

Benjamin B. Brubaker

Professor

School of Mathematics

University of Minnesota

email: brubaker@math.umn.edu

web: math.umn.edu/~brubaker

EDUCATION

- **Amherst College**, Amherst, Massachusetts.
A.B. *summa cum laude* with highest distinction in Mathematics, 1998.
 - **Brown University**, Providence, Rhode Island.
Sc. M. in Mathematics, 2000.
Ph. D. in Mathematics, 2003.
Thesis Advisor : Jeffrey Hoffstein.
Dissertation titled “Analytic Continuation for Cubic Multiple Dirichlet Series”
-

POSITIONS/EMPLOYMENT

- **University of Minnesota**, Twin Cities Campus.
Deputy Director, Institute for Mathematics and Its Applications, 2017 - present.
Professor of Mathematics, 2015 - present.
Associate Professor of Mathematics, 2012 - 2015.
 - **Massachusetts Institute of Technology**, Cambridge, Massachusetts.
Associate Professor of Mathematics, 2011 - 2012.
Cecil and Ida B. Green Development Chair, 2010 - 2012.
Assistant Professor of Mathematics, 2006 - 2011.
 - **Stanford University**, Stanford, California.
Szegő Assistant Professor of Mathematics, 2003 - 2006.
-

HONORS AND AWARDS (EXTERNAL SOURCES)

- **Invited Keynote Addresses** (2011) - AMS Southern Sectional, Wake Forest Univ., (2016) - FPSAC, Vancouver, BC, (2017) - TORA VIII, Stillwater, OK
- **Cecil and Ida B. Green Chair** (2010 - 2012) - Endowed chair from MIT, awarded to an assistant professor for career development
- **NSF CAREER Grant** (2009) - Lone PI on a five-year award (DMS-0844185 at MIT and DMS-1258675 at Minnesota) to study “Multiple Dirichlet Series, Automorphic Forms, and Combinatorial Representation Theory.”
- **James H. Ferry, Jr. Fund for Innovation in Research Education** (2007) - Lone PI on a grant from MIT to develop and support student interest in number

theory titled “Mathematics as a Laboratory Science: Building a Number Theory Community at MIT.”

- **Outstanding Teaching Award, Stanford Math Dept.** (2006) - Awarded every few years for distinguished contributions to teaching.
- **President’s Award for Teaching Excellence** (2003) - Brown’s university-wide award given annually to up to four graduate student teachers across all departments.
- **George Irving Hopkins Dissertation Fellowship** (2002) - One-year research grant from Brown University awarded for outstanding progress toward a thesis.
- **Brown Univ. Math Department Outstanding Teaching Award** (2002)
- **Phi Beta Kappa** (1998) - membership from Amherst College.

RESEARCH

Grants at University of Minnesota

- **IMA Special Programs Grant** (2017-2018) - With co-PI Gregg Musiker to offer SageMath Coding Sprints, short stays at the IMA to accomplish mathematical coding projects in Sage.
- **NSF Individual Grant** (2014-2017) - Lone PI on NSF grant (DMS-1406238) to study “Metaplectic automorphic forms and matrix coefficients” (\$180,000)
- **NSF CAREER Grant** (2009-2014) - Lone PI on a five-year award (DMS-0844185 at MIT and DMS-1258675 at Minnesota) to study “Multiple Dirichlet Series, Automorphic Forms, and Combinatorial Representation Theory.” (\$302,697)

Grants at Prior Insitutions

- **NSF Individual Grant** (2007-2010) - Lone PI on NSF grant (DMS-0702438) to study “Multiple Dirichlet Series with Applications to Automorphic Representation Theory” (\$170,409)
- **NSF FRG Grant** (2006-2009) - PI on NSF grant (DMS-0652529) with Co-PI Alina Bucur (my postdoctoral advisee) to study “Combinatorial representation theory, multiple Dirichlet series, and moments of L-functions” (\$98,412). The FRG was also granted to fellow PIs at Boston College, Brown, Columbia, CUNY, Minnesota and Stanford, though awards were made separately to each institute. The amount above is only that given to MIT.
- **NSF FRG Grant** (2003-2006) - Senior personnel (postdoctoral researcher) at Stanford University on focused research grant DMS-0354662 with fellow PIs at Boston College, Brown, and Columbia.

Conference Grants

- **Clay Mathematics Institute** (2014) Lone PI on “Analytic number theory and its applications,” an international conference in Thessaloniki, Greece in July, 2014. (\$18,000)
 - **NSF Conference Grant** (2012) Lone PI on “Automorphic forms, representations, and combinatorics,” an international conference at Stanford University in July, 2012. (DMS-1205558, \$30,400)
-

PUBLICATIONS

Books

- Co-author – *Weyl group multiple Dirichlet series: Type A combinatorial theory* (with D. Bump and S. Friedberg), 170 pp., *Annals of Math Studies* vol. 175 (2011).

Refereed Journal Articles (Published)

1. *On Hamiltonians for six-vertex models* (with A. Schultz), *J. Combin. Theory Ser. A* **155**, 100–121 (2018)
2. *Hecke modules from metaplectic ice* (with V. Buciumas, D. Bump, and S. Friedberg), *Selecta Math New Ser.*, To appear, 48 pages. (2017)
<https://doi.org/10.1007/s00029-017-0372-0> (2017)
3. *Matrix coefficients and Iwahori-Hecke algebra modules* (with D. Bump and S. Friedberg), *Advances in Math.* **299**, 247–271 (2016)
4. *The six-vertex model and deformations of the Weyl character formula* (with A. Schultz) *J. Algebraic Combin.*, **42**, no. 4, 917–958 (2015)
5. *Whittaker coefficients of metaplectic Eisenstein series* (with S. Friedberg) *Geom. Funct. Anal.* **25**, no. 4, 1180–1239 (2015)
6. *Whittaker functions and Demazure operators* (with D. Bump and A. Licata) *J. Number Theory* **146** 41–68 (2015)
7. *Unique functionals and representations of Hecke algebras* (with D. Bump and S. Friedberg) *Pacific J. Math.* **260**, no. 2, 381–394 (2012)
8. *Metaplectic ice* (with D. Bump, G. Chinta, S. Friedberg, and P. Gunnells) in *Multiple Dirichlet series, L-functions and automorphic forms*, *Progress in Math.* **vol. 300**, 65–92 (2012)
9. *Weyl group multiple Dirichlet series of type B* (with D. Bump, G. Chinta, and P. Gunnells) in *Multiple Dirichlet series, L-functions and automorphic forms*, *Progress in Math.* **vol. 300**, 93–118 (2012)

10. *A crystal definition of symplectic multiple Dirichlet series* (with J. Beineke and S. Frechette) in *Multiple Dirichlet series, L-functions and automorphic forms*, Progress in Math. **vol. 300**, 37–63 (2012)
11. *On Hecke relations for coefficients of the n -fold theta function* (with D. Bump, S. Friedberg, and J. Hoffstein) in *Contributions in Analytic and Algebraic Number Theory* (eds. Blomer, Mihailescu), Springer Proc. in Math., **Volume 9** 83–95 (2012)
12. *Eisenstein Series, Crystals, and Ice* (with D. Bump and S. Friedberg), *Notices of AMS* **58**, no. 11, 1563–1571 (2011)
13. *Schur polynomials and the Yang-Baxter equation* (with D. Bump and S. Friedberg), *Comm. Math. Phys.* **308**, no. 2, 281–301 (2011)
14. *Weyl group multiple Dirichlet series of Type C* (with J. Beineke and S. Frechette), *Pacific J. Math.* **254**, no. 1, 11–46 (2011)
15. *Weyl group multiple Dirichlet series, Eisenstein series, and crystal bases* (with D. Bump and S. Friedberg), *Annals of Math. (2)* **173** 1081–1120 (2011)
16. *Gauss sum combinatorics and metaplectic Eisenstein series* (with D. Bump and S. Friedberg), Automorphic forms and L-functions I. Global aspects, *Contemp. Math.* vol. 488, 61–81 (2009)
17. *Twisted Weyl group multiple Dirichlet series: the stable case*, (with D. Bump and S. Friedberg) *Eisenstein Series and Applications* (Gan, Kudla, Tschinkel eds.), Progress in Math vol. 258, 1–26 (2008)
18. *Weyl Group Multiple Dirichlet Series III: Eisenstein series and twisted unstable A_r* (with D. Bump, S. Friedberg, and J. Hoffstein) *Annals of Math. (2)*, **166** 293–316 (2007)
19. *Weyl group multiple Dirichlet series II: the stable case*, (with D. Bump and S. Friedberg) *Invent. Math.*, **165** 325–355 (2006)
20. *Weyl group multiple Dirichlet series I*, (with D. Bump, G. Chinta, S. Friedberg, and J. Hoffstein) Multiple Dirichlet Series, Automorphic Forms, and Analytic Number Theory (S. Friedberg, D. Bump, D. Goldfeld, and J. Hoffstein, ed.), *Proc. Symp. Pure Math.*, vol. 75, 91–114 (2006)
21. *Residues of Weyl group multiple Dirichlet series associated to \widetilde{GL}_{r+1}* , (with D. Bump) Multiple Dirichlet Series, Automorphic Forms, and Analytic Number Theory (S. Friedberg, D. Bump, D. Goldfeld, and J. Hoffstein, ed.), *Proc. Symp. Pure Math.*, vol. 75, 115–134 (2006).
22. *On Kubota's Dirichlet series* (with D. Bump) *J. Reine Angew. Math.*, **598** 159–184 (2006)
23. *Cubic twists of $GL(2)$ automorphic L-functions* (with S. Friedberg and J. Hoffstein) *Invent. Math.* **160** no. 1, 31–58 (2005)

24. *Non-vanishing twists of $GL(2)$ automorphic L -functions*, (with A. Bucur, G. Chinta, S. Frechette and J. Hoffstein), *IMRN* **78**, 4211-4239 (2004)
25. *Analytic continuation for cubic multiple Dirichlet series*, Brown University Ph.D. thesis. (2003)

Papers Submitted for Publication

- Duality for metaplectic ice (with V. Buciumas, D. Bump, and N. Gray), submitted for publication, [arxiv.org:1704.00701](https://arxiv.org/abs/1704.00701) (14 pages)
- A Yang-Baxter equation for metaplectic ice (with V. Buciumas and D. Bump), submitted for publication. [arXiv:1604.02206](https://arxiv.org/abs/1604.02206) (32 pages)

Papers In Preparation

- A Fermionic Fock space realization of metaplectic Whittaker functions (with V. Buciumas, D. Bump, and H. Gustafsson). In preparation.

Presentations

- Automorphic Forms Conference, ETH, Zurich (Summer 2018)
- BIRS workshop on automorphic forms and string theory, Banff, Canada (Fall 2017)
- TORA VIII Plenary Speaker, Stillwater, OK (Spring 2017)
- Simons Center Workshop on Physics and Number Theory (Fall 2016)
- BIRS workshop on Whittaker functions, Banff, Canada (Summer 2016)
- FPSAC 2016 Plenary Speaker, Vancouver, BC (Summer 2016)
- Midwest Combinatorics Conference, Plenary Speaker (Summer 2015)
- BC-MIT Number Theory Seminar (Spring 2015)
- AMS Sectional Meeting, Wisconsin-Eau Claire (Fall 2014)
- Analytic Number Theory and Applications, Thessaloniki, Greece (Summer 2014)
- University of North Texas Colloquium (Spring 2014)
- William H. Oliver Lecture, Williams College (Fall 2013)
- ICERM workshop on “Whittaker functions, Schubert calculus, and crystals” (Spring 2013)
- ICERM tutorial lectures on special functions on p -adic groups (Spring 2013)
- Automorphic Forms Seminar, Minnesota (Fall 2012, Fall 2013)
- Algebra Reading Seminar, Minnesota (Fall 2012, Fall 2013)

- Lie Groups Seminar, Minnesota (Fall 2012)
- Automorphic Forms, Representations and Combinatorics, Stanford (Summer 2012)
- UIUC Department Colloquium (Spring 2012)
- UIUC Number Theory seminar (Spring 2012)
- UNC Department Colloquium (Spring 2012)
- Minnesota Combinatorics Seminar (Spring 2012)
- Minnesota Department Colloquium (Spring 2012)
- Cornell Department Colloquium (Spring 2012)
- Plenary Address, AMS Southeastern Section Meeting (Fall, 2011)
- Banff International Research Workshop on Whittaker Functions (Summer, 2010)
- AMS/MAA Joint Meetings Number Theory Section (Spring, 2010)
- Plenary Address, Palmetto Number Theory Series XI (Fall, 2009)
- Stanford Workshop on Multiple Dirichlet Series (Summer, 2009)
- Michigan Group, Lie, and Number Theory Seminar (Spring, 2009)
- ICMS Edinburgh International Number Theory Conference (Summer, 2008)
- Wellesley College Colloquium (Fall, 2007)
- Illinois Number Theory Fest (Summer 2007)
- Boston University Algebra Seminar (Spring 2007)
- Conn. Valley Undergraduate Colloquium (Spring 2007)
- Five College Number Theory Seminar, Amherst, MA (Spring 2007)
- Stanford Number Theory Seminar (Winter, 2007)
- MIT Lie Groups Seminar (Spring, 2006)
- New York Number Theory Seminar (Winter, 2005)
- Michigan Number Theory Seminar (Fall, 2005)
- Texas A&M Number Theory Seminar (Fall, 2005)
- Wisconsin Number Theory Seminar (Fall, 2005)
- Bretton Woods Workshop on Multiple Dirichlet Series (Summer, 2005)
- Urbana-Champaign Number Theory Seminar (Spring, 2005)

- Stanford Math Competition Address to High-Schoolers (Winter, 2005)
- Claremont Five College Colloquium (Fall, 2004)
- AIM/Stanford Number Theory Seminar (Fall, 2004)
- Illinois Number Theory Conference (Summer, 2004)
- UCLA Number Theory Seminar (Spring, 2004)
- Princeton/IAS Number Theory Seminar (Spring, 2004)
- Automorphic Forms Workshop, Santa Barbara (Spring, 2004)
- UC-Berkeley Number Theory Seminar (Spring, 2004)
- Stanford Algebraic Methods Seminar (Fall, 2003)
- Boston University Number Theory Seminar (Spring, 2003)
- Brown Algebra Seminar (Fall, 2002)

TEACHING AND CURRICULUM DEVELOPMENT

University of Minnesota

- Spring 2017 – Math 3283W Sequences, Series, and Foundations
- Fall 2016 – Math 8300 Topics in Algebra - Hecke Algebras
- Spring 2016 – Math 3593H Honors Mathematics II
- Fall 2015 – Math 3592H Honors Mathematics I
- Fall 2014 – Math 8251 Algebraic Number Theory
- Spring 2014 – Math 8702 Complex Analysis II
- Fall 2013 – Math 8701 Complex Analysis I
- Fall 2012 – Math 8701 Complex Analysis I

MIT

- Spring 2012 – 18.785 Analytic Number Theory
- Fall 2011 – 18.03 Differential Equations (Lead Instructor)
- Spring 2011 – 18.785 Analytic Number Theory
- Fall 2010 – 18.784 Seminar – Additive Number Theory
- Fall 2009 – 18.01 Calculus I (Lead Instructor)

- Spring 2009 – 18.786 Topics in Algebraic Number Theory
- Fall 2008 – 18.01 Calculus I (Lead Instructor)
- Spring 2008 – 18.784 Seminar – Mathematical Legacy of Ramanujan
- Fall 2007 – 18.781 Theory of Numbers
- Spring 2007 – 18.103 Fourier Analysis and Applications
- Fall 2006 – 18.786 Topics in Algebraic Number Theory

Stanford University

- Spring 2006 – Math 152 Topics in Number Theory, Math 249B An Introduction to the Langlands Program
- Fall 2005 – Math 51 Linear Algebra and Differential Calculus of Several Variables, Math 248 Automorphic Forms
- Spring 2005 – Math 110 Applied Number Theory – Cryptography
- Winter 2005 – Math 109 Applied Group Theory, Math 263A Lie groups
- Fall 2004 – Math 52 Integral Calculus of Several Variables
- Winter 2004 – Math 109 Applied Group Theory, Math 249B Algebraic Number Theory
- Fall 2003 – Math 51 Linear Algebra and Differential Calculus of Several Variables

Curriculum Development

- Course notes and syllabi for courses developed available at my homepage: <http://math.umn.edu/~brubaker/>, including many scanned notes from recent courses and the open source 180-page typed manuscript on automorphic forms: <http://math.umn.edu/~brubaker/docs/mit/785notes.pdf>
- Leader of re-design of Single Variable Calculus (18.01) in MIT's OpenCourseWare Scholar version (Summer 2010) <http://ocw.mit.edu/courses/mathematics/18-01sc-single-variable-calculus-fall-2010/>

Further Development Activities in Teaching

- Co-Organizer, Graduate Teacher Training Seminar, Stanford University (2003 – 2006)
- Boston College Case Studies Project teaching consultant (published as AMS Issues in Mathematics Education, vol. 10) (2000-2002)

ADVISING AND MENTORING

Minnesota

Undergraduate Major Adviser (2014 – 2017)

With Keel, Bilyk and (since 2017) Musiker, we are the faculty undergraduate major advisers to over 500 mathematics majors, meeting 5 hours per week to discuss course planning, career options, corrections to their academic audits, etc.

Senior Undergraduate Research Projects - Math 4997W (14)

- Jared Genteman, Spring 2018
- Erzhuo Li, Spring 2018
- Greg Reta, Spring 2018
- Ian McMeeking, Spring 2018 (Honors thesis)
- Lin (Blair) Xu, Fall 2017
- Matt Mason, Spring 2017
- Daniel Tran, Spring 2017
- Justen Rickert, Spring 2017
- Weijing Wang, Spring 2017
- Lauren Diven, Summer 2016
- Christopher Pope, Spring 2015
- Jeremy Olson, Spring 2015
- Chunyang (Kevin) Tang, Fall 2014
- Zheng Ding, Spring 2014

Doctoral Students Currently Advising (4)

- Ben Strasser (5th year, passed oral exam)
- Katy Weber (3rd year, reading course/weekly meetings)
- Andy Hardt (2nd year, reading course/weekly meetings)
- Claire Frechette (2nd year, reading course/weekly meetings)

Doctoral Students Graduated from UMN (4)

- William Grodzicki (graduated May 2017)
- Nathan Gray (graduated May 2017)
- Heidi Goodson (graduated May 2016)

Post-doctoral Fellows Supervised

- Ian Whitehead (2014 – 2017)

Additional Mentoring

- Faculty Mentor for Assistant Professor Christine Berkesch-Zamaere
- Graduate Advisor to first and second year Minnesota graduate students (Madeline Handschy, Ben Strasser, Craig Corsi, Mathieu De Langis, Drisana Mosaphir, Cecily Santiago)

MIT

UROPs

- Hansheng Diao, ShinnYih Huang, Jonathan Zhu, Alexandr Zamorzaev

Doctoral Dissertations Directed

- Peter J. McNamara (Ph.D. May 2010),
- Sawyer Tabony (Ph.D. May 2011),
- Catherine Lennon (Ph.D. May 2011),
- Mario DeFranco (Ph.D. May 2014)

Postdoctoral Fellows Supervised

- Alina Bucur (2006–2009)
- Karl Mahlburg (2006–2009)
- David Whitehouse (2008–2010)

Additional Mentoring

- PROMYS mentor, project leader for six-week summer program at Boston University (Summer 2007, 2008)

Stanford

UROPs

- Robert Hough, Carl Erickson
-

SERVICE AND PUBLIC OUTREACH

Service to the Discipline - Minnesota

- Editor, Proceedings of the AMS (2018 – present)
- Math Alliance F-GAP mentor for 2 students (2017 – present)
- Reviewer for numerous journals, NSA grants, and NSERC applications
- NSF Grants Panel (2015)
- NSA Mathematics Grants Panel (2014, 2015)
- Co-organizer of several international conferences and workshops, including
 - BIRS workshop on Whittaker functions: Number theory, geometry, and physics, Banff, Canada (July 2016)
 - Analytic Number Theory and Applications, Thessaloniki, Greece (July, 2014)
 - ICERM semester program (Spring, 2013)
 - BIRS international workshops on Whittaker functions and Physics, Banff, Canada, (October 2013)
 - Automorphic Forms, Representations and Combinatorics: A Conference in Honor of Daniel Bump, Stanford University, Stanford, CA (Summer 2012)

Service to the Discipline - MIT

- Reviewer for numerous journals
- NSF Career Grant Panelist (2009)
- Co-organizer of BIRS international workshops on Crystal graphs and Whittaker functions, Banff, Canada, (June 2010)

Service to the University – Minnesota

- CSE Indigo Committee (Strategic Planning) (2018)
- School of Mathematics Tenure and Promotions Committee (2017)
- IMA 2020 Committee (2016-2020)
- School of Mathematics Strategic Planning Committee (2016-2017)

- Undergraduate Curriculum Committee (2014-2018) Chair: 2015-2018
- Doctoral Dissertation Fellowship Committee (University-wide) (2015-2018)
- Postdoctoral Search Committee (2014-2016)
- IMA Summer Boot Camp Selection Committee (2016)
(read 105 applicant files and made decisions on offers)
- Promotion Committee for Contract Faculty (2015-2016)
- Faculty Search Committee (2013-2014)
- Graduate Admissions Committee (2012-2014)
- Undergraduate Major Advisor (2014-2017)

Service to the University – MIT

- Graduate Admissions Committee (2007-2012)
- Co-Organizer for various seminars while at MIT (2006 - 2012), including Boston Joint Mathematics Colloquium, BC-MIT number theory seminar, MIT number theory seminar, MIT graduate student lunch seminar

Public Service

- Speaker for Public Lecture at Young Scientists' Roundtable, a group of 200 students grades K-12 with interest in science, Wayzata, MN (January 2013)