

TOM BRADEN

Department of Mathematics
and Statistics
University of Massachusetts
Amherst, MA 01003

Office: LGRT 120
phone: (413) 545-1732
email: braden@math.umass.edu
web: <http://www.math.umass.edu/~braden>

Education

1986–1990 University of Chicago, BA in Mathematics.
1990–1991 Cambridge University, Part III of the Mathematics Tripos.
1991–1995 MIT Ph.D., June 1995.

Employment

1995–1997 Member, Institute for Advanced Study
1997–2001 Benjamin Peirce Instructor, Harvard. On leave 1999-2000.
2001–2007 Assistant Professor, UMass Amherst.
2007– Associate Professor, UMass Amherst.
Spring 2007 Visitor, Hebrew University Institute for Advanced Studies,
program: “Combinatorics of Polytopes and Complexes: Relations
with Topology and Algebra”

Awards and grant support

NSF Graduate Fellow, 1991-94
Sloan Dissertation Fellow, 1994-95
NSF grant DMS-0201823, “Combinatorial models of perverse sheaves”,
2002-2005, \$87,000.
NSA grant “Equivariant Topology of Singular Varieties”, 2008-2010, \$61,120.

Research Interests

Topology of singular spaces. Perverse sheaves and intersection cohomology on singular algebraic varieties, and their interactions with representation theory and combinatorics of convex polytopes and hyperplane arrangements.

Publications

Perverse sheaves on rank stratifications, with Mikhail Grinberg. *Duke Math. J.* **96** (1999), no. 2, 317–362.
Intersection homology of toric varieties and a conjecture of Kalai, with Robert MacPherson. *Comment. Math. Helv.* **74** (1999), no. 3, 442–455.
From moment graphs to intersection cohomology, with Robert MacPherson. *Math. Ann.* **321** (2001), no. 3, 533–551.
On the reducibility of characteristic varieties. *Proc. Amer. Math. Soc.* **130** (2002), no. 7, 2037–2043.
Perverse sheaves on Grassmannians. *Canad. J. Math.* **54** (2002), no. 3, 493–532.
Hyperbolic localization of intersection cohomology. *Transform. Groups* **8** (2003), no. 3, 209–216.

Lower bounds for Kazhdan-Lusztig polynomials from patterns, with Sara Billey. Transform. Groups **8** (2003), no. 4, 321–332.

Equivariant-constructible Koszul duality for dual toric varieties, with Valery Lunts, Adv. Math. **201** (2006), no. 2, 408–453.

Remarks on the combinatorial intersection cohomology of fans, Pure Appl. Math. Quart. **2** (2006), no. 4, 1149–1186.

Koszul duality for toric varieties, Trans. Amer. Math. Soc. **359** (2007), 385–415.

Equivariant Chow rings of quot schemes, with Linda Chen and Frank Sottile, Pacific J. Math. **238** (2008), no. 2, 201–232.

Examples of torsion in intersection cohomology of Schubert varieties, in preparation.

The hypertoric intersection cohomology ring, with Nicholas Proudfoot, preprint arXiv:0802.0641, 47pp. To appear in Inventiones Mathematicae.

Gale duality and Koszul duality, with A. Licata, N. Proudfoot and B. Webster, preprint arxiv:0806.3256, 49pp. Submitted.

Cohomological symplectic duality, with A. Licata, N. Proudfoot and B. Webster, in preparation.

Mathematical software

MG: software to compute equivariant cohomology and intersection cohomology using moment graphs, available at <http://www.math.umass.edu/~braden/MG>.

Organizational activities

Organized a working seminar for faculty and graduate students on quiver varieties: Spring 2006.

Co-organizer of special session “Combinatorial methods in equivariant topology”, at AMS Fall 2006 sectional meeting, Storrs, CT.

Co-director of Five College Valley Geometry Seminar, 2006–2007.

Recent Invited Talks

Symplectic duality and hypertoric varieties, in meeting “Toric geometry”, Mathematische Forschungsinstitut Oberwolfach, Germany, January 2009.

The Geometry of Bar-and-Joint Machines, Reed College colloquium, October 2008.

Toric and hypertoric varieties: topology and combinatorics, topology seminar, Wesleyan University, April 2008.

Hypertoric varieties and Gale duality, in special session on algebraic combinatorial geometry, AMS meeting, NYU, March 2008.

Category \mathcal{O} for hyperplane arrangements, GASC seminar, Northeastern University, November 2007.

A ring structure on intersection cohomology of hypertoric varieties, special session on toric varieties, AMS meeting, Rutgers, New Brunswick, NJ, October 2007.

Hyperplane arrangements and hypertoric varieties, workshop on Combinatorics and Topology, Institute for Advanced Studies, Hebrew University, Jerusalem, June 2007.

Counting faces of polytopes and geometry of toric varieties (two talks), Basic Notions seminar, mathematics department, Hebrew University, April and May 2007.

Polytope duality and Koszul duality, IAS, Hebrew University, March 2007.

Combinatorics of arrangements and topology of hypertoric varieties, in meeting “Geometric and Topological Combinatorics”, Oberwolfach, Germany, January 2007.

Equivariant intersection cohomology of toric varieties and applications, international conference on Toric Topology, Osaka City University, May 2006.

Semi-infinite moment graphs, in special session “Algebraic Groups” at AMS sectional meeting, Durham, NH, April 2006.

Rigidity of polytopes and toric varieties, University of Connecticut math department colloquium, March 2006.

Hypertoric varieties and Gale duality of hyperplane arrangements, Combinatorics seminar, UC Berkeley, March 2006.

Intersection cohomology of hypertoric varieties and Gale duality, at meeting “Convexity and Algebraic Geometry”, Oberwolfach, Germany, February 2006.

Convex polytopes and intersection cohomology, colloquium, Albert-Ludwigs-Universität, Freiburg, Germany, January 2006.

Koszul duality for perverse sheaves on dual toric varieties, Boston University Geometry seminar, April 2005.

Stanley’s convolution and Koszul duality for dual affine toric varieties, in special session “Algebraic Geometry and Combinatorics”, AMS sectional meeting, Santa Barbara, April 2005.

Equivariant cohomology of Quot schemes, IAS, Princeton, NJ, January 2005.

Equivariant localization and intersection cohomology., in conference “Geometry, Combinatorics and Algebraic Groups, on the occasion of the sixtieth birthday of Robert MacPherson”, IAS, Princeton, NJ, Fall 2004.

Equivariant Cohomology of Quot Schemes, in special session in Modern Schubert Calculus, AMS sectional meeting, Evanston, IL, Fall 2004.

Presentation of MG: software to compute equivariant (intersection) cohomology with moment graphs, at Park City Mathematics Institute, Summer 2004.

Cohomology of intersections of opposite Bruhat cells, SIAM Conference on Discrete Mathematics, Nashville, TN, Summer 2004.

Toric Koszul duality, in special session on Algebraic geometry and topology, AMS sectional meeting, Tallahassee, FL, Spring 2004

Torsion in intersection cohomology of Schubert varieties in meeting “Algebraische Gruppen”, Mathematisches Forschungsinstitut Oberwolfach, Spring 2004.

Koszul duality for sheaves on toric varieties, in meeting “Convex bodies and algebraic geometry”, Tokyo Institute of Technology, Fall 2003.

g- and h-polynomials of non-rational polytopes—recent progress, in meeting “Topological and geometric combinatorics”, Mathematisches Forschungsinstitut Oberwolfach, Spring 2003.

Torsion in intersection cohomology of Schubert varieties, IAS, Princeton, NJ, Spring 2003.

Supervision of graduate students

Currently supervising one Ph.D. student, Chris McDaniel.
Member of thesis committees for Christine von Renesse, Molly Fenn, Patrick Boland and Louis Theran (outside member).

Courses Taught

At UMass

Calculus for life and social sciences – large lecture class, 265 students
Calculus I, II, and III (a total of eight regular and honors sections)
Introduction to Abstract Algebra I and II (first semester with a one-credit honors colloquium)
Fundamental Concepts of Mathematics (introduction to proofs)
Topology I (graduate)
Algebraic Topology (graduate), twice
graduate topics course: Convex polytopes and toric varieties
graduate reading course: constructible sheaves
graduate reading course: combinatorics of convex polytopes

At Harvard

Honors advanced calculus and linear algebra, two semester sequence
Complex Analysis
Point-set Topology
Calculus on Manifolds
Multivariable Calculus
Algebraic Topology (graduate), two semester sequence.

Departmental service

Graduate Admissions Committee, since 2002-07.
Graduate Affairs Committee, starting Fall 2006.
Faculty search committee, elected member 2004-05, 2007-08.
Topology qualifying exam committee, eight semesters since January 2002, chair for six semesters.
Reader for two undergraduate honors theses.

Outside service

Refereeing for miscellaneous journals, including Journal of the American Mathematical Society, *Inventiones Mathematicae*, *Annals of Mathematics*, *Advances in Mathematics* (twice), and *Transactions of the AMS*.
Reviewing for *Mathematical Reviews*.
Paid reviewer for undergraduate geometry textbook.
Grant reviewing for the NSF and NSA.

Leisure interests

Performing Central Javanese gamelan music since 1990, mostly with the Boston Village Gamelan and the New York Indonesian Consulate gamelan. Major performances in Yogyakarta, Indonesia; Boston; New York (joint with the Brooklyn Philharmonic); and Saint Paul, MN.