

Matthew Kahle

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Columbus, OH 43210

Positions Associate Professor, The Ohio State University, 2015–present
Assistant Professor, The Ohio State University, 2011–2015
Member, Institute for Advanced Study, Princeton, 2010–2011
Samelson Postdoctoral Fellow, Stanford University, 2007–2010

Visiting positions ICERM, Providence, Rhode Island, Fall 2016
CIMAT, Guanajuato, Mexico, Summer 2016
IMA, Minneapolis, Minnesota, Spring 2014
MRSI, Berkeley, California, Fall 2006
IAS-PCMI, Park City, Utah, Summer 2003

Education University of Washington, Seattle, Washington USA
Ph.D., Mathematics, June 2007

- Dissertation: *Random simplicial complexes and phase transitions for homology*
- Thesis advisors: Eric Babson and Christopher Hoffman

Colorado State University, Fort Collins, Colorado USA
M.S., Mathematics, May 2001
B.S., Mathematics, May 1999

Grants NSF #DMS-1613094: Conference TGDA@OSU 2016
NSF-RTG #DMS-1547357: Algebraic topology and its applications, 2016–21
NSF-CAREER #DMS-1352386: Random spaces and groups, 2013–18
NSF #CCF-1017182: Higher-dimensional spanning trees, 2013–14
DARPA #N66001-12-1-4226: Topology and geometry of random simplicial complexes, 2012–14
NSA #H98230-10-1-0227: Random simplicial complexes, 2009–2011

Fellowships Alfred P. Sloan Research Fellowship, 2012–2016
Samelson Postdoctoral Fellowship, Stanford, 2007–2010
NSF-VIGRE Fellowship, 2001–2004, 2005–2006
Andrew Gavin Gaudette ARCS Foundation Fellowship 2001–2004

Publications

1. C. Hoffman, M. Kahle, and E. Paquette. The threshold for integer homology in random d -complexes. (to appear in *Discrete Comput. Geom.*, arXiv:1308.6232).
2. M. Kahle. Book chapter on “Random Simplicial Complexes” (to appear in *Handbook of Discrete & Computational Geometry, 3rd Edition*, arXiv:1607.07069).
3. O. Bobrowski, M. Kahle., and P. Skraba. Maximally persistent cycles in random geometric complexes. (to appear in *Annals of Applied Probability*, arXiv:1509.04347)

4. O. Bobrowski and M. Kahle. Topology of random geometric complexes: a survey. (to appear in *AMS Proceedings of Symposia in Applied Mathematics*, arXiv:1409.4734)
5. M. Kahle and E. Meckes. Erratum to “Limit theorems for Betti numbers of random simplicial complexes”. *Homology Homotopy Appl.* 18 (2016), no. 1, 129–142.
6. M. Kahle and B. Pittel. Inside the critical window for cohomology of random k-complexes. *Random Structures Algorithms* 48 (2016), no. 1, 102–124.
7. M. Kahle and B. Taha. New lower bounds on $\chi(\mathbb{R}^2)$ for $d = 8, \dots, 12$. *Geombinatorics* 24 (2015), 109–116.
8. M. Davis and M. Kahle. Random graph products of finite groups are rational duality groups. *J. Topol.*, 7 (2014), 589–606.
9. M. Kahle. Topology of random simplicial complexes: a survey. *AMS Contemp. Math.*, 620 (2014), 201–221.
10. M. Kahle. Sharp vanishing thresholds for cohomology of random flag complexes. *Ann. of Math.* 179 (2014), 1085–1107.
11. Y. Baryshnikov, P. Bubenik, and M. Kahle. Min-type Morse theory for configuration spaces of hard spheres. *Int. Math. Res. Notices* 9 (2014), 2577–2592.
12. M. Kahle and E. Meckes. Limit theorems for Betti numbers of random simplicial complexes. *Homology, Homotopy Appl.* 15(2) (2013), 343–374.
13. D. Dotterrer and M. Kahle. Coboundary expanders. *J. Topol. Anal.* 4 (2012), no. 4, 499–514.
14. M. Kahle. Sparse locally-jammed disk packings. *Ann. Comb.* 16(4) (2012), 773–780.
15. G. Carlsson, J. Gorham, M. Kahle, and J. Mason. Computational topology for configuration spaces of hard disks. *Phys. Rev. E*, 85 (2012).
16. M. Kahle. Random geometric complexes. *Discrete Comput. Geom.*, 45 (2011), no. 3, 553–573.
17. E. Babson, C. Hoffman, and M. Kahle. The fundamental group of random 2-complexes. *J. Amer. Math. Soc.* 24 (2011), no. 1, 1–28.
18. M. Kahle. Topology of random clique complexes. *Discrete Math.*, 309 (2009), no. 6, 1658–1671.
19. M. Kahle. Points in a triangle forcing small triangles *Geombinatorics* 18 (2009), no. 3, 114–128.
20. M. Kahle. The neighborhood complex of a random graph. *J. Combin. Theory Ser. A* 114 (2007), no. 2, 380–387.
21. M. Kahle. Scatters, unavoidable shapes, and crystallization. *Geombinatorics* 15 (2006), no. 3, 138–149.
22. M. Kahle. A generalization of the chromatic number of the plane. *Geombinatorics* 1 (2000), no. 2, 69–74.

Preprints

1. D. Dotterrer, L. Guth, and M. Kahle. 2-complexes with large homological systoles. (submitted, arXiv:1509.03871)
2. C. Hoffman, M. Kahle, and E. Paquette. Spectral gaps of random graphs and applications to random topology. (submitted, arXiv:1201.0425)
3. S. Fadnavis and M. Kahle. Warmth and mobility of random graphs. (arXiv:1009.0792, in revision)

In preparation

1. M. Kahle and R. MacPherson. Configuration spaces of hard disks in an infinite strip.
2. C. Fowler, C. Hoffman, M. Kahle, G. Malen. The bouquet-of-spheres conjecture.

Research Talks

Combinatorics seminar, Ohio State, 2017-01-12
Special session in Computational Topology, Joint Mathematics Meetings, Atlanta, 2017-01-04
Future directions in Network Mathematics, Royal Society, London, 2016-11-22
Topology seminar, Oxford, 2016-11-21
Probabilistic methods in topology, CRM, Montreal (three talks), week of 2016-11-14
Colloquium, University of South Carolina, 2016-11-03
Topology seminar, Brown, 2016-09-28
Stochastic topology seminar, ICERM, Providence, 2016-09-21
Topology and geometry seminar, UNAM, Mexico City, 2016-08-18
CIMAT, mini-course on Stochastic topology and topological statistical mechanics (four talks), week of 2016-08-08
Cornell topology festival, weekend of 2016-5-12 (two talks)
Colloquium, UT Austin, 2016-04-18
Algorithms, Combinatorics and Optimization seminar, Carnegie Mellon, 2016-04-07
Topology seminar, Florida, 2016-03-08
Colloquium, Florida, 2016-03-07
AIMR, Sendai, Japan, 2016-02-22
Random and statistical topology, Sendai, Japan, week of 2016-02-15 (two talks)
Kempner colloquium, CU Boulder, 2015-12-11
Colloquium, Georgia Tech, 2015-11-12
Computational algebraic and geometric topology, Oberwolfach, 2015-10-12
Geometry and physics of spatial random systems, Bad Herrenalb, 2015-09-09
Topology seminar, Ohio State, 2015-09-01
Dynamics, topology, and computations, Bedlewo, 2015-06-15
Special session in applied algebraic topology, AMS / EMS / SPM International Meeting, Porto, 2015-06-11
Workshop: Random graphs, simplicial complexes, and their applications, Northeastern, 2015-05-19
Colloquium, University Southern California, 2015-03-25
Joint Colloquium, Brandeis-Harvard-MIT-Northeastern, 2015-02-19
School on Topological Data Analysis and Stochastic Topology (four lectures), CIMAT, Guanajuato, week of 2015-01-19
Foundations of Computational Mathematics, Computational Topology and Geometry workshop, Montevideo, 2014-12-15
Discrete, Computational and Algebraic Topology, Copenhagen, 2014-11-11
AMS Invited address, Central Fall Sectional Meeting, Eau Claire, 2014-09-20
Colloquium, Yale, 2014-08-01
SUMRY colloquium, Yale, 2014-07-31
Research cluster on random groups, Tufts, 2014-07-20
Combinatorics, geometry, and physics, ESI, Vienna, Austria, 2014-07-18
Applied topology seminar, IST, Klosterneuburg, Austria, 2014-07-10
Applied algebraic topology, Castro Urdiales, Spain, 2014-07-04
Toponets14: Topology and networks, Berkeley, 2014-06-02
IMA workshop: Topology and Geometry of Networks and Discrete Metric Spaces, 2014-04-29
Colloquium, University of Wisconsin, 2014-04-04
IMA Annual Program Seminar, 2014-03-12 and 2014-04-02
AMS Short Course on Geometry and Topology in Statistical Inference, Baltimore, 2014-01-14
Colloquium, Western Ontario University, 2013-11-07
IMA workshop: Topological data analysis, 2013-10-09
Applied and interdisciplinary mathematics seminar, Northeastern, 2013-10-01
Research seminar in mathematics, Northeastern, 2013-10-01
Combinatorics seminar, Ohio State, 2013-09-18
Topology, geometry, and data seminar, Ohio State, 2013-09-13 and 2013-09-20
Metric Geometry, Geometric Topology and Groups, BIRS, Banff, Canada, 2013-08-04
Applied and Computational Algebraic Topology, ALTA, Bremen, Germany, 2013-07-18

Dynamics and Applied Topology, (three lectures), Kyoto, week of 2013-06-09
Colloquium, Indiana, 2013-03-22
Triangle lectures in combinatorics, Wake Forest University, 2013-02-09
Data seminar, Duke, 2013-02-07
MacPherson seminar, IAS, 2013-01-24 & 2013-01-31
Workshop: Topological data analysis and machine learning theory, Banff, 2012-10-15
Colloquium, University of Washington, 2012-10-05
Stanford symposium on Algebraic topology: applications and new directions, 2012-07-25
ATMCS 5, Edinburgh, 2012-07-04
Dynamics, topology, and computation, Bedlewo, Poland, 2012-06-27
Workshop: Triangulations, Oberwolfach, 2012-05-03
CATS (Combinatorics, Algebra, Topology, and Statistics) seminar, Kentucky, 2012-04-23
Colloquium, Colorado State, 2012-04-13
Topology seminar, Ohio State, 2012-04-10
Applications of Combinatorial Topology to Computer Science, Dagstuhl, Germany, 2012-03-20
AMS Meeting, Tampa, FL, special session in algebraic & geometric combinatorics, 2012-03-10
Topology seminar, Rice, 2012-02-27
Invitation to Mathematics, Ohio State, 2012-01-18 & 2012-01-25
Workshop: Computational topology, Fields Institute, 2011-11-07
Topology and geometry of data seminar, Ohio State, October 21, 2011
SIAM Conference on Applied Algebraic Geometry, NC State, October 6, 2011
Topological Methods in Complex Systems, U Penn, August 9, 2011
Applied Algebraic Topology, ETH-Zurich, July 6, 2011
Geometric group theory conference, Ohio State, June 2, 2011
Combinatorics seminar, Washington, May 18, 2011
Colloquium, Alcatel-Lucent, Murray Hill, May 12, 2011
Distinguished interdisciplinary speaker series, NC State, April 29, 2011
Geometry/topology seminar, Chicago, March 10, 2011
Geometry seminar, Yale, February 21, 2011
Colloquium, Colorado State, February 3, 2011
Colloquium, Ohio State, January 18, 2011
Soft matter seminar, U Penn, November 29, 2010
Members seminar, IAS, Princeton, November 15, 2010
Geometry seminar, Courant Institute, NYU, November 2, 2010
Topology: identifying order in complex systems, Rutgers, October 6, 2010
Geometry & cell complexes seminar, IAS, Princeton, October 5, 2010
Algebra and Topology: Methods, Computation, and Science IV, Münster, Germany, June 24, 2010
2010 Barrett Memorial Lectures in Discrete Differential Geometry and Applications, May 17, 2010
Workshop in algebraic and random topology I, Chicago, April 18, 2010
Applied topology seminar, University of Zürich, March 26, 2010
Colloquium, Case Western Reserve, March 19, 2010
Geometry seminar, Toronto, March 8, 2010
Theory seminar, Dartmouth, March 2, 2010
Combinatorics seminar, Dartmouth, March 1, 2010
Colloquium, Cleveland State, February 26, 2010
Combinatorics seminar, UC Berkeley, February 22, 2010
Colloquium, Oregon, January 25, 2010
Joint seminar in probability and topology, Oregon, November 20, 2009
Probability seminar, Stanford, November 9, 2009
Applied topology, Chicago, November 5, 2009
Topological complexity of random sets, American Institute of Mathematics, August 12, 2009
Topological Methods in Scientific Computing seminar, Stanford, May 18, 2009
Data analysis using computational topology and geometric statistics, Banff, March 11, 2009
Probability seminar, Washington, February 9, 2009

Discrete math seminar, Berkeley, February 4, 2009
Probability seminar, Duke, October 30, 2008
Computational algebraic topology, Oberwolfach, June 29–July 5, 2008
Topology seminar, Oregon, April 22, 2008
Colloquium, Cal. State East Bay, February 22, 2008
Bay Area Discrete Math Day, Google, October 20, 2007
Geometry/topology seminar, Davis, October 18, 2006
Computational applications of algebraic topology, MSRI, October 2, 2006

Courses taught *Ohio State (2011–)*: Graph Theory and Combinatorics I & II (graduate courses), Linear algebra and differential equations for engineers, graduate topics courses in: Random graphs and percolation theory, Random spaces and groups
Stanford (2007–2010): Mathematics of the Rubik’s Cube, Modern Algebra, Applied Number Theory and Cryptography, Polya Problem Solving Seminar, Ordinary Differential Equations and Linear Algebra, Introduction to Combinatorics, Set Theory, Linear Algebra and Multivariable Calculus
Canada/USA Mathcamp (Summers 2003, 2005–2007) Zoology of Polytopes, Moore Method Topology, Topological and Geometric Graph Theory, The Probabilistic Method, Combinatorial Homotopy Theory, Linear algebra, Symmetric Functions, Enumeration Celebration, . . .
University of Washington (2001–2007): Ordinary Differential Equations, Linear algebra, Calculus, Grader for Topology and Geometry of Manifolds
Colorado State University (1999–2001): Modern Algebra, Linear algebra, Calculus, Trigonometry; Assistant director of the Individualized Mathematics Program

Organizing ICERM Semester Program on “Topology in Motion”, Fall 2016 Probabilistic Methods in Topology, CRM, November 14–18, 2016 Special session in “Random spaces”, AMS Central Fall Sectional Meeting, Eau Claire, WI, September 20–21, 2014
Executive committee, ATMCS 6, Vancouver, Canada, summer 2014.
Scientific committee, Applied Topology, Bedlewo, Poland, summer 2013.
TGDA seminar, Ohio State, 2013–
Special session in applied topology, AMS sectional meeting, Akron, OH, October 20–21, 2012
Combinatorics seminar, Ohio State, 2011–
IAS seminar in “Geometry and cell complexes”, 2010–2011
Seminar in “Graph homomorphisms”, Stanford, Fall 2009
Bay Area Discrete Math Day, 2007–2010
Local organizer, Bay Area Discrete Math Day, Stanford, September 27, 2008
Combinatorics and geometry seminar, Stanford, 2007–2008
Graduate Student Conference in Combinatorics, UW, Spring 2007.

Outreach and synergistic activities Mentor, Canada/USA Mathcamp, summers 2003, 2005–2007
Polya problem solving seminar, Stanford, Fall 2009
Coach of 4th place team, William Lowell Putnam competition, Stanford, Fall 2009
Visitor and speaker, Nebraska IMMERSE program, week of 2013-07-01
Judge, Denman Undergraduate Research Forum, Ohio State, March 2013
Radical Pi (OSU undergraduate math club): 2013-02-27 and 2012-08-02
Visitor, Canada/USA Mathcamp, Summer 2012
Invitation to Mathematics, Ohio State, January 18 & 25, 2012
Columbus Math Circle, 2012-03-25
IAS School of Mathematics Council Meeting, 2013-06-13
Undergraduate math club, Yale, 2011-02-22

Visitor, Canada/USA Mathcamp, week of 2010-07-04
Graduate Student Representative, UW, 2004–2005

Public talks Collaborative STEAM Factory talk on Kepler's Harmonices Mundi, 2016-02-12
National Math Festival, Washington D.C., 2015-04-18
Panel discussion: Colorado Math Olympiad, 30th Anniversary award ceremony, 2013-05-03
Demonstrations, Shift studio, Seattle, 2007-06-02

Advising Érika Roldan (current Ph.D. student, CIMAT)
Katherine Ritchey (current Ph.D. student)
John Andrew Newman (current Ph.D. student)
Kyle Parsons (current Ph.D. student)
Greg Malen (Ph.D. awarded Spring 2016)
Peter Kosek (M.S. awarded in Fall 2014)

Other students mentored (next position) Birra Taha, B.S., Ohio State, 2013 (Medical school, Cornell)
Elliot Paquette, Ph.D., Washington, 2013 (NSF Postdoc, Weizmann Inst.)
Dominic Dotterrer, Ph.D., Toronto, 2013 (Dickson Assistant Professor, Chicago)
Ted Dokos, B.S., Ohio State, 2012 (Ph.D. program in mathematics, UCLA)
Sukhada Fadnavis, Ph.D., Stanford, 2012 (Benjamin Peirce Fellow, Harvard)
Jackson Gorham, B.S., Stanford 2010 (Ph.D. program in statistics, Stanford)
Heather M. Lee, B.S., Washington 2007 (Ph.D. program in mathematics, Berkeley)

Postdocs mentored Hannah Alpert
Izhar Oppenheim
Benjamin Schweinhart
Matthew Wright

Refereeing Algebraic & Geometric Topology
Annals of Applied Probability
Annals of Probability
Annals of Mathematics
Discrete & Computational Geometry
Discrete Mathematics
Experimental Mathematics
European Journal of Combinatorics
Journal of Topology & Analysis
Pacific Journal of Mathematics
Probability Theory and Related Fields
Proceedings of the American Mathematical Society
Random Structures & Algorithms
Rose-Hulman Undergraduate Journal
Symposium on Computational Geometry

Service AMS Central Section Committee (2016–18)
NSF-DMS grant review panels (2014–15)