The Arcata Conference on Representations of Finite Groups

Volume 47 - Part 2

PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS

AMERICAN MATHEMATICAL SOCIETY

PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS Volume 47, Part 2

The Arcata Conference on Representations of Finite Groups

Paul Fong, Editor

American Mathematical Society Providence, Rhode Island

PROCEEDINGS OF THE SUMMER RESEARCH INSTITUTE ON REPRESENTATIONS OF FINITE GROUPS HELD AT HUMBOLDT STATE UNIVERSITY ARCATA, CALIFORNIA JULY 7-25, 1986

with support from the National Science Foundation, Grant DMS-8512866

1980 Mathematics Subject Classification (1985 Revision). Primary 20C15, 20C20, 20G05, 20G40; Secondary 20C05, 20C30, 20G10.

Library of Congress Cataloging-in-Publication Data

Arcata Conference on Representations of Finite Groups
(1986: Humboldt State University)
The Arcata Conference on Representations of Finite Groups.
(Proceedings of symposia in pure mathematics; v. 47)
1. Representations of groups-Congresses. 2. Finite groups-Congresses.
I. Fong, Paul, 1933- II. Title. III. Series.
QA171.A73 1986 512'.2 87-19348
ISBN 0-8218-1479-6 (set) (alk. paper)
ISBN 0-8218-1477-x (Part 1)
ISBN 0-8218-1478-8 (Part 2)

COPYING AND REPRINTING. Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication (including abstracts) is permitted only under license from the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

The appearance of the code on the first page of an article in this book indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law, provided that the fee of \$1.00 plus \$.25 per page for each copy be paid directly to the Copyright Clearance Center, Inc., 21 Congress Street, Salem, Massachusetts 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

 Copyright © 1987 by the American Mathematical Society. All rights reserved. Printed in the United States of America.
 The American Mathematical Society retains all rights except those granted to the United States Government.
 The paper used in this book is acid-free and falls within the guidelines established to ensure permanence and durability. 😒

Table of Contents

PART 1	
Preface	xi
I. Expository Papers	
Cohomology is representation theory	
J. L. Alperin	3
Families of irreducible characters of Weyl groups	
Dean Alvis	13
Modular representations of algebraic groups	
HENNING HAAHR ANDERSEN	23
Varieties for modules	
JON F. CARLSON	37
Irreducible characters of finite groups of Lie type	
R. W. CARTER	45
The Hecke algebra of a finite Coxeter group	
CHARLES W. CURTIS	51
Shintani descent and $\mathcal L$ functions on Deligne-Lusztig varieties	
François Digne	61
Good filtrations of rational modules for reductive groups	
S. Donkin	69
Problems in representation theory arising from Galois modules	
A. FRÖHLICH	81
Holonomic \mathcal{D} -modules in representation theory	
Ryoshi Hotta	87
Characters of solvable groups	
I. M. ISAACS	103
The representation theory of the symmetric groups	
GORDON JAMES	111
Representations of Chevalley groups in their own characteristic	
J. C. JANTZEN	127
Shintani lifting and Gelfand-Graev representations	
NORIAKI KAWANAKA	147
Introduction to character sheaves	
GEORGE LUSZTIG	165
Finite groups and modular functions	
GEOFFREY MASON	181

Representation theory and translation planes	
GEOFFREY MASON	211
Modular representation theory and the classification of finite simple groups	
GERHARD O. MICHLER	223
Cohomology of algebraic groups	
BRIAN J. PARSHALL	233
Double cosets and modular representation theory	
GEOFFREY R. ROBINSON	249
Recent progress on the isomorphism problem	
LEONARD L. SCOTT	259
Representations and maximal subgroups	
GARY M. SEITZ	275
Green functions of reductive groups over a finite field	
Toshiaki Shoji	289
Constructing representations from group geometries	
Stephen D. Smith	303
Perverse sheaves and representation theory	
T. A. Springer	315
Toward Lusztig's classification of characters	
Bhama Srinivasan	323
Tensor product theorems	
ROBERT STEINBERG	331
Coding theory and representation theory	
HAROLD N. WARD	339
Subgroup complexes	
P. J. WEBB	349
II. Block Theory and Modular Representations	
Weights for finite groups	
J. L. ALPERIN	369
Some remarks on the decomposition numbers for the symmetric groups	
DAVE BENSON	381
On block induction	
HARVEY I. BLAU	395
Products and projective resolutions	
JON F. CARLSON	399
Extending self-dual modules	
CLAUDE CIBILS	409
Order-theoretic properties of the center of a block	
G. H. CLIFF, W. PLESKEN, AND A. WEISS	413
Real 2-blocks of S_n , A_n and their double covers	
R. Gow	421

iv

Hypercohomology varieties for complexes of modules, the realizability cri-	
terion, and equivalent formulations of a conjecture of Carlsson	
NATHAN HABEGGER	431
Blocks of projective representations of the symmetric groups	
JOHN F. HUMPHREYS	439
A condition for the existence of p -blocks of defect 0	
Zhang Ji-ping	443
The Loewy structure of projective indecomposable modules for some	
modular group algebras	
Shigeo Koshitani	447
The λ -structure of the Green rings of cyclic <i>p</i> -groups	
FRANK M. KOUWENHOVEN	451
On the cohomology of <i>p</i> -constrained groups	
P. A. LINNELL AND U. STAMMBACH	467
Block invariants in A_n , \hat{A}_n , and \hat{S}_n	
Jørn B. Olsson	471
On the Loewy structure of the modular group-algebra over a group of small	
p-length	
Reiner Staszewski	475
Blocks of defect zero and degree problems	
W. WILLEMS	481
Degrees of Brauer characters in p -solvable groups	
THOMAS R. WOLF	485

PART II

III. Characters and Representations

On products of conjugacy classes and irreducible characters in finite groups	
Zvi Arad	3
On products of irreducible characters and conjugacy classes of finite groups	
in complementary sets	
Zvi Arad and Elsa Fisman	11
Monomial representations and generalizations	
Christine Bessenrodt	25
Characters, nonnegative matrices, and generalized circulants	
DAVID CHILLAG	33
Character restriction and the existence of relative normal complements in	
finite groups	
PAMELA A. FERGUSON	41
Primes dividing character degrees and character orbit sizes	
DAVID GLUCK	45
Degree problems over Q	
BERTRAM HUPPERT	47

Characters and Hall subgroups of solvable groups	
I. M. ISAACS	51
On the Brauer-Suzuki theorem	
HENRY S. LEONARD	57
Arithmetical conditions on character degrees and group structure	
OLAF MANZ	65
Noncommutators and the number of projective characters of a finite group	
WILLIAM F. REYNOLDS	71
Clifford theory of simple modules	
Peter Schmid	75
Fully ramified characters	
Shahriar shahriari	83
Character degrees of finite <i>p</i> -groups	
MICHAEL C. SLATTERY	89
The Schur indices of quasiprimitive characters	
A. TURULL	93
IV. Finite Groups of Lie Type	
Twisting operators on the space of class functions of finite special linear	
groups	
Teruaki Asai	99
Simulating algebraic geometry with algebra, III: The Lusztig conjecture as	
a TG_1 -problem	
ED CLINE	149
Composition factors of induced modules for algebraic groups and their	

Frobenius subgroups	
Stephen Doty	163
A Hopf algebra associated to the cohomology of the symmetric groups	
JEANNE DUFLOT	171
Cohomology of irreducible modules with large weights	
ERIC M. FRIEDLANDER	187
On the generic cohomology	
WANG JIANPAN	195
On the symmetry of inverse Kazhdan-Lusztig polynomials for affine Weyl	
groups	
Masaharu Kaneda	201
Some representations of special linear groups	
L. G. KOVÁCS	207
On hyperoctahedral hyperplane complements	
G. I. LEHRER	219
Leading coefficients of character values of Hecke algebras	
G. LUSZTIG	235

vi

Simulating algebraic geometry with algebra, II: Stratifying representation	
Categories Brian I Parshall	263
Simulating algebraic geometry with algebra, I: The algebraic theory of derived categories	200
LEONARD L. SCOTT	271
Blocks and Brauer trees for groups of type $G_2(q)$ JOSEPHINE SHAMASH	283
Shintani descent for exceptional groups over a finite field TOSHIAKI SHOJI	297
Geometrical Gel'fand models, tensor quotients, and Weil representations JORGE SOTO-ANDRADE	305
The values of irreducible characters of the symmetric group MICHIO SUZUKI	317
The characters of $G_2(2^n)$ and its subgroups HIROMICHI YAMADA	321
V. Related topics	
On the representations of the Weyl groups of type D corresponding to the zero weights of the representations of $SO(2n - C)$	
SUSUMU ARIKI	327
The study of distance-regular graphs from the algebraic (i.e., character theoretical) viewpoint	
EIICHI BANNAI AND TATSURO ITO	343
Raising and lowering operators for \mathfrak{sl}_n , with applications to orthogonal bases of \mathfrak{sl}_n -modules	
R. W. CARTER	351
On finite simple subgroups of the complex Lie group of type E_8 ARJEY COHEN AND ROBERT GRIESS	367
Symmetric powers of cyclic sets and the definition of A. Weil's zeta-functions ANDREAS W. M. DRESS AND CHRISTIAN SIEBENEICHER	407
The geometry of homogeneous extension categories K. W. GRUENBERG AND K. W. ROGGENKAMP	413
On self-normalizing cyclic subgroups ZHANG GUANGXIANG	419
On the order of a projective plane and planes with a totally irregular collineation group	
CHAT YIN HO	423
Permanents, immanants, and determinants GORDON JAMES	431
Young-diagrammatic methods for the representation theory of the groups Sp and SO	
KAZUHIKO KOIKE AND ITARU TERADE	437

vii

On maximal subgroups and maximal factorizations of almost simple groups	
MARTIN W. LIEBECK, CHERYL E. PRAEGER, AND JAN SAXL	449
The local maximal subgroups of the finite simple groups	
MARTIN W. LIEBECK	455
On the generalized exponents of classical Lie groups	
JUN-ICHI MATSUZAWA	463
Automorphisms and isomorphisms of linear groups over skew fields	
HONGSHUO REN, ZHEXIAN WAN, AND XIAOLONG WU	473
Picard groups of integral group rings of nilpotent groups	
K. W. ROGGENKAMP	477
Maximal subgroups in classical groups over arbitrary fields	
Li Shangzhi	487
Applications of explicit Brauer induction	
VICTOR SNAITH	495
A characterization of $PSU(3, 4)$	
RONALD SOLOMON	533
Highest weight vectors associated to some branchings	
TAKESHI TOKUYAMA	541
Eigenvalues connected to the radical of Brauer's centralizer algebras	
DAVID WALES	547

viii