

Introductory Workshop: Algebraic Topology

January 27 - 31, 2014

MSRI, Berkeley, CA, USA

Organizers:

Teena Gerhardt (Michigan State University)

Jesper Grodal (University of Copenhagen)

Kathryn Hess (École Polytechnique Fédérale de Lausanne)

Michael Hill (University of Virginia)

1 Workshop Description

This workshop was one of the first events of the semester long program in Algebraic Topology at MSRI, the first such program in twenty-five years. Building on the Connections for Women Workshop in Algebraic Topology, held January 23-24, the Introductory Workshop provided a stable foundation, grounding the hot research topics and introducing researchers to some of the exciting developments in the field.

Algebraic topology blends algebraic and geometric methods, using each to inform and solve problems in the other. These connections of late have been fantastically successful, as tools and techniques from algebraic and algebraic geometry have been imported directly into algebraic topology, resulting in work that freely uses and applies deep results in algebra, number theory, and representation theory to better explain topological phenomena.

The workshop centered around talks given by experts in various branches of algebraic topology, more details of which are elaborated below. The focus of the talks was expository, introducing people, especially early-career researchers, to other areas in algebraic topology. Though focusing on background and techniques, the talks also described some of the ongoing avenues of research, helping people feel comfortable with the ideas and language used by the experts.

Over 170 mathematicians at all stages of their careers participated in the workshop, making it one of the largest held at MSRI. Reception was uniformly positive, and the talks provided the perfect balance of historical overview and cutting edge mathematics.

2 Introductory Lectures

We were extremely impressed with the quality and caliber of the introductory lectures. The focus was exactly right, allowing the audience to get a taste of the area and the problems with it.

In contrast to most workshops, topics were chosen for speakers, rather than by speakers. This worked quite well, although many speakers found it curious at first. Speakers were chosen because of their ability to give clear but broad-scoped lectures in their speciality, and the lecturers came from many career stages, allowing some younger mathematicians to showcase their areas.

The lectures were groups loosely thematically by day. Full videos of all of the talks and careful transcripts of the lectures are also available at <http://www.msri.org/workshops/685> We present here, however, a short summary of each talk. The goal of this is to stress the extreme care taken by the speakers to present talks with a clear, coherent story that explained the importance of the topic and how the topic fit into the broader topology framework.

Monday - Operads and algebras

Bill Dwyer (University of Notre Dame) - Introduction to operads

Operads have become to central way to describe algebraic structures “up to homotopy”. Dwyer gave a careful treatment, building up from well known examples of just monoids in sets to symmetric sequences and then operads. He spent time on examples, and then moved to duality in operads, the tensor product of operads, and then a large list of fundamental results in homotopy theory (many of which are quite recent) that needed operads in an essential way to solve. He finished with some similar results in algebra, closing with several very natural conjectures.

Michael Ching (University of Massachusetts, Amherst) -Goodwillie's calculus of functors

Goodwillie calculus is a way to decompose an arbitrary functor into a sequence of increasingly good "polynomial approximations" to that functor. Ching spent time describing exactly what we might mean by "polynomial" and "approximation". Much of the talk was spent discussing "linear functors", showing how the abstract formalism can be readily understood in this context. This then motivated the higher levels of Goodwillie's Taylor tower.

Brooke Shipley (University of Illinois at Chicago) -Morita theory in stable homotopy

Morita theory is the name used to describe a family of results about the equivalence of categories of modules over rings. The modern point-set notions of spectra allowed similarly questions to be stated in homotopy theory. Shipley began by discussing carefully the classical Morita theory, and then she moved into discussing derived Morita theory (in particular Morita theory over DGAs). The talk closed with recent discussions of spaces of equivalences, higher categorical versions, and the Brauer group.

Lars Hesselholt (Nagoya University) -MSRI/Evans Lecture: Topological cyclic homology

Hesselholt's lecture was also an MSRI/Evans lecture. As such, the focus was even more broad than a survey talk for an algebraic topology crowd. Hesselholt described several results and problems in algebraic K-theory, showing how basic questions in the algebraic K-theory of the integers are tied to deep and classical questions in number theory (for example, the Kummer-Vandiver conjecture). He also described the general homotopical approach to algebraic K-theory via topological cyclic homology.

Tuesday -K-theories and higher categories

John Rognes (University of Oslo)-Chromatic redshift

Rognes' redshift conjecture is one of the most important in the algebraic K-theory of structured ring spectra. Foundational work of Quillen showed that the algebraic K-theory functor takes height 0 information (in this case discrete rings) to height 1 information (built from topological K-theory). Rognes described the classical data supporting the conjecture and then described computations providing additional support. Rognes finished by exploring several future directions in this area.

Andrew Blumberg (University of Texas)-Higher categories and algebraic K-theory

Blumberg gave an introduction to the modern approaches and applications of algebraic K-theory. Starting with a very general mantra of "K-theory is a functor from the homotopical category of (certain) homotopical categories to spectra", he outlined several classical constructions (most notably Waldhausen's) of algebraic K-theory. He then moved into the natural question of how one could show that really the K-theory functor should depend only on the underlying homotopical category. He used this as a springboard to then talk about what algebraic K-theory does in a higher-categorical context, focusing on Waldhausen's Additivity Theorem, and then he moved into more recent work (Barwick, Blumberg-Gepner-Tabuada) exploring the universal formulations of algebraic K-theory.

Christopher Douglas (University of Oxford) -Towards explicit models for higher K-theories

Douglas spoke on a long-term project seeking to build geometric cycles for some of the chromatically higher height versions of K-theory described by Hopkins and Miller. He began by describing the various approaches to the height 1 case, topological K-theory. A careful retelling of the Fredholm operator approach allowed him to transition into higher versions of quantum field theories, out of which he described their conjectural model.

Julie Bergner (University of California Riverside)-Models for homotopical higher categories

Bergner gave a detailed introduction to the very active field of higher categories. Motivating everything with bordism categories (important in the Baez-Dolan Conjecture, solved recently by Lurie), Bergner described exactly what subtleties arise in the higher contexts and how they are solved. Bergner then described Rezk's model structure on θ_n -spaces and how this is a model for (∞, n) -categories.

Wednesday -Computations

Mark Behrens (Massachusetts Institute of Technology) -Computations in the stable homotopy groups of spheres

The determination of the homotopy groups of spheres is a central and fundamental problem in algebraic topology with deep implications in fields outside of the area. Behrens spoke about the major approaches to computing the homotopy groups of spheres, starting with foundational work of Serre and then moving into the more modern techniques pioneered by Adams, Mahowald, and Miller-Ravenel-Wilson. He closed with a collection of important open problems in the area, describing them in the context of prior work and exploring their importance.

Daniel Isaksen (Wayne State University) -Computations in motivic homotopy theory

Motivic homotopy exploded onto the scene with Voevodsky's proof of the Milnor conjecture. Computations in this area blend algebraic geometry and classical stable homotopy techniques, and few are known. Isaksen presented a summary of ways one can approach the computation of the (bi-graded) motivic homotopy groups of spheres and explained how these can give new insight into the classical picture described by Behrens. He then explored some purely motivic implications, looking at recent computations with Guillou on the homotopy of the " η -inverted sphere", an object with no classical analogue.

Craig Westerland (University of Minnesota Twin Cities) -Views on the J-homomorphism

The J-homomorphism is a fantastic tool to build elements in the homotopy groups of spheres. Westerland described a modern take on the classical construction of the J-homomorphism, and then moved into analogues of the J-homomorphism for higher chromatic heights.

Thursday -Groups and homotopy

Bob Oliver (Universit e de Paris XIII)-Local structure of groups and their classifying spaces

Oliver spoke on how much of the classifying space of a Lie group is determined by the collection of finite subgroups therein. This data is described as " p -local structure" for a finite group. Oliver stated some beautiful results about the structure of algebraic groups in general, then indicated how such things are proved using homotopy theoretic methods. He described "fusion systems", a way to abstract the data that a p -Sylow subgroup of a finite group G , and recast several classical results in

this language. He finished describing the compact Lie analogue.

Michael Hopkins (Harvard University) -Equivariant homotopy and localization

Hopkins gave an extremely gentle introduction to equivariant stable homotopy theory. Building on classical results from geometry, he introduced some of the basic problems in equivariant homotopy theory. He then walked the audience through how the standard techniques for stabilization in ordinary homotopy are insufficient to describe the kinds of things we want (like Poincaré duality). This is a subtle point that was made quite clear. He moved from there to computing the 0th equivariant stable homotopy group of spheres, reproving in a concise way a result of Segal and tom Dieck. He then closed with several important connections to other problems, highlighting how the basic issues that arose with stabilization are endemic to the subject and how an understanding of them in this basic example helps build intuition.

Nitya Kitchloo (Johns Hopkins University) -Homotopy theory of Kac-Moody groups

Kac-Moody groups are a well-studied generalization of compact Lie groups. Kitchloo described how a homotopy theorist can understand these objects and work with them. He began by carefully reminding people of the classical cases of a compact Lie group, and then he moved into an illuminating example of a more general form of a Weyl group acting on a maximal torus. Out of this, he described a way to build a topological group with the desired properties, and he determined the basic invariants like its homology and cohomology. The talk was extremely concrete: he focused on an individual special case in some detail, indicating then how everything he did in this case generalizes essentially without change in higher cases.

Tyler Lawson (University of Minnesota Twin Cities) -Topological automorphic forms

Lawson gave an introduction to the recently developed area of “topological automorphic forms”, a generalization of the Goerss-Hopkins-Miller theory of “topological modular forms”. The focus was predominantly on the classical results of Quillen’s which tie algebraic topology and algebraic geometry together via formal groups. Lawson showed some fundamental examples including curves and K-theory, then he moved into higher height theories. He underscored the computational importance of families of examples rather than of simply having a single example, stressing that this makes problems more tractable.

Friday -Manifolds and homotopy

Thomas Church (Stanford University) -Representation stability and applications to homological stability

Church described his long standing joint work on explaining how to understand many of the stabilization results of classical invariants of families of groups. He began by recasting a traditional stabilization result (namely the cohomology of the moduli space of n -points in a manifold) as a problem of the representation theory of symmetric groups. He then produced a new, more algebraic model of this which allowed a determination of the representations arising from these cohomology groups. He moved into a discussion of a more general family of stabilization problems, exploring a notion of an “FI-module” (sometimes called an I-space in the literature), showing how this framework can be used to better understand classical results and prove new ones.

Oscar Randal-Williams (University of Cambridge) -Stability of moduli spaces of manifolds

This talk and the next were somewhat coordinated. Randal-Williams described the basic questions posed by moduli spaces of manifolds and what one means by “stability”. He focused on moduli of manifolds with extra structure on their normal bundle, describing recent work with Galatius and of younger students, then he explained how one proves classes of these theorems.

Soren Galatius (Stanford University) -Stable homology of moduli spaces of manifolds

Galatius explored the theory of stability in the homology of moduli space of manifolds from a more computational approach. Beginning with some of the classical reformulations in terms of Thom spectra of manifolds, Galatius sketched some of the fundamental and early results. He cast everything in homotopy theoretic terms, but also underscored the connections with geometry. He finished with the very concrete connection to the classical k classes of manifold bundles, showing how this can be used to produce classes in the stable cohomology of certain diffeomorphism groups.

Constantin Teleman (UC Berkeley) -Loop Groups, TQFTs, and algebraic geometry

Teleman wrapped up the workshop describing the connections between algebraic topology and mathematical physics. After describing the underlying physical problems in terms of bundles, he described how an equivariant version of index theory gives rise to certain computations in twisted equivariant K-theory. He finished by exploring how this foundational work with Freed and Hopkins could be extended from twisting by line bundles to other vector bundles.

Organizers

| First | Last | Institution |
|---------|----------|---|
| Teena | Gerhardt | Michigan State University |
| Jesper | Grodal | University of Copenhagen |
| Kathryn | Hess | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Michael | Hill | University of Virginia |

Speakers

| First | Last | Institution |
|-------------|-----------------|---------------------------------------|
| Mark | Behrens | Massachusetts Institute of Technology |
| Julie | Bergner | University of California |
| Michael | Ching | Amherst College |
| Thomas | Church | Stanford University |
| Christopher | Douglas | University of Oxford |
| William | Dwyer | University of Notre Dame |
| Soren | Galatius | Stanford University |
| Lars | Hesselholt | Nagoya University |
| Michael | Hopkins | Harvard University |
| Daniel | Isaksen | Wayne State University |
| Nitya | Kitchloo | Johns Hopkins University |
| Tyler | Lawson | University of Minnesota Twin Cities |
| Bob | Oliver | Universite Paris 13 |
| Oscar | Randal-Williams | University of Cambridge |
| John | Rognes | University of Oslo |
| Brooke | Shipley | University of Illinois at Chicago |
| Constantin | Teleman | UC Berkeley Math Faculty |
| Craig | Westerland | University of Minnesota Twin Cities |



Introductory Workshop: Algebraic Topology

January 27 - 31, 2014

Schedule

| Monday, January 27, 2014 | | | |
|--------------------------|-------------------|-----------------|---|
| 9:15 AM - 9:30 AM | Simons Auditorium | | Welcome |
| 9:30 AM - 10:30 AM | Simons Auditorium | William Dwyer | Introduction to operads |
| 10:30 AM - 11:00 AM | Atrium | | Tea |
| 11:00 AM - 12:00 PM | Simons Auditorium | Michael Ching | Goodwillie's calculus of functors |
| 12:00 PM - 2:00 PM | Atrium | | Lunch |
| 2:00 PM - 3:00 PM | Simons Auditorium | Brooke Shipley | Morita theory in stable homotopy |
| 3:00 PM - 3:20 PM | Atrium | | Tea |
| 4:10 PM - 5:00 PM | 60 Evans Hall | Lars Hesselholt | MSRI/Evans Lecture: Topological cyclic homology |

Note: Special Charter buses will leave MSRI at 3:10 and 3:40 for Evans Hall

| Tuesday, January 28, 2014 | | | |
|---------------------------|-------------------|---------------------|---|
| 9:30 AM - 10:30 AM | Simons Auditorium | John Rognes | Chromatic redshift |
| 10:30 AM - 11:00 AM | Atrium | | Tea |
| 11:00 AM - 12:00 PM | Simons Auditorium | Andrew Blumberg | Higher categories and algebraic K-theory |
| 12:00 PM - 2:00 PM | Atrium | | Lunch |
| 2:00 PM - 3:00 PM | Simons Auditorium | Christopher Douglas | Towards explicit models for higher K-theories |
| 3:00 PM - 3:30 PM | Atrium | | Tea |
| 3:30 PM - 4:30 PM | Simons Auditorium | Julie Bergner | Models for homotopical higher categories |
| 4:30 PM - 6:20 PM | Atrium | | Reception |

| Wednesday, January 29, 2014 | | | |
|-----------------------------|-------------------|------------------|---|
| 9:00 AM - 10:00 AM | Simons Auditorium | Mark Behrens | Computations in the stable homotopy groups of spheres |
| 10:00 AM - 10:30 AM | Atrium | | Tea |
| 10:30 AM - 11:30 AM | Simons Auditorium | Daniel Isaksen | Computations in motivic homotopy theory |
| 11:30 AM - 12:30 PM | Simons Auditorium | Craig Westerland | Views on the J-homomorphism |

| Thursday, January 30, 2014 | | | |
|----------------------------|-------------------|-----------------|---|
| 9:30 AM - 10:30 AM | Simons Auditorium | Bob Oliver | Local structure of groups and of their classifying spaces |
| 10:30 AM - 11:00 AM | Atrium | | Tea |
| 11:00 AM - 12:00 PM | Simons Auditorium | Michael Hopkins | Equivariant homotopy and localization |
| 12:00 PM - 2:00 PM | Atrium | | Lunch |
| 2:00 PM - 3:00 PM | Simons Auditorium | Nitya Kitchloo | Homotopy theory of Kac-Moody groups |
| 3:00 PM - 3:30 PM | Atrium | | Tea |
| 3:30 PM - 4:30 PM | Simons Auditorium | Tyler Lawson | Topological automorphic forms |

| Friday, January 31, 2014 | | | |
|--------------------------|-------------------|-----------------------|--|
| 9:30 AM - 10:30 AM | Simons Auditorium | Thomas Church | Representation stability and applications to homological stability |
| 10:30 AM - 11:00 AM | Atrium | | Tea |
| 11:00 AM - 12:00 PM | Simons Auditorium | Oscar Randal-Williams | Stability of moduli spaces of manifolds |
| 12:00 PM - 2:00 PM | Atrium | | Lunch |
| 2:00 PM - 3:00 PM | Simons Auditorium | Soren Galatius | Stable homology of moduli spaces of manifolds |
| 3:00 PM - 3:30 PM | Atrium | | Tea |
| 3:30 PM - 4:30 PM | Simons Auditorium | Constantin Teleman | Loop Groups, TQFTs and algebraic geometry |

| Registered Participants | | |
|--------------------------------|----------------|--|
| First | Last | Institution |
| Daniel | Alvarez-Gavela | Stanford University |
| Michael | Andrews | Massachusetts Institute of Technology |
| Gabriel | Angelini-Knoll | Wayne State University |
| Benjamin | Antieau | University of Washington |
| Nerses | Aramyan | University of Illinois at Urbana-Champaign |
| David | Ayala | Montana State University |
| Jeffrey | Bailes | University of Melbourne |
| Lauren | Bandklayder | Northwestern University |
| Matthew | Barber | University of California |
| Tobias | Barthel | Harvard University |
| Maria | Basterra | University of New Hampshire |
| Agnes | Beaudry | University of Chicago |
| Petter | Bergh | Norwegian University of Science and Technology (NTNU) |
| Hakon | Bergsaker | Massachusetts Institute of Technology |
| Daniel | Berwick-Evans | Stanford University |
| Irina | Bobkova | Northwestern University |
| Anna Marie | Bohmann | Northwestern University |
| anthony | bordg | Universite de Nice Sophia Antipolis |
| Eric | Bunch | Kansas State University |
| Jonathan | Campbell | University of Texas |
| Federico | Cantero | Universitat Munster |
| David | Carchedi | Max Planck Institute for Mathematics |
| Greg | Chadwick | University of California |
| Virgil | Chan | University of California, Davis |
| Mei-Chu | Chang | University of California |
| Artem | Chernikov | Institut de Mathematiques de Jussieu - Paris Rive Gauche |
| Safia | Chettih | University of Oregon |
| Boris | Chorny | University of Haifa--Oranim |
| Ralph | Cohen | Stanford University |
| Lee | Cohn | University of Texas |
| Dominic | Culver | University of Notre Dame |
| James | Davis | Indiana University |
| Michael | Donovan | Massachusetts Institute of Technology |
| Emanuele | Dotto | Massachusetts Institute of Technology |
| Bjorn | Dundas | University of Bergen |
| Taylor | Dupuy | University of California, Los Angeles |
| Philip | Egger | Northwestern University |
| Elden | Elmanto | Northwestern University |
| Maggie | Ewing | University of Minnesota Twin Cities |
| melissa | fabros | University of California, Merced |
| Daniel | Flores | Instituto de Ciencias Nucleares |
| John | Foley | University of Copenhagen |
| Ernest | Fontes | University of Texas |
| Michael | Freedman | University of California |
| James | Freitag | University of California, Berkeley |

| | | |
|------------|---------------|--|
| Jennifer | Garbett | University of Notre Dame |
| David | Gepner | Purdue University |
| Paul | Goerss | Northwestern University |
| Matthias | Grey | University of Copenhagen |
| Ilya | Grigoriev | University of Chicago |
| Bertrand | Guillou | University of Kentucky |
| Robert | Hank | University of Minnesota Twin Cities |
| Joe | Hannon | Boston University |
| John | Harper | Ohio State University |
| Rune | Haugsgeng | Max-Planck-Institut für Mathematik |
| Fabian | Hebestreit | Westfälische Wilhelms-Universität Münster |
| Ellen | Henke | University of Copenhagen |
| Joseph | Hirsh | Massachusetts Institute of Technology |
| Geoffroy | Horel | Universität Münster |
| Marc | Hoyois | Northwestern University |
| John | Huerta | Instituto Superior Tecnico |
| Samuel | Hutchinson | University of Sheffield |
| Brenda | Johnson | Union College |
| Sara | Kalisnik | Stanford University |
| Daniel | Kaplan | University of Texas |
| Inbar | Klang | Stanford University |
| Benjamin | Knudsen | Northwestern University |
| Johan | Konter | Northwestern University |
| Alexander | Kupers | Stanford University |
| Robert | Legg | Northwestern University |
| Guchuan | Li | Northwestern University |
| Ayelet | Lindenstrauss | Indiana University |
| Cary | Malkiewich | Stanford University |
| Maryanthe | Malliaris | University of Chicago |
| Aaron | Mazel-Gee | University of California, Berkeley |
| John | McCleary | Vassar College |
| Leanne | Merrill | University of Oregon |
| Haynes | Miller | Massachusetts Institute of Technology |
| Sage (Ann) | Moore | Mills College |
| Apurva | Nakade | Johns Hopkins University |
| Peter | Nelson | University of Illinois at Urbana-Champaign |
| Oscar | Ocampo | University of Sao Paulo (USP) |
| Cihan | Okay | PIMS - Pacific Institute for the Mathematical Sciences |
| Kyle | Ormsby | MIT / Reed College |
| Angelica | Osorno | Reed College |
| Viktoriya | Ozornova | Universität Bremen |
| Martin | Palmer | Westfälische Wilhelms-Universität Münster |
| Matthew | Pancia | University of Texas |
| Liz | Pannell | University of California, Santa Cruz |
| Dmitri | Pavlov | Westfälische Wilhelms-Universität Münster |
| Nathan | Perlmutter | University of Oregon |
| Eric | Peterson | University of California, Berkeley |

| | | |
|--------------|----------------|---|
| Jeremiah | Peterson | University of Minnesota Twin Cities |
| Kathleen | Ponto | University of Kentucky |
| Michael | Pors | University of Calgary |
| Matan | Prasma | Radboud Universiteit Nijmegen |
| Tomasz | Prytula | University of Copenhagen |
| Truls | Raeder | Norwegian University of Science and Technology (NTNU) |
| Charles | Rezk | University of Illinois at Urbana-Champaign |
| Emily | Riehl | Harvard University |
| Martina | Rovelli | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Carmen | Rovi | University of Edinburgh |
| Aaron | Royer | University of Texas |
| Steffen | Sagave | Rheinische Friedrich-Wilhelms-Universität Bonn |
| Mychael | Sanchez | University of Illinois at Urbana-Champaign |
| Beren | Sanders | University of California, Los Angeles |
| Jenny | Santoso | Universität Stuttgart |
| Matthew | Sartwell | University at Buffalo (SUNY) |
| Jerome | Scherer | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Nora | Seeliger | Australian National University |
| Andrew | Senger | University of Minnesota Twin Cities |
| Shan | Shah | Rijksuniversiteit te Utrecht |
| Shiyu | Shen | University of Illinois at Urbana-Champaign |
| Scott | Slinker | University of Virginia |
| Elaine | So | University of Pennsylvania |
| David | Sprehn | University of Washington |
| Mentor | Stafa | Tulane University |
| Don | Stanley | University of Regina |
| Nathaniel | Stapleton | Massachusetts Institute of Technology |
| Marc | Stephan | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Augusto | Stoffel | University of Notre Dame |
| Vesna | Stojanoska | Massachusetts Institute of Technology |
| Yuri | Sulyma | University of Alberta |
| Markus | Szymik | University of Copenhagen |
| Felicia | Tabing | University of California, Santa Cruz |
| Hiro | Tanaka | Harvard University |
| Amelia | Tebbe | University of Illinois at Urbana-Champaign |
| Marius | Thaule | Norwegian University of Science and Technology (NTNU) |
| Sean | Tilson | Royal Institute of Technology (KTH) |
| Peter | Ulrickson | University of Notre Dame |
| Massimiliano | Ungheretti | University of Copenhagen |
| Dmitry | Vagner | Duke University |
| Paul | VanKoughnett | Northwestern University |
| Tane | Vergili | Ege University |
| Jean | Verrette | University of Hawaii at Manoa |
| Christine | Vespa | Université de Strasbourg |
| Deborah | Vicinsky | University of Oregon |
| Juan | Villela-Garcia | University of Illinois at Urbana-Champaign |
| Nathalie | Wahl | University of Copenhagen |

| | | |
|-----------|-------------|---|
| Kay | Werndli | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Jacob | West | University of California |
| Kirsten | Wickelgren | Georgia Institute of Technology |
| Brian | Williams | Northwestern University |
| Dylan | Wilson | Northwestern University |
| W Stephen | Wilson | Johns Hopkins University |
| Kevin | Wray | University of California, Berkeley |
| Sarah | Yeakel | University of Illinois at Urbana-Champaign |
| Dimitri | Zaganidis | Ecole Polytechnique Federale de Lausanne (EPFL) |
| Inna | Zakharevich | University of Chicago |

Officially Registered Participant Information

| | | |
|---------------------|--|------------|
| Participants | | 171 |
|---------------------|--|------------|

| | | |
|--------------------------|--------|------------|
| Gender | | 171 |
| Male | 74.27% | 127 |
| Female | 25.15% | 43 |
| Declined to state | 0.58% | 1 |

| | | |
|--------------------------|--------|------------|
| Ethnicity* | | 171 |
| White | 78.36% | 134 |
| Asian | 6.43% | 11 |
| Hispanic | 4.09% | 7 |
| Pacific Islander | 0.58% | 1 |
| Black | 0.00% | 0 |
| Native American | 0.00% | 0 |
| Mixed | 3.51% | 6 |
| Declined to state | 7.02% | 12 |

* ethnicity specifications are not exclusive

This form will soon be upgraded to the new version of Google Forms. [Learn more.](#)

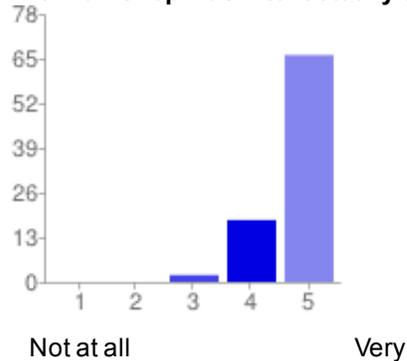
86 [responses](#)

86 responses/171 participants = 50% response rate

Summary [See complete responses](#)

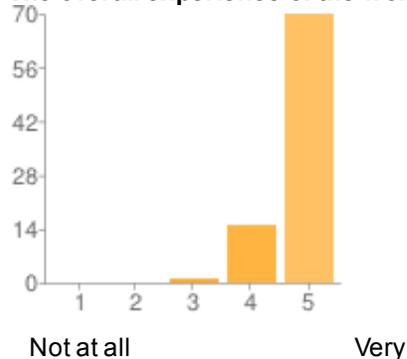
Workshop assessment

The workshop was intellectually stimulating



| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 0 | 0% |
| 3 | 2 | 2% |
| 4 | 18 | 21% |
| 5 - Very | 66 | 77% |

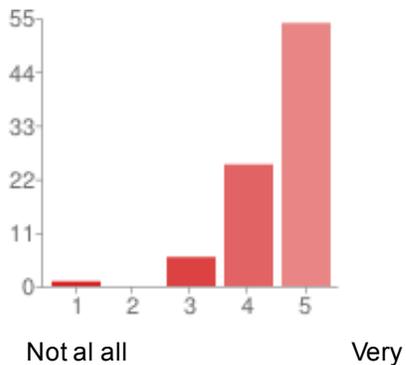
The overall experience of the workshop was worthwhile



| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 0 | 0% |
| 3 | 1 | 1% |
| 4 | 15 | 17% |
| 5 - Very | 70 | 81% |

The time between lectures was adequate for discussion

| | | |
|----------------|-----------|-----|
| 1 - Not at all | 1 | 1% |
| 2 | 0 | 0% |
| 3 | 6 | 7% |
| 4 | 25 | 29% |
| 5 - Very | 54 | 63% |

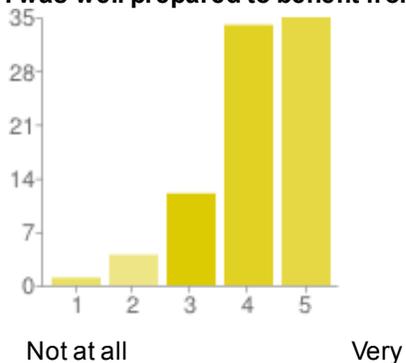


Additional comments on the workshop organization

Please increase time intervals between talks. The selection of the talks was very nicely done. While some of the talks towards the end of the week started running over time, in general however the spe ...

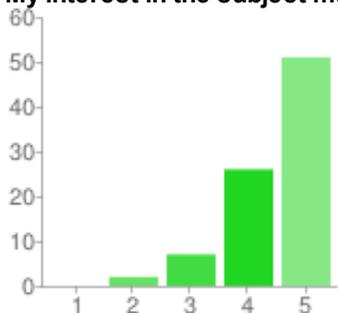
Personal assessment

I was well prepared to benefit from the lectures



| | | |
|----------------|-----------|-----|
| 1 - Not at all | 1 | 1% |
| 2 | 4 | 5% |
| 3 | 12 | 14% |
| 4 | 34 | 40% |
| 5 - Very | 35 | 41% |

My interest in the subject matter was increased by the workshop

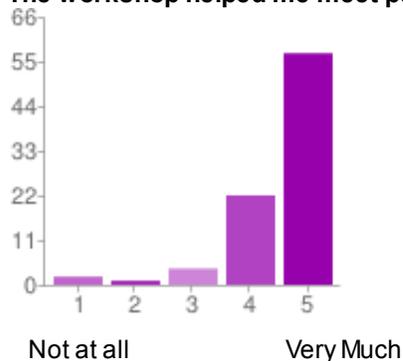


| | | |
|-----------------|-----------|-----|
| 1 - Niot at all | 0 | 0% |
| 2 | 2 | 2% |
| 3 | 7 | 8% |
| 4 | 26 | 30% |
| 5 - Very | 51 | 59% |

Not at all

Very

The workshop helped me meet people with similar scientific interests



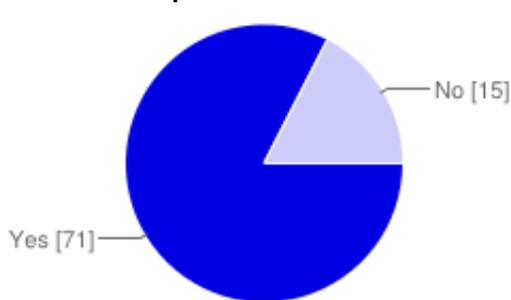
| | | |
|----------------|-----------|-----|
| 1 - Not at all | 2 | 2% |
| 2 | 1 | 1% |
| 3 | 4 | 5% |
| 4 | 22 | 26% |
| 5 - Very Much | 57 | 66% |

Additional comments on your personal assessment

This was useful to topologists of all ranks. The workshop was a great opportunity to both meet up with people, and get to know people. I'm not an algebraic topologist and many talks were actually most ...

Additional Activities

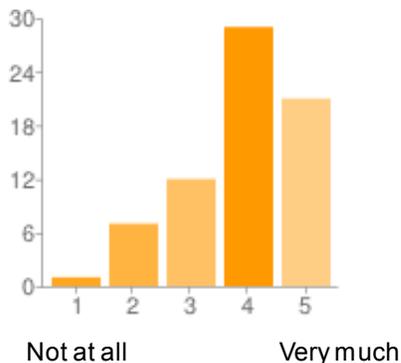
Did you attend the reception?



| | | |
|-----|-----------|-----|
| Yes | 71 | 83% |
| No | 15 | 17% |

If you did attend the reception, did it help to solidify the contacts you made in the workshop?

| | | |
|----------------|-----------|-----|
| 1 - Not at all | 1 | 1% |
| 2 | 7 | 8% |
| 3 | 12 | 14% |



| | | |
|---------------|-----------|-----|
| 4 | 29 | 34% |
| 5 - Very much | 21 | 24% |

Please provide any comments on the reception

enjoyable!
 high. The wine and food could have been prolonged.
 didn' ...

very nice

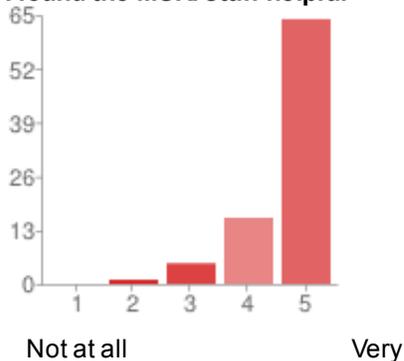
It was highly

The reception ended while the social inertia was still

I didn't attend because I was ill and not because I

Venue

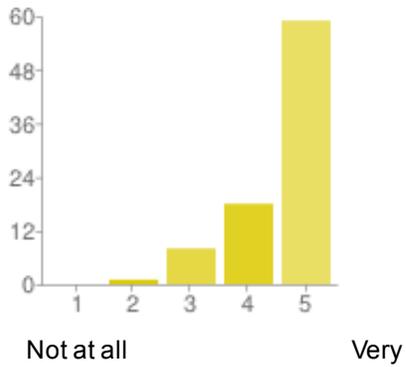
I found the MSRI staff helpful



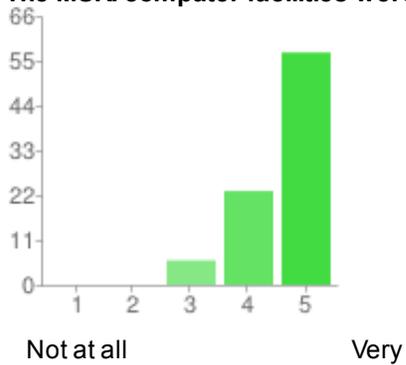
| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 1 | 1% |
| 3 | 5 | 6% |
| 4 | 16 | 19% |
| 5 - Very | 64 | 74% |

The MSRI physical facilities were conducive for such a workshop

| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 1 | 1% |
| 3 | 8 | 9% |
| 4 | 18 | 21% |
| 5 - Very | 59 | 69% |

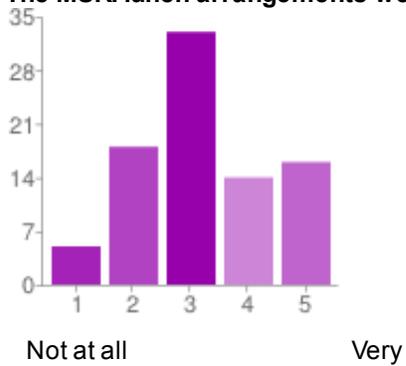


The MSRI computer facilities were adequate for such a workshop



| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 0 | 0% |
| 3 | 6 | 7% |
| 4 | 23 | 27% |
| 5 - Very | 57 | 66% |

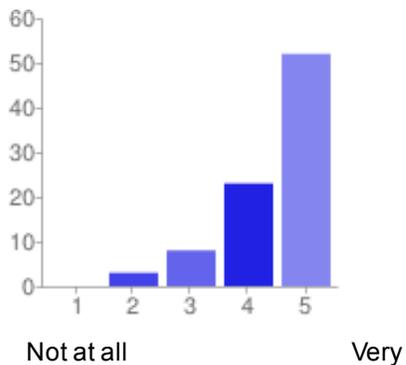
The MSRI lunch arrangements were satisfactory



| | | |
|----------------|-----------|-----|
| 1 - Not at all | 5 | 6% |
| 2 | 18 | 21% |
| 3 | 33 | 38% |
| 4 | 14 | 16% |
| 5 - Very | 16 | 19% |

The MSRI tea arrangements were satisfactory

| | | |
|----------------|-----------|-----|
| 1 - Not at all | 0 | 0% |
| 2 | 3 | 3% |
| 3 | 8 | 9% |
| 4 | 23 | 27% |
| 5 - Very | 52 | 60% |



Additional comments on the venue

Lunch logistics need to be improved. Please increase the selection of tea and/or provide loose tea. tea & coffee are needed while listening to talks!!
 Gorgeous location! You have to fix the heating syst ...

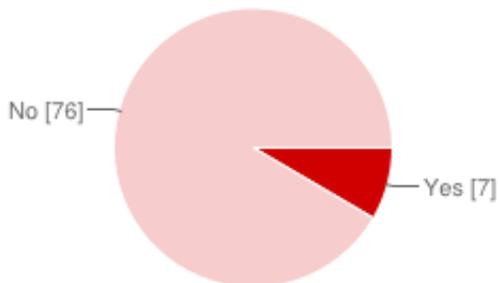
MSRI Wireless Network

Did you use MSRI's wireless network?



| | | |
|-----|-----------|-----|
| Yes | 78 | 91% |
| No | 8 | 9% |

Did you experience any difficulties with the network?



| | | |
|-----|-----------|-----|
| Yes | 7 | 8% |
| No | 76 | 88% |

Introductory Workshop: Algebraic Topology

January 27 - 31, 2014

Additional Survey Responses

Additional comments on your personal assessment

- This was useful to topologists of all ranks.
- The workshop was a great opportunity to both meet up with people, and get to know people.
- I'm not an algebraic topologist and many talks were actually mostly aimed to the other algebraic topologists in the room. So the workshop didn't quite live up to my expectation of an introductory workshop where the talks can be followed with a general mathematical background.
- great attention
- Slightly too introductory for my taste but excellent nonetheless.

Additional comments on the venue

- Lunch logistics need to be improved.
- Please increase the selection of tea and/or provide loose tea.
- tea & coffee are needed while listening to talks!!
- Gorgeous location!
- You have to fix the heating system in the lecture room! Also, the screen/blackboard system is not optimal. The screen is too small, and the blackboards reflect too much from some angles.
- Logistically, lunch was a disaster. The arrangements were totally inadequate for a conference of this size.
- Several presentations were affected by projector. Some colors did not display at all, and the screen was too small. It would be ideal to have two projectors.
- More food or at least more sustaining food during the lunch breaks would have been needed. We were forced to leave the Institute at lunch entailing a walk back up the hill. Also, the waste production during tea breaks was abhorrent.
- If the food were set on two smaller tables (separated from each other) instead of one long one it would help participants to flow through the area better. Often only one section of the food table was being fully utilized, and that contributed to a backup. Otherwise the teas were great.
- Something to keep in mind for the future is that MSRI is much farther away from the attendees' residences than the average hotel-to-math-department distance of these things. The start time of the workshop was a little early -- I'd rather have traded a fraction of the tea times and of lunch in for a later start, just in the interest of having adequate time to get up the hill.
- The "Stuffed Inn" catering service provided much tastier food than the other catering service.
- the staff was amazing, the lunch was fine but would prefer more variety
- Better selection and an additional line would be appreciated.
- There were a lot of people and so food was less than convenient. However, the caterer was very efficient.
- 2 or more lunch lines for large crowds would be helpful.
- The venue seemed a little bit small for the size of the workshop
- It is sad that coffee is not allowed in the auditorium. That would make things a lot more pleasant. Apart from the fact that I was not overwhelmed by the quality of the lunch, the main

problem was the set up. One (long) table is hardly sufficient for such a group. Several lines, with several tables of food and cashiers, would have greatly benefited the experience. In a similar way the snacks for tea could be distributed over the round tables already present.

- There was not always enough food for everyone at tea.
- The conference room does not have so many good seats. The space is not used optimally, in particular because the first three rows take so much space.
- There was no earl grey tea!

We welcome any additional comments or suggestions you may have to improve the overall experience for future participants.

- You should not require answers to survey questions - or at least allow N/A as an answer.
- Thanks for holding this fantastic workshop!
- It would be nice to have more people serving lunch when there are so many participants.
- The name "Introductory Workshop" was perhaps slightly misleading since only a few of the talks could, for graduate students, really be called introductory. Many demanded a substantial background in the topic from the listener.
- If anything, perhaps too many talks. The time between talks was the most rewarding.
- I'm really pleased that the Connections for Women workshop happened immediately before this. I think it changed the tenor of the main workshop in a great way. Thanks for that!
- Thank you so much! I learned a lot, and I really enjoyed meeting other graduate students as well as mathematicians with similar interests to my own.
- This workshop was a great follow up to the connections for women and I'm glad they were arranged back to back. Thanks for the opportunity to learn more at MSRI!

If you did experience difficulties with the network, please explain:

- Extremely slow
- slow connection (failure to skype)
- On-campus wifi is essential, especially for long term visitors like me.
- I tried to skype home for around 10 minutes and the call was bad quality
- At times the network would only work for a short time after connecting
- Too slow for most skype conversations.
- I missed Andrew Blumberg's talk, and when I went to watch it later in the day, the local network was too slow to load the video (50 minutes for load for ~5 minutes of video). I'd expect video hosted on the MSRI server to be of exceptionally fast access to someone on-site, so that was surprising. Otherwise, everything was perfectly fine.

Please provide any comments on the reception

- very nice
- It was highly enjoyable!
- The reception ended while the social inertia was still high. The wine and food could have been prolonged.
- I didn't attend because I was ill and not because I didn't find it worthwhile.
- It was really nice to have such a social event right there at MSRI with all the other attendees!
- Too short.
- I took the reception time to meet with someone that I had met at the conference whose work was similar to my own.

Additional comments on the workshop organization

- Please increase time intervals between talks.
- The selection of the talks was very nicely done.
- While some of the talks towards the end of the week started running over time, in general however the speakers and organizers were really good at keep everything moving efficiently and on-time. A highly non-trivial task.
- If the workshop was aimed at grad students and postdocs, then I may have not been in the target audience.
- The organizers did a very good job in steering speakers to pitch their talks at a useful level. There were instructive contrasts in style.
- Perfect, even the buses.
- I would like to thank the organizers.
- Having people give accessible surveys was a wonderful idea
- Awesome
- Incredibly well done
- The number of lectures per day and the timing of them was great. I wouldn't change a thing.
- excellent job
- Flawless
- Talks on topics, chosen by the organizers, given by the speakers, led to better introductions. Great idea!!
- the location was too small for the number of participants.
- Was excellent.
- Thanks to the organizers!
- very well put together
- exceptional
- I loved the talks. The ones that started with basics and built up to recent results were very good. It's always useful to me as a grad student to hear experts discuss the basics.
- All the organizers and staff spoke quite well.
- Terrific workshop -- there should be more in algebraic topology