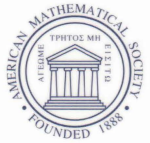
CONTEMPORARY MATHEMATICS

274

Groups of Homotopy Self-Equivalences and Related Topics

Proceedings of the Workshop on
Groups of Homotopy Self-Equivalences
and Related Topics
September 5–11, 1999
University of Milan, Gargnano, Italy

Ken-ichi Maruyama
John W. Rutter
Editors



American Mathematical Society

http://dx.doi.org/10.1090/conm/274

Selected Titles in This Series

274 **Ken-ichi Maruyama and John W. Rutter, Editors,** Groups of homotopy self-equivalences and related topics, 2001

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 dynamics, geometry and topology, 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-Esteva 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

(*Continued in the back of this publication*)

Groups of Homotopy Self-Equivalences and Related Topics

CONTEMPORARY MATHEMATICS

274

Groups of Homotopy Self-Equivalences and Related Topics

Proceedings of the Workshop on
Groups of Homotopy Self-Equivalences
and Related Topics
September 5–11, 1999
University of Milan, Gargnano, Italy

Ken-ichi Maruyama
John W. Rutter
Editors

American Mathematical Society
Providence, Rhode Island

Editorial Board

Dennis DeTurck, managing editor

Andreas Blass Andy R. Magid Michael Vogelius

This volume contains the proceedings of the Workshop on "Groups of Homotopy Self-Equivalences and Related Topics," which was held at the University of Milan, Gargnano, Italy, September 5–11, 1999. The conference was made possible by a grant from the National Institute for Advanced Mathematics "Francesco Severi" (INdAM).

2000 *Mathematics Subject Classification.* Primary 55P10, 55P15, 55P20, 55P35, 55P45, 55P60, 55P62, 55R05, 55R35.

Library of Congress Cataloging-in-Publication Data

Workshop on Groups of Homotopy Self-Equivalences and Related Topics (1999 : Università di Milano)

Groups of homotopy self-equivalences and related topics : proceedings of the Workshop on Groups of Homotopy Self-Equivalences and Related Topics, September 5–11, 1999, University of Milan, Gargnano, Italy / Ken-ichi Maruyama, John W. Rutter, editors.

p. cm.

ISBN 0-8218-2683-2 (alk. paper)

1. Homotopy equivalences—Congresses. I. Maruyama, Ken-ichi, 1954– II. Rutter, John W., 1935– III. Title.

QA612.72.W67 1999
514′.24—dc21 00-069977

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

Foreword ix

Homotopy self-equivalences 1988–1999
JOHN W. RUTTER 1

Bibliography on $\mathcal{E}(X)$ 1988–1999
JOHN W. RUTTER 13

Subgroups of the group of self-homotopy equivalences
MARTIN ARKOWITZ, GREGORY LUPTON, AND ANICETO MURILLO 21

The space of free loops on a real projective space
SVEN BAUER, MICHAEL CRABB, AND MAURO SPREAFICO 33

Indecomposable homotopy types with at most two non-trivial homology groups
HANS-JOACHIM BAUES AND YURI DROZD 39

Square rings associated to elements in homotopy groups of spheres
HANS-JOACHIM BAUES AND NORIO IWASE 57

Fibrations with product of Eilenberg-MacLane space fibres I
PETER I. BOOTH 79

Self homotopy equivalences of equivariant spheres
DAVIDE L. FERRARIO 105

Two examples to illustrate properties of the group of self-equivalences of a finite CW complex X
Y. FELIX 133

Nilpotency and localization of groups of fibre homotopy equivalences
A. GARVÍN, A. MURILLO, P. PAVEŠIĆ, AND A. VIRUEL 145

The homotopy groups of the homotopy fibre of an induced map of function spaces
K. A. HARDIE AND K. H. KAMPS 159

Fibrations, self homotopy equivalences and negative derivations
VOLKER HAUSCHILD 169

Classifying spaces and a subgroup of the exceptional Lie group G_2
KENSHI ISHIGURO 183

The structure of the Hurewicz homomorphism
DONALD KAHN AND CHRISTOPHER SCHWARTZ 195

Joins, diagonals and Hopf invariants
HOWARD J. MARCUM 203

A subgroup of self homotopy equivalences which is invariant on genus
KEN-ICHI MARUYAMA 225

Composition structure of the self-maps of $SU(3)$ or $Sp(2)$
KAORU MORISUGI 233

Self-homotopy of a suspension of the real 4-projective space
JUNO MUKAI 241

Phantom elements and its applications
JIANZHONG PAN AND MOO HA WOO 257

Homotopy equivalences of lens spaces of one-relator groups
JOHN W. RUTTER 269

Principal S^1-bundles and forgetful maps
H. SHIGA, K. TSUKIYAMA, AND T. YAMAGUCHI 293

Rational type of classifying spaces for fibrations
SAMUEL BRUCE SMITH 299

Problems on self-homotopy equivalences
MARTIN ARKOWITZ 309

Foreword

From September 5 to 11, 1999, a workshop on groups of homotopy self-equivalences and related topics was held at the Gargnano conference centre of the University of Milan, located in the town of Gargnano (Lake Garda). The workshop was attended by some 30 mathematicians from Canada, England, Germany, Italy, Japan, Korea, the Republic of South Africa, Singapore, Slovenia, Spain and the United States. This volume contains papers presented to the workshop. It contains two specially written articles—a review of work done in the area of homotopy self-equivalences since the Montreal conference of 1988, including a bibliography, and a list of problems.

The workshop was made possible by a grant from the National Institute for Advanced Mathematics "Francesco Severi" (INdAM). Thanks are due to Martin Arkowitz and Renzo Piccinini who were main organisers before and during the workshop.

Each research paper in this volume was carefully refereed and thanks are due to all who helped in this.

Ken-ichi Maruyama and John W. Rutter

Selected Titles in This Series

(*Continued from the front of this publication*)

250 **Robert H. Gilman, Editor,** Groups, languages and geometry, 1999

249 **Myung-Hwan Kim, John S. Hsia, Yoshiyuki Kitaoka, and Rainer Schulze-Pillot, Editors,** Integral quadratic forms and lattices, 1999

248 **Naihuan Jing and Kailash C. Misra, Editors,** Recent developments in quantum affine algebras and related topics, 1999

247 **Lawrence Wasson Baggett and David Royal Larson, Editors,** The functional and harmonic analysis of wavelets and frames, 1999

246 **Marcy Barge and Krystyna Kuperberg, Editors,** Geometry and topology in dynamics, 1999

245 **Michael D. Fried, Editor,** Applications of curves over finite fields, 1999

244 **Leovigildo Alonso Tarrío, Ana Jeremías López, and Joseph Lipman,** Studies in duality on noetherian formal schemes and non-noetherian ordinary schemes, 1999

243 **Tsit Yuan Lam and Andy R. Magid, Editors,** Algebra, K-theory, groups, and education, 1999

242 **Bernhelm Booss-Bavnbek and Krzysztof Wojciechowski, Editors,** Geometric aspects of partial differential equations, 1999

241 **Piotr Pragacz, Michał Szurek, and Jarosław Wiśniewski, Editors,** Algebraic geometry: Hirzebruch 70, 1999

240 **Angel Carocca, Víctor González-Aguilera, and Rubí E. Rodríguez, Editors,** Complex geometry of groups, 1999

239 **Jean-Pierre Meyer, Jack Morava, and W. Stephen Wilson, Editors,** Homotopy invariant algebraic structures, 1999

238 **Gui-Qiang Chen and Emmanuele DiBenedetto, Editors,** Nonlinear partial differential equations, 1999

237 **Thomas Branson, Editor,** Spectral problems in geometry and arithmetic, 1999

236 **Bruce C. Berndt and Fritz Gesztesy, Editors,** Continued fractions: From analytic number theory to constructive approximation, 1999

235 **Walter A. Carnielli and Itala M. L. D'Ottaviano, Editors,** Advances in contemporary logic and computer science, 1999

234 **Theodore P. Hill and Christian Houdré, Editors,** Advances in stochastic inequalities, 1999

233 **Hanna Nencka, Editor,** Low dimensional topology, 1999

232 **Krzysztof Jarosz, Editor,** Function spaces, 1999

231 **Michael Farber, Wolfgang Lück, and Shmuel Weinberger, Editors,** Tel Aviv topology conference: Rothenberg Festschrift, 1999

230 **Ezra Getzler and Mikhail Kapranov, Editors,** Higher category theory, 1998

229 **Edward L. Green and Birge Huisgen-Zimmermann, Editors,** Trends in the representation theory of finite dimensional algebras, 1998

228 **Liming Ge, Huaxin Lin, Zhong-Jin Ruan, Dianzhou Zhang, and Shuang Zhang, Editors,** Operator algebras and operator theory, 1999

227 **John McCleary, Editor,** Higher homotopy structures in topology and mathematical physics, 1999

226 **Luis A. Caffarelli and Mario Milman, Editors,** Monge Ampère equation: Applications to geometry and optimization, 1999

225 **Ronald C. Mullin and Gary L. Mullen, Editors,** Finite fields: Theory, applications, and algorithms, 1999

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

Groups of Homotopy Self-Equivalences and Related Topics

Ken-ichi Maruyama and John W. Rutter, Editors

This volume offers the proceedings from the workshop held at the Gargnano Institute of the University of Milan (Italy) on groups of homotopy self-equivalences and related topics. The book comprises articles of current research on the group of homotopy self-equivalences, the homotopy of function spaces, rational homotopy theory, the classification of homotopy types, and equivariant homotopy theory.

Mathematicians from many areas of the globe attended the workshops to discuss their research and to share ideas. Included are two specially-written articles, by J. W. Rutter, reviewing the work done in the area of homotopy self-equivalences since 1988. Included also is a bibliography of some 122 articles published since 1988 and a list of problems. This book is suitable for both advanced graduate students and researchers.

ISBN 0-8218-2683-2

9 780821 826836

CONM/274

AMS *on the* Web
www.ams.org