

# Ralph Morrison

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## CONTACT INFORMATION

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## RESEARCH INTERESTS

Tropical geometry, algebraic geometry, discrete geometry, non-Archimedean geometry, combinatorics, chip-firing on graphs.

## EDUCATION

University of California, Berkeley, 2010 - 2015.

Ph.D., Mathematics, May 2015

Dissertation: “Tropical and non-Archimedean curves.”

Advisor: Bernd Sturmfels.

Williams College, Williamstown, MA, 2006 - 2010.

B.A., Highest Honors in Mathematics, Summa Cum Laude, Phi Beta Kappa, June 2010

## POSITIONS

KTH Stockholm, 2015 - 2016.

Postdoctoral researcher

Williams College, 2016 to present.

Assistant Professor of Mathematics

## PUBLICATIONS

1. *Prism graphs in tropical plane curves*, with L. Jacoby and B. Weber, to appear in *Involve, A Journal in Mathematics*.
2. *The moduli space of tropical curves with fixed Newton polygon*, with D. Coles, N. Dutta, S. Jiang, and A. Scharf, to appear in *Advances in Geometry*.
3. *Gonality sequences of graphs*, with I. Aidun, F. Dean, T. Yu, and J. Yuan, *SIAM Journal of Discrete Mathematics* 35 (2021), no. 2, 814-839.
4. *On the gonality of Cartesian products of graphs*, with I. Aidun, *Electronic Journal of Combinatorics* 27 (2020), no. 4, Paper No. 4.52, 35 pp.
5. *Convex lattice polygons with all lattice points visible*, with A. K. Tewari, *Discrete Mathematics, Volume 344* (2021), Issue 1.
6. *Higher distance commuting varieties*, with M. Elyze A. Guterman, and K. Šivic, *Linear and Multilinear Algebra* (2020).
7. *Tropical hyperelliptic curves in the plane*, *Journal of Algebraic Combinatorics* (2021), no. 2, 369–388.
8. *Tropical Geometry*, in P. Harris, E. Inkso, & A. Wootton (eds.), *A Project-Based Guide to Undergraduate Research in Mathematics: Starting and Sustaining Accessible Undergraduate Research* (pp. 63-105). Birkhuser Basel.
9. *Treewidth and gonality of glued grid graphs*, with I. Aidun, F. Dean, T. Yu, and J. Yuan, *Discrete Applied Mathematics*, 279 (2020), 1–11.
10. *Nullstellenfont: typesetting with algebraic curves*, with B. Logsdon and A. Michaelsen, *Math Horizons*, 27:4, 5-7 (2020). To be included in *The Best Writing on Mathematics 2021*, Princeton University Press.

11. *Graphs of gonality three*, with I. Aidun, F. Dean, T. Yu, and J. Yuan, Algebraic Combinatorics, Volume 2 (2019) no. 6 p. 1197-1217.
12. *The smallest art gallery not guarded by every third vertex*, Geombinatorics 29 (2019), no. 1, 24-32.
13. *The tropical commuting variety*, with N. M. Linear Algebra and Its Applications, 507 (2016), 300-321.
14. *Bitangents of tropical plane quartic curves*, with M. Baker, Y. Len, N. Pflueger, and Q. Ren, Mathematische Zeitschrift, 282 (2016), No 3-4, 1017-1031
15. *Moduli of tropical plane curves*, with S. Brodsky, M. Joswig, and B. Sturmfels, Research in the Mathematical Sciences, Vol. 2 (2015), 2:4.
16. *Tropical images of intersection points*, Collectanea Mathematica, Vol. 66 (2015), Issue 2, 273-283.
17. *Algorithms for Mumford curves*, with Q. Ren, Journal of Symbolic Computation, Vol. 68 (2015), 259-284.
18. *An elliptic curve family test of the L-functions Ratios Conjecture*, with D. Huynh and S. Miller, Journal of Number Theory, Vol. 131 (2011), 1117-1147
19. *The spiral index of knots*, with C. Adams, W. George, R. Hudson, L. Starkston, S. Taylor, and O. Turanova, Mathematical Proceedings of the Cambridge Philosophical Society, Vol. 149 (2010), Issue 2, 297-315

#### PREPRINTS

1. *Tropically planar graphs*, with D. Coles, N. Dutta, S. Jiang, and A. Scharf, submitted.
2. *Iterated and Mixed Discriminants*, with A. Dickenstein and S. di Rocco, submitted.
3. *Moduli dimensions of lattice polygons*, with M. Echavarría, M. Everett, S. Huang, L. Jacoby, A. Tewari, R. Vlad, and B. Weber, submitted
4. *On the scramble number of graphs*, with M. Echavarría, M. Everett, S. Huang, L. Jacoby, and B. Weber, submitted

#### TALKS

- Goethe-Universität Frankfurt, DIGO Seminar, June 2021, *Tropically planar graphs: counting and constraints*.
- Williams College, Mathematics Colloquium, June 2021, *Chip-firing games on graphs*.
- Santa Clara University, Mathematics Colloquium, April 2021, *Chip-firing games and graph gonality*.
- University of Kentucky, Mathematics Colloquium, March 2021, *Higher-distance commuting varieties*.
- Washington and Lee University, Pi Mu Epsilon Induction Speaker, March 2021, *Tropicalize ALL the things*.
- Mentor Project Luncheon Seminar, March 2021, *The importance of being wrong in mathematics*.
- Williams College, Mathematics Colloquium, June 2020, *Snapshots of tropical geometry*.
- Mentor Project "1 Hour Mentor" series, May 2020, *Undergraduate research in tropical geometry*.
- Mentor Project "1 Hour Mentor" series, April 2020, *Chip-firing games on graphs*.
- Nonlinear Algebra Seminar Online, MPI Leipzig, March 2020, *Higher distance commuting varieties*.
- Discrete Geometry Seminar, TU Berlin, February 2020, *Tropically planar graphs: geometry and*

*combinatorics.*

Valley Geometry Seminar, UMass Amherst, February 2020, *Higher distance commuting varieties.*

Wesleyan University, Wesleyan Undergraduate Math Club, February 2020, *Chip-firing games on graphs.*

Joint Math Meetings, AMS-MAA Special Session on Getting Started in Undergraduate Research: Topics, Tools and Open Problems, Denver CO, January 2020, *Undergraduate research topics in tropical geometry.*

Yale University, Algebraic and Tropical Geometry Seminar, November 2019, *Gonality of Cartesian products of graphs.*

Yale University, Yale Undergraduate Mathematics Society Colloquium, November 2019, *Chip-firing games on graphs.*

Binghamton University, Combinatorics Seminar, October 2019, *Tropically planar graphs.*

“Algebra meets combinatorics in Neuchatel” Conference, Neuchatel, Switzerland, July 2019, *The moduli space of tropical curves with fixed Newton polygon.*

SIAM conference on Applied Algebraic Geometry, Bern, Switzerland, July 2019, *Graphs of gonality three.*

Williams College, Weekly Science Lunch, March 2019, *Chip firing games on graphs.*

Amherst College, Mathematics Colloquium, November 2018, *Chip firing games on graphs.*

Williams College, Faculty Seminar, November 2018, *Higher-distance commuting varieties.*

Williams College, Mathematics Colloquium, July 2018, *Chip firing games and graph gonality.*

Cornell University, Number Theory Seminar, April 2018, *Tropical hyperelliptic curves in the plane.*

Cornell University, Oliver Club, April 2018, *Tropical curves and bitangents.*

AMS Spring Central Sectional Meeting (Columbus, OH), Special Session on Algebraic and Combinatorial Aspects of Tropical Geometry, March 2018, *Most planar graphs aren't tropical.*

Williams College, Faculty Seminar, February 2018, *Tropical hyperelliptic curves in the plane.*

Institut Mittag-Leffler Seminar, Djursholm, Sweden, January 2018, *Tropical graphs in the plane.*

Joint Math Meetings MAA Contributed Paper Session on Geometry, San Diego CA, January 2018, *Hyperelliptic tropical curves in the plane.*

Valley Geometry Seminar, UMass Amherst, December 2017, *Tropical graphs in the plane.*

SIAM conference on Applied Algebraic Geometry, Atlanta GA, August 2017, *Tropical hyperelliptic curves in the plane.*

Williams College, Mathematics Colloquium, July 2017, *Tropical graphs in the plane.*

Williams College, Summer Science Lunch Talk, July 2017, *Tropicalize ALL the things.*

Joint Math Meetings, AMS Contributed Paper Session on Algebraic Geometry, Atlanta GA, January 2017, *Tropical curves of genus 2.*

Williams College, Mathematics Faculty Colloquium, October 2016, *The moduli space of tropical*

*plane curves.*

Williams College, Weekly Science Lunch, October 2016, *Triangles and tropical curves.*

Brown University, Bi-annual Algebraic and Tropical Meetings of Brown and YaLE, September 2016, *Tropical curves of genus 2.*

SIAM Conference on Discrete Mathematics, Atlanta GA, June 2016, *Bitangents of tropical plane quartic curves.*

KTH/SU Stockholm, Pre-colloquium for *Complex, tropical and non-Archimedean geometry*, June 2016.

Stockholm-Uppsala Mini-Conference, May 2016, *Tropical curves: bitangents and beyond.*

KTH/SU Stockholm, Algebra and Geometry Seminar, May 2016, *The commuting variety: classically and tropically.*

University of Oslo, ASGARD Math, April 2016, *Moduli of tropical plane curves.*

Uppsala University, Geometry and Topology Seminar, March 2016, *Bitangents of tropical plane quartic curves.*

KTH/SU Stockholm, Algebra and Geometry Seminar, November 2015, *Moduli of tropical plane curves.*

University of Oslo, Norwegian Algebra Symposium, November 2015, *Bitangents of smooth tropical plane quartics.*

SIAM Conference on Applied Algebraic Geometry, Daejeon, Korea, August 2015, *Tropical Igusa invariants.*

Columbia University, Special Algebraic Geometry Seminar, April 2015, *Moduli of tropical plane curves.*

Courant Institute, Algebraic Geometry Seminar, April 2015, *Moduli of tropical plane curves.*

Brown, Student Tropical Algebraic Geometry Seminar, April 2015, *Moduli of tropical plane curves.*

University of Kentucky, Algebra & Statistics Seminar, March 2015, *Moduli of tropical plane curves.*

UC Berkeley, Commutative Algebra and Algebraic Geometry Seminar, March 2015, *Moduli of tropical plane curves.*

Williams College Colloquium, January 2015, *Tropical geometry: bitangents and beyond.*

Joint Math Meetings AMS Special Session on Studies in Interconnections among Parameters in Graph Theory, Combinatorics, and Discrete Geometry, January 2015, *Commuting tropical variety.*

Georgia Tech Algebra Seminar, November 2014, *Moduli of tropical plane curves.*

UT Austin Algebra, Number Theory & Combinatorics Seminar, October 2014, *Moduli of tropical plane curves.*

AMS Fall Western Sectional Meeting (San Francisco, CA), Special Session on Combinatorics and Algebraic Geometry, October 2014, *Moduli of hyperelliptic tropical plane curves.*

Conference for new PhDs in Algebraic Geometry, Seattle, WA, August 2014, *Computing actual*

*things.*

Yale, Student Tropical Algebraic Geometry Seminar, May 2014, *Bitangents of smooth tropical plane quartics.*

UC Santa Cruz, Algebra and Number Theory Seminar, April 2014, *Algorithms for Mumford curves over the  $p$ -adics.*

University of Michigan, Group, Lie and Number Theory Seminar, March 2014, *Algorithms for Mumford curves over the  $p$ -adics.*

UC Berkeley Commutative, Algebra and Algebraic Geometry Seminar, January 2014, *Algorithms for Mumford curves over the  $p$ -adics.*

Joint Math Meetings Special Session on Tropical and Non-Archimedean Analytic Geometry, January 2014, *Algorithms for Mumford curves over the  $p$ -adics: Good starting data.*

Saarland University, Algebraic Geometry Seminar, December 2013, *Tropical geometry and Mumford curve algorithms.*

Utrecht University GAGA Seminar, December 2013, *Algorithms for Mumford curves over the  $p$ -adics.*

KTH/SU Stockholm, Algebra and Geometry Seminar, November 2013, *Algorithms for Mumford curves over the  $p$ -adics.*

Goethe University Frankfurt, Oberseminar, October 2013, *Algorithms for Mumford curves over the  $p$ -adics.*

Max Planck Institute for Mathematics (Bonn), Seminar on Computational Algebraic Geometry, August 2013, *Algorithms for Mumford curves.*

UC Berkeley, Commutative Algebra and Algebraic Geometry Seminar, April 2013, *Tropical implicitization.*

Joint Math Meetings Session on Number Theory, Field Theory, and Polynomials, January 2012, *An elliptic curve test for the  $L$ -functions ratios conjecture.*

#### GRANTS AND FELLOWSHIPS

NSF Grant: RUI: Algorithms and Complexity in Chip-Firing Games and Graph Gonality, 2020-2023 (\$99,445)

AMS and the Simons Foundation: AMS-Simons Travel Grant, 2019-2023 (\$5,000)

Williams College: Class of 1945 World Fellowship Program, 2019-2020 (\$8,100)

Williams College: Summer Tutorial Stipend, Summer 2017 (\$4,000)

National Science Foundation: Graduate Research Fellowship, 2010

#### HONORS AND AWARDS

UC Berkeley: Kenneth Ribet and Lisa Goldberg Award in Algebra, 2015.

UC Berkeley: Outstanding Graduate Student Instructor Award, 2012.

#### TEACHING

At Williams:

Spring 2021: Math 474, *Tropical geometry.*

Fall 2020: Math 151, *Multivariable calculus* (three sections).

Spring 2019: Math 334, *Graph theory* and Math 487: *Computational algebraic geometry*

Winter 2019: Math 13, *The Mathematics of SET (and other games)*  
Fall 2018: Math 200, *Discrete mathematics* (two sections).  
Spring 2018: Math 329T, *Discrete geometry* and Math 474, *Tropical geometry*.  
Fall 2017: Math 200, *Discrete mathematics* (two sections).  
Spring 2017: Math 378, *Computational algebraic geometry*.  
Fall 2016: Math 151, *Multivariable calculus* (three sections).

At KTH:

Fall 2015: *Tropical Geometry Minicourse*.

At UC Berkeley (as a graduate student instructor):

Spring 2014: Math 10B, *Methods of Mathematics: Calculus, Statistics, and Combinatorics*.  
Fall 2012: Math 10A, *Methods of Mathematics: Calculus, Statistics, and Combinatorics*.  
Spring 2012: Math 55, *Discrete Mathematics*.  
Fall 2011: Math 53, *Multivariable Calculus*.  
Spring 2011: Math 1B, *Calculus*.

## ADVISING

While at Williams:

Fall 2021-Spring 2022: First year advisor for Prairie Resch, Talia Sanders, and Callan Sandquist.  
Summer 2021: Advisor for the chip-firing games group in the SMALL REU (seven students: Lisa Cenek, Lizzie Ferguson, Eyobel Gebre, Cassandra Marcussen, Jason Meintjes, Liz Ostermeyer, and Shefali Ramakrishna).  
Fall 2020-Spring 2021: Thesis advisor for Max Everett, Robin Huang, and Ben Weber. Second reader for John Petrucci and Maria Hertz Rodriguez. Colloquium advisor for Markus Feng, Rishad Karim, Eli Miller, Andrew Thai, and Peter Zhao. First year advisor for Elizabeth High, Spencer Huang, and Peter Miles.  
Summer 2020: Advisor for the tropical geometry group in the SMALL REU (six students: Marino Echavarría, Max Everett, Robin Huang, Liza Jacoby, Raluca Vlad, and Benjamin Weber).  
Spring 2020: Second reader for Michael Curran. Research mentor for Eunice Sukarto, a junior at UC Berkeley.  
Fall 2018-Spring 2019: Thesis advisor for Jian Lu. Second reader for Neel Jain. Colloquium advisor for Franny Dean, Coly Elhai, Francesca Eluhu, Amy Qiu, and Stuart Read. First year advisor for Brian Crane, Irfan Durmic, Jihoon Kim, and Ryan Watson.  
Summer 2018: Advisor for the tropical geometry group in the SMALL REU (five students: Ivan Aidun, Franny Dean, Sanmmy Rosofsky, Teresa Yu, and Julie Yuan).  
Fall 2017-Spring 2018: Thesis advisor for Madeleine Elyze and Andrew Scharf. Second reader for Isabella Huang. First year advisor for Sarah Baldree, Rishad Karim, and Marya Rana.  
Summer 2017: Advisor for the tropical geometry group in the SMALL REU (four students: Desmond Coles, Neelav Dutta, Sifan Jiang, and Andrew Scharf).  
Fall 2016-Spring 2017: Colloquium advisor for Patrick Anderson, Robin Park, Molly Siebecker, Ben Solis-Cohen, Eleanor Wachtel, and Wendy Wiberg.

While at KTH:

Spring 2016: Tomas Petkov, Degree project in engineering physics, first level. *Elliptic curves over finite fields and the rationals: Determining the underlying group structure*.

SERVICE TO WILLIAMS COLLEGE Summer 2021

- Assistant Director of the SMALL REU

Summer 2020-Spring 2021

- Member of the Information Technology Committee
- Math/Stat departmental coordinator for Alums and for Puzzles and Contests; member of the working group on Diversity, Equity, and Inclusion

Summer 2018-Spring 2019

- Member of the College and Community Advisory Committee
- Member of the International Education and Study Away Faculty Advisory Group
- Math/Stat departmental coordinator for website and publicity, and member of the math hiring committee
- Department representative at a panel/discussion about research opportunities in math and science at Williams (August 2018)
- Department representative at the Academic Expo (September 2018)
- Faculty participant in EphL(a)unch (September 2018)

Summer 2017-Spring 2018

- Member of the Committee on Undergraduate Life.
- Junior Faculty Representative on the Science Executive Committee
- Math/Stat departmental coordinator for website, publicity, and student spaces
- Department representative at the Academic Expo (September 2017) and the Previews Academic Open House (April 2018)

Fall 2016 - Spring 2017:

- Faculty liaison for the Student Math and Statistics Advisor Board (SMASAB)
- Faculty coordinator of Math Puzzle Night and math contests
- Math/stat alumni relations coordinator
- Department representative at the Academic Expo (September 2016) and the Previews Academic Open House (April 2017)
- Faculty participant in Windows on Williams (WOW) (September 2016)
- Panelist for a math/stats graduate school panel (October 2016)
- Debater at the Latke-Hamentaschen Debate (March 2017)
- Speaker at SophLaunch (April 2017)

OTHER SERVICE AND PROFESSIONAL ACTIVITIES Referee for multiple journals (the European Journal of Combinatorics, the Journal of Symbolic Computation, and the Proceedings of the London Mathematical Society, Discrete Mathematics and Theoretical Computer Science, Le Matematiche, Special Matrices).

Reviewer for AMS Math Reviews, Summer 2017-present.

Mentor for the Mentor Project, March 2020-present.

Participant in “Creating a Better Summer Experience: A DEI Workshop for REU Directors and Faculty Mentors”, hosted by the Center for Minorities in the Mathematical Sciences, May 2021.

Co-organizer (with Josh Carlson and Pamela Harris) of the Discrete Math Days 2021 conference at Williams College, April 2021.

Remote participant at ICERM, *Combinatorial Algebraic Geometry* program, Spring 2021.

Member of a reading group on *Successful STEM Mentoring Initiatives for Underrepresented Students: A Research-Based Guide for Faculty and Administrators* by Becky Wai-Ling Packard, Spring 2021.

Coauthor of AMS Blog Post “Opportunities for First and Second Year College Students”, December 2020.

Member of a reading group on *Small Teaching Online* by Flower Darby and James M. Lang, Summer 2020.

Guest at the Max Planck Institute for Mathematics in the Sciences in Leipzig, Germany, February-April 2020.

Tabling for the AMS MRC Program, Joint Mathematics Meetings, January 2018 and January 2020.

Visitor at ICERM, September 2019 for “Illustrating Geometry and Topology”.

Member of a reading group on *Small Teaching* by James M. Lang, Summer 2019.

Panelist for early career mathematicians at the “Ideals, Varieties, and Algorithms: Celebrating the Influence of David Cox” conference, June 2019.

Participant in the Faculty Writing Roundtable program at Williams, Fall 2018.

Participant in the “Tropical Geometry and Moduli Spaces” Satellite Conference to the International Congress of Mathematics; Cabo Frio, Brazil, August 2018.

Judge for MAA Mathfest Undergraduate Session, August 2018.

Participant in Institut Mittag-Leffler’s research program in “Tropical Geometry, Amoebas, and Polytopes,” January-February 2018.

Moderator for an MAA General Contributed Paper Sessions, Joint Mathematics Meetings, January 2018.

Young Mathematicians Conference Mentor, August 2017.

Participant in the Faculty Writing Roundtable program at Williams, Spring 2017.

Chair for an AMS Contributed Paper Session, Joint Mathematics Meetings, January 2017.

Presenter for PRAO program for young women in mathematics, KTH, November and December 2015.

Guest at the Max Planck Institute for Mathematics in Bonn, Germany, Fall 2013.

AMS Mathematical Research Community participant in Snowbird, Utah, June 2013.

Officer for the Mathematics Graduate Student Association at Berkeley, January 2012 to January



2015.

Member of Unbounded Representation at Berkeley, 2011-2012.