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Research Interests

Algebraic, geometric, and topological combinatorics

Education

Massachusetts Institute of Technology

Ph.D. in Mathematics

Thesis Advisor : Richard Stanley

Thesis title : Quotients of Coxeter complexes and P-partitions

September 1986–June 1990

Princeton University

A.B. in Mathematics

September 1982–June 1986

Experience

Professor, University of Minnesota

Fall 2001–present

Associate Professor, University of Minnesota

Fall 1997–Fall 2001

Assistant Professor, University of Minnesota

Fall 1993–Fall 1997

Dunham Jackson Assistant Professor, University of Minnesota

Fall 1990–Spring 1993

Honors and awards

NSF Math Sciences Postdoctoral Research Fellowship

September 1992–August 1995

Alfred P. Sloan Research Fellow

September 1996–August 1998

Univ. of Minnesota McKnight Land Grant Professor

July 1996–June 1998

Univ. of Minnesota Taylor Career Development Award

June 1997

Univ. of Minnesota Distinguished McKnight Professor

July 2003–present

Editorships

Editor-in-Chief of Journal of Algebraic Combinatorics

2000–2005

Member of Editorial Board of ORDER

1998–2007

Associate Editor of Journal of the AMS

2004–2009

Member of Editorial Board of Algebra and Number Theory

2007–present

Grants

Traditional NSF grants

1999–2002, 2003–2006, 2007–2009, 2010–2012

Co-PI on Israeli BSF US-Israel Binational grant

2004–2006

Publications

Appeared:

1. “Free modules of relative invariants of finite groups”, *Stud. in Appl. Math.*, **81**(1989), 181–184.
2. “Quotients of Coxeter complexes and P-partitions”, *Mem. AMS. 460*, **95**(1992), 1–134.
3. “Signed posets”, *J. Comb. Theory, Ser. A*, **62**(1993), 324–360.
4. (with M. Hawrylycz) “The lattice of closure relations of a poset”, *Alg. Universalis*, **30** (1993), 301–310.
5. (with P. H. Edelman) “Free hyperplane arrangements between A_{n-1} and B_n ”, *Math. Zeit.*, **215**(1994), 347–365.
6. “Signed permutation statistics”, *Eur. J. Comb.*, **14**(1993), 553–567.
7. “Signed permutation statistics and cycle type”, *Eur. J. Comb.*, **14**(1993), 569–579.
8. “Upper binomial posets and signed permutation statistics”, *Eur. J. Comb.*, **14**(1993), 581–588.
9. (with P. H. Edelman) “A counterexample to Orlik’s conjecture”, *Proc. AMS*, **118**(1993), 927–929.
10. (with P. H. Edelman) “H-shellings and h-complexes”, *Adv. Math*, **106**(1994), 36–62.
11. (with G. Ziegler) “Coxeter-associahedra”, *Mathematika*, **41**(1994), 364–393.
12. (with P. H. Edelman) “Not all free arrangements are $K(\pi, 1)$ ”, *Bull. AMS*, **32** (1995), 61–65.
13. (with M. Shimozono) “Key polynomials and a flagged Littlewood-Richardson rule”, *J. Comb. Theory, Ser. A*, **70** (1995), 107–143.
14. “Descents and one-dimensional characters for classical Weyl groups”, *Disc. Math*, **140**(1995), 129–140.
15. (with M. Shimozono) “Specht series for column-convex diagrams”, *J. Algebra*, **174** (1995), 489–522.
16. (with M. Shimozono) “Plactification”, *J. Algebraic Comb.* **4** (1995), 331–351
17. “On Göbel’s bound for invariants of permutation groups”, *Archiv der Math.*, **65** (1995), 475–480.
18. “The distribution of descents and length in a Coxeter group”, *Elec. J. Comb.*, **2** (1995), R25, 20pp.
19. (with P. H. Edelman) “Free arrangements and rhombic tilings”, *Disc. and Computational Geom.*, **15** (1996), 307–340.
20. (with P. H. Edelman) “The higher Stasheff-Tamari posets”, *Mathematika*, **43** (1996), 127–154.

21. (with S. V. Fomin, C. Greene, and M. Shimozono) “Balanced Diagrams, reduced decompositions, Schur functions, and Schubert polynomials”, *Europ. J. Comb.*, **18** (1997), 373–389.
22. “Non-crossing partitions for classical reflection groups”, *Discrete Math.*, **177** (1997), 195–222.
23. (with P. H. Edelman) “Catalan triangulations of the Möbius band”, *Graphs and Combinatorics*, **13** (1997), 231–243.
24. (with M. Shimozono) “Straightening for standard monomials on Schubert varieties”, *J. Algebra*, **195** (1997), 130–140.
25. (with D. Stanton) “Unimodality of differences of specialized Schur functions”, *J. Algebraic Comb.*, **7** (1998), 91–107.
26. (with P. H. Edelman) “Visibility complexes and the Baues problem for triangulations in the plane”, *Disc. and Computational Geom.*, **20** (1998), 35–59.
27. (with J. A. Eagon) “Resolutions of Stanley-Reisner rings and Alexander duality”, *J. Pure and Appl. Algebra*, **130** (1998), 265–275.
28. (with Irena Peeva and Bernd Sturmfels) “How to shell a monoid”, *Math. Annalen*, **310** (1998), 379–393.
29. (with M. Shimozono) “Percent-avoiding, northwest shapes and peelable tableaux”, *J. Comb. Thy. Ser. A*, **82** (1998), 1–73.
30. (with H. Burgiel) “Two signed associahedra”, *New York J. Math*, **4** (1998), 83–95.
31. (with I. Peeva and V. Welker) “Cohomology of real diagonal subspace arrangements via resolutions”, *Compositio Mathematica*, **117** (1999), 99–115.
32. (with J. Herzog and V. Welker) “The Koszul property in affine semigroup rings”, *Pacific J. Math.*, **186** (1998), 39–65.
33. “An interpretation for the Tutte polynomial”, *Europ. J. Combin.*, **20** (1999), 149–161.
34. (with A. Duval), “Perron-Frobenius type results and discrete versions of nodal domain theorems”, *Lin. Algebra. Appl.*, **294** (1999), 259–268.
35. (with W. Kook and D. Stanton) “A convolution formula for the Tutte polynomial”, *J. Comb. Theory Ser. B*, **76** (1999), 297–300.
36. “The generalized Baues problem”, in *New perspectives in algebraic combinatorics* (Billera, Björner, Greene, Simion, Stanley, eds.), MSRI publications **38**, Cambridge Univ. Press, 1999.
37. (with J. Herzog and V. Welker) “Componentwise linear ideals and Golod rings”, *Michigan J. Math.* **46** (1999), 211–223.
38. (with M. Shimozono) “Flagged Weyl modules for two-column shapes”, *J. Pure Appl. Algebra* **141** (1999), 59–100.
39. (with W. Kook and D. Stanton) “Combinatorial Laplacians of matroid complexes”, *Journal of the Amer. Math. Soc.* **13** (2000), 129–148.
40. (with V. Welker) “A homological lower bound for order dimension of lattices”, *Order* **16** (1999), 165–170.

41. (with C. Athanasiadis, J. deLoera and F. Santos) “Fiber polytopes for the maps between cyclic polytopes”, *Europ. J. Combin.* **21** (2000), 19–47.
42. (with P. H. Edelman and J. Rambau) “On subdivision posets of cyclic polytopes”, *Europ. J. Combin.* **21** (2000), 85–101.
43. (with J. Roberts) “Minimal resolutions and the homology of chessboard and matching complexes”, *J. Algebraic Combinatorics* **11**(2000), 135–154.
44. (with P. H. Edelman), “Counting the interior points of a point configuration”, *Disc. and Comput. Geometry* **23** (2000), 1–13.
45. (with C. Athanasiadis and P. H. Edelman) “Monotone paths in polytopes”, *Math. Zeit.* **235** (2000), 315–334.
46. (with V. Welker and K. Yanagawa) “Local cohomology modules of Stanley-Reisner rings with supports in general monomial ideals”, *J. Algebra* **244** (2001), 706–736.
47. (with V. Welker) “Linear syzygies of Stanley-Reisner ideals”, *Math. Scand.* **89** (2001), 117–132.
48. (with P.H. Edelman and V. Welker) “Convex, pointed and free sets of an oriented matroid”, *Discrete Comput. Geom.* **27** (2002), 99–116.
49. (with D. Karaguezian and M. Wachs) “Matching complexes, bounded degree graph complexes and weight spaces of GL_n -Complexes”, *J. Algebra* **239** (2001), 77–92.
50. (with N.C. Leung) “The signature of a toric variety”, *Duke J. Math.*, **111**(2002), 253–286.
51. (with P. Orlik and A. Shepler) “The sign representation for Shephard groups” *Math. Annalen* **322** (2002), 477–492.
52. (with H. Christianson) “The critical group of a threshold graph”, *Lin. Alg. Appl.* **349**, (2002), 233–244.
53. “Equivariant fiber polytopes”, *Documenta Mathematica* **7** (2002), 113–132.
54. (with A. Duval), “Shifted simplicial complexes are Laplacian integral”, *Trans. Amer. Math. Soc.* **354** (2002), 4313–4344
55. “Note on a theorem of Eng”, *Ann. Comb.***6** (2002), 117–118.
56. (with V. Gasharov) “Cohomology of smooth Schubert varieties in partial flag manifolds”, *J. London Math. Soc.***66** (2002), 550–562.
57. (with B. Jacobson and A. Niedermaier) “Critical groups for complete multipartite graphs and Cartesian products of complete graphs”, *J. Graph Theory***44** (2003), 231–250.
58. (with P.H. Edelman, S. Peterson, J. Stout) “Geochemical phase diagrams and Gale diagrams”, *SIAM J. Appl. Math.* **64**, 231–259
59. (with D. Stanton and V. Welker) “The Charney-Davis quantity for certain graded posets”, *Séminaire Lotharingien de Combinatoire***50**(2003), 13pp.
60. (with J. Martin) “Factorization of some weighted spanning tree enumerators”, *J. Combin. Theory Ser. A***104** (2003), 287–300.

61. (with P. Webb) “The combinatorics of the bar resolution in group cohomology”, *J. Pure Appl. Algebra* **190** (2004), 291–327.
62. (with S. Hirschman) “Note on the Pfaffian matrix-tree theorem”, *Graphs Combin.* **20** (2004), 59–63.
63. (with D. Stanton and D. White) “The cyclic sieving phenomenon”, *J. Combin. Theory Ser. A* **108** (2004), 17–50.
64. (with C. Athanasiadis) “Noncrossing partitions for the group D_n ”, *SIAM J. Discrete Math.* **18** (2004), 397–417
65. (with E. Babson) “Coxeter-like complexes”, *Disc. Math. and Theor. Comp. Sci.* **6** (2004), 223–251.
66. (with V. Welker) “On the Charney-Davis and Neggers-Stanley conjectures”, *J. Combin. Theory Ser. A* **109** (2005), 247–280.
67. (with E.N. Miller) “Reciprocal domains and Cohen-Macaulay d -complexes in \mathbf{R}^d ”, *Elec. J. Combin.* **11(2)** (2004-2005),#N1.
68. “Note on the expected number of Yang-Baxter moves applicable to reduced decompositions”, *Europ. J. Combin.* **26**(2005), 1019–1021.
69. (with J. Martin) “Cyclotomic and simplicial matroids”, *Israel J. Math.* **150** (2005), 229–240.
70. (with D. Stanton and P. Webb) “Springer’s regular elements over arbitrary fields”, *Math. Proc. Camb. Phil. Soc.* **141** (2006), 209–229.
71. (with E.N. Miller) “Stanley’s simplicial poset conjecture, after Masuda”, *Comm. in Algebra* **34** (2006), 1049–1053
72. (with F. Ardila and L. Williams) “Bergman complexes, Coxeter arrangements, and graph associahedra”, to appear in *Sem. Lothar. Combin.* **54Aj** (2006),25 pp.
73. (with M. Develin and J. Martin) “Rigidity theory for matroids”, *Comm. Math. Helv.* **82** (2007), no. 1, 197–233.
74. (with M. Develin and J. Martin) “Classification of Ding’s Schubert varieties: finer rook equivalence”, *Canad. J. Math.* **59** (2007), no. 1, 36–62.
75. (with K. Shaw and S. van Willigenburg) “Coincidences among skew Schur functions”, *Adv. Math.* **216** (2007), 118–152. (with corrigendum, *Adv. Math.* **220** (2009), no. 5, 1655–1656.)
76. (with A. Galambos) “Acyclic sets of linear orders via the Bruhat orders”, *Social Choice and Welfare* **30** (2008), 245–264.
77. (with C. Klivans) “Shifted set families, degree sequences, and plethysm”, *Elec. J. Combin.* **15 (1)** (2008), paper R14, 35 pp.
78. (with H. Barcelo and D. Stanton) “Bimahonian distributions”, *J. London Math. Soc.* **77** (2008), 627–646.
79. (with F. Brenti and Y. Roichman) “Alternating subgroups of Coxeter groups”, *J. Comb. Theory Ser. A*, **115** (2008), 845–877.
80. (with A. Postnikov and L. Williams) “Faces of simple generalized permutohedra”, *Doc. Math.* **13** (2008), 207–273.
81. (with U. Nagel) “Betti numbers of monomial ideals and shifted skew shapes”, *Electron. J. Combin.* **16** (2009), no. 2, Special volume in honor of Anders Bjorner, Research Paper 3, 59 pp.
82. (with A. Miller), “Differential posets and Smith normal forms”, *Order* **26** (2009), no. 3, 197–228.
83. (with A. Yong and A. Woo), “Presenting the cohomology of a Schubert variety”, *Trans. Amer. Math. Soc.* **363** (2011), no. 1, 521543.

84. (with D. Stamate), “Koszul incidence algebras, affine semigroups and Stanley-Reisner ideals”, *Adv. Math.* **224** (2010), no. 6, 23122345.
85. (with L. Billera and N. Jia) “A quasisymmetric function for matroids”, *Europ J. Combin.* **30** (2009), no. 8, 17271757.
86. (with D. Stanton) “ (q, t) -analogues and $GL_n(\mathbf{F}_q)$ ”, *J. Algebraic Combin.* **31** (2010), no. 3, 411454.

To appear:

(with D. Bessis) “Cyclic sieving of noncrossing partitions for complex reflection groups”, to appear in *Annals. Combin.*

(with A. Broer, L. Smith and P. Webb), “Extending the Coinvariant Theorems of Chevalley, Shephard-Todd, Mitchell, and Springer”, to appear in *Proc. Lond. Math. Soc.*

(with A. Berget, A. Manion, M. Maxwell, and A. Potechin), “Critical groups of line graphs”, to appear in *Annals Combin.*

(with A. Berget and S.-P. Eu) “Constructions for cyclic sieving phenomena”, to appear in *SIAM J. Disc. Math.*

Submitted:

(with Y. Roichman) “Diameter of reduced words”, submitted to *Disc. Comput. Geom.*

(with A. Boussicault, V. Feray, and A. Lascoux) “Linear extension sums as valuations of cones”, submitted to *J. Algebraic. Comb.*

(with G. Muisker) “The cyclotomic polynomial topologically”, submitted to *J. Reine. Angew. Math.*

In preparation:

(with F. Saliola and V. Welker), “Spectra of symmetrized shuffling operators”.

(with V. Feray), “P-partitions revisited”.

Book editing: (with E. Miller and B. Sturmfels) “Geometric combinatorics: lectures from the Park City Math Institute Summer School 2004” IAS/Park City Mathematics Series **13**, Amer. Math. Soc., 2007.

Book chapter: (with K. Fowler) “Recommended resources in combinatorics”, in *Using the mathematics literature*, Kris Fowler, ed. Marcel-Dekker, New York, 2004.

Graduate Students

Masters Level:

Debbie M. Zollinger, defended April 1994

Thesis title: Equivalence classes of reduced words.

Michelle Raymond, defended June 1998.

Thesis title: Posets of rook placements on rectangular boards.

Sam Peterson, defended June 2000

(co-advisors: Paul Edelman, and James Stout of Univ. Minnesota Geology Department).

Thesis title: Oriented matroid analysis of thermochemical reaction systems.

Ádám Galambos, defended June 2004

Thesis title: Acyclic sets of linear orders.

Doctoral Level:

Guy David Bailey, defended March 1997.

Thesis title: Tilings of zonotopes- discriminantal arrangements, oriented matroids, and enumeration.

Xun Dong, defended June 2001.

Thesis title: The topology of bounded-degree graph complexes and finite free resolutions.

Nathan Reading, defended April 2002.

Thesis title: On the structure of Bruhat order.

(2002 Dept. Outstanding Thesis prize)

Kyle Calderhead, defended May 2002.

Thesis title: Variations on the slopes problem.

Muge Taskin, defended May 2006.

Thesis title: Properties of four partial orders on standard Young tableaux.

Sangwook Kim, defended July 2007.

Thesis title: Topology of diagonal arrangements and flag enumerations of matroid base polytopes.

Molly Maxwell, defended September 2007.

Thesis title: Enumerating self-dual spanning trees and self-dual matroid bases.

Brendon Rhoades, defended June 2008.

Thesis title: Cyclic sieving and promotion.

Andy Berget, defended August 2009.

Thesis title: Symmetries of tensors.

Jia Huang, preliminary oral exam completed Feb. 2010.

Alex Miller, preliminary oral exam completed Oct. 2010.

C.E. Csar, preliminary oral exam not yet taken.

Kevin Dilks, preliminary oral exam not yet taken.

Other grad student mentorship

Dumitru Stamate, Fulbright scholar from Romania, 2006-2008

Postdoctoral mentorship

Jesus de Loera, Geometry Center postdoc, 1996–1998.

Woong Kook, Univ. of Minnesota postdoc, 1997–1998.

Mark de Longueville, Minnesota Dunham Jackson asst. prof., 2000–2001.

Geanina Tudose, NSERC postdoc, 2002.

Tamon Stephen, IMA postdoc, 2003–2004.

Jeremy Martin, NSF postdoc, 2002–2004.

Michael Develin, AIM Fellow, 2004–2005.

Alex Yong, NSERC postdoc and Minnesota Dunham Jackson asst. prof., 2005–2007.

Drew Armstrong, NSF postdoc 2006 – 2008.

Sen-Peng Eu, Taiwanese postdoctoral fellowship 2006–2007

Ben Howard, IMA postdoc, 2006–2007.

Milena Hering, IMA postdoc 2006–2008.

Ricky Liu, NSF postdoc, 2010–11.

Research with undergraduates

Have mentored roughly 40 undergraduates in REU's, solo or in some cases, co-mentored with Dennis Stanton. See www.math.umn.edu/reiner/REU/REU.html for their reports and a summary.

In 2005, I mentored a UROP student, Michael Barany, who produced research software (see www.math.umn.edu/reiner/Tutte/TUTTE.html) that quickly computes Tutte polynomials of matroids defined over the rationals \mathbf{Q} or over a prime field \mathbf{F}_p .

Personal

Born April 30, 1965 in Utica, NY.

Wishes he had time to play ultimate frisbee again.