Alpine Perspectives on Algebraic Topology

Third Arolla Conference on Algebraic Topology
August 18–24, 2008
Arolla, Switzerland

Christian Ausoni
Kathryn Hess
Jérôme Scherer
Editors
Alpine Perspectives on Algebraic Topology
Alpine Perspectives on Algebraic Topology

Third Arolla Conference on Algebraic Topology
August 18–24, 2008
Arolla, Switzerland

Christian Ausoni
Kathryn Hess
Jérôme Scherer
Editors
Dedicated to Dominique Arlettaz, initiator of the Arolla Conference series.
## Contents

Preface ............................................. ix
List of Conference Talks .......................... xi
List of Participants ................................. xiii

*L-complete Hopf algebroids and their comodules*

A. Baker ........................................... 1

The lattice path operad and Hochschild cochains

M. A. Batanin and C. Berger ....................... 23

Open-closed field theories, string topology, and Hochschild homology

A. J. Blumberg, R. L. Cohen, and C. Teleman ........ 53

Cellular covers of divisible abelian groups

W. Chachólski, E. D. Farjoun, R. Göbel, and Y. Segev .... 77

Some geometric properties of the Witten genus

A. Dessai .......................................... 99

Localization and cellularization of principal fibrations

W. G. Dwyer and E. D. Farjoun ..................... 117

Operadic cobar constructions, cylinder objects and homotopy morphisms of algebras over operads

B. Fresse .......................................... 125

Involutions on the rational $K$-theory of group rings of finite groups

B. Jahren .......................................... 189

A quick trip through localization

J. A. Neisendorfer ................................ 203

Divided power structures and chain complexes

B. Richter .......................................... 237
Participants in the third Arolla Conference
Preface

Nine years after the first edition, the Third Arolla Conference on Algebraic Topology brought together around 80 mathematicians specialised in a broad range of topics in algebraic topology. Some of us have had the privilege to attend all three editions, and we felt almost at home up there in the Alps, at an altitude of 2000 meters. However, along with the more experienced and faithful participants, many PhD students and postdocs (altogether 30 younger mathematicians) attended the conference. This reveals the vigor of the subject, and is, hopefully, a good sign for the future of the Arolla conferences series!

These proceedings reflect the variety of topics discussed at the conference. Quite roughly, Monday and Tuesday were dedicated to geometry, unstable homotopy theory and operads, Wednesday to algebraic $K$-theory and traces, Thursday to Goodwillie calculus and its applications, and Friday to field theories and moduli spaces. Saturday then offered conference participants a bouquet of these topics.

We would like to thank the following institutions and organizations for their generous financial support and sponsorship of the Third Arolla Conference on Algebraic Topology:

- Swiss National Science Foundation
- Bonn International Graduate School, Hausdorff Center for Mathematics
- Ministerio de Educación y Ciencia de España
- Institute of Geometry, Algebra and Topology, EPFL, Lausanne
- Faculty of Basic Sciences, EPFL, Lausanne
- III-ème Cycle Romand de Mathématiques
- Swiss Mathematical Society

We would like to warmly thank the owners and personnel of the Hôtel Mont-Collon in Arolla. It is a pleasure to organize a conference with their help.

Our thanks also go to the speakers and to all the participants, to the contributors of the present volume, and of course to the anonymous referees; without them this volume would not exist. We also thank Chris Thivierge at the AMS for her help and guidance.

Finally J. Scherer would like to thank the MPI in Bonn and the IHES in Bures-sur-Yvette for their generous hospitality during the months where most of the editorial work on this volume has been done.

Christian Ausoni, Kathryn Hess and Jérôme Scherer
Pre-conference trek: Pigne d’Arolla (3’796m)
List of Conference Talks

Monday, August 18

Anand Dessai  
Some applications of elliptic genera to group actions and positive curvature

Tuesday, August 19

Natàlia Castellana  
Constructing maps between classifying spaces of p-local finite groups

Assaf Libman  
The Burnside ring of a saturated fusion system

Kasper Andersen  
The isogeny theorem for p-compact groups

Clemens Berger  
The lattice path operad

Benoît Fresse  
Koszul duality of the chain little cubes operads

Short communications

Jonathan Barmak  
Simple homotopy types and finite spaces

Simona Paoli  
Algebraic André-Quillen homology and higher categorical structures

My Ismail Mamouni  
Lower bounds on the cohomological dimension of elliptic spaces

Wednesday, August 20

Bjørn Ian Dundas  
Witt rings

Lars Hesselholt  
K-theory of the dual numbers

Christian Schlichtkrull  
Higher topological Hochschild homology of Thom spectra

Birgit Richter  
An involution on the K-theory of (some) bimonoidal categories

Holger Reich  
Algebraic K-theory of virtually cyclic groups
<table>
<thead>
<tr>
<th>Day</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, August 21</td>
<td>Tom Goodwillie</td>
<td>Functor calculus and pseudoisotopy spaces</td>
</tr>
<tr>
<td></td>
<td>Pascal Lambrechts</td>
<td>Rational homology of the space of smooth embeddings</td>
</tr>
<tr>
<td></td>
<td>Ismar Volić</td>
<td>Embedding calculus and Milnor invariants</td>
</tr>
<tr>
<td>Friday, August 22</td>
<td>Ralph Cohen</td>
<td>Field theories, string topology, and Hochschild homology</td>
</tr>
<tr>
<td></td>
<td>Nathalie Wahl</td>
<td>Homological conformal field theories</td>
</tr>
<tr>
<td></td>
<td>Søren Galatius</td>
<td>Spaces of graphs</td>
</tr>
<tr>
<td></td>
<td>Paolo Salvatore</td>
<td>The topological cyclic Deligne conjecture</td>
</tr>
<tr>
<td></td>
<td>Ulrike Tillmann</td>
<td>From braid to mapping class groups, configuration to moduli spaces</td>
</tr>
<tr>
<td>Saturday, August 23</td>
<td>Jean-Claude Hausmann</td>
<td>Conjugation spaces</td>
</tr>
<tr>
<td></td>
<td>Ian Hambleton</td>
<td>Equivariant CW-complexes and the orbit category</td>
</tr>
<tr>
<td></td>
<td>Jacob Lurie</td>
<td>Moduli problems for ring spectra</td>
</tr>
<tr>
<td></td>
<td>Wojciech Chachólski</td>
<td>How to enumerate Bousfield classes in derived categories of abelian categories?</td>
</tr>
<tr>
<td></td>
<td>Nick Kuhn</td>
<td>Towards calculating the unstable $v_n$-periodic homotopy groups of spheres</td>
</tr>
</tbody>
</table>
### List of Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilias Amrani</td>
<td>EPFL</td>
</tr>
<tr>
<td>Kasper Andersen</td>
<td>University of Aarhus</td>
</tr>
<tr>
<td>Christian Ausoni</td>
<td>University of Bonn</td>
</tr>
<tr>
<td>David Ayala</td>
<td>Stanford University</td>
</tr>
<tr>
<td>Andrew Baker</td>
<td>University of Glasgow</td>
</tr>
<tr>
<td>Noé Bárcenas Torres</td>
<td>University of Münster</td>
</tr>
<tr>
<td>Jonathan Barmak</td>
<td>University of Buenos Aires</td>
</tr>
<tr>
<td>Tilman Bauer</td>
<td>University of Münster</td>
</tr>
<tr>
<td>Clemens Berger</td>
<td>University of Nice-Sophia Antipolis</td>
</tr>
<tr>
<td>Alexander Berglund</td>
<td>University of Stockholm</td>
</tr>
<tr>
<td>Agnieszka Bojanska</td>
<td>University of Warsaw</td>
</tr>
<tr>
<td>Carles Broto</td>
<td>Autonomous University of Barcelona</td>
</tr>
<tr>
<td>Jan Brunner</td>
<td>EPFL</td>
</tr>
<tr>
<td>Martin Čadek</td>
<td>Masaryk University</td>
</tr>
<tr>
<td>Natàlia Castellana</td>
<td>Autonomous University of Barcelona</td>
</tr>
<tr>
<td>Wojciech Chachólski</td>
<td>KTH Stockholm</td>
</tr>
<tr>
<td>Lia Chechalshvili</td>
<td>Georgian Technical University</td>
</tr>
<tr>
<td>Francis Clarke</td>
<td>University of Wales Swansea</td>
</tr>
<tr>
<td>Ralph Cohen</td>
<td>Stanford University</td>
</tr>
<tr>
<td>Anand Dessai</td>
<td>University of Fribourg</td>
</tr>
<tr>
<td>Christopher Douglas</td>
<td>Stanford University</td>
</tr>
<tr>
<td>Bjørn Ian Dundas</td>
<td>University of Bergen</td>
</tr>
<tr>
<td>Bill Dwyer</td>
<td>University of Notre Dame</td>
</tr>
<tr>
<td>Chris Dwyer</td>
<td>SUNY Binghamton</td>
</tr>
<tr>
<td>Benoît Fresse</td>
<td>University of Lille</td>
</tr>
<tr>
<td>Søren Galatius</td>
<td>Clay Institute/Stanford University</td>
</tr>
<tr>
<td>Josh Genauer</td>
<td>Stanford University</td>
</tr>
<tr>
<td>Alex Gonzalez</td>
<td>Autonomous University of Barcelona</td>
</tr>
<tr>
<td>Thomas Goodwillie</td>
<td>Brown University</td>
</tr>
<tr>
<td>John Greenlees</td>
<td>University of Sheffield</td>
</tr>
</tbody>
</table>
Jesper Grodal
University of Copenhagen

Ian Hambleton
McMaster University

John Harper
University of Notre Dame/EPFL

Jean-Claude Hausmann
University of Geneva

André Henriques
Utrecht University

Kathryn Hess
EPFL

Lars Hesselholt
University of Nagoya

Stefan Jackowski
University of Warsaw

Bjørn Jahren
University of Oslo

Rick Jardine
University of Western Ontario

Michael Joachim
University of Münster

Brenda Johnson
Union College

Vladimir Kotov
Northwestern/St. Petersburg

Robin Koytcheff
Stanford University

Nick Kuhn
University of Virginia

Anssi Lahtinen
Stanford University

Pascal Lambrechts
University of Louvain-la-Neuve

Ran Levi
University of Aberdeen

Assaf Libman
University of Aberdeen

Jacob Lurie
AIM-MIT

Eric Malm
Stanford University

My Ismail Mamouni
University of Casablanca

Leonard Mdzinarishvili
Georgian Technical University

Nicolas Michel
EPFL

Dustin Mulcahey
CUNY

Daniel Müllner
University of Bonn

Théophile Naito
EPFL

Joseph Neisendorfer
University of Rochester

Bob Oliver
University of Paris XIII

Iver Ottosen
University of Aalborg

Simona Paoli
Macquarie University

Wolfgang Pitsch
Autonomous University of Barcelona

Dorette Pronk
Dalhousie University

Oscar Randal-Williams
University of Oxford

Holger Reich
University of Düsseldorf

Birgit Richter
University of Hamburg

Jirí Rosický
Masaryk University

Rustam Sadykov
Max Planck Institute - Bonn
Paolo Salvatore  
University of Rome Tor Vergata

Rubén Sánchez-García  
University of Düsseldorf

Jérôme Scherer  
Autonomous University of Barcelona

Christian Schlichtkrull  
University of Bergen

Nora Seeliger  
University of Aberdeen

Neil Strickland  
University of Sheffield

Henrik Strohmeyer  
University of Stockholm

Ulrike Tillmann  
University of Oxford

Mark Ullmann  
University of Düsseldorf

Ismar Volić  
Wellesley College

Nathalie Wahl  
University of Copenhagen

Sarah Whitehouse  
University of Sheffield

Hadi Zare  
University of Manchester
Titles in This Series

504 Christian Ausoni, Kathryn Hess, and Jérôme Scherer, Editors, Alpine perspectives on algebraic topology, 2009
503 Marcel de Jeu, Sergei Silvestrov, Christian Skau, and Jun Tomiyama, Editors, Operator structures and dynamical systems, 2009
502 Viviana Ene and Ezra Miller, Editors, Combinatorial Aspects of Commutative Algebra, 2009
501 Karel Dekimpe, Paul Igodt, and Alain Valette, Editors, Discrete groups and geometric structures, 2009
500 Philippe Briet, François Germinet, and Georgi Raikov, Editors, Spectral and scattering theory for quantum magnetic systems, 2009
499 Antonio Giambruno, César Polcino Milies, and Sudarshan K. Sehgal, Editors, Groups, rings and group rings, 2009
498 Nicolau C. Saldanha, Lawrence Conlon, Rémi Langevin, Takashi Tsuboi, and Pawel Walczak, Editors, Foliations, geometry and topology, 2009
497 Maarten Bergvelt, Gaywalee Yamskulna, and Wenhua Zhao, Editors, Vertext operator algebras and related areas, 2009
496 Daniel J. Bates, GianMario Besana, Sandra Di Rocco, and Charles W. Wampler, Editors, Interactions of classical and numerical algebraic geometry, 2009
495 G. L. Litvinov and S. N. Sergeev, Editors, Tropical and idempotent mathematics, 2009
494 Habib Ammari and Hyeonbae Kang, Editors, Imaging microstructures: Mathematical and computational challenges, 2009
493 Ricardo Baeza, Wai Kiu Chan, Detlev W. Hoffmann, and Rainer Schulze-Pillot, Editors, Quadratic Forms—Algebra, Arithmetic, and Geometry, 2009
492 Fernando Giraldez and Miguel A. Herrero, Editors, Mathematics, Developmental Biology and Tumour Growth, 2009
491 Carolyn S. Gordon, Juan Tirao, Jorge A. Vargas, and Joseph A. Wolf, Editors, New developments in Lie theory and geometry, 2009
490 Donald Babbitt, Vyjayanthi Chari, and Rita Fioresi, Editors, Symmetry in mathematics and physics, 2009
489 David Ginzburg, Erez Lapid, and David Soudry, Editors, Automorphic Forms and L-functions II. Local aspects, 2009
488 David Ginzburg, Erez Lapid, and David Soudry, Editors, Automorphic forms and L-functions I. Global aspects, 2009
487 Gilles Lachaud, Christophe Ritzenthaler, and Michael A. Tsfasman, Editors, Arithmetic, geometry, cryptography and coding theory, 2009
486 Frédéric Mynard and Elliott Pearl, Editors, Beyond topology, 2009
485 Idris Assani, Editor, Ergodic theory, 2009
484 Motoko Kotani, Hisashi Naito, and Tatsuya Tate, Editors, Spectral analysis in geometry and number theory, 2009
483 Vyacheslav Futorny, Victor Kac, Iryna Kashuba, and Efim Zelmanov, Editors, Algebras, representations and applications, 2009
482 Kazem Mahdavi and Deborah Koslover, Editors, Advances in quantum computation, 2009
481 Aydin Aytuna, Reinhold Meise, Tosun Terzioglu, and Dietmar Vogt, Editors, Functional analysis and complex analysis, 2009
479 Timothy Y. Chow and Daniel C. Isaksen, Editors, Communicating mathematics, 2008
478 Zongzhu Lin and Jianpan Wang, Editors, Representation theory, 2008
477 Ignacio Luengo, Editor, Recent Trends in Cryptography, 2008
For a complete list of titles in this series, visit the AMS Bookstore at www.ams.org/bookstore/.
This volume contains the proceedings of the Third Arolla Conference on Algebraic Topology, which took place in Arolla, Switzerland, on August 18–24, 2008.

This volume includes research papers on stable homotopy theory, the theory of operads, localization and algebraic K-theory, as well as survey papers on the Witten genus, on localization techniques and on string topology—offering a broad perspective of modern algebraic topology.