry and analysis and advanced graduate students and researchers interested in an overview of the most recent progress in these fields.

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

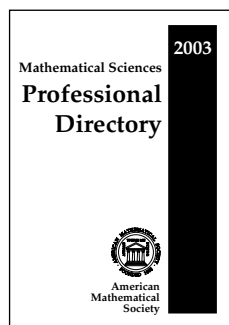
Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

**Contents:** **R. L. Bryant**, Levi-flat minimal hypersurfaces in two-dimensional complex space forms; **A. Čap** and **G. Schmalz**, Partially integrable almost CR manifolds of CR dimension and codimension two; **J. Gasqui** and **H. Goldschmidt**, Some remarks on the infinitesimal rigidity of the complex quadric; **S. Igonin** and **J. Krasil'shchik**, On one-parametric families of Bäcklund transformations; **G. Ishikawa**, **M. Kimura**, and **R. Miyaoka**, Submanifolds with degenerate Gauss mappings in spheres; **P. Kersten** and **J. Krasil'shchik**, Complete integrability of the coupled KdV-mKdV system; **M. Kuranishi**, An approach to the Cartan geometry I: Conformal Riemann manifolds; **B. Malgrange**, Differential algebra and differential geometry; **T. Morimoto**, Lie algebras, geometric structures and differential equations on filtered manifolds; **T. Nomura**, Cayley transforms and symmetry conditions for homogeneous Siegel domains; **P. J. Olver**, The canonical contact form; **H. Omori**, Associativity breaks down in deformation quantization; **A. L. Onishchik**, Lifting of holomorphic actions on complex supermanifolds; **T. Ozawa** and **H. Sato**, Contact transformations and their Schwarzian derivatives; **P. Tomter**, Isometric immersions into complex projective space; **K. Yamaguchi** and **T. Yatsui**, Geometry of higher order differential equations of finite type associated with symmetric spaces; **A. Yoshioka**, Contact Weyl manifold over a symplectic manifold.

**Advanced Studies in Pure Mathematics**, Volume 37

December 2002, 492 pages, Hardcover, ISBN 4-931469-21-3, 2000 *Mathematics Subject Classification*: 58-XX; 22-XX, 32-XX, 35-XX, 53-XX, List \$110\*, Order code ASPM/37N

## General and Interdisciplinary



## Mathematical Sciences Professional Directory, 2003

This annual directory provides a handy reference to various organizations in the mathematical sciences community. Listed in the directory are the following: officers of over thirty professional mathematical organizations; addresses of selected government agencies; academic departments in the mathematical

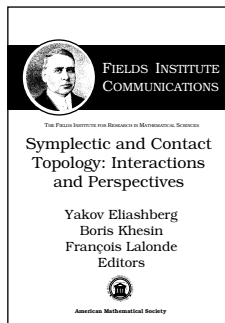
sciences; and alphabetic listings of colleges and universities.

April 2003, approximately 232 pages, Softcover, ISBN 0-8218-3289-1, 2000 *Mathematics Subject Classification*: 00-XX, List \$55\*, Order code PRODIR/2003N

## Geometry and Topology

### Symplectic and Contact Topology: Interactions and Perspectives

**Yakov Eliashberg**, *Stanford University, CA*, **Boris Khesin**, *University of Toronto, ON, Canada*, and **François Lalonde**, *University of Québec at Montréal, Canada*, Editors



The papers presented in this volume are written by participants of the "Symplectic and Contact Topology, Quantum Cohomology, and Symplectic Field Theory" symposium. The workshop was part of a semester-long joint venture of The Fields Institute in Toronto and the Centre de Recherches

Mathématiques in Montréal.

The twelve papers cover the following topics: Symplectic Topology, the interaction between symplectic and other geometric structures, and Differential Geometry and Topology.

The Proceeding concludes with two papers that have a more algebraic character. One is related to the program of Homological Mirror Symmetry: the author defines a category of extended complex manifolds and studies its properties. The subject of the final paper is Non-commutative Symplectic Geometry, in particular the structure of the symplectomorphism group of a non-commutative complex plane.

The in-depth articles make this book a useful reference for graduate students as well as research mathematicians.

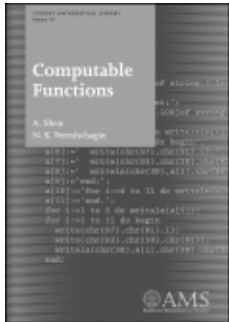
**Contents:** **M. Abreu**, Kähler geometry of toric manifolds in symplectic coordinates; **V. Apostolov** and **T. Drăghici**, The curvature and the integrability of almost-Kähler manifolds: A survey; **F. Bourgeois**, A Morse-Bott approach to contact homology; **J. Chen**, Deforming surfaces in four dimensional manifolds; **A. Dancer** and **M. Y. Wang**, Integrability and the Einstein equations; **J. Epstein** and **D. Fuchs**, On the invariants of Legendrian mirror torus links; **R. Ibáñez**, **Yu. Rudyak**, **A. Tralle**, and **L. Ugarte**, Symplectically harmonic cohomology of nilmanifolds; **D. Kotschick**, Godbillon-Vey invariants for families of foliations; **S. A. Merkulov**, A note on extended complex manifolds; **V. Pidstrygach**, On action of symplectomorphisms of the complex plane on pairs of matrices; **L. Polterovich**, Slow symplectic maps, continued fractions, and related stories; **J.-C. Sikorav**, The gluing construction for normally generic  $J$ -holomorphic curves.

**Fields Institute Communications**, Volume 35

March 2003, approximately 207 pages, Hardcover, ISBN 0-8218-3162-3, 2000 *Mathematics Subject Classification*: 53Cxx, 53Dxx, 57R17; 37Jxx, 57Nxx, 58Jxx, 53Z05, List \$64\*, Order code FIC/35N

## Logic and Foundations

Recommended Text



### Computable Functions

A. Shen, *Independent University of Moscow, Russia*, and N. K. Vereshchagin, *Moscow State Lomonosov University, Russia*

In 1936, before the development of modern computers, Alan Turing proposed the concept of a machine

that would embody the interaction of mind, machine, and logical instruction. The idea of a “universal machine” inspired the notion of programs stored in a computer’s memory. Nowadays, the study of computable functions is a core topic taught to mathematics and computer science undergraduates.

Based on the lectures for undergraduates at Moscow State University, this book presents a lively and concise introduction to the central facts and basic notions of the general theory of computation. It begins with the definition of a computable function and an algorithm, and discusses decidability, enumerability, universal functions, numberings and their properties,  $m$ -completeness, the fixed point theorem, arithmetical hierarchy, oracle computations, and degrees of unsolvability. The authors complement the main text with over 150 problems. They also cover specific computational models, such as Turing machines and recursive functions.

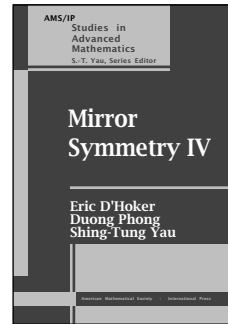
The intended audience includes undergraduate students majoring in mathematics or computer science, and all mathematicians and computer scientists that would like to learn basics of the general theory of computation. The book is also an ideal reference source for designing a course.

**Contents:** Computable functions, decidable and enumerable sets; Universal functions and undecidability; Numberings and operations; Properties of Gödel numberings; Fixed point theorem;  $m$ -reducibility and properties of enumerable sets; Oracle computations; Arithmetical hierarchy; Turing machines; Arithmeticity of computable functions; Recursive functions; Bibliography; Glossary; Index.

Student Mathematical Library, Volume 19

January 2003, 166 pages, Softcover, ISBN 0-8218-2732-4, LC 2002038567, 2000 *Mathematics Subject Classification:* 03-01, 03Dxx, List \$29\*, Order code STML/19N

## Mathematical Physics



### Mirror Symmetry IV

Eric D'Hoker, *University of California, Los Angeles*, Duong Phong, *Columbia University, New York*, and Shing-Tung Yau, *Harvard University, Cambridge, MA*, Editors

This book presents contributions of participants of a workshop held at the

Centre de Recherches Mathématiques (CRM), University of Montréal. It can be viewed as a sequel to Mirror Symmetry I (1998), Mirror Symmetry II (1996), and Mirror Symmetry III (1999), copublished by the AMS and International Press.

The volume presents a broad survey of many of the noteworthy developments that have taken place in string theory, geometry, and duality since the mid 1990s. Some of the topics emphasized include the following: Integrable models and supersymmetric gauge theories; theory of  $M$ - and  $D$ -branes and noncommutative geometry; duality between strings and gauge theories; and elliptic genera and automorphic forms. Several introductory articles present an overview of the geometric and physical aspects of mirror symmetry and of corresponding developments in symplectic geometry. The book provides an efficient way for a very broad audience of mathematicians and physicists to explore the frontiers of research into this rapidly expanding area.

This book is copublished by the AMS, International Press, and CRM.

**Contents:** *Calabi-Yau Manifolds, Mirror Symmetry, and Symplectic Geometry:* B. H. Lian, K. Liu, and S.-T. Yau, A survey of mirror principle; B. R. Greene, Mirror symmetry: aspects of the first 10 years; W.-D. Ruan, Lagrangian torus fibrations of Calabi-Yau hypersurfaces in toric varieties and SYZ mirror symmetry conjecture; G. Liu, Moduli space of stable maps; F. Lalonde and D. McDuff, Cohomological properties of ruled symplectic structures; *Supersymmetric gauge theories and integrable models:* J. C. Hurtubise, Spectral Lax pairs and Calogero-Moser systems; I. P. Ennes, C. Lozano, S. G. Naculich, H. Rhedin, and H. J. Schnitzer,  $M$ -theory tested by  $\mathcal{N} = 2$  Seiberg-Witten theory; I. P. Ennes, C. Lozano, S. G. Naculich, and H. J. Schnitzer, Seiberg-Witten curves for elliptic models; I. Krichever and K. L. Vaninsky, The periodic and open Toda lattice; J.-L. Gervais, Exact integration methods for supersymmetric Yang-Mills theory; *M-theory, D-branes, and non-commutative geometry:* R. C. Meyers, Nonabelian  $D$ -branes and noncommutative geometry; P. Pouliot, Evidence for winding states in noncommutative quantum field theory; K. G. Savvidy, The discrete bound state spectrum of the rotating  $D0$ -brane system, and its decay by emission of Ramond-Ramond field radiation; F. Denef, On the correspondence between  $D$ -branes and stationary supergravity solutions of type II Calabi-Yau compactifications; M. Faux, D. Lüüst, and B. A. Ovrut, Phase-transitions and tensor dynamics in  $M$ -theory; N. A. Obers and B. Pioline, Duality, Eisenstein series and exact thresholds; *Strings, gauge theories, and AdS/CFT correspondence:* E. Witten and S.-T. Yau, Connectedness of the boundary in the AdS/CFT correspondence; S.-T. Yau, A note on the topology of the boundary in the AdS/CFT correspon-

dence; **M. Porrati** and **A. Starinets**, Holographic duals of 4D field theories; **D. Kabat**, **G. Lifschytz**, and **D. A. Lowe**, Black hole thermodynamics from calculations in strongly-coupled gauge theory; **O. Lunin** and **S. D. Mathur**, Correlation functions for orbifolds of the type  $M^N/S^N$ ; *Elliptic genera and automorphic forms*: **L. A. Borisov** and **A. Libgober**, Elliptic genera of singular varieties, orbifold elliptic genus and chiral de Rham complex; **K. Liu** and **X. Ma**, On family rigidity theorems for  $\text{Spin}^c$  manifolds; **J. Jorgenson** and **A. Todorov**, Ample divisors, automorphic forms and Shafarevich's conjecture.

**AMS/IP Studies in Advanced Mathematics**, Volume 33

March 2003, 381 pages, Hardcover, ISBN 0-8218-3335-9, LC 2002038580, 2000 *Mathematics Subject Classification*: 14-XX, 32-XX, 81-XX, List \$69\*, Order code AMSIP/33N

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