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**NATHAN READING**  
**North Carolina State University**

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## RESEARCH INTERESTS

Algebraic and geometric combinatorics.

## EDUCATION

University of Minnesota, 1996 to 2002. Ph.D. Mathematics, April, 2002.

Thesis Title: On the structure of Bruhat order

Adviser: Victor Reiner

Stanford University, 1989 to 1990, 1992 to 1995. B.S., Physics, 1995.

## EMPLOYMENT

Professor, North Carolina State University, August 2018 to present.

Associate Professor, North Carolina State University, August 2012 to August 2018.

Assistant Professor, North Carolina State University, August 2006 to August 2012.

Postdoctoral Assistant Professor, University of Michigan, September 2002 to June 2006.

Graduate Teaching Assistant, University of Minnesota, September 2001 to June 2002.

Graduate Fellow (Shevlin Fellowship), University of Minnesota, September 2000 to June 2001.

Graduate Teaching Assistant, University of Minnesota, September 1996 to June 2000.

Math Teacher, Pinewood School, Los Altos Hills, CA, September 1995 to June 1996.

## GRANTS, FELLOWSHIPS AND AWARDS

NSF Research Grant, “Coxeter Groups, Scattering Diagrams, and Shards”, August 2021 to July 2024.

Simons Foundation Collaboration Grant, “Cluster algebras, representation theory, and Coxeter groups”, September 2018 to August 2023.

NSF Research Grant, “Combinatorics And Geometry Of Mutations”, August 2015 to July 2018.

NSA Conference Grant, “Triangle Lectures in Combinatorics”, August 2014 to August 2016.

NSF Conference Grant, “Triangle Lectures in Combinatorics”, April 2014 to March 2017.

NSF Research Grant, “Coxeter combinatorics and cluster algebras”, August 2011 to July 2015.

NSA Conference Grant, “Triangle Lectures in Combinatorics”, April 2012 to April 2014.

NSF Conference Grant, “Triangle Lectures in Combinatorics”, August 2012 to July 2014.

Simons Foundation Collaboration Grant, “Coxeter combinatorics and cluster algebras”, July 2011 to June 2012.

NSF Conference Grant, “Triangle Lectures in Combinatorics”, March 2010 to February 2012.

NSA Young Investigator Grant, “Partial orders on Coxeter groups”, January 2009 to July 2011.

NCSU Faculty Research Professional Development Grant, “Sortable elements and cluster algebras”, July 2008 to August 2009.

NSF Research Training Grant (RTG) Fellowship, September 2005 to August 2006.  
 NSF Postdoctoral Research Fellowship, June 2002 to May 2005.  
 Thesis Prize, University of Minnesota, School of Mathematics, 2002.  
 Excellence in Teaching Award, University of Minnesota, School of Mathematics, 2001.  
 Thomas H. Shevlin Fellowship, University of Minnesota, September 2000 to June 2001.  
 University of Minnesota Graduate School Fellowship, September 1996 to June 1997.  
 AWU/DOE Fellowship, Lawrence Livermore National Laboratory, Summer 1993.  
 David Starr Jordan Scholar, Stanford University, 1989.

## PUBLICATIONS, PREPRINTS AND WORK IN PROGRESS

49. “Noncrossing partitions of an annulus”, preprint 2022.
48. “Noncrossing partitions of a marked surface”, preprint 2022.
47. “Cluster scattering diagrams of acyclic affine type” (with Salvatore Stella), preprint 2022.
46. “The fundamental theorem of finite semidistributive lattices” (with David Speyer and Hugh Thomas), *Selecta Mathematica* **27**, Article number: 59 (2021).
45. “Dominance phenomena: mutation, scattering and cluster algebras”, *Trans. Amer. Math. Soc.* **376**, Number 2 (2023) 773–835.
44. “A combinatorial approach to scattering diagrams”, *Algebraic Combin.* **3** no. 3 (2020), 603–636.
43. “Scattering fans”, *Int. Math. Res. Notices* **2020**, no. 23, 9640–9673.
42. “Lattice theory of torsion classes” (with Osamu Iyama, Idun Reiten, and Hugh Thomas), preprint 2017.
41. “Lattice structure of Weyl groups via representation theory of preprojective algebras” (with Osamu Iyama, Idun Reiten, and Hugh Thomas), *Compos. Math.* **154**, no. 6 (2018), 1269–1305.
40. “Coxeter-biCatalan combinatorics” (with Emily Barnard), *J. Algebraic Combin.* **47(2)** (2018), 241–300.
39. “Universal geometric coefficients for the four-punctured sphere” (with Emily Barnard, Emily Meehan, and Shira Viel), *Ann. Comb.* **22(1)** (2018), 1–44.
38. “An affine almost-positive roots model” (with Salvatore Stella), *J. Comb. Algebra* **4** (2020), 1–59.
37. “The action of a Coxeter element on an affine root system” (with Salvatore Stella), *Proc. Amer. Math. Soc.* **148**, no. 7 (2020) 2783–2798.
36. “Lattice homomorphisms between weak orders”, *Electron. J. Combin.* **26** (2019), Article Number P2.23, 50 pages.
35. “A Cambrian framework for the oriented cycle” (with David Speyer), *Electron. J. Combin.* **22(4)** (2015), #P4.46, 21 pp.
34. “Cambrian frameworks for cluster algebras of affine type” (with David Speyer), *Trans. Amer. Math. Soc.* **370**, no. 2, (2018), 1429–1468.
33. “Coxeter arrangements in three dimensions” (with Richard Ehrenborg and Caroline Klivans), *Beitr. Algebra Geom.* **57** (2016), no. 4, 891–897.
32. “Initial-seed recursions and dualities for  $\mathbf{d}$ -vectors” (with Salvatore Stella), *Pacific J. Math.*

- 293-1** (2018), 179–206.
31. “Finite Coxeter groups and the weak order”, *Lattice Theory: Special Topics and Applications*, editors George Grätzer and Friedrich Wehrung. Vol. 2, 489–561, Birkhäuser/Springer, 2016.
  30. “Lattice theory of the poset of regions”, *Lattice Theory: Special Topics and Applications*, editors George Grätzer and Friedrich Wehrung. Vol. 2, 399–487, Birkhäuser/Springer, 2016.
  29. “Noncrossing arc diagrams and canonical join representations”, *SIAM J. Discrete Math.* **29** (2015), no. 2, 736–750.
  28. “Universal geometric coefficients for the once-punctured torus”, *Sém. Lothar. Combin.* B71e (2015), 30 pp.
  27. “Universal geometric cluster algebras from surfaces”, *Trans. Amer. Math. Soc.* **366** (2014), 6647–6685.
  26. “Universal geometric cluster algebras”, *Math. Z.* **277** (2014), no. 1–2, 499–547.
  25. “Combinatorial frameworks for cluster algebras” (with David Speyer), *Int. Math. Res. Notices* **2016**, no. 1, 109–173.
  24. “From the Tamari lattice to Cambrian lattices and beyond”, in *Associahedra, Tamari Lattices and Related Structures*, Tamari Memorial Festschrift, ed. F. Mueller-Hoissen, J. Pallo, J. Stasheff. *Progress in Mathematics* **299**. Birkhauser, 2012.
  23. “Generic rectangulations”, *European J. Combin.* **33** (2012) 610–623.
  22. “The Hopf algebra of rectangulations” (with Shirley Law), *J. Combin. Theory Ser. A* **119** (2012) no. 3, 788–824.
  21. “Coarsening polyhedral complexes”, *Proc. Amer. Math. Soc.* **140** (2012), 3593–3605.
  20. “Noncrossing partitions and the shard intersection order”, *J. Algebraic Combin.* **33** (2011), no. 4, 483–530.
  19. “Sortable elements for quivers with cycles” (with David Speyer), *Electron. J. Combin.* **11(1)** (2010), Research Paper 90, 19 pp.
  18. “Sortable elements in infinite Coxeter groups” (with David Speyer), *Trans. Amer. Math. Soc.* **363** (2011), 699–761.
  17. “Noncrossing partitions, clusters and the Coxeter plane”, *Sém. Lothar. Combin.* **63** (2010), Article B63b.
  16. “Chains in the noncrossing partition lattice”, *SIAM J. Discrete Math.* **22** (2008), no. 3, 875–886.
  15. “Cambrian fans” (with David Speyer) *J. Eur. Math. Soc. (JEMS)* **11** (2009), no. 2, 407–447.
  14. “Sortable elements and Cambrian lattices”, *Algebra Universalis* **56** (2007) no. 3–4, 411–437.
  13. “Clusters, Coxeter-sortable elements and noncrossing partitions”, *Trans. Amer. Math. Soc.* **359** (2007), 5931–5958.
  12. “Generalized cluster complexes and Coxeter combinatorics” with Sergey Fomin, *Int. Math. Res. Notices*, **2005** no. 44, 2709–2757.
  11. “Root systems and generalized associahedra” with Sergey Fomin, *IAS/Park City Math. Ser.* **13**, 63–131.
  10. “Cambrian lattices”, *Adv. Math.*, **205** (2006), no. 2, 313–353.

9. “Lattice congruences, fans and Hopf algebras”, *J. Combin. Theory Ser. A*, **110** (2005) no. 2, 237–273.
8. “Lattice congruences of the weak order”, *Order*, **21** (2004) no. 4, 315–344.
7. “The order dimension of Bruhat order on infinite Coxeter groups” with Debra J. Waugh, *Electron. J. Combin.* **11(2)** (2005), Research Paper 13, 26 pages (electronic).
6. “The order dimension of the poset of regions in a hyperplane arrangement”, *J. Combin. Theory Ser. A*, **104** (2003) no. 2, 265–285.
5. “Lattice and order properties of the poset of regions in a hyperplane arrangement”, *Algebra Universalis*, **50** (2003), 179–205.
4. “The cd-index of Bruhat intervals”, *Electron. J. Combin.* **11(1)** (2004), Research Paper 74, 25 pages (electronic).
3. “Order Dimension, Strong Bruhat Order and Lattice Properties for Posets”, *Order*, **19** (2002) no. 1, 73–100.
2. “Non-negative cd-coefficients of Gorenstein\* posets”, *Discrete Math*, **274** (2004) no. 1–3, 323–329.
1. “Nim-Regularity of Graphs”, *Electron. J. Combin.* **6** (1999) no. 1, Research paper 11, 8 pages (electronic).

## COLLOQUIA, PLENARY TALKS, AND LECTURE SERIES

*Scatter, cluster, scatter, model*, ZMP Colloquium, Center for Mathematical Physics, Hamburg University, January, 2022.

*Lattice congruences of the weak order: Algebra, combinatorics, and geometry*, Triangle Lectures in Combinatorics (TLC), Wake Forest University, NC, March 2019.

*To scatter or to cluster?*, Mathematical Colloquium, Linköping University, May 2018.

*Lattice congruences of the weak order*, (2 lectures, 2 hours each) for the CRM/LaCIM Spring School on Algebraic and Geometric Combinatorics of Reflection Groups, Montreal, Québec, June 1–2, 2017.

*Lattice Congruences of the Weak Order on a Finite Weyl Group*, Expository Lecture, Maurice Auslander International Conference, April 2016.

*Mutation-linear maps*, 26th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2014), Chicago, IL, July 2014.

*Mutation-linear algebra*, BYU Mathematics Colloquium, March 2013.

*Cluster algebras and Coxeter combinatorics*, Minicourse (5 lectures, 1.5 hours each) for the MSRI Graduate Workshop on Cluster Algebras and Cluster Combinatorics, August, 2011.

*Coxeter groups and cluster algebras*, UNC Charlotte Mathematics Colloquium, April 2011.

*Cluster algebras and infinite associahedra*, Plenary talk, Combinatexas Conference, El Paso, TX, April 2008.

*Catalan combinatorics of finite Coxeter groups*, Texas A&M Mathematics Colloquium, February 2006.

*Catalan combinatorics of finite Coxeter groups*, University of South Carolina Mathematics Colloquium, February 2006.

## CONFERENCE PRESENTATIONS

- Cluster scattering diagrams: Models and mutations*, ISM Discovery School on Mutations , UQAM, July, 2022.
- Noncrossing partitions of classical affine type*, Special Session on Representation Theory of Algebras and Related Combinatorics (changed to an online meeting when the AMS canceled the Southeastern Sectional meeting), Online, March 2022.
- Cluster scattering diagrams of affine type*, Special Session on Cluster Algebras and Plabic Graphs, AMS Eastern Sectional Meeting, Online, October, 2020.
- A Combinatorial Approach to Cluster Scattering Diagrams*, Cluster structures in geometry, physics, combinatorics and representation theory, Jerusalem, December 2018.
- A fan for every cluster algebra*, Combinatorics and beyond: the many facets of Sergey Fomin’s mathematics, University of Michigan, November, 2018.
- Dominance phenomena: mutation, scattering and cluster algebras*, Vingt ans d’algèbres amassées, CIRM, Luminy, March 2018.
- Lattice homomorphisms between weak orders and between Cambrian lattices*, CRM/LaCIM Workshop on Algebraic and Geometric Combinatorics of Reflection Groups, Montreal, Québec, June 5, 2017.
- Lattice congruences on the weak order*, Session on algebraic combinatorics, CMS Winter Meeting, Montreal, December 2015.
- Sortable Elements in Cluster-algebra Computations*, Sage Days 64.5: Cluster Algebras, June 2015.
- Models for cluster algebras of affine type*, Conference on Cluster Algebras in Combinatorics and Topology (CMC Thematic Program on Cluster Algebras in Mathematics and Physics), KIAS, Seoul, Korea, December 2014.
- Noncrossing diagrams for permutations*, BIREP Workshop “Non-crossing partitions in representation theory”, Bielefeld, Germany, June 2014.
- Mutation-linear algebra and universal geometric coefficients for cluster algebras*, AMS Sectional Meeting, University of Colorado Boulder, April 2013.
- Cambrian models for cluster algebras*, AMS Sectional Meeting, Special Session on Combinatorial Algebraic Geometry, Wake Forest University, September 2011.
- Generic triangulations and pattern-avoiding permutations*, AMS Sectional Meeting, Special Session on Species and Hopf Algebraic Combinatorics, Cornell University, September 2011.
- The Hopf algebra, lattice and polytope of triangulations*, SIAM Conference on Discrete Mathematics, Minisymposium on Enumerative Combinatorics, Austin, TX, June 2010.
- Coarsening polyhedral complexes*, CMS Summer Meeting, Session on Algebraic Combinatorics, University of New Brunswick, June 2010.
- A Cambrian approach to cluster algebras*, AMS Sectional Meeting, Special Session on Combinatorial Representation Theory, Macalester College, St. Paul, MN, April 2010.
- The Hopf algebra, lattice and polytope of triangulations*, AMS Sectional Meeting, Special Session on Advances in Algebraic & Geometric Combinatorics, University of Kentucky, March 2010.
- Coarsening polyhedral complexes*, Workshop on Combinatorics, Enumeration and Invariant Theory, George Mason University, March 2010.

- Noncrossing partitions and the shard intersection order*, Ulam Centennial Conference, University of Florida, March 2009.
- Clusters, noncrossing partitions and the Coxeter plane*, FPSAC, Nankai University, Tianjin, China, July 2007.
- Dual combinatorics of clusters*, AMS Sectional Meeting, Special Session on Geometric and Combinatorial Methods in Representation Theory, Davidson, NC, March 2007.
- Lattice theory of the poset of regions, with applications to  $W$ -Catalan combinatorics*, AMS Winter Meetings, Special Session on Arrangements, New Orleans, LA, January 2007.
- The algebra and geometry of sortable elements*, AMS Sectional Meeting, Special Session on Algebraic Combinatorics, Fayetteville, AR, November 2006.
- The combinatorics (and “dual” combinatorics) of clusters*, NSF/CBMS Regional Conference on Cluster Algebras and Applications, Raleigh, NC, June 2006.
- Clusters, Coxeter-sortable elements and noncrossing partitions*, FPSAC, San Diego, CA, June 2006.
- Clusters, diminishing elements and noncrossing partitions*, AIM Workshop on Braid Groups, Clusters and Free Probability, Palo Alto, CA, January, 2005.
- Lattice congruences and Hopf algebras*, BIRS Workshop on Combinatorial Hopf Algebras, Banff, Canada, September 2004.
- Cambrian lattices and generalized associahedra*, PCMI/IAS Research Program in Geometric Combinatorics, Park City, UT, July 2004.
- Cambrian lattices and generalized associahedra*, FPSAC, Vancouver, Canada, 2004.
- The order dimension of the poset of regions in a hyperplane arrangement* (Poster), FPSAC, Vadstena, Sweden, 2003.
- Order dimension, strong Bruhat order and lattice properties for posets*, AMS Winter Meetings, Special Session on Lattice Theory, San Diego, CA, January 2002.
- Bases for the flag  $f$ -vectors of Eulerian posets* (Poster), FPSAC, Arizona State University, June 2001.
- Bases for the flag  $f$ -vectors of Eulerian posets*, AMS Sectional Meeting, Special Session on Polytopes, Lawrence, KS, March 2001.
- Problem Session, Victor Klee 75th Birthday Conference, University of Washington, August 2000.

## SEMINAR TALKS

- Theta functions and the mutation fan*, Online Cluster Algebras Seminar (OCAS), January, 2021.
- To scatter or to cluster?*, Seminario di Algebra e Geometria, Roma “La Sapienza”, March 2018.
- Dominance phenomena: mutation, scattering and cluster algebras*, University of Michigan Combinatorics Seminar, November 2017.
- Scattering fans, cluster algebras, and Narayana numbers*, University of Minnesota Combinatorics Seminar, March 2017.
- To scatter or to cluster?*, University of Minnesota Student Combinatorics Seminar, March 2017.
- Mutation-linear algebra*, Northeastern University Representation Theory Seminar, April 2013.
- Universal geometric cluster algebras*, University of Michigan Combinatorics Seminar, January

2012.

*Generic rectangulations and pattern-avoiding permutations*, Georgia Tech Combinatorics Seminar, April 2011.

*Noncrossing partitions and the shard intersection order*, University of Washington Combinatorics and Geometry Seminar, May 2009.

*Noncrossing partitions and the shard intersection order*, University of California at Davis Algebra and Discrete Mathematics Seminar, March 2009.

*Noncrossing partitions and the shard intersection order*, University of California at Santa Barbara Discrete Geometry Seminar, March 2009.

*Noncrossing partitions and intersections of shards*, University of Kentucky WILDCATS (Work, Interactions, and Leading Developments in Combinatorics, Algebra, Topology, and Statistics) Seminar, November 2008.

*Noncrossing partitions and intersections of shards*, University of Michigan Combinatorics Seminar, October 2008.

*Noncrossing partitions and intersections of shards*, MIT Combinatorics Seminar, September 2008.

*Sortable elements and Cambrian fans*, University of Michigan Combinatorics Seminar, September 2006.

*Catalan combinatorics of finite Coxeter groups*, NC State Mathematics Seminar, January, 2006.

*Catalan combinatorics of finite Coxeter groups*, BYU Mathematics Seminar, January, 2006.

*Clusters, Coxeter-sortable elements and noncrossing partitions*, University of Washington Combinatorics Seminar, March 2005.

*Clusters,  $c$ -sortable elements and noncrossing partitions*, UC Berkeley Combinatorics Seminar, March 2005.

*Noncrossing partitions and the Coxeter plane*, UC Santa Barbara Discrete Geometry and Combinatorics Seminar, November 2004.

*Noncrossing partitions and the Coxeter plane*, Texas A&M Algebra and Combinatorics Seminar, October 2004.

*Cambrian Lattices*, University of Minnesota Combinatorics Seminar, September 2003.

*The order dimension of the poset of regions in a hyperplane arrangement*, University of Minnesota Combinatorics Seminar, March 2003.

*Cambrian Lattices*, Michigan State University Combinatorics Seminar, March 2003.

*Order dimension of supersolvable arrangements*, University of Michigan Combinatorics Seminar, February, 2002.

*The  $cd$ -index of an Eulerian poset*, York University Applied Algebra Seminar, May, 2001.

## JOURNAL EDITORIAL BOARDS

Algebra universalis, October 2017–present.

ORDER, August 2018–present.

## POSTDOCTORAL SCHOLARS MENTORED

Salvatore Stella (Ph.D. April 2013 with Andrei Zelevinsky). August 2013 to May 2015.

## **STUDENTS MENTORED**

### **Doctoral students**

Jessie Copher. Ph.D. expected 2024.

Jordan Almeter. Ph.D. expected Summer 2022.

Laura Brestensky. Ph.D. Summer 2022.

Chetak Hossain (jointly advised with Patricia Hersh). Ph.D. Fall 2019.

Shira Viel. Ph.D. Summer 2018.

Emily Barnard. Ph.D. Spring 2017.

Emily Meehan. Ph.D. Spring 2017.

Shirley Law. Ph.D. Summer 2013.

Erin Bancroft. Ph.D. Summer 2011.

### **Masters students**

Matt Watson, Masters Spring 2012.

Jesse Copher. Masters Spring 2019.