

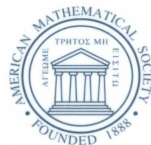
CONTEMPORARY MATHEMATICS

273

Abelian Groups, Rings and Modules

AGRAM 2000 Conference
July 9–15, 2000
Perth, Western Australia

A. V. Kelarev
R. Göbel
K. M. Rangaswamy
P. Schultz
C. Vinsonhaler
Editors

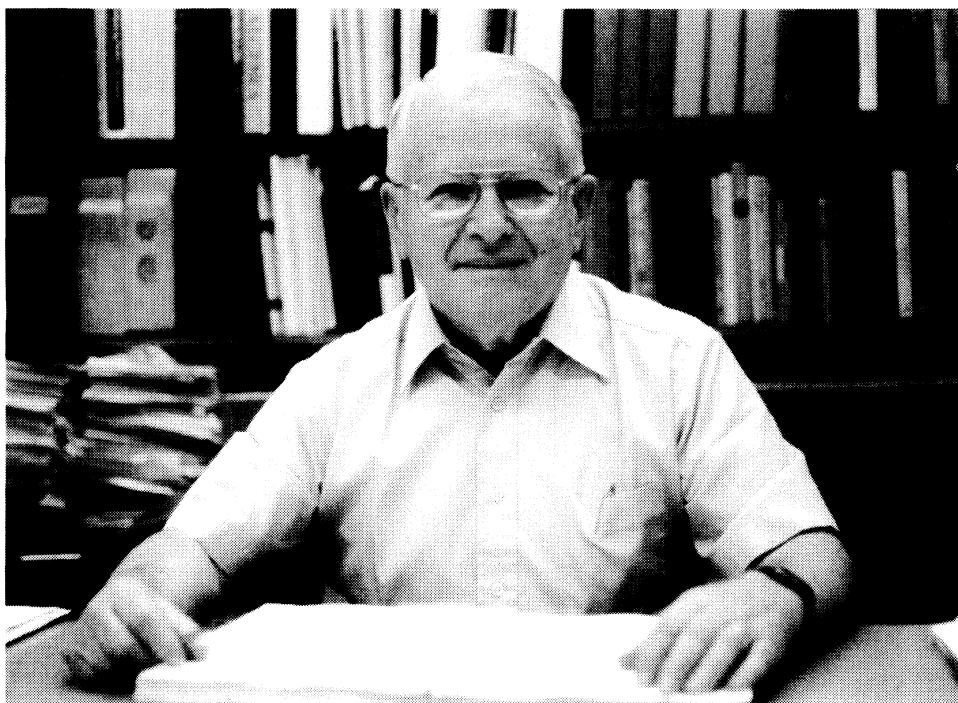


Selected Titles in This Series

- 273 **A. V. Kelarev, R. Göbel, K. M. Rangaswamy, P. Schultz, and C. Vinsonhaler, Editors**, Abelian groups, rings and modules, 2001
- 272 **Eva Bayer-Fluckiger, David Lewis, and Andrew Ranicki, Editors**, Quadratic forms and their applications, 2000
- 271 **J. P. C. Greenlees, Robert R. Bruner, and Nicholas Kuhn, Editors**, Homotopy methods in algebraic topology, 2001
- 270 **Jan Denef, Leonard Lipschitz, Thanases Pheidas, and Jan Van Geel, Editors**, Hilbert's tenth problem: Relations with arithmetic and algebraic geometry, 2000
- 269 **Mikhail Lyubich, John W. Milnor, and Yair N. Minsky, Editors**, Laminations and foliations in geometry, topology and dynamics, 2001
- 268 **Robert Gulliver, Walter Littman, and Roberto Triggiani, Editors**, Differential geometric methods in the control of partial differential equations, 2000
- 267 **Nicolás Andruskiewitsch, Walter Ricardo Ferrer Santos, and Hans-Jürgen Schneider, Editors**, New trends in Hopf algebra theory, 2000
- 266 **Caroline Grant Melles and Ruth I. Michler, Editors**, Singularities in algebraic and analytic geometry, 2000
- 265 **Dominique Arlettaz and Kathryn Hess, Editors**, Une dégustation topologique: Homotopy theory in the Swiss Alps, 2000
- 264 **Kai Yuen Chan, Alexander A. Mikhalev, Man-Keung Siu, Jie-Tai Yu, and Efim I. Zelmanov, Editors**, Combinatorial and computational algebra, 2000
- 263 **Yan Guo, Editor**, Nonlinear wave equations, 2000
- 262 **Paul Igodt, Herbert Abels, Yves Félix, and Fritz Grunewald, Editors**, Crystallographic groups and their generalizations, 2000
- 261 **Gregory Budzban, Philip Feinsilver, and Arun Mukherjea, Editors**, Probability on algebraic structures, 2000
- 260 **Salvador Pérez-Esteve and Carlos Villegas-Blas, Editors**, First summer school in analysis and mathematical physics: Quantization, the Segal-Bargmann transform and semiclassical analysis, 2000
- 259 **D. V. Huynh, S. K. Jain, and S. R. López-Permouth, Editors**, Algebra and its applications, 2000
- 258 **Karsten Grove, Ib Henning Madsen, and Erik Kjær Pedersen, Editors**, Geometry and topology: Aarhus, 2000
- 257 **Peter A. Cholak, Steffen Lempp, Manuel Lerman, and Richard A. Shore, Editors**, Computability theory and its applications: Current trends and open problems, 2000
- 256 **Irwin Kra and Bernard Maskit, Editors**, In the tradition of Ahlfors and Bers: Proceedings of the first Ahlfors-Bers colloquium, 2000
- 255 **Jerry Bona, Katarzyna Saxton, and Ralph Saxton, Editors**, Nonlinear PDE's, dynamics and continuum physics, 2000
- 254 **Mourad E. H. Ismail and Dennis W. Stanton, Editors**, q -series from a contemporary perspective, 2000
- 253 **Charles N. Delzell and James J. Madden, Editors**, Real algebraic geometry and ordered structures, 2000
- 252 **Nathaniel Dean, Cassandra M. McZeal, and Pamela J. Williams, Editors**, African Americans in Mathematics II, 1999
- 251 **Eric L. Grinberg, Shiferaw Berhanu, Marvin I. Knopp, Gerardo A. Mendoza, and Eric Todd Quinto, Editors**, Analysis, geometry, number theory: The Mathematics of Leon Ehrenpreis, 2000

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

Abelian Groups, Rings and Modules



László Fuchs, November 2000

CONTEMPORARY MATHEMATICS

273

Abelian Groups, Rings and Modules

AGRAM 2000 Conference
July 9–15, 2000
Perth, Western Australia

A. V. Kelarev
R. Göbel
K. M. Rangaswamy
P. Schultz
C. Vinsonhaler
Editors



American Mathematical Society
Providence, Rhode Island

Editorial Board

Dennis DeTurck, managing editor

Andreas Blass Andy R. Magid Michael Vogelius

The Proceedings of the AGRAM 2000 Conference on Abelian Groups, Rings and Modules, held at the University of Western Australia, Perth, Western Australia, July 9–15, 2000.

2000 *Mathematics Subject Classification*. Primary 05Axx, 06Bxx, 06Fxx, 13Cxx, 15–XX, 16–XX, 20Kxx, 20Exx.

Library of Congress Cataloging-in-Publication Data

AGRAM 2000 Conference (2000 : Perth, Western Australia)

Abelian groups, rings, and modules : AGRAM 2000 Conference July 9–15, 2000, Perth, Western Australia / A. V. Kelarev . . . [et. al.], editors.

p. cm. — (Contemporary mathematics, ISSN 0271-4132 ; 273)

Includes bibliographical references.

ISBN 0-8218-2751-0 (alk. paper)

1. Abelian groups—Congresses. I. Kelarev, A. V. (Andrei V.) II. Contemporary mathematics (American Mathematical Society) ; v. 273.

QA251.3 .A35 2000
512'.2—dc21

2001016047

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 Assistant to the Publisher, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940-6248. 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.)

© 2001 by the American Mathematical Society. All rights reserved.

The American Mathematical Society retains all rights
except those granted to the United States Government.
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 URL: <http://www.ams.org/>

10 9 8 7 6 5 4 3 2 1 06 05 04 03 02 01

Contents

Preface	ix
Conference Participants	xi

Part I. Introduction

László Fuchs and his “moddom” work L. SALCE	3
--	---

Part II. Survey Articles

Error-correcting codes as ideals in group rings A. V. KELAREV AND P. SOLÉ	11
Homomorphisms and duality for torsion-free modules B. OLBERDING	19
Generalizations of isomorphism in torsion-free abelian groups K. C. O’MEARA AND C. VINSONHALER	39
Automorphism groups of abelian groups P. SCHULTZ	51

Part III. Contributed Papers

Direct sum decompositions of torsion-free abelian groups of finite rank D. M. ARNOLD	65
The endomorphism ring of a bounded abelian p -group M. A. AVIÑÓ AND P. SCHULTZ	75
The Baer–Kaplansky theorem for almost completely decomposable groups E. BLAGOVESHCHENSKAYA, G. IVANOV, AND P. SCHULTZ	85
Maximal pure independent sets A. BLASS AND J. IRWIN	95
Characterization of the tori via density of the solution set of linear equations D. DIKRANJAN AND M. TKACHENKO	107

Quotient divisible mixed groups A. A. FOMIN	117
Stacked bases over h -local Prüfer domains L. FUCHS AND S. B. LEE	129
Groups with locally defined heights and products of \mathfrak{R}^* groups A. J. GIOVANNITTI	135
Reflexive subgroups of the Baer–Specker group and Martin’s axiom R. GÖBEL AND S. SHELAH	145
Σ -isotype subgroups of local k -groups P. HILL, C. MEGIBBEN, AND W. ULLERY	159
Character modules and endomorphism rings of modules over Artinian serial rings G. IVANOV	177
Topologically pure extensions P. LOTH	191
Rings having simple adjoint semigroup N. R. MCCONNELL AND T. STOKES	203
Invariants of global crq-groups A. MADER, L. G. NONGXA, AND M. A. OULD–BEDDI	209
On varieties of groups generated by wreath products of abelian groups V. H. MIKAELIAN	223
Existence of rigid indecomposable almost completely decomposable groups O. MUTZBAUER	239
C2-rings and the FGF-conjecture W. K. NICHOLSON AND M. F. YOUSIF	245
Lifting direct sum decompositions of bounded abelian p -groups B. L. OSOFSKY	253
On modules and submodules with finite projective dimension K. M. RANGASWAMY	261
On the torsion groups in cotorsion classes L. STRÜNGMANN AND S. L. WALLUTIS	269
Cotorsion theories induced by tilting and cotilting modules J. TRLIFAJ	285
Steadiness is tested by a single module J. ŽEMLIČKA	301

Preface

This volume contains the Proceedings of the AGRAM 2000 Conference on Abelian Groups, Rings and Modules held at The University of Western Australia, in Perth, Australia from July 9 to July 15, 2000. In addition to talks presented at the Conference a few specially invited papers make up this volume.

AGRAM 2000 brought together 50 researchers and graduate students from 5 continents and 17 countries.

The AGRAM Conference was another link in a chain of meetings dealing with abelian groups, related structures and applications that have taken place in recent years in the United States, Italy, Germany, Curaçao and Ireland. The next link will be forged in 2001 in Honolulu, Hawaii.

These Proceedings are dedicated to Professor László Fuchs on the occasion of his 75th birthday, and are headed by a tribute and a review of his recent research by his long time collaborator Professor Luigi Salce.

Then follow four surveys in which experts in the field present recent results in active research areas:

- Error correcting codes as ideals in group rings
- Duality in module categories
- Automorphism groups of abelian groups
- Generalizations of isomorphism in torsion-free abelian groups.

The volume contains also 22 research articles in diverse areas connected with the themes of the conference, including various aspects of abelian groups and their endomorphism rings, modules over various rings, commutative and non-commutative ring theory, varieties of groups and topological aspects of algebra.

The papers in this volume have not been published before and underwent a rigorous refereeing procedure. The Editors wish to thank Professor Fuchs for his invaluable assistance in the production of this volume.

We would like to thank the Australian Mathematical Society for a generous grant and the Department of Mathematics and Statistics of The University of Western Australia for assistance in kind and for hosting the Conference. Phill Schultz did all of the organizational work single-handedly: he deserves the lion's share of the credit for the success of the conference.

Also, we would like to thank graduate students Sandra Maria Pereira and John Bamberg for their efforts to ensure the smooth administration of the Conference. Special thanks are due to Beth Schultz for many activities which made the Conference more enjoyable both for the participants and for their accompanying spouses.

Conference Participants

Dave Arnold	Baylor University	arnoldd@baylor.edu
Robert Bashir	Charles University	bashir@karlin.mff.cuni.cz
Kostia Beidar	Taiwan	beidar@mail.ncku.edu.tw
Howard Bell	Brock University	hbell@spartan.ac.brocku.ca
Dikran Dikranjan	University of Udine	dikranjan@dimi.uniud.it
Alberto Facchini	University of Padua	facchini@math.unipd.it
Laszlo Fuchs	Tulane University	fuchs@mailhost.tcs.tulane.edu
Tony Giovanitti	West Georgia State	agiovann@westga.edu
Ruediger Goebel	University of Essen	R.Goebel@uni-essen.de
Brendan Goldsmith	Dublin Institute of Technology	bgoldsmith@dit.ie
Vishal Goundar	University of the South Pacific	vi_go@excite.com
Ola Helenius	University of Goteburg	olahe@math.chalmers.se
George Ivanov	Macquarie University	ivanov@ics.mq.edu.au
Yasuo Iwanaga	Shinshu University	iwanaga@gipnc.shinshu-u.ac.jp
Ming-chang Kang	National Taiwan University	kang@math.ntu.edu.tw
Andrei Kelarev	University of Tasmania	kelarev@hilbert.maths.utas.edu.au
Toshiko Koyama	Tokyo	koyama@is.ocha.ac.jp
Fang Li	Zhejiang University	lifang3@sohu.com.cn
Peter Loth	Sacred Heart University	lothp@sacredheart.edu
Neil McConnell	Department of Defence	nickm@defcen.gov.au
Adolf Mader	University of Hawaii	adolf@math.hawaii.edu
Claudia Metelli	University of Naples	cmetelli@math.unipd.it
Ray Mines	New Mexico State University	ray@nmsu.edu
Bernhard Neumann	Australian National University	Bernhard.Neumann@wintermute.anu.edu.au
W. Keith Nicholson	University of Calgary	wmkeith@home.com
Loyiso Nongxa	University of the Western Cape	gnongxa@uwc.ac.za
Kevin O'Meara	University of Canterbury	K.OMeara@math.canterbury.ac.nz
Takashi Okuyama	Toba National College	okuyamat@toba-cmt.ac.jp
K. M. Rangaswamy	University of Colorado	ranga@math.uccs.edu
Phill Schultz	University of Western Australia	schultz@maths.uwa.edu.au
Mike Siddoway	Colorado College	MSiddoway@ColoradoCollege.edu
Tim Stokes	Murdoch University	stokes@prodigal.murdoch.edu.au
Alexander Stolin	University of Goteborg	astolin@math.chalmers.se
Lutz Struengmann	Hebrew University	lutz@math.huji.ac.il
Jan Trlifaj	Charles University	trlifaj@karlin.mff.cuni.cz
Chuck Vinsonhaler	University of Connecticut	vinson@math.uconn.edu
Carol Walker	New Mexico State University	hardy@NMSU.Edu
Elbert Walker	New Mexico State University	elbert@nmsu.edu
Simone Wallutis	University of Essen	simone.wallutis@uni-essen.de
Tsai-Lien Wong	Kaohsiung	tlwong@ibm7.math.nsysu.edu.tw
Paolo Zanardo	University of Padua	pzanardo@math.unipd.it
Jan Zemlicka	Charles University	zemlicka@karlin.mff.cuni.cz

Abelian Groups, Rings and Modules

A. V. Kelarev, R. Göbel, K. M. Rangaswamy, P. Schultz, and
C. Vinsonhaler, Editors

This volume presents the proceedings from the conference on Abelian Groups, Rings, and Modules (AGRAM) held at the University of Western Australia (Perth). Included are articles based on talks given at the conference, as well as a few specially invited papers. The proceedings are dedicated to Professor László Fuchs. The book includes a tribute and a review of his work by his long-time collaborator, Professor Luigi Salce.

Four surveys from leading experts follow Professor Salce's article. They present recent results from active research areas:

- Error correcting codes as ideals in group rings,
- Duality in module categories,
- Automorphism groups of abelian groups, and
- Generalizations of isomorphism in torsion-free abelian groups.

In addition to these surveys, the volume contains 22 research articles in diverse areas connected with the themes of the conference. The areas discussed include abelian groups and their endomorphism rings, modules over various rings, commutative and non-commutative ring theory, varieties of groups, and topological aspects of algebra. The book offers a comprehensive source for recent research in this active area of study.

ISBN 0-8218-2751-0



9 780821 827512

CONM/273

AMS on the Web
www.ams.org