

**Vita**  
**BERND STURMFELS**

Department of Mathematics, University of California, Berkeley, CA 94720  
Phone: (510) 642 4687, Fax: (510) 642 8204, [bernd@math.berkeley.edu](mailto:bernd@math.berkeley.edu)

M.A. [*Diplom*] TH Darmstadt, Germany, Mathematics and Computer Science, 1985  
Ph.D. [*Dr. rer. nat.*] TH Darmstadt, Germany, Mathematics, 1987  
Ph.D. University of Washington, Seattle, Mathematics, 1987

**Professional Experience:**

1987–1988 Postdoctoral Fellow, I.M.A., University of Minnesota, Minneapolis  
1988–1989 Assistant Professor, Research Institute for Symbolic Computation,  
(RISC-Linz), Linz, Austria  
1989–1991 Assistant Professor, Department of Mathematics, Cornell University  
1992–1996 Associate Professor, Department of Mathematics, Cornell University  
1994–2001 Professor, Department of Mathematics, University of California, Berkeley  
2001– Professor, Department of Mathematics and Computer Science, UC Berkeley

**Academic Honors:**

1986 - 1987 Alfred P. Sloan Doctoral Dissertation Fellowship  
1991 - 1993 Alfred P. Sloan Research Fellow  
1992 - 1997 National Young Investigator (NSF)  
1992 - 1997 David and Lucile Packard Fellowship  
1999 Lester R. Ford Prize for Expository Writing (MAA)  
2000-2001 Miller Research Professorship, UC Berkeley  
Spring 2003 John von Neumann Professor, Technical University München  
2003-2004 Hewlett-Packard Research Professor at MSRI Berkeley  
July 2004 Clay Mathematics Institute Senior Scholar

**Research Interests:**

Computational Algebra, Combinatorics, Algebraic Geometry

**Selected Professional Activities:**

**Visiting Positions:**

Département de Mathématiques, Université de Nice, France, Spring 1989  
Mathematical Sciences Research Institute, Berkeley, Fall 1992  
Courant Institute, New York University, 1994–95  
RIMS, Kyoto University, Japan, 1997–98

**Current Editorial Board Membership:**

*Journal of the American Mathematical Society*, *Duke Mathematical Journal*,  
*Collectanea Mathematica*, *Beiträge zur Geometrie und Algebra*, *Order*,  
*Discrete and Computational Geometry*, *Applicable Algebra (AAECC)*  
*Journal of Combinatorial Theory (Ser. A)*, *Annals of Combinatorics*,  
*Algorithms and Computation in Mathematics (Springer Book Series)*

**Research Funding:** National Science Foundation, Algebra and Number Theory

**Conference and Special Programs Organized:** (selected)

- “Algebraic Issues in Geometric Computation”, DIMACS, Rutgers, May 1990
- “Computational Algebraic Geometry”, *Geometry Institute*, Amherst, July 1992
- U.S.-Italian workshop on “Hilbert functions”, MSI Cornell, Ithaca, October 1993.
- MEGA '96 (Effective methods in algebraic geometry), Eindhoven, June 1996
- “Symbolic Computation in Geometry and Analysis”, Fall 1998, MSRI Berkeley
- “Commutative Algebra”, Academic Year 2002-2003, MSRI Berkeley
- “Amoebas and Tropical Geometry”, October 2003, AIM Palo Alto
- “Computational Algebraic Statistics”, December 2003, AIM Palo Alto
- “Geometric Combinatorics”, Park City IAS Summer Program, July 2004.
- “Applications of Algebraic Geometry”, Acad. Year 2006-2007, IMA Minneapolis

**Ph.D. dissertations supervised**

1. Rekha Thomas: “Gröbner Basis Methods for Integer Programming” (1994, Operations Research, Cornell; now at the University of Washington, Seattle)
2. John Dalbec: “Geometry and Combinatorics of Chow Forms” (1995, Mathematics, Cornell; now at Youngstown State University)
3. Jesus De Loera: “Triangulations of Polytopes and Computational Algebra” (1995, Applied Mathematics, Cornell; now at the University of California at Davis)
4. Birkett Huber: “Polyhedral Decompositions and Solving Sparse Polynomial Systems” (1996, Mathematics, Cornell; now at the National Security Agency)
5. Serkan Hosten: “Degree Bounds for Gröbner bases of Integer Programs” (1997, Operations Research, Cornell; now at San Francisco State University)
6. Ezra Miller: “Resolutions and Duality for Monomial Ideals” (2000, UC Berkeley, Math; now at the University of Minnesota)
7. Diane Maclagan: “Structures on Sets of Monomial Ideals” (2000, UC Berkeley, Math; now at Rutgers University)
8. Harrison Tsai: “Algorithms for Algebraic Analysis” (2000, UC Berkeley, Math; now at Goldman-Sachs, New York City)
9. Laura Matusevich: “Combinatorial Aspects of Hypergeometric Functions” (2002, UC Berkeley, Math; currently at Harvard University)
10. Amit Khetan: “Formulas for Resultants”, (2003, UC Berkeley, Math, currently at University of Massachusetts, Amherst)
11. Michael Develin: “Topics in Discrete Geometry”, (2003, UC Berkeley, Math, currently AIM postdoctoral fellow at the University of Minnesota).
12. Ruchira Datta: “Algebraic Methods in Game Theory”, (2003, UC Berkeley, Math, currently Google, Inc).

**Postdoctoral scholars mentored (1989 – 2004):**

Paul Filliman, Mikhael Kapranov, Michael Kalkbrener, Anna Bigatti, Francisco Santos, Felix Ulmer, Irena Peeva, James Pommersheim, Allen Knutson, Xenia Kramer, John McDonald, Will Traves, Zvezdelina Stankova-Frenkel, Isabella Novik, Alexander Postnikov, Thorsten Theobald, Christian Haase, Tamas Hausel, James Mihalisin, Pablo Parrilo, Carlos D’Andrea, Jessica Sidman, Federico Ardilla, Caroline Klivans.

### **A sample of invited lectures during the last five years:**

June 2004: Tropical Geometry and its Applications, plenary lecture at 2004 SIAM Discrete Mathematics conference, Nashville, Tennessee.

May 2004: Tropical Geometry, 2004 Erdos Memorial Lecture, AMS-SMM Joint Meeting, Houston, Texas.

March 2004: Phylogenetic Invariants, Statistics Colloquium, Stanford University.

March 2004: Algebraic Geometry of Statistical Models, Gergen Memorial Lectures, three lectures, Mathematics Department, Duke University.

November 2003: Gröbner Bases in Integer Programming, Hewlett Packard Colloquium, HP Labs, Palo Alto.

October 2003: Tropical Algebraic Geometry, Mathematics Colloquium, University of Pennsylvania, Philadelphia.

September 2003: Tropical Algebraic Geometry, Western Algebraic Geometry Conference, University of British Columbia, Vancouver, Canada

June 2003: From Phylogenetic Trees to Tropical Algebraic Geometry, Plenary Lecture, MEGA 2003, Conference on Effective Methods in Algebraic Geometry, Kaiserslautern, Germany

May 2003: Computing the Integer Programming Gap, Joint Computer Science and Mathematics Colloquium, University of Saarbrücken, Germany.

December 2002: The Geometry of Nash Equilibria Colloquium on Information and Decision Systems M.I.T., Cambridge.

October 2002: The Geometry of Nash Equilibria, Math. Colloquium, Princeton University.

May 2002: Ten Lectures on Solving Polynomial Equations, CBMS Conference, Texas A & M University, College Station.

March 2002: Multigraded Hilbert Schemes, Mathematics Colloquium, University of Utah

January 2002: The toric algebra of graphical models, Stockholm Math. Colloq., Sweden.

July 2001: Multigraded Hilbert Schemes, Latin-American Algebra Congress, Cordoba, Argentina.

March 2001: Minimizing Polynomial Functions, Workshop on Algorithmic and Quantitative Aspects of Real Algebraic Geometry in Mathematics and Computer Science, DIMACS, Rutgers University.

December 2000: Convex Optimization and Real Algebraic Geometry, Mathematics Colloquium, Georgia Tech, Atlanta.

November 2000: Solving Holonomic Systems of Differential Equations, Mathematics Colloquium, UC Davis.

February 2000: Computational Algebraic Geometry, AAAS Science Exposition, Washington D.C.

December 1999: Hypergeometric Functions, Ritt Lectures, Columbia University

September 1999: Gröbner deformations of hypergeometric differential equations, Plenary talk at the Annual Meeting of the German Mathematical Society, Mainz, Germany.

July 1999: Gröbner deformations of hypergeometric differential equations, Plenary talk at ISSAC 1999, Simon Fraser University, Vancouver, Canada.

June 1999: Monomial Ideals, Eight Lectures in the COCOA Summer School, Torino, Italy

**Dissertations:**

- Zur linearen Realisierbarkeit orientierter Matroide, 169 pp., M.A. Thesis, Technische Hochschule Darmstadt, Germany, 1985; Supervisor: Jürgen Bokowski
- Oriented Matroids and Combinatorial Convex Geometry, 95 pp., D.Sc. Dissertation, Technische Hochschule Darmstadt, Germany, 1987; Supervisor: Jürgen Bokowski
- Computational Synthetic Geometry, 144 pp., Ph.D. Dissertation, University of Washington, Seattle, 1987; Supervisor: Victor Klee

**Books, authored:**

- Computational Synthetic Geometry, (with J. Bokowski), 165 pp., *Lecture Notes in Mathematics*, **1355**, Springer, Heidelberg, 1989.
- Oriented Matroids, (with A. Björner, M. Las Vergnas, N. White, G. Ziegler), Cambridge University Press, 1993; Second Edition, 1999.
- Algorithms in Invariant Theory, Springer Verlag, Vienna and New York, 1993.
- Gröbner Bases and Convex Polytopes, American Mathematical Society, University Lectures Series, No. 8, Providence, Rhode Island, 1996.
- Gröbner Deformations of Hypergeometric Differential Equations, (with N. Takayama and M. Saito), Algorithms and Computation in Mathematics **6**, Springer Verlag, Heidelberg, 1999.
- Solving Systems of Polynomial Equations, American Mathematical Society, CBMS Regional Conferences Series, No. 97, Providence, Rhode Island, 2002.
- Combinatorial Commutative Algebra, (with E. Miller), Graduate Texts in Mathematics, Springer Verlag, New York, 2004, <http://www.math.umn.edu/~ezra/cca.html>

**Books, edited:**

- Applied Geometry and Discrete Mathematics (The Victor Klee Festschrift), edited jointly with P. Gritzmann, DIMACS Series **4**, American Mathematical Society, 1991.
- D. Hilbert's 1897 Lectures on "The Algebraic Theory of Invariants", edited jointly with R. Laubenbacher, Cambridge University Press, 1993.
- Applications of Computational Algebraic Geometry, edited jointly D. Cox, Proceedings of Symposia in Applied Mathematics, Volume **53**, American Mathematical Society, 1997.
- Mathematical Computations with Macaulay2 (with D. Eisenbud, D. Grayson, and M. Stillman) Algorithms and Computation in Mathematics, **8**, Springer Verlag, Heidelberg, 2001.
- Lectures in Contemporary Commutative Algebra, (with L. Avramov, M. Green, C. Huneke, and K. Smith), Mathematical Sciences Research Institute Publications, Cambridge University Press, 2004.

## Research Articles:

### 1986

1. On the coordinatization of oriented matroids, (with J. Bokowski), *Discrete and Computational Geometry* **1** (1986) 293–306.
2. Central and parallel projections of polytopes, *Discrete Mathem.* **62** (1986) 315–318.
3. Reell realisierbare orientierte Matroide, (with J. Bokowski), in A. Kerber (ed.): “Diskrete Strukturen, algebraische Methoden und Anwendungen”, *Bayreuther Mathematische Schriften* **21** (1986) 1–13.

### 1987

4. On the decidability of diophantine problems in combinatorial geometry, *Bulletin American Math. Soc.* **17** (1987) 121–124.
5. Polytopal and non-polytopal spheres - An algorithmic approach, (with J. Bokowski), *Israel Journal of Mathematics* **57** (1987) 257–271.
6. Boundary complexes of convex polytopes cannot be characterized locally, *Journal London Math. Soc.* **35** (1987) 314–326.
7. Cyclic polytopes and  $d$ -order curves, *Geometriae Dedicata* **24** (1987) 103–107.
8. Aspects of computational synthetic geometry - I. Algorithmic coordinatization of matroids, in H. Crapo (ed.) : *Computer-aided geometric reasoning*, INRIA Rocquencourt, France, June 1987, pp. 57–86.

### 1988

9. Some applications of affine Gale diagrams to polytopes with few vertices, *SIAM J. Discrete Mathematics* **1** (1988) 121–133.
10. Simplicial cells in arrangements and mutations of oriented matroids, (with J.-P. Roudneff), *Geometriae Dedicata* **27** (1988) 153–170.
11. Totally positive matrices and cyclic polytopes, *Linear Alg. Appl.* **107** (1988) 275–281.
12. Tridiagonalization of complex matrices and a problem of Longstaff, *Linear Algebra Appl.* **109** (1988) 165–166.
13. Neighborly polytopes and oriented matroids, *European J. Combinatorics* **9** (1988) 537–546.

### 1989

14. Uniform oriented matroids without the isotopy property, (with B. Jaggi, P. Mani-Levitska, N. White), *Discrete Comput. Geometry* **4** (1989) 97–100.
15. Arrangements of lines and pseudolines without adjacent triangles, (with D. Ljubić, J.-P. Roudneff), *J. Combinatorial Theory A* **50** (1989) 24–32.
16. An infinite family of minor-minimal nonrealizable 3-chirotopes, (with J. Bokowski), *Mathematische Zeitschrift* **200** (1989) 583–589.
17. Computing final polynomials and final syzygies using Buchberger’s Gröbner bases method, *Resultate der Mathematik* **15** (1989) 351–360.
18. On the matroid stratification of Grassmann varieties, specialization of coordinates, and a problem of N. White, *Advances in Mathematics* **75** (1989) 202–211.
19. Gröbner bases and invariant theory, (with N. White), *Advances in Mathematics* **76** (1989) 245–259.

20. Proposal for a geometric algebra software package, (with T. Havel, N. White), *SIGSAM Bulletin* **23** (1989) 13–15.
21. Introduction to invariant theory in superalgebras, (with G-C. Rota), in D. Stanton (ed.): *Invariant Theory and Tableaux*, I.M.A. Volumes in Mathematics and its Applications, **19**, Springer, New York, 1989, pp. 1–35.
22. Coordinate representation of order types requires exponential storage, (with J.E. Goodman, R. Pollack), *Proceedings of the 21<sup>st</sup> Annual ACM Symposium on Theory of Computing*, Seattle, 1989, pp. 405–410.

### 1990

23. On the existence of certain smooth toric varieties, (with J. Gretenkort, P. Kleinschmidt), *Discrete Comput. Geometry* **5** (1990) 255–262.
24. Lawrence polytopes, (with M. Bayer), *Canadian J. Mathematics* **17** (1990) 62–79.
25. Nonrealizability proofs in computational geometry, (with J. Bokowski, J. Richter), *Discrete Comput. Geometry* **5** (1990) 333–350.
26. All  $11_3$ - and  $12_3$ -configurations are rational, (with N. White), *Aequationes Mathematicae* **39** (1990) 254–260.
27. The intrinsic spread of a configuration in  $\mathbf{R}^d$ , (with J.E. Goodman, R. Pollack), *Journal American Math. Society* **3** (1990) 639–651.
28. Gröbner bases and Stanley decompositions of determinantal rings, *Mathematische Zeitschrift* **205** (1990) 137–144.
29. Constructions and complexity of secondary polytopes, (with L.J. Billera, P. Filliman), *Advances in Mathematics* **83** (1990) 155–179.
30. Stanley decompositions of the bracket ring, (with N. White), *Math. Scandinavica* **67** (1990) 183–189.

### 1991

31. Smooth toric varieties with small Picard number are projective, (with P. Kleinschmidt), *Topology* **30** (1991) 289–299.
32. On the topology and geometric construction of oriented matroids and convex polytopes, (with J. Richter), *Transactions American Math. Soc.* **325** (1991) 389–412.
33. Gröbner bases of toric varieties, *Tôhoku Mathematical Journal* **43** (1991) 249–261.
34. On the synthetic factorization of projectively invariant polynomials, (with W. Whiteley), *J. Symbolic Computation* **11** (1991) 439–454.
35. Computational algebraic geometry of projective configurations, *J. Symbolic Computation* **11** (1991) 595–618.
36. Quotients of toric varieties, (with M. Kapranov, A. Zelevinsky), *Mathematische Annalen* **290** (1991), 643–655.
37. Computing combinatorial decompositions of rings, (with N. White), *Combinatorica* **11** (1991), 275–293.
38. Unimodular fans, toric manifolds and linear codes, (with P. Kleinschmidt and N. Schwartz), in “Discrete and Computational Geometry: Papers from the DIMACS Special Year”, (eds. J.E. Goodman, R. Pollack, W.L. Steiger), American Math. Soc.. Providence, 1991, pp. 179–186.

## 1992

39. Fiber polytopes, (with L.J. Billera), *Annals of Mathematics* **135** (1992) 527–549.
40. Algorithms for the Quillen-Suslin theorem, (with A. Logar), *Journal of Algebra* **145** (1992) 231–239.
41. Chow polytopes and general resultants, (with M. Kapranov, A. Zelevinsky), *Duke Mathematical Journal* **67** (1992) 189–218.
42. Asymptotic analysis of toric ideals, *Memoirs of the Faculty of Sciences, Kyushu University, Series A: Mathematics* **46**, No. 2, (1992) 217–228.

## 1993

43. Maximal minors and their leading terms, (with A. Zelevinsky), *Advances in Mathematics* **98** (1993) 65–112.
44. Duality and minors of secondary polyhedra, (with L.J. Billera, I.M. Gel'fand), *Journal of Combinatorial Theory B* **57** (1993) 258–268.
45. Minkowski addition of polytopes: Computational complexity and applications to Gröbner bases, (with P. Gritzmann), *SIAM J. Discrete Math.* **6** (1993) 246–269.
46. Extension spaces of oriented matroids, (with G. Ziegler), *Discrete and Computational Geometry* **10** (1993) 23–45.
47. Non-extremal Camion bases, (with R.G. Bland, C.W. Ko), *Linear Algebra and its Applications* **187** (1993) 195–199.
48. Sparse elimination theory, in “*Computational Algebraic Geometry and Commutative Algebra*” [D. Eisenbud and L. Robbiano, eds.], Proceedings Cortona (June 1991), Cambridge University Press, 1993, pp. 264–298.
49. Product formulas for resultants and Chow forms, (with P. Pedersen), *Mathematische Zeitschrift* **214** (1993) 377–396.
50. A note on polynomial reduction, (with A. Reeves), *Journal of Symbolic Computation* **11** (1993) 273–277.

## 1994

51. Multigraded resultants of Sylvester type, (with A. Zelevinsky), *Journal of Algebra* **163** (1994) 115–127.
52. On the Newton polytope of the resultant, *Journal of Algebraic Combinatorics* **3** (1994) 207–236.
53. Finding sparse systems of parameters, (with D. Eisenbud), *Journal of Pure and Applied Algebra* **94** (1994) 143–157.
54. A quantitative Steinitz Theorem, (with S. Onn), *Beiträge zur Algebra und Geometrie* **35** (1994) 125–129.  
<http://www.zblmath.fiz-karlsruhe.de:80/e-journals/BAG/vol.35/no.1/>
55. Minimal polynomials and sparse resultants, (with J. Yu), in “*Zero-Dimensional Schemes*”, (eds. F. Orecchia and L. Chiantini), Proceedings Ravello (June 1992), De Gruyter, Berlin, 1994, pp. 317–324
56. A note on lattice simplices and toric varieties, (with S. Onn), *American Journal of Mathematics* **116** (1994) 1337–1339.
57. Cellular strings on polytopes, (with L. Billera, M. Kapranov), *Proceedings of the Amer. Math. Soc.* **122** (1994) 549–555.

58. Iterated fibre polytopes, (with L.J. Billera), *Mathematika* **41** (1994) 549–555.
59. On the number of real roots of a sparse polynomial system, in *Hamiltonian and Gradient Flows: Algorithms and Control*, (ed. A. Bloch), Fields Institute Communications Vol. 3, American Math. Soc, Providence, RI, 1994, pp. 137–143.
60. Viro’s theorem for complete intersections, *Annali della Scuola Normale Superiore di Pisa.* (4) **21** (1994), no. 3, 377–386.

### 1995

61. Intersection theory on spherical varieties, (with W. Fulton, R. MacPherson, F. Sottile), *Journal of Algebraic Geometry* **4** (1995) 181–193.
62. Introduction to Chow forms, (with J. Dalbec), in “*Invariant Methods in Discrete and Computational Geometry*” [N. White, ed.], Proceedings Curacao (June 1994), Kluwer Academic Publishers, 1995, pp. 37–58.
63. Bounds for degrees of projective schemes, (with N.V. Trung, W. Vogel), *Mathematische Annalen* **302** (1995) 417–432.
64. GRIN: An implementation of Gröbner bases for integer programming, (with S. Hosten), in “Integer Programming and Combinatorial Optimization”, [E. Balas and J. Clausen, eds.], Proceedings of the IV. IPCO Conference (Copenhagen, May 1995), *Springer Lecture Notes in Computer Science* **920** (1995) 267–276.
65. Gröbner bases of lattices, corner polyhedra, and integer programming, (with R. Weismantel, G. Ziegler), *Beiträge zur Algebra und Geometrie* **36** (1995), 281–298.
66. A polyhedral method for solving sparse polynomial systems, (with B. Huber), *Mathematics of Computation* **64** (1995) 1541–1555.
67. Gröbner bases and triangulations of the second hypersimplex, (with J. De Loera, R. Thomas), *Combinatorica* **15** (1995) 409–424.
68. On vector partition functions, *J. of Combinatorial Theory, Ser. A* **72** (1995) 302–309.
69. Initial complexes of prime ideals, (with M. Kalkbrener) *Advances in Mathematics* **116** (1995) 365–376.

### 1996

70. The polytope of all triangulations of a point configuration, (with J. De Loera, F. Santos, S. Hosten), *Documenta Mathematica* **1** (1996) 103–119;  
<http://www.mathematik.uni-bielefeld.de/documenta>.
71. Primitive partition identities, (with P. Diaconis, R. Graham), in *Combinatorics, Paul Erdős is Eighty*, (eds. D. Miklós, V.T. Sós, T. Szönyi), János Bolyai Mathematical Society, Budapest, Hungary, 1996, pp. 173–192.
72. Computing multidimensional residues, (with E. Cattani, A. Dickenstein), in *Algorithms in Algebraic Geometry and Applications*, (eds. L. Gonzalez-Vega and T. Recio), Progress in Mathematics, Vol. 143, Birkhäuser, Basel, 1996, pp. 135–164.
73. Mixed monomial bases, (with P. Pedersen), in *Algorithms in Algebraic Geometry and Applications*, (eds. L. Gonzalez-Vega and T. Recio), Progress in Mathematics, Vol. 143, Birkhäuser, Basel, 1996, pp. 307–316.
74. Binomial ideals, (with D. Eisenbud), *Duke Mathematical Journal* **84** (1996) 1–45.
75. A normal form algorithm for modules over  $k[x, y]/\langle xy \rangle$ , (with R. Laubenbacher), *Journal of Algebra* **184** (1996) 1001–1024.



### 1997

76. Intersection theory on toric varieties, (with W. Fulton), *Topology* **36** (1997) 335–353.
77. Bernstein’s Theorem in affine space, (with B. Huber), *Discrete and Computational Geometry* **17** (1997) 137–141.
78. Structural Gröbner basis detection, (with M. Wiegelmann), *Applicable Algebra in Engineering, Communication and Computing (AAECC Journal)* **8** (1997) 257–263.
79. Computing Hopf bifurcations, (with J. Guckenheimer, M. Myers), *SIAM J. Numerical Analysis* **34** (1997) 1–21.
80. Variation of cost functions in integer programming, (with R.R. Thomas), *Mathematical Programming* **77** (1997) 357–387.
81. Introduction to resultants, in: D. Cox, B. Sturmfels (eds.), *Applications of Computational Algebraic Geometry*, Proceedings of Symp. in Applied Math., **53**, American Mathematical Society, 1997, pp. 25–39.
82. Equations defining toric varieties, *Algebraic Geometry – Santa Cruz 1995*, Proc. Sympos. Pure Math., **62**, Part 2, Amer. Math. Soc., Providence, RI, 1997, pp. 437–449.

### 1998

83. A toric ring with irrational Poincaré-Betti series, (with J.-E. Roos), *Comptes Rendus Acad. Sci. Paris, Ser. I Math.* **326** (1998) 141–146.
84. Gröbner bases and hypergeometric functions, (with N. Takayama), in *Gröbner Bases and Applications (Proc. of the Conference 33 Years of Gröbner Bases)*, B. Buchberger and F. Winkler (eds.), Cambridge University Press, London Mathematical Society Lecture Notes Series, **251**, (1998), pp. 246–258.
85. How to shell a monoid, (with I. Peeva and V. Reiner), *Mathematische Annalen* **310** (1998) 379–393.
86. Non-commutative Gröbner bases for commutative algebras, (with D. Eisenbud and I. Peeva), *Proceedings of the American Mathematical Society* **126** (1998) 687–691.
87. Generic lattice ideals, (with I. Peeva), *Journal of the American Mathematical Society* **11** (1998) 363–373.
88. Algebraic algorithms for sampling from conditional distributions, (with P. Diaconis), *Annals of Statistics* **26** (1998) 363–397.
89. Lattice walks and primary decomposition, (with P. Diaconis and D. Eisenbud), *Mathematical Essays in Honor of Gian-Carlo Rota*, eds. B. Sagan and R. Stanley, Progress in Mathematics, Vol. 161, Birkhäuser, Boston, 1998, pp. 173–193.
90. Residues and resultants, (with E. Cattani and A. Dickenstein), *Journal of Mathematical Sciences of the University of Tokyo* **5** (1998) 119–148.
91. Monomial resolutions, (with D. Bayer and I. Peeva), *Mathematical Research Letters* **5** (1998) 31–46.
92. Polynomial equations and convex polytopes, *American Mathematical Monthly* **105** (1998) 907–922.
93. Gröbner deformations of regular holonomic systems, (with M. Saito and N. Takayama), *Proceedings of the Japan Academy, Ser. A Math. Sci.* **74** (1998) 111–113.
94. Cellular resolution of monomial modules, (with D. Bayer), *Journal für die Reine und Angewandte Mathematik* **502** (1998) 123–140.

95. Syzygies of codimension 2 lattice ideals, (with I. Peeva), *Mathematische Zeitschrift* **229** (1998) 163–194.
96. Numerical Schubert calculus, (with B. Huber and F. Sottile), *Journal of Symbolic Computation* **20** (1998) 767–788.

### 1999

97. Hypergeometric polynomials and integer programming (with M. Saito and N. Takayama), *Compositio Mathematica* **115** (1999) 185–204.
98. The Co-Scarf resolution, in “*Commutative Algebra, Algebraic Geometry and Computational Methods*”, Proceedings Hanoi 1996, [editor D. Eisenbud] Springer Verlag, Singapore, 1999, pp. 315–320.
99. Cutting corners, (with S. Onn), *Advances in Applied Mathematics* **23** (1999) 29–48.
100. Monomial ideals and planar graphs, (with E. Miller), in “Applied Algebra, Algebraic Algorithms and Error-Correcting Codes”, [M. Fossorier, H. Imai, S. Lin and A. Poli, eds.], Proceedings of AAEECC-13 (Honolulu, November 1999), *Springer Lecture Notes in Computer Science* **1719** (1999) 19–28.

### 2000

101. Solving algebraic equations in terms of  $\mathcal{A}$ -hypergeometric series, *Discrete Mathematics* **210** (2000) 171–181.
102. Generic and cogenerated monomial ideals, (with E. Miller and K. Yanagawa), *Journal of Symbolic Computation* **28** (2000) 691–708.
103. Four counterexamples in combinatorial algebraic geometry, *Journal of Algebra* **230** (2000) 282–294.

### 2001

104. A sagbi basis for the quantum Grassmannian, (with F. Sottile), *Journal for Pure and Applied Algebra* **158** (2001) 347–366.
105. Syzygies of unimodular Lawrence ideals, (with D. Bayer and S. Popescu), *Journal für die Reine und Angewandte Mathematik* **534** (2001) 169–186.
106. Rational hypergeometric functions, (with E. Cattani and A. Dickenstein), *Compositio Mathematica* **128** (2001) 217–240.
107. Gröbner bases of abelian matrix groups, in *Symbolic Computation: Solving Equations in Algebra, Geometry, and Engineering*, (eds. E. Green, S. Hosten, R. Laubenbacher, V. Powers), Contemporary Mathematics, Volume **286**, American Math. Soc, Providence, RI, 2001, pp. 141–143.

### 2002

108. Syzygies of oriented matroids, (with I. Novik and A. Postnikov), *Duke Mathematical Journal* **111** (2002) 287–317.
109. Binomial residues, (with E. Cattani and A. Dickenstein), *Annales de l’Institut Fourier (Grenoble)*, **52** (2002), no. 3, 687–708.
110. Elimination theory in codimension two, (with A. Dickenstein), *Journal of Symbolic Computation* **34** (2002) 119–135.
111. Toric hyperkähler varieties (with T. Hausel), *Documenta Mathematica* **7** (2002) 495–534.

### 2003

112. Alexander duality in subdivisions of Lawrence polytopes (with F. Santos), *Advances in Geometry*, **3** (2003) 177–189.
113. Higher Lawrence Configurations (with F. Santos), *Journal of Combinatorial Theory, Series A*, **103** (2003) 151–164.
114. Minimizing polynomial functions, (with P. Parrilo), Proceedings of the DIMACS Workshop on Algorithmic and Quantitative Aspects of Real Algebraic Geometry in Mathematics and Computer Science (March 2001), (eds. S. Basu and L. Gonzalez-Vega), American Mathematical Society, 2003, pp. 83–100.
115. Algebraic unimodular counting, (with J. De Loera), *Mathematical Programming, Series B*, **96** (2003) 183–203.

### 2004 –

116. Tropical Convexity, (with M. Develin), *Documenta Mathematica* **9** (2004) 1–27.
117. Supernormal vector configurations, (with S. Hosten and D. Maclagan), *Journal of Algebraic Combinatorics* **19** (2004) 297–313.
118. Multigraded Hilbert schemes (with M. Haiman), *Journal of Algebraic Geometry* **13** (2004) 725–769.
119. Classification of six-point metrics, (with J. Yu), *Electronic Journal of Combinatorics* **11** (2004/05) R44.
120. The tropical Grassmannian, (with D. Speyer), *Advances in Geometry* **4** (2004) 389–411.
121. The graph of monomial ideals, (with K. Altmann), 15 pp., [math.AC/0209152](#), to appear in *Journal of Pure and Applied Algebra*.
122. Computing the integer programming gap, (with S. Hoşten), 19 pp., [math.OC/0301266](#), to appear in *Combinatorica*.
123. Algebraic Geometry of Bayesian Networks, (with L. Garcia and M. Stillman), [math.AG/0301255](#), to appear in *Journal of Symbolic Computation*.
124. On the toric algebra of graphical models (with D. Geiger and C. Meek), 36 pp., to appear in *Annals of Statistics*.
125. First steps in tropical geometry, (with J. Richter-Gebert and T. Theobald), 29 pp., [math.AG/0306366](#), to appear in “Idempotent Mathematics and Mathematical Physics”, Proceedings Vienna 2003, (editors G.L. Litvinov and V.P. Maslov).
126. Short rational functions for toric algebra, (with J. A. De Loera, D. Haws, R. Hemmecke, P. Huggins, and R. Yoshida), 11 pp., [math.CO/0307350](#), to appear in *Journal of Symbolic Computation*.
127. Algebraic Recipes for Integer Programming, 15 pages, to appear in AMS Short Course, “Trends in Optimization”, Phoenix, January 5-6, 2004.
128. Tropical geometry of statistical models, (with L. Pachter), 14 pp., [q-bio.QM/0311009](#), to appear in *Proceedings of the National Academy of Sciences*.
129. Parametric inference for biological sequence analysis, (with L. Pachter), 15 pp., [q-bio.GN/0401033](#), to appear in *Proceedings of the National Academy of Sciences*.
130. On the tropical rank of a matrix, (with F. Santos and M. Develin) to appear in *Discrete and Computational Geometry*, (eds. J.E. Goodman and J. Pach), Mathematical Sciences Research Institute Publications, Cambridge University Press, 2005.

131. Toric ideals of phylogenetic invariants, (with S. Sullivan), 28 pp., `q-bio.PE/0402015`, to appear in *Journal of Computational Biology*.
132. Resultants in genetic linkage analysis, (with I. Hallgrimsdottir), `q-bio.QM/0405001`, 15 pp., submitted to *Journal of Symbolic Computation*, special issue in “Computational Algebraic Statistics”,
133. The maximum likelihood degree, (with F. Catanese, S. Hoşten and A. Khetan), `math.AG/0406533`, 32 pp., submitted to *American Journal of Mathematics*.
134. Phylogenetic algebraic geometry, (with N. Eriksson, K. Ranestad and S. Sullivan), `math.AG/0407033`, 15 pp, submitted to the Conference Proceedings “Varieties with Unexpected Properties” (Siena, June 2004).
135. Tropical mathematics, Clay Mathematics Institute Senior Scholar given at Park City, Utah, July 2004, `math.CO/0408099`, 15 pp.
136. Solving the likelihood equations, (with S. Hoşten and A. Khetan), `math.ST/0408270`, 20 pp., submitted to *Foundations of Computational Mathematics*.
137. The mathematics of phylogenomics, (with L. Pachter), `math.ST/0409132`, 38 pp., submitted to *Bulletin of the AMS*.

M.A. [Diplom] TH Darmstadt, Germany, Mathematics and Computer Science, 1985 Ph.D. [Dr. rer. nat.] TH Darmstadt, Germany, Mathematics, 1987 Ph.D. University of Washington, Seattle, Mathematics, 1987. Professional Experience: 1987â€”1988 Postdoctoral Fellow, I.M.A., University of Minnesota, Minneapolis. Computer Science (Ph.D.) Degree Level: Ph.D. Focus: preparing exceptional students for careers at the cutting edge of academia, industry, and government through a highly individualized program of study. Computer Science (Ph.D.) Course Description and Catalog. Facebook. Twitter. Psychology at universities in Germany is either in the natural sciences or in philosophy, depending on the university. This affects the kind of academic title you get. People doing their doctoral thesis either get the doctor in natural sciences (Dr. rer. nat.) or the doctor in philosophy (Dr. phil.).Â As a doctor of natural sciences? As a Ph.D. (even if you have a Dr. rer. nat.)? Are there legal requirements? I am thinking about a website that is generally understood internationally and -- perhaps -- about business cards. (And yup, personally, I think -- and act if -- psychology is closer to natural sciences than philosophy.) (I'm sorry if I can't specify the question more closely.