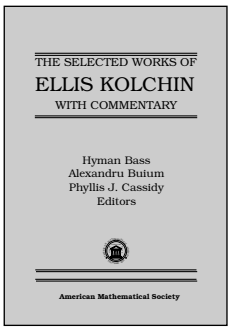
New Publications Offered by the AMS

Algebra and Algebraic Geometry



Selected Works of Ellis Kolchin with Commentary

Hyman Bass, *Columbia University, New York*, **Alexandru Buium**, *University of New Mexico, Albuquerque*, and **Phyllis J. Cassidy**, *Smith College, Northampton, MA*, Editors

The work of Joseph Fels Ritt and Ellis Kolchin in differential algebra paved the way for exciting new applications in constructive symbolic computation, differential Galois theory, the model theory of fields, and Diophantine geometry. This volume assembles Kolchin's mathematical papers, contributing solidly to the archive on construction of modern differential algebra. This collection of Kolchin's clear and comprehensive papers—in themselves constituting a history of the subject—is an invaluable aid to the student of differential algebra.

In 1910, Ritt created a theory of algebraic differential equations modeled not on the existing transcendental methods of Lie, but rather on the new algebra being developed by E. Noether and B. van der Waerden. Building on Ritt's foundation, and deeply influenced by Weil and Chevalley, Kolchin opened up Ritt theory to modern algebraic geometry. In so doing, he led differential geometry in a new direction. By creating differential algebraic geometry and the theory of differential algebraic groups, Kolchin provided the foundation for a "new geometry" that has led to both a striking and an original approach to arithmetic algebraic geometry. Intriguing possibilities were introduced for a new language for nonlinear differential equations theory.

The volume includes commentary by A. Borel, M. Singer, and B. Poizat. Also Buium and Cassidy trace the development of Kolchin's ideas, from his important early work on the differential Galois theory to his later groundbreaking results on the theory of differential algebraic geometry and differential algebraic groups. Commentaries are self-contained with numerous examples of various aspects of differential algebra and its applications. Central topics of Kolchin's work are discussed, presenting the history of differential algebra and exploring how his work grew from and transformed the work of Ritt. New directions of differential algebra are illustrated, outlining important current advances. Prerequisite to understanding the text is a background at the beginning graduate level in algebra, specifically commutative algebra, the theory of field extensions, and Galois theory.

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

Contents: Picard-Vessiot theory of partial differential fields; The notion of dimension in the theory of algebraic differential equations; *Part I. The Papers of Ellis Kolchin:* On certain ideals of differential polynomials; On the basis theorem for infinite systems of differential polynomials; On the exponents of differential ideals; On the basis theorem for differential systems; Extensions of differential fields. I; Extensions of differential fields. II; Algebraic matric groups; The Picard-Vessiot theory of homogeneous linear ordinary differential equations; Extensions of differential fields. III; Algebraic matric groups and the Picard-Vessiot theory of homogeneous linear ordinary differential equations; On certain concepts in the theory of algebraic matric groups; Existence theorems connected with the Picard-Vessiot theory of homogeneous linear ordinary differential equations; Algebraic groups and differential equations; Two proofs of a theorem on algebraic groups; Picard-Vessiot theory of partial differential fields; Galois theory of differential fields; Differential fields and group varieties (First lecture); Differential fields and group varieties (Second lecture); On the Galois theory of differential fields; Algebraic groups and the Galois theory of differential fields; Rational approximation to the solutions of algebraic differential equations; Existence of invariant bases; Abelian extensions of differential fields; Le théorème de la base finie pour les polynômes différentiels; The notion of dimension in the theory of algebraic differential equations; Singular solutions of algebraic differential equations and a lemma of Arnold Shapiro; Some problems in differential algebra; Algebraic groups and algebraic dependence; Differential polynomials and strongly normal extensions; Constrained extensions of differential fields; Differential equations in a projective space and linear dependence over a projective variety; Differential algebraic groups; Differential algebraic structures; On universal extensions of differential fields; Differential algebraic groups; A problem on differential polynomials; Painlevé transcendent; *Part II. Commentary:* **A. Borel**, Algebraic groups and Galois theory in the work of Ellis R. Kolchin; **M. F. Singer**, Direct and inverse problems in differential Galois theory; **B. Poizat**, Les corps différentiellement clos, compagnons de route de la théorie des modèles; **A. Buium** and **P. J. Cassidy**, Differential

algebraic geometry and differential algebraic groups: From algebraic differential equations to Diophantine geometry.

Collected Works, Volume 12

March 1999, approximately 664 pages, Hardcover, ISBN 0-8218-0542-8, 1991 *Mathematics Subject Classification*: 00B60, 12H05; 03C60, 11D99, 12F12, 12H20, 12Y05, 13A35, 13N10, 14E20, 14G20, **Individual member $72**, List $120, Institutional member $96, Order code CWORKS/12N

Sur le Transfert des Intégrales Orbitales Pour les Groupes Linéaires (CAS *p*-adique)

François Courtès, *Université de Poitiers, France*

A publication of Société Mathématique de France.

In this memoir, the author considers the transfer problem for orbital integrals for the linear group $SL_n(F)$, where F is a non-Archimedean local field of characteristic zero and residual characteristic p with $p > n$. In particular, Courtès establishes the transfer of the orbitals integrals from $SL_n(F)$ to its endoscopic groups. In order to do this, he proves the following result: For $G = GL_n(F)$ and $H = GL_m(E)$, with E a tamely ramified extension of F of degree n/m and any p, the transfer from G to H holds on the set of semisimple regular elements, which generates an algebra in $M_n(F)$ that is the product of tamely ramified extensions of F.

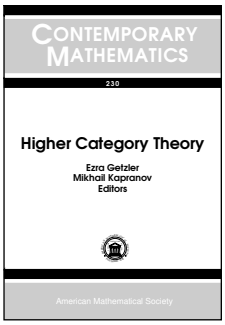
In a neighborhood of the identity, orbital integrals on G and H can be developed in Shalika germs; it is enough then to compare them for functions belonging to some well-chosen space. For these functions, one obtains another development in germs, related to twisted traces of induced Steinberg representations. The computation of such traces, combined with recurrence relations (on n) on the value of orbital integrals, yields recurrence relations on the values of these germs. One also obtains recurrence relations on the value of the transfer factors. All these relations allow one to compare the value of germs on G and H, and the result follows.

Distributed by the AMS in the United States, Canada, and Mexico. 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: Introduction; Préliminaires; Fonctions utilisées; Calcul de traces; Calcul des germes par récurrence; Le transfert; Bibliographie.

Mémoires de la Société Mathématique de France, Number 69

March 1998, 140 pages, Softcover, ISBN 2-85629-062-0, 1991 *Mathematics Subject Classification*: 22E50; 11F70, **Individual member $23**, List $26, Order code SMFMEM/69N



Higher Category Theory

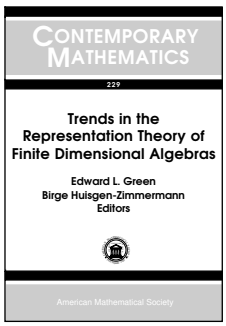
Ezra Getzler and **Mikhail Kapranov**, *Northwestern University, Evanston, IL*, Editors

This volume presents the proceedings of the workshop on higher category theory and mathematical physics held at Northwestern University. Exciting new developments were presented with the aim of making them better known outside the community of experts. In particular, presentations in the style, "Higher Categories for the Working Mathematician", were encouraged. The volume is the first to bring together developments in higher category theory with applications. This collection is a valuable introduction to this topic—one that holds great promise for future developments in mathematics.

Contents: J. C. Baez and **J. Dolan**, Categorification; **M. A. Batanin**, Computads for finitary monads on globular sets; **L. Breen**, Braided n-categories and Σ-structures; **J.-L. Brylinski**, Categories of vector bundles and Yang-Mills equations; **R. Street**, The role of Michael Batanin's monoidal globular categories; **D. N. Yetter**, Braided deformations of monoidal categories and Vassiliev invariants.

Contemporary Mathematics, Volume 230

February 1999, 134 pages, Softcover, ISBN 0-8218-1056-1, LC 98-32266, 1991 *Mathematics Subject Classification*: 18–06, 18D05, 18G50, **Individual member $20**, List $34, Institutional member $27, Order code CONM/230N



Trends in the Representation Theory of Finite Dimensional Algebras

Edward L. Green, *Virginia Polytechnic Institute and State University, Blacksburg*, and **Birge Huisgen-Zimmermann**, *University of California, Santa Barbara*, Editors

This refereed collection of research papers and survey articles reflects the interplay of finite-dimensional algebras with other areas (algebraic geometry, homological algebra, and the theory of quantum groups). Current trends are presented from the discussions at the AMS-IMS-SIAM Joint Summer Research Conference at the University of Washington (Seattle).

The volume features several excellent expository articles which will introduce the beginning researcher to cutting-edge topics in representation theory. The book will also provide inspiration to researchers in related areas, as it includes original papers spanning a broad spectrum of representation theory.

Features:

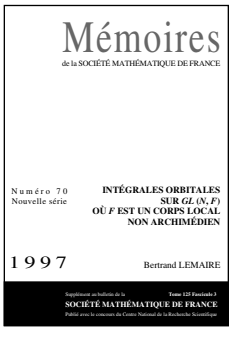
· Work outlining significant progress on long-standing open problems.

- Survey articles offering both overviews and introductions to various subfields of the topic.
- Expositions reflecting the interplay between the representation theory of algebras and other fields.

Contents: I. Assem and **F. U. Coelho**, Postprojective partitions for tilting torsion pairs; **M. Barot** and **H. Lenzing**, Derived canonical algebras as one-point extensions; **F. M. Bleher**, Special biserial algebras and their automorphisms; **S. Brenner** and **M. C. R. Butler**, Wild subquivers of the Auslander-Reiten quiver of a tame algebra; **K. A. Brown**, Representation theory of Noetherian Hopf algebras satisfying a polynomial identity; **R.-O. Buchweitz**, Finite representation type and periodic Hochschild (co-)homology; **M. C. R. Butler**, The syzygy theorem for monomial algebras; **J. A. de la Peña**, Algebras whose derived category is tame; **P. Dräxler**, Circular biextensions of tame concealed algebras; **R. Farnsteiner**, On the distribution of AR-components of restricted Lie algebras; **M. Gerstenhaber** and **A. Giaquinto**, Compatible deformations; **D. Happel** and **I. Reiten**, Directing objects in hereditary categories; **D. Happel** and **L. Unger**, On subcategories associated with tilting modules; **Y. Iwanaga** and **J. Miyachi**, Modules of the highest homological dimension over a Gorenstein ring; **M. Kauer**, Derived equivalence of graph algebras; **O. Kerner**, Basic results on wild hereditary algebras; **H. Krause** and **M. Saorín**, On minimal approximations of modules; **R. Martínez-Villa**, Serre duality for generalized Auslander regular algebras; **S. Montgomery**, Classifying finite-dimensional semisimple Hopf algebras; **C. Riedtmann**, Geometry of modules: Degenerations; **C. M. Ringel**, The preprojective algebra of a tame quiver: The irreducible components of the module varieties; **D. Simson**, Representation types, Tits reduced quadratic forms and orbit problems for lattices over orders; **A. Skowroński** and **G. Zwara**, Degenerations in module varieties with finitely many orbits.

Contemporary Mathematics, Volume 229

January 1999, 356 pages, Softcover, ISBN 0-8218-0928-8, LC 98-44526, 1991 *Mathematics Subject Classification*: 14D15, 14L30, 16D30, 16D60, 16E10, 16E30, 16E40, 16G10, 16G20, 16G30, 16G50, 16G60, 16G70, 16P10, 16P20, 16P40, 16S80, 16W30, 17B37, 81R50, **Individual member $45**, List $75, Institutional member $60, Order code CONM/229N



Intégrales Orbitales sur *GL(N, F)* Où *F* Est Un Corps Local Non Archimédien

Bertrand Lemaire, *Université de Paris-Sud, Orsay, France*

A publication of Société Mathématique de France.

This memoir gathers together the fundamental results about orbital integrals for $G = GL(N, F)$ for a non-Archimedean field F of characteristic $p \geq 0$, and $N \geq 2$. Many of the results were already known, but had not been published for the case $p > 0$: convergence, reduction formulas, germ expansion in a neighborhood of a point in a closed orbit and linear independence of the germs, characterization on the set of regular absolutely semi-simple elements, and the density of the regular absolutely semi-simple orbital integrals in the space of invariant distributions. The treatment of the inseparable elements requires the decomposition of the Dixmier strata of G into sub-strata and a normalization $J^G(f, x)(f \in C_c^\infty(G), x \in G)$ of the orbital integrals on G which induce, for all $f \in C_c^\infty(G)$, a map $x \mapsto J^G(f, x)$ that is locally constant on each of these sub-strata.

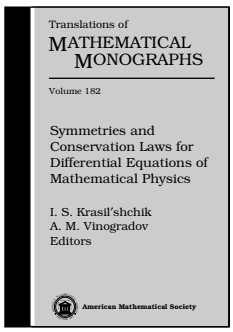
Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a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

Contents: Introduction; Les classes de conjugaison de G; Intégrales orbitales sur G; Normalisation $\langle\langle J \rangle\rangle$ des intégrales orbitales sur G; Indépendance linéaire des germes; Caractérisation des intégrales orbitales sur G et théorème de densité; Bibliographie.

Mémoires de la Société Mathématique de France, Number 70

June 1998, 94 pages, Softcover, ISBN 2-85629-063-9, 1991 *Mathematics Subject Classification*: 22E50, **Individual member $23**, List $26, Order code SMFMEM/70N

Differential Equations



Symmetries and Conservation Laws for Differential Equations of Mathematical Physics

I. S. Krasil′shchik, *Moscow Institute for Municipal Economy, Russia*, and **A. M. Vinogradov**, *University of Salerno, Italy*, Editors

This book presents developments in the geometric approach to nonlinear partial differential equations (PDEs). The expositions discuss the main features of the approach, and the theory of symmetries and the conservation laws based on it. The book combines rigorous mathematics with concrete examples. Nontraditional topics, such as the theory of nonlocal symmetries and cohomological theory of conservation laws, are also included.

The volume is largely self-contained and includes detailed motivations, extensive examples and exercises, and careful proofs of all results. Readers interested in learning the basics of applications of symmetry methods to differential equations of mathematical physics will find the text useful. Experts will also find it useful as it gathers many results previously only available in journals.

Contents: Ordinary differential equations; First-order equations; The theory of classical symmetries; Higher symmetries; Conservation laws; Nonlocal symmetries; From symmetries of partial differential equations towards secondary ("quantized") calculus; Bibliography; Index.

Translations of Mathematical Monographs, Volume 182

February 1999, approximately 347 pages, Hardcover, ISBN 0-8218-0958-X, 1991 *Mathematics Subject Classification*: 35A30, 58F07; 58F05, 58G05, **Individual member $77**, List $129, Institutional member $103, Order code MMONO/182N

General and Interdisciplinary

Proceedings of the International Congress of Mathematicians, Berlin 1998

Gerd Fischer, *University of Dusseldorf, Germany*, and **Ulf Rehmann**, *University of Bielefeld, Germany*, Editors

A publication of DOCUMENTA MATHEMATICA.

Each International Congress brings together mathematicians from all over the world to discuss recent developments in all areas of mathematics. It is one of the most exciting gatherings of mathematicians. The 1998 Congress in Berlin was no exception.

The invited speakers at the ICM have been recognized by their colleagues as important leaders in their fields, with their work representing some of the most significant recent research in mathematics. The twenty-one plenary speakers are asked to address the whole congress on recent results and trends that are shaping mathematics today. All plenary and invited lectures are published in these proceedings.

The announcement of the Fields Medalists and the Nevanlinna Prize Winner is a particular highlight of each International Congress. Volume I of the proceedings includes a short description of their work and the text of the lectures presented by the Medalists and Prize Winner at the Congress. This year, the Fields Medal Committee also paid special tribute to Andrew Wiles for his proof of Fermat's Last Theorem.

The *Proceedings of an International Congress of Mathematicians* provides a snapshot of mathematics at a given time. The articles for ICM '98 are guideposts to the significant developments in mathematical research at the end of the millenium.

Contents: *Volume I: Plenary One-Hour Invited Lectures:* **J.-M. Bismut**, Local index theory and higher analytic torsion; **C. Deninger**, Some analogies between number theory and dynamical systems; **P. Diaconis**, From shuffling cards to walking around the building: An introduction to modern Markov chain theory; **G. Gallavotti**, Chaotic hypothesis and universal large deviations properties; **W. Hackbusch**, From classical numerical mathematics to scientific computing; **H. H. W. Hofer**, Dynamics, topology and holomorphic curves; **E. Hrushovski**, Geometric model theory; **I. G. Macdonald**, Constant term identities, orthogonal polynomials and affine Hecke algebras; **S. Mallat**, Applied mathematics meets signal processing; **D. McDuff**, Fibrations in symplectic topology; **T. Miwa**, Solvable lattice models and representation theory of quantum affine algebras; **G. Papanicolaou**, Mathematical problems in geophysical wave propagation; **G. Pisier**, Operator spaces and similarity problems; **P. Sarnak**, L-functions; **P. W. Shor**, Quantum computing; **K. Sigmund**, The population dynamics of conflict and cooperation; **M. Talagrand**, Huge random structures and mean field models for spin glasses; **C. Vafa**, Geometric physics; **M. Viana**, Dynamics: A probabilistic and geometric perspective; **V. Voevodsky**, $\mathbf{A}^1$-homotopy theory; *Appendix:* **M. Safonov**, Estimates near the boundary for solutions of second order parabolic equations; **A. J. Wilkie**, o-minimality; Appendix; *Volume II: Invited Forty-five Minute Lectures, Section 1–9:* Logic, see also Appendix Vol. I; Algebra; Number theory an arithmetic algebraic geometry; Algebraic geometry; Differential geometry and global analysis; Topology; Lie groups and Lie algebras; Analysis; Ordinary differential equations and dynamical systems; Author index for volumes II, III; *Volume III: Invited Forty-five Minute Lectures, Sections 10–19:* Partial differential equations, see also Appendix Vol. I; Mathematical physics; Probability and statistics; Combinatorics; Mathematical aspects of computer science; Numerical analysis and scientific computing; Applications; Control theory and optimization; Teaching and popularization of mathematics; History of mathematics; Appendix; Author index for volumes II, III.

December 1998, 2374 pages, Hardcover, 1991 *Mathematics Subject Classification*: 00, **Individual member $105**, List $140, Order code PICM/98N