

MARK JOSEPH BEHRENS

Curriculum Vitae

MIT Department of Mathematics
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Degrees:

Ph.D., Mathematics, University of Chicago, 2003, Thesis Advisor: J. P. May
M.A., Mathematics, University of Alabama at Tuscaloosa, 1998
B.S., Mathematics, University of Alabama at Tuscaloosa, 1998
B.S., Physics, University of Alabama at Tuscaloosa, 1998

Employment:

CLE Moore Instructor, Department of Mathematics, MIT, Supervisor: M. J. Hopkins,
2003-2005
Assistant Professor, Department of Mathematics, MIT, 2005-2011
Visiting Scholar, Department of Mathematics, Harvard University, 2007-2008
Associate Professor, Department of Mathematics, MIT, 2011-2014
Professor, Department of Mathematics, Notre Dame, beginning 2014

Honors:

Scholar, Barry M. Goldwater Scholarship and Excellence in Education Program, 1995
Postdoctoral Fellow, NSF, 2003
Fellow, Sloan Foundation, 2007
Invited Address, 1044th meeting American Mathematical Society, 2008
CAREER grant, NSF, 2011
Cecil and Ida B. Green Career Development Associate Professorship, 2011-2014
MIT School of Science Teaching Prize for Graduate Education, 2011
John and Margaret McAndrews Professorship, beginning 2014

MIT undergraduate research projects supervised:

Sauter, Trace, summer 2009
Lerner, Ben, spring 2010
Tynan, Phillip, summer 2010
Li, Yan, summer 2010
Atsaves, Louis, spring, summer 2011
Hahn, Jeremy, summer, fall 2011, spring 2012
Wear, Peter, spring 2012
Velcheva, Katerina, fall 2012, spring 2013
Tseng, Dennis, spring, summer 2013
Kraft, Benjamin, summer 2013

Ph.D. Students Supervised:

Osorno, Angelica, An infinite loop space structure for K-theory of bimonoidal categories, 2010
French, Jennifer, Derived mapping spaces as models for localizations, 2010
Pereira, Luis Alexandre, Goodwillie calculus and algebras over a spectral operad, 2013
Ullman, John, On the regular slice spectral sequence, 2013
Wang, Guozhen, in progress.

Postdoctoral Researchers Supervised:

Ormsby, Kyle, 2010-2013
Stapleton, Nathaniel, 2011-present
Stojanoska, Vesna, 2011-present

Teaching Experience (at MIT):

18.02A, Calculus lecture, fall 2011, 2012, IAP 2012, 2013.
18.02, Calculus recitation, fall 2003, spring 2007
18.100A, Analysis I, spring 2007, spring 2009
18.904, Seminar in Topology, fall 2005
18.906, Algebraic Topology II, spring 2006, 2010, 2011, 2012, 2013
18.915, Graduate Topology Seminar, fall 2006, fall 2009
18.917, Topics in Algebraic Topology, fall 2008
18.950, Differential Geometry, fall 2009

Service (at MIT):

Graduate admissions committee, Department of Mathematics, 2005-2006, 2007-2012.
Moore Instructor committee, Department of Mathematics, 2009-2012.
Colloquium Committee, Department of Mathematics, 2009-2012
Diversity Committee, Department of Mathematics, 2010-2012
MSRP, Mentor: 2009, 2011, Math coordinator: 2011-2013, faculty lecture, 2011
Undergraduate academic advisor, Department of Mathematics, 2007-current
Microteaching workshop, 2009-2013
SEPT program lecturer, 2006, 2009
Laureates and Leaders dinner, 2009, 2010
MMBA mentorship dinner, 2010
Graduate student lunch seminar, Speaker: spring 2008, fall 2008, 2009, 2011, fall 2012
Organizer: spring 2011
Organizer: K-theory lunch seminar, spring 2009
MAP mentor, 2010-2012

External Service:

Editor, Geometry and Topology, 2013-current
Editor, Advances in Mathematics, 2011-current
Editor, Journal of Homotopy and Related Structures, 2012-current
Reviewer, AMS math reviews, 2004-current

Publications:

1. *A new proof of the Bott periodicity theorem*, Topology Appl. 119 (2002), 167-183.
2. *Addendum to "A new proof of the Bott periodicity theorem"*, Topology Appl. 143 (2004), 281-290.
3. *On the existence of the self map v_2^9 on the Smith-Toda complex $V(1)$ at the prime 3*, with Satya Pemmaraju, Contemp. Math. 346 (2004), 9-49.
4. *Root invariants in the Adams spectral sequence*, Trans. Amer. Math. Soc. 358 (2006), 4279-4341.*
5. *A modular description of the $K(2)$ -local sphere at the prime 3*, Topology 45 (2006), 343-402.
6. *Isogenies of elliptic curves and the Morava stabilizer group*, with Tyler Lawson, J. of Pure Appl. Algebra 207 (2006), 37-49.
7. *Some root invariants at the prime 2*, Geom. Topol. Monographs 10 (2007), 1-40.
8. *Buildings, elliptic curves, and the $K(2)$ -local sphere*, Amer. J. Math. 129 (2007) 1513-1563.
9. *On the existence of a v_2^{32} -self map on $M(1,4)$ at the prime 2*, with Michael Hill, Michael J. Hopkins, and Mark Mahowald, Homology, Homotopy Appl. 10 (2008), 45-84.
10. *Congruences between modular forms given by the divided beta family in homotopy theory*, Geom. Topol. 13 (2009), 319-357.
11. *β -family congruences and the f -invariant*, with Gerd Laures, Geom. Topol. Monographs 16 (2009) 9-29.
12. *Topological automorphic forms*, with Tyler Lawson, Memoirs of the AMS. 958 (2010), i-xxiii, 1-132.
13. *The homotopy fixed point spectra of profinite Galois extensions*, with Daniel G. Davis, Trans. Amer. Math. Soc. 362 (2010) 4983-5042.
14. *Topological automorphic forms on $U(1,1)$* , with Tyler Lawson, Math. Zeit. 267 (2011), 497-522.
15. *Higher real K -theories and topological automorphic forms*, with Michael J. Hopkins, J. Topology 4 (2011), 39-72.
16. *The Goodwillie tower for S^1 and Kuhn's theorem*, Algebr. Geom. Topol. 11 (2011), 2453-2475.
17. *The homotopy groups of $SE(2)$ at $p \geq 5$ revisited*, Adv. Math. 230 (2012), 458-492.
18. *The EHP sequence and the Goodwillie tower*, Memoirs of the AMS 1026 (2012), i-xi, 1-90.

Submitted and In Progress Publications:

19. *Notes on the construction of tmf* , to appear in proceedings of 2007 Talbot Workshop (52 pages).
20. *On the homotopy of $Q(3)$ and $Q(5)$ at the prime 2*, with Kyle Ormsby, submitted.
21. *The Bousfield-Kuhn functor and topological Andre-Quillen cohomology*, with Charles Rezk, preprint (28 pages).
22. *Exotic spheres detected by topological modular forms*, with Michael Hill, Michael Hopkins, and Mark Mahowald, in progress.
23. *On the ring of tmf cooperations at the prime 2*, with Kyle Ormsby, Nathaniel Stapleton, and Vesna Stojanoska, in progress.

Invited Presentations:

- Root invariants in the Adams spectral sequence*, Topology seminar, University of Illinois at Urbana-Champaign, 2002
- Root invariants and v_2 -periodicity at the prime 3*, Topology seminar, University of Chicago, 2002
- Root invariants in the Adams spectral sequence*, Sectional meeting of the AMS, Orlando, FL, 2002
- On the homology of tmf* , Topology seminar, University of Notre Dame, 2003
- Homotopy beta elements at the prime 3*, Northwestern University, 2003
- Isogenies of elliptic curves and the $K(2)$ -local sphere*, Conference in honor of Goro Nishida, Kinoshita, Japan, 2003
- Lecture series on root invariants*, Workshop attached to Nishida conference, Nagoya, Japan, 2003
- Root invariants, Adams spectral sequences, and Greek letter elements*, Topology seminar, MIT,

2003

Isogenies of elliptic curves and the $K(2)$ -local sphere, Topology seminar, University of Chicago, 2003

A modular description of the $K(2)$ local sphere, MIT topology seminar, 2004

A modular description of the $K(2)$ -local sphere at the prime 3, Special session on homotopy theory (in honor of William Browder's 70th birthday), Sectional meeting of the AMS, Lawrenceville, NJ, 2004

Isogenies of elliptic curves and the $K(2)$ -local sphere, Workshop on forms of homotopy theory: elliptic cohomology and loop spaces, Fields Institute, 2004

Isogenies of elliptic curves and the $K(2)$ -local sphere, Topology/geometry seminar, Brown University, 2004

The $K(2)$ -local sphere and isogenies of elliptic curves, Topology seminar, Northwestern University, 2004

Stable homotopy groups of spheres and modular forms, Wayne State University Colloquium, 2005

A resolution of the $K(2)$ -local sphere, Wayne State University Topology Seminar, 2005

A resolution of the $K(2)$ -local sphere, University of Rochester, 2005

Hypercohomology of categories, Union College Mathematics Conference, Union College, 2005

Whitehead products and the Goodwillie tower, Workshop on operads and the Goodwillie Calculus, Clay Mathematics Institute, 2005

Buildings, elliptic curves, and the $K(2)$ -local sphere, Topology seminar, University of Illinois at Urbana-Champaign, 2005

Buildings, elliptic curves, and the stable homotopy groups of spheres, Topology seminar, Bonn, Germany, 2005

Buildings, elliptic curves, and the stable homotopy groups of spheres, Joint meeting of AMS, DMV, OMG, Mainz, Germany, 2005

Computing homotopy groups of spheres with modular forms, Colloquium, Purdue University, 2005

Hypercohomology of categories, Topology seminar, Purdue university, 2005

The Eichler-Shimura correspondence for $GL(2)$, Talbot Workshop, North Conway, NH, 2005

Cohomology theories associated to Shimura varieties, Topology seminar, MIT, 2005

Computing homotopy groups of spheres with modular forms, Colloquium, University of Chicago, 2006

Cohomology theories associated to Shimura varieties, Topology seminar, University of Chicago, 2006

Computing homotopy groups of spheres with modular forms, Colloquium, University of Texas at Austin, 2006

Cohomology theories associated to Shimura varieties, Seminar, University of Texas at Austin, 2006

Computing homotopy groups of spheres with modular forms, Colloquium, Johns Hopkins University, 2006

v_2 -periodicity at the prime 2, Algebraic and Geometric Topology: a conference in honor of Bob Stong, University of Virginia, 2007

Stable homotopy groups of spheres and modular forms, Harvard faculty colloquium, Harvard University, 2007

Topological automorphic forms, Workshop on stacks in geometry and topology, Fields Institute, 2007

On the construction of tmf , Talbot workshop, North Conway, NH, 2007

Topological automorphic forms, Complex cobordism in homotopy theory: its impacts and prospects, Johns Hopkins University, 2007

Topological automorphic forms, Abel Symposium, Oslo, Norway, 2007

Lecture series on topological automorphic forms, Nagoya Institute of Technology, Nagoya,

Japan, 2008

Wrapping spheres around spheres, General lecture, Nagoya Institute of Technology, Nagoya, Japan, 2008

Congruences amongst modular forms and the divided beta family, Special session on algebraic topology, Joint meetings of the AMS, San Diego, CA, 2008

Congruences amongst modular forms and periodic families of elements in the stable homotopy groups of spheres, Boston University number theory seminar, 2008

On the existence of a v_2^{32} self-map at the prime 2, Special session on applications of ring spectra, Sectional meeting of the AMS, Bloomington, IN, 2008

Discussion sessions, Homotopical group theory and topological algebraic geometry workshop, University of Copenhagen, Denmark, 2008

Congruences amongst modular forms and the divided beta family, Homotopical group theory and topological algebraic geometry, Bonn, Germany, 2008

Homotopy fixed points of profinite Galois extensions, MIT topology seminar, 2008

Congruences between modular forms and the divided beta family, Wayne State University Topology Seminar, 2008

Congruences amongst modular forms and the stable homotopy groups of spheres, Invited address, 1044th meeting of the AMS, Huntsville, AL, 2008

Modular forms and topology, Graduate student colloquium, Northwestern University, 2008

Orientations and Eisenstein series, Topology seminar, University of Minnesota, 2008

Orientations and Eisenstein series, Number theory seminar, Harvard University, 2008

Orientation theory, Topology Seminar, Hebrew University of Jerusalem, Jerusalem, Israel, 2009

Lecture series on topological modular forms, Workshop in homotopy theory on topological modular forms, Caesarea Maritime Center, Caesarea, Israel, 2009

Orientations and Eisenstein series, Topology seminar, Berkeley University, 2009

Orientations and Eisenstein series, Topology seminar, Johns Hopkins University, 2009

Modular forms in topology, Colloquium, Tufts University, 2009

Chromatic fracture of gl_1 , Mini-FRG on p-divisible groups and stable homotopy theory, 2009

On the relationship between EO_n and TAF, Eastern Section Meeting of the AMS, University Park, Penn State University, 2009

Higher real K-theories and topological automorphic forms, Topology seminar, University of British Columbia, 2010

Higher real K-theories and topological automorphic forms, Midwest Topology Seminar, Michigan University, 2010

The homotopy groups of the $E(2)$ -local sphere, revisited, Topology seminar, MIT, 2010

The EHP sequence and the Goodwillie tower, Georgia topology conference, Athens, GA, 2010

The homotopy groups of the $E(2)$ -local sphere, revisited, Conference on homotopy theory and derived algebraic geometry, Fields Institute, 2010

Introduction to the Adams-Novikov Spectral Sequence: Ravenel's Proof for Primes > 3 , Hot topics workshop on the Kervaire invariant, MSRI, 2010

The homotopy groups of the $E(2)$ -local sphere, revisited, Topology seminar, CUNY graduate center, 2010

The EHP sequence and the Goodwillie tower, Algebraic topology seminar, Princeton, 2010

The Goodwillie tower and the Whitehead conjecture, Topology seminar, UIUC, 2011

The Goodwillie tower and the Whitehead conjecture, Topology seminar, Univ. of Chicago, 2011

A survey of the Goodwillie tower of the identity, Workshop on functor calculus and operads, BIRS, 2011

The odd primary EHP sequence, Union mathematics conference, 2011

XII Lisbon Summer Lectures in Geometry: Topological Automorphic Forms, Instituto Superior Técnico, Lisbon, Portugal, 2011

Congruences between modular forms and the divided β family, MSRP faculty lecture, MIT, 2011

The Morava E-homology of the $L(k)$ spectra, Topology summer seminar, MIT, 2011

Homological behavior of the Goodwillie tower, Workshop on homotopy theory, MFO, 2011
The Morava E-theory of the Goodwillie tower, Special session on calculus of functors, JMM, Boston, 2012
Exotic spheres and topological modular forms, Second Abel Conference: A Mathematical Celebration of John Milnor, IMA, 2012
The Morava E-theory of the Goodwillie tower, Topology seminar, University of Chicago, 2012
Exotic spheres and topological modular forms, Midwest topology seminar, Northwestern, 2012
Exotic spheres and topological modular forms, Colloquium, UIC, 2013
Exotic spheres and topological modular forms, Colloquium, University of Washington, 2013
Exotic spheres and topological modular forms, Colloquium, Northwestern University, 2013
Exotic spheres and topological modular forms, Colloquium, University of Notre Dame, 2013
Exotic spheres, Colloquium, Wellesley College, 2013
The Bousfield-Kuhn functor and topological Andre-Quillen cohomology, Conference on Equivariant, Chromatic, and Motivic Homotopy Theory, Northwestern University, 2013
Faculty mentor, Talbot workshop on chromatic homotopy, Lake Tahoe, CA, 2013
A Lie algebra model for unstable v_n -periodic homotopy, JHU-UMD Algebra and Number Theory Day, Johns Hopkins University, 2013
A Lie algebra model for unstable v_n -periodic homotopy, Principle speaker, Lehigh University Geometry and Topology Conference, Lehigh University, 2013
Lecture series on computational methods in stable homotopy theory, MSRI summer school in algebraic topology, 2013

Conferences organized:

1. Special session on Homotopy Theory and Algebraic Topology (with Mike Hill), 2008 Fall Southeastern Meeting of the AMS, Huntsville, AL, October 24-26, 2008
2. Mayday 2009 (with Maria Basterra, Andrew Blumberg, Mike Mandell, and Jim McClure), Conference honoring Peter May on the occasion of his 70th birthday, University of Chicago, Oct 16-18 2009.
3. Special session and satellite conference on Homotopy Theory (with Mark Johnson, Haynes Miller, James Turner, and Donald Yau), 2012 Joint meetings of the AMS, Jan 6-7, 2012 (satellite conference: MIT, Jan 5, 2012).
4. Quillen Memorial Conference (with Clark Barwick, Joachim Cuntz, Eric Friedlander, Michael Hopkins, Jean-Louis Loday, Haynes Miller, Andrew Ranicki, Graeme Segal, Isadore Singer), MIT, Oct 6-8, 2012.

Research Contracts and Grants:

NSF Conference grant: The legacy of Daniel Quillen: K-theory and homotopical algebra (with Clark Barwick and Haynes Miller), 9/1/2012-9/1/2013, \$50,000.00
 NSF, CAREER: Arithmetic structure of homotopy theory, 7/1/2011-current, \$434,087.00
 NSF, Collaborative Research: Homotopy theory: Applications and new dimensions (with H. Miller, C. Barwick, M. J. Hopkins, J. Lurie), 9/1/2009-current, \$1,624,205.00
 NSF, EMSW21-RTG: Geometry and topology (with T. Mrowka, D. Auroux, P. Seidel, K. Wehrheim), 6/2010-current, \$1,623,935.00
 NSF, Conference grant: Current and classical themes in homotopy theory, 7/2009-7/2010, \$25,000.00
 MIT, NEC Corporation fund for research in computers and communications, 2008, \$50,000
 Alfred P. Sloan foundation, Research fellowship, 7/2007-9/2011, \$45,000.00
 NSF, Local and global methods in homotopy theory, 7/2006-6/2010, \$188,313.00
 NSF, Postdoctoral fellowship, 7/2003-6/2006, \$108,000.00

Contributions to the Educational Commons at MIT not listed in the Service Section above:

IAP math lecture series, 2006, 2007

School of Science underrepresented minority strategic group, 2008-2010, 2012-current

Participant in hooding ceremony, spring 2010

IAP Directed reading program, coorganizer, 2011-2013

Freshman Advisor, 2011-2012

UROP coordinator: pure mathematics, 2011-2014

Lecturer: 18.02A Fall/IAP 2011-2013