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Preface

Representation theory has played a central role in mathematics through its rich interplay with, and applications to, many other fields. The 2004 **AMS-IMS-SIAM Joint Summer Research Conference**, *Representations of Algebraic Groups, Quantum Groups, and Lie Algebras*, focused on the geometric and combinatorial aspects of the subject. New developments involving quiver representations were presented in connection with important constructions for quantum groups. Another major theme was use of methods from algebraic geometry, via derived categories, to study the representation theory of algebraic groups and Lie algebras, including Kac-Moody Lie algebras, modular restricted Lie algebras (or, more generally, finite group schemes), and Lie superalgebras.

Each morning session featured principal speakers on the designated major themes. Each afternoon, two parallel sessions allowed attendees to present talks on current research, providing a forum for junior mathematicians to communicate new developments in the area, followed by ample time for informal discussions and interaction.

The present volume brings together papers from the principal speakers and other participants on a wide variety of topics in modern representation theory. Several contributions are surveys that aim to introduce the topics to a wider audience of researchers. All of the papers were carefully refereed, and the editors express their gratitude to the anonymous referees for the high standards employed in preparing their reports.

During the conference, a banquet was held to celebrate the achievements of James E. Humphreys on the occasion of his 65th birthday. Over the last 40 years, Jim's contributions have inspired many deep insights and new developments in the representations of algebraic groups and finite groups of Lie type. In addition, his well-known books in the area have brought vast, intertwined research topics together in a concise and coherent manner. Jim has also encouraged many of us by taking a genuine interest in our work. Several months before the conference, he formally retired from the University of Massachusetts, Amherst, to devote himself to research and to book writing. We are delighted to include here one of his recent articles, which poses an interesting conjecture relating irreducible representations of semisimple Lie algebras in positive characteristics to left cells in affine Weyl groups.

Financial support for the conference was provided by a grant from the National Science Foundation, and the staff of the American Mathematical Society provided considerable logistical support. In particular, the organizers acknowledge Wayne Drady for his professional dedication to managing the conference and Christine M. Thivierge for her patience and help in editing this volume. We also thank the participants for making the conference a success: the speakers during the conference

and at the banquet and the afternoon session chairs for their work in keeping the conference on schedule. Special thanks go to Leonard Scott, whose toastmastership during the banquet provided many humorous and wonderful memories.

Georgia Benkart
Jens C. Jantzen
Zongzhu Lin
Daniel K. Nakano
Brian J. Parshall
January 2006

List of Talks

Talks by Principal Speakers

- Henning H. Andersen,
Cohomology of line bundles
- Jie Du,
Strong monomial basis property and canonical basis for a cyclic quiver
- Eric M. Friedlander,
 π -points for finite group schemes
- Seok-Jin Kang,
Crystal bases for quantum affine algebras and combinatorics of Young walls
- Alexander Kleshchev,
On the structure of finite W -algebras of type A
- Ivan Mirković,
Beilinson-Bernstein localization for quantum groups at roots of unity
- Hiraku Nakajima,
Instanton counting
- Alexander Premet,
Minimal nilpotent representations, quantizations of Slodowy slices, and the Joseph ideal
- Eric Vasserot,
Representations of double affine Hecke algebras
- Jie Xiao,
Representations of tame quivers and affine canonical bases

Contributed Talks

- Susumu Ariki,
Representation type of Hecke algebras and the Poincare polynomial
- Christopher P. Bendel,
Cohomology for Frobenius kernels
- Brian D. Boe,
Varieties of nilpotent matrixes for simple Lie algebras: Restricted null-cones and support varieties
- Jon F. Carlson,
Endotrivial modules for finite groups of Lie type
- Joseph Chuang,
Derived equivalence between blocks of $GL(n)$
- Stephen Doty,
Generators and relations for generalized q -Schur algebras

- David J. Hemmer,
Fixed point functors for symmetric groups and Schur algebras
- Terrell L. Hodge,
Nilpotent orbits in restricted symmetric spaces
- James E. Humphreys,
Representations of reduced enveloping algebras and cells in the affine Weyl group
- Dijana Jakelic,
Crystal and tensor products in category \mathcal{O}
- Joel Kamnitzer,
Mirković-Vilonen cycles and polytopes
- Masaharu Kaneda,
Localization of D -modules in positive characteristic
- Gizem Karaali,
How to construct an r -matrix on a Lie superalgebra
- Sergei Krutelevich,
Exceptional groups, Jordan algebras, and higher composition laws
- Jonathan Kujawa,
Crystal structures arising from representations of $GL(m|n)$
- Yiqiang Li,
Affine quivers of type \hat{A}_n and canonical bases
- George J. McNinch,
Optimal $SL(2)$ -homomorphisms
- Kailash C. Misra,
Affine Lie algebra representations and multisum identities of Rogers-Ramanujan type
- Toshiki Nakashima,
Geometric crystals and crystal bases
- Alison Parker,
Higher extensions for $SL_2(k)$
- Aaron Phillips,
On 2-modular representations of the symmetric groups
- Cornelius Pillen,
Extensions for finite groups of Lie type and the truncated induction functor
- Eric C. Rowell,
Towards a classification of modular tensor categories
- Travis Schedler,
Quantization of necklace Lie algebras
- Toshiyuki Tanisaki,
The Beilinson-correspondence for quantized enveloping algebras
- Monica Vazirani,
Vanishing integrals of Macdonald polynomials
- Weiqiang Wang,
A super duality and Kazhdan-Lusztig polynomials

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