

CONTEMPORARY MATHEMATICS

392

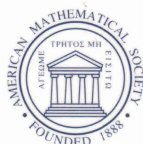
Infinite-Dimensional Aspects of Representation Theory and Applications

International Conference on Infinite-Dimensional Aspects of
Representation Theory and Applications

May 18–22, 2004

University of Virginia
Charlottesville, Virginia

Stephen Berman
Brian Parshall
Leonard Scott
Weiqiang Wang
Editors



Infinite-Dimensional Aspects of Representation Theory and Applications

CONTEMPORARY MATHEMATICS

392

Infinite-Dimensional Aspects of Representation Theory and Applications

International Conference on Infinite-Dimensional
Aspects of Representation Theory and Applications
May 18–22, 2004
University of Virginia
Charlottesville, Virginia

Stephen Berman
Brian Parshall
Leonard Scott
Weiqiang Wang
Editors



American Mathematical Society
Providence, Rhode Island

Editorial Board

Dennis DeTurck, managing editor

George Andrews Carlos Berenstein Andreas Blass Abel Klein

2000 *Mathematics Subject Classification*. Primary 14C05, 14N35, 16E40, 16G20, 16G60, 17B37, 17B69, 20C08, 82B23.

Library of Congress Cataloging-in-Publication Data

International Conference on Infinite-Dimensional Aspects of Representation Theory and Applications (2004 : University of Virginia)

Infinite-dimensional aspects of representation theory and applications : International Conference on Infinite-Dimensional Aspects of Representation Theory and Applications, University of Virginia, Charlottesville, Virginia, May 18–22, 2004 / Stephen Berman . . . [et al.], editors.

p. cm. — (Contemporary mathematics, ISSN 0271-4132 ; 392)

Includes bibliographical references.

ISBN 0-8218-3701-X (pbk. : acid-free paper)

1. Representations of algebras—Congresses. 2. Representations of groups—Congresses. 3. Geometry, Algebraic—Congresses. 4. Algebra, Homological—Congresses. 5. Quantum groups—Congresses. I. Berman, Stephen, 1944– II. Title. III. Contemporary mathematics (American Mathematical Society) ; v. 392.

QA176.I58 2004
512—dc22

2005053615

Copying and reprinting. Material in this book may be reproduced by any means for educational and scientific purposes without fee or permission with the exception of reproduction by services that collect fees for delivery of documents and provided that the customary acknowledgment of the source is given. This consent does not extend to other kinds of copying for general distribution, for advertising or promotional purposes, or for resale. Requests for permission for commercial use of material should be addressed to the Acquisitions Department, American Mathematical Society, 201 Charles Street, Providence, Rhode Island 02904-2294, USA. Requests can also be made by e-mail to reprint-permission@ams.org.

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

© 2005 by the American Mathematical Society. All rights reserved.

The American Mathematical Society retains all rights
except those granted to the United States Government.

Copyright of individual articles may revert to the public domain 28 years
after publication. Contact the AMS for copyright status of individual articles.

Printed in the United States of America.

∞ The paper used in this book is acid-free and falls within the guidelines
established to ensure permanence and durability.

Visit the AMS home page at <http://www.ams.org/>

10 9 8 7 6 5 4 3 2 1 10 09 08 07 06 05

Contents

Modular representation theory of Hecke algebras, a survey SUSUMU ARIKI	1
An application of free Lie algebras to polynomial current algebras and their representation theory VYJAYANTHI CHARI and JACOB GREENSTEIN	15
Canonical basic sets for Hecke algebras NICOLAS JACON	33
On Universal Central Extensions of $\mathfrak{sl}_n(A)$ MICHAEL LAU	43
Pseudoderivations, pseudoautomorphisms and simple current modules for vertex algebras HAISHENG LI	55
Hilbert scheme intersection numbers, Hurwitz numbers, and Gromov-Witten invariants WEI-PING LI, ZHENBO QIN, and WEIQIANG WANG	67
On Demazure crystals for $U_q(D_4^{(3)})$ KAILASH C. MISRA	83
Populations of solutions of the XXX Bethe equations associated to Kac-Moody algebras E. MUKHIN and A. VARCHENKO	95
Representations of rational Cherednik algebras RAPHAËL ROUQUIER	103
A geometric construction of crystal graphs using quiver varieties: extension to the non-simply laced case ALISTAIR SAVAGE	133

Preface

In May 2004, the Department of Mathematics at the University of Virginia (UVA) hosted an international conference on Infinite-dimensional Aspects of Representation Theory and Applications. About 80 mathematicians participated in the meeting, including senior researchers, postdocs, and graduate students, who worked in diverse fields including representation theory (of Hecke algebras, quivers, quantum groups, infinite-dimensional Lie algebras, etc.) and algebraic geometry (of Gromov-Witten theory, moduli spaces, Hilbert schemes, etc.).

The conference offered a mixture of mini-courses and regular talks. The three mini-courses were given by S. Ariki, W. Crawley-Boevey, and A. Okounkov. The speakers included: David Ben-Zvi, Vyjayanthi Chari, William Haboush, Shrawan Kumar, Haisheng Li, Tetsuji Miwa, Evgeny Mukhin, Zhenbo Qin, Raphaël Rouquier, Ravi Vakil, Michela Varagnolo, and Kari Vilonen.

This volume contains 10 papers from that conference. We thank the speakers and participants who made the conference successful, all the authors for their fine contributions to this volume, and all the referees for their careful reviews. We are grateful to the National Science Foundation, the Institute of Mathematical Science, and the Department of Mathematics at UVA for their generous financial support. We also thank Karen Klintworth for her help in organizing the conference.

The Editors

Titles in This Series

- 392 **Stephen Berman, Brian Parshall, Leonard Scott, and Weiqiang Wang, Editors**, Infinite-dimensional aspects of representation theory and applications, 2005
- 391 **Jürgen Fuchs, Jouko Mickelsson, Grigori Rozenblioum, Alexander Stolin, and Anders Westerberg, Editors**, Noncommutative geometry and representation theory in mathematical physics, 2005
- 390 **Sudhir Ghorpade, Hema Srinivasan, and Jugal Verma, Editors**, Commutative algebra and algebraic geometry, 2005
- 389 **James Eells, Etienne Ghys, Mikhail Lyubich, Jacob Palis, and José Seade, Editors**, Geometry and dynamics, 2005
- 388 **Ravi Vakil, Editor**, Snowbird lectures in algebraic geometry, 2005
- 387 **Michael Entov, Yehuda Pinchover, and Michah Sageev, Editors**, Geometry, spectral theory, groups, and dynamics, 2005
- 386 **Yasuyuki Kachi, S. B. Mulay, and Pavlos Tzermias, Editors**, Recent progress in arithmetic and algebraic geometry, 2005
- 385 **Sergiy Kolyada, Yuri Manin, and Thomas Ward, Editors**, Algebraic and topological dynamics, 2005
- 384 **B. Diarra, A. Escassut, A. K. Katsaras, and L. Narici, Editors**, Ultrametric functional analysis, 2005
- 383 **Z.-C. Shi, Z. Chen, T. Tang, and D. Yu, Editors**, Recent advances in adaptive computation, 2005
- 382 **Mark Agranovsky, Lavi Karp, and David Shoikhet, Editors**, Complex analysis and dynamical systems II, 2005
- 381 **David Evans, Jeffrey J. Holt, Chris Jones, Karen Klintworth, Brian Parshall, Olivier Pfister, and Harold N. Ward, Editors**, Coding theory and quantum computing, 2005
- 380 **Andreas Blass and Yi Zhang, Editors**, Logic and its applications, 2005
- 379 **Dominic P. Clemence and Guoqing Tang, Editors**, Mathematical studies in nonlinear wave propagation, 2005
- 378 **Alexandre V. Borovik, Editor**, Groups, languages, algorithms, 2005
- 377 **G. L. Litvinov and V. P. Maslov, Editors**, Idempotent mathematics and mathematical physics, 2005
- 376 **José A. de la Peña, Ernesto Vallejo, and Natig Atakishiyev, Editors**, Algebraic structures and their representations, 2005
- 375 **Joseph Lipman, Suresh Nayak, and Pramathanath Sastry**, Variance and duality for cousin complexes on formal schemes, 2005
- 374 **Alexander Barvinok, Matthias Beck, Christian Haase, Bruce Reznick, and Volkmar Welker, Editors**, Integer points in polyhedra—geometry, number theory, algebra, optimization, 2005
- 373 **O. Costin, M. D. Kruskal, and A. Macintyre, Editors**, Analyzable functions and applications, 2005
- 372 **José Burillo, Sean Cleary, Murray Elder, Jennifer Taback, and Enric Ventura, Editors**, Geometric methods in group theory, 2005
- 371 **Gui-Qiang Chen, George Gasper, and Joseph Jerome, Editors**, Nonlinear partial differential equations and related analysis, 2005
- 370 **Pietro Poggi-Corradini, Editor**, The p -harmonic equation and recent advances in analysis, 2005
- 369 **Jaime Gutierrez, Vladimir Shpilrain, and Jie-Tai Yu, Editors**, Affine algebraic geometry, 2005

TITLES IN THIS SERIES

- 368 **Sagun Chanillo, Paulo D. Cordaro, Nicholas Hanges, Jorge Hounie, and Abdelhamid Meziani, Editors**, Geometric analysis of PDE and several complex variables, 2005
- 367 **Shu-Cheng Chang, Bennett Chow, Sun-Chin Chu, and Chang-Shou Lin, Editors**, Geometric evolution equations, 2005
- 366 **Bernhelm Booß-Bavnbek, Gerd Grubb, and Krzysztof P. Wojciechowski, Editors**, Spectral geometry of manifolds with boundary and decomposition of manifolds, 2005
- 365 **Robert S. Doran and Richard V. Kadison, Editors**, Operator algebras, quantization, and non-commutative geometry, 2004
- 364 **Mark Agranovsky, Lavi Karp, David Shoikhet, and Lawrence Zalcman, Editors**, Complex analysis and dynamical systems, 2004
- 363 **Anthony To-Ming Lau and Volker Runde, Editors**, Banach algebras and their applications, 2004
- 362 **Carlos Concha, Raul Manasevich, Gunther Uhlmann, and Michael S. Vogelius, Editors**, Partial differential equations and inverse problems, 2004
- 361 **Ali Enayat and Roman Kossak, Editors**, Nonstandard models of arithmetic and set theory, 2004
- 360 **Alexei G. Myasnikov and Vladimir Shpilrain, Editors**, Group theory, statistics, and cryptography, 2004
- 359 **S. Dostoglou and P. Ehrlich, Editors**, Advances in differential geometry and general relativity, 2004
- 358 **David Burns, Christian Popescu, Jonathan Sands, and David Solomon, Editors**, Stark's Conjectures: Recent work and new directions, 2004
- 357 **John Neuberger, Editor**, Variational methods: open problems, recent progress, and numerical algorithms, 2004
- 356 **Idris Assani, Editor**, Chapel Hill ergodic theory workshops, 2004
- 355 **William Abikoff and Andrew Haas, Editors**, In the tradition of Ahlfors and Bers, III, 2004
- 354 **Terence Gaffney and Maria Aparecida Soares Ruas, Editors**, Real and complex singularities, 2004
- 353 **M. C. Carvalho and J. F. Rodrigues, Editors**, Recent advances in the theory and applications of mass transport, 2004
- 352 **Marek Kubale, Editor**, Graph colorings, 2004
- 351 **George Yin and Qing Zhang, Editors**, Mathematics of finance, 2004
- 350 **Abbas Bahri, Sergiu Klainerman, and Michael Vogelius, Editors**, Noncompact problems at the intersection of geometry, analysis, and topology, 2004
- 349 **Alexandre V. Borovik and Alexei G. Myasnikov, Editors**, Computational and experimental group theory, 2004
- 348 **Hiroshi Isozaki, Editor**, Inverse problems and spectral theory, 2004
- 347 **Motoko Kotani, Tomoyuki Shirai, and Toshikazu Sunada, Editors**, Discrete geometric analysis, 2004
- 346 **Paul Goerss and Stewart Priddy, Editors**, Homotopy theory: Relations with algebraic geometry, group cohomology, and algebraic K -theory, 2004
- 345 **Christopher Heil, Palle E. T. Jorgensen, and David R. Larson, Editors**, Wavelets, frames and operator theory, 2004

For a complete list of titles in this series, visit the
AMS Bookstore at www.ams.org/bookstore/.

The University of Virginia (Charlottesville) hosted an international conference on Infinite-dimensional Aspects of Representation Theory and Applications. This volume contains papers resulting from the mini-courses and talks given at the meeting.

Beyond the techniques and ideas related to representation theory, the book demonstrates connections to number theory, algebraic geometry, and mathematical physics. Specific topics covered include Hecke algebras, quantum groups, infinite-dimensional Lie algebras, quivers, modular representations, and Gromov-Witten invariants.

The book is suitable for graduate students and researchers interested in representation theory.

ISBN 0-8218-3701-X



9 780821 837016

CONM/392

AMS *on the Web*
www.ams.org