

Matthew Kahle

Contact

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Positions

Associate Professor, Ohio State University, 2015–present
Assistant Professor, 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, Autumn 2016
CIMAT, Guanajuato, Mexico, Summer 2016
IMA, Minneapolis, Minnesota, Spring 2014
MRSI, Berkeley, California, Autumn 2006 (6 weeks)
IAS-PCMI, Park City, Utah, Summer 2003 (5 weeks)

Education

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

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

Grants

NSF-TRIPODS #CCF-1740761, 2017–2020 (Senior Personnel)
NSF #DMS-1613094: Conference TGDA@OSU, 2016 (PI)
NSF-RTG #DMS-1547357: Algebraic topology and its applications, 2016–21 (PI)
NSF-CAREER #DMS-1352386: Random spaces and groups, 2013–18 (PI)
NSF #CCF-1017182: Higher-dimensional spanning trees, 2013–14 (PI)
DARPA #N66001-12-1-4226: Topology and geometry of random simplicial complexes, 2012–14 (PI)
NSA #H98230-10-1-0227: Random simplicial complexes, 2009–2011 (PI)

Fellowships and awards

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. O. Bobrowski and M. Kahle. Topology of random geometric complexes: a survey. *Journal of Applied & Computational Topology*,
2. M. Kahle. Book chapter on “Random Simplicial Complexes” in *Handbook of Discrete & Computational Geometry, 3rd Edition*, CRC Press, 2017.
3. D. Dotterrer; L. Guth, Larry; M. Kahle. 2-Complexes with Large 2-Girth. *Discrete Comput. Geom.* 59 (2018), no. 2, 383–412.

4. O. Bobrowski; M. Kahle, and P. Skraba. Maximally persistent cycles in random geometric complexes. *Ann. Appl. Probab.* 27 (2017), no. 4, 2032–2060.
5. C. Hoffman, M. Kahle, and E. Paquette. The threshold for integer homology in random d -complexes. *Discrete Comput. Geom.* 57 (2017), no. 4, 810–823.
6. 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.
7. M. Kahle and B. Pittel. Inside the critical window for cohomology of random k -complexes. *Random Structures Algorithms* 48 (2016), no. 1, 102–124.
8. M. Kahle and B. Taha. New lower bounds on $\chi(\mathbb{R}^d)$ for $d = 8, \dots, 12$. *Geombinatorics* 24 (2015), 109–116.
9. M. Davis and M. Kahle. Random graph products of finite groups are rational duality groups. *J. Topol.*, 7 (2014), 589–606.
10. M. Kahle. Topology of random simplicial complexes: a survey. *AMS Contemp. Math.*, 620 (2014), 201–221.
11. M. Kahle. Sharp vanishing thresholds for cohomology of random flag complexes. *Ann. of Math.* 179 (2014), 1085–1107.
12. 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.
13. M. Kahle and E. Meckes. Limit theorems for Betti numbers of random simplicial complexes. *Homology, Homotopy Appl.* 15(2) (2013), 343–374.
14. D. Dotterrer and M. Kahle. Coboundary expanders. *J. Topol. Anal.* 4 (2012), no. 4, 499–514.
15. M. Kahle. Sparse locally-jammed disk packings. *Ann. Comb.* 16(4) (2012), 773–780.
16. G. Carlsson, J. Gorham, M. Kahle, and J. Mason. Computational topology for configuration spaces of hard disks. *Phys. Rev. E*, 85 (2012).
17. M. Kahle. Random geometric complexes. *Discrete Comput. Geom.*, 45 (2011), no. 3, 553–573.
18. E. Babson, C. Hoffman, and M. Kahle. The fundamental group of random 2-complexes. *J. Amer. Math. Soc.* 24 (2011), no. 1, 1–28.
19. M. Kahle. Topology of random clique complexes. *Discrete Math.*, 309 (2009), no. 6, 1658–1671.
20. M. Kahle. Points in a triangle forcing small triangles *Geombinatorics* 18 (2009), no. 3, 114–128.
21. M. Kahle. The neighborhood complex of a random graph. *J. Combin. Theory Ser. A* 14 (2007), no. 2, 380–387.
22. M. Kahle. Scatters, unavoidable shapes, and crystallization. *Geombinatorics* 15 (2006), no. 3, 138–149.
23. M. Kahle. A generalization of the chromatic number of the plane. *Geombinatorics* 1 (2000), no. 2, 69–74.

Preprints

1. M. Kahle, E. Roldán. Polyominoes with maximally many holes. (submitted)
2. M. Kahle, F. Lutz, A. Newman, K. Parsons. Cohen–Lenstra heuristics for homology of random complexes. (submitted)
3. C. Hoffman, M. Kahle, and E. Paquette. Spectral gaps of random graphs and applications to random topology. (submitted, arXiv:1201.0425)
4. 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.

Selected lectures and lecture series Probabilistic methods in topology, CRM, Montreal, week of 2016-11-14 (three lectures)
Stochastic topology and topological statistical mechanics, CIMAT, week of 2016-08-08 (four lectures)
Cornell topology festival, weekend of 2016-05-12 (two lectures)
Random and statistical topology, Sendai, Japan, week of 2016-02-15 (three lectures)
Geometry and physics of spatial random systems, Bad Herrenalb, 2015-09-09
Joint Colloquium, Brandeis-Harvard-MIT-Northeastern, 2015-02-19
Topological Data Analysis and Stochastic Topology, CIMAT, Guanajuato, week of 2015-01-19 (four lectures)
AMS Invited address, Central Autumn Sectional Meeting, Eau Claire, 2014-09-20
AMS Short Course on Geometry and Topology in Statistical Inference, Baltimore, week of 2014-01-14
Dynamics and Applied Topology, Kyoto, week of 2013-06-09 (three lectures)
MacPherson seminar, IAS, 2013-01-24 & 2013-01-31
Stanford symposium on Algebraic topology: applications and new directions, 2012-07-25

Public lectures Science Sundays, Ohio State University, February 2018
Inaugural CSU Math Day Lecture, November 2017
Collaborative STEAM Factory talk on Kepler's Harmonices Mundi, Franklinton, 2016-02-12
National Math Festival, Washington D.C., 2015-04-18 (two talks)
Panel: Colorado Math Olympiad, 30th Anniversary award ceremony, Colorado Springs, 2013-05-03
Demonstrations, Shift studio, Seattle, 2007-06-02

Invited talks CombinaTexas, 2018-02-12 MCA 2017, Session on Quantitative Geometry and Topology, Montreal, 2017-07-26
FoCM 2017, Workshop on Computational Geometry and Topology, Barcelona, 2017-07-12
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 lectures), 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
Stochastic topology and topological statistical mechanics, CIMAT, week of 2016-08-08 (four lectures)
Cornell topology festival, weekend of 2016-5-12 (two lectures)
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 lectures)
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 TDA and Stochastic Topology (four lectures), CIMAT, Guanajuato, week of 2015-01-19

FoCM, Workshop on Computational Topology and Geometry, Montevideo, 2014-12-15
Discrete, Computational and Algebraic Topology, Copenhagen, 2014-11-11
AMS Invited address, Central Autumn 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, Japan, week of 2013-06-09
Colloquium, Indiana University, 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–): Introductory combinatorics (undergraduate), Graph Theory and Combinatorics I & II (graduate courses), Linear algebra and differential equations for engineers (undergraduate), Random graphs and percolation theory (graduate topics course), Random spaces and groups (graduate topics course)
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

AMS Central Sectional Meeting, March 2018
 ICERM Semester Program on “Topology in Motion”, Autumn 2016
 Probabilistic Methods in Topology, CRM, November 14–18, 2016
 TGDA@OSU 2016, May 2016
 Special session in “Random spaces”, AMS Central Autumn Sectional Meeting, Eau Claire, WI, 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, Autumn 2009
Bay Area Discrete Math Day, 2007–2010
Combinatorics and geometry seminar, Stanford, 2007–2008
Graduate Student Conference in Combinatorics, UW, Spring 2007.

Outreach and synergistic activities

Visitor and speaker, Nebraska IMMERSE program, week of 2013-07-01
Visitor (1 week), Canada/USA Mathcamp, summers 2012, 2010
Mentor (5 weeks), Canada/USA Mathcamp, summers 2007, 2006, 2005, 2003
Judge, Denman Undergraduate Research Forum, 2013
Radical Pi (OSU undergraduate math club): talks in 2013, 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
Polya problem solving seminar and coach of 4th place Putnam team, Stanford, Autumn 2009
Mentor, Canada/USA Mathcamp, summers 2003, 2005–2007

Graduate advising

Jimin Kim (current PhD student) Érika Roldán Roa (current PhD student)
Katherine Ritchey (current PhD student)
John Andrew Newman (current PhD student)
Kyle Parsons (PhD Summer 2017, currently data scientist at Root Insurance)
Greg Malen (PhD Spring 2016, currently postdoc at Duke)
Peter Kosek (M.S. Autumn 2014)

Other students mentored

Birra Taha, B.S., Ohio State, 2013 (Medical school, Cornell)
Dominic Dotterrer, Ph.D., Toronto, 2013 (Dickson Assistant Professor, Chicago)
Ted Dokos, B.S., Ohio State, 2012 (PhD program in mathematics, UCLA)
Sukhada Fadnavis, Ph.D., Stanford, 2012 (Benjamin Peirce Fellow, Harvard)
Jackson Gorham, B.S., Stanford 2010 (PhD program in statistics, Stanford)
Heather M. Lee, B.S., Washington 2007 (PhD program in mathematics, Berkeley)

Postdocs mentored

Hannah Alpert (current postdoc)
Fedor Manin (current postdoc)
Benjamin Schweinhart (current postdoc)
Jeremy Mason (tenure-track at UC Davis)
Matthew Wright (tenure-track at St. Olaf College)
Izhar Oppenheim (tenure-track at Ben Gurion University)

Editor

Associate Editor, ALEA (Latin American Journal of Probability and Mathematical Statistics), 2016–18

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)
Grant review for various agencies: NSF, NSA, ISF, ESF