

BOSTON COLLEGE

MORRISSEY COLLEGE OF ARTS AND SCIENCES



GRADUATE PROGRAM

MATHEMATICS



WELCOME TO THE DEPARTMENT OF MATHEMATICS

The Department of Mathematics at Boston College seeks to advance mathematics through a commitment to excellence in research, teaching and service to the community. The faculty has a strong research reputation, with highly regarded research groups in the areas of Algebraic Geometry, Geometry, Number Theory, Representation Theory and Topology.

The department’s Ph.D. program was launched in 2010 and now supports 25 to 30 graduate students, attracting doctoral students from top programs both nationally and internationally. Service contributions include extensive work with pre-collegiate math teachers, involvement with mathematics policy questions at the state and national levels and support for scholarship in mathematics through the organization of international scholarly meetings and the editing of high-quality journals.

As you explore Boston College, you will no doubt be impressed by the strength of our graduate programs and the depth of the resources we offer to support outstanding graduate study. On campus, one-third of all students are graduate

students; they are a vital part of the intellectual life of the university. Graduate students across all Boston College programs contribute to and benefit from the charism of a Jesuit university, combining a zest for academic achievement with a climate that fosters personal growth and a caring concern for the individual.

Our location in Boston—a world-renowned center for mathematics—also provides a vibrant intellectual climate in which our graduate students thrive.

We invite your questions and encourage you to find out more about our department at bc.edu/math and to visit our campus.

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PROGRAM OVERVIEW

Ph.D. Program

The Department of Mathematics at Boston College offers a selective and focused doctoral program for talented students specializing in two broad areas of research:

Geometry/Topology

- ❖ Three-dimensional manifolds and their geometry
- ❖ Heegaard-Floer and Khovanov homology
- ❖ Hyperbolic geometry
- ❖ Kleinian groups
- ❖ Knot theory
- ❖ Dynamics
- ❖ Geometry of moduli space

Number Theory/Algebraic Geometry/ Representation Theory

- ❖ Automorphic forms
- ❖ Cohomology of arithmetic groups
- ❖ Geometry of Shimura varieties
- ❖ Local Langlands correspondence
- ❖ Multiple Dirichlet series
- ❖ Representation theory
- ❖ Algebraic geometry
- ❖ Spectral geometry

REQUIREMENTS

Residency

A student must be in residence in the Department of Mathematics at Boston College for at least two consecutive semesters of one academic year with full-time (two courses per semester) registration.

Coursework

Students must complete at least 50 credit hours at the graduate level, including the first-year courses in Algebra, Geometry/Topology, Real and Complex Analysis, and second-year courses such as Number Theory, Representation Theory, Geometry or Topology. Very well-prepared students may be allowed to skip some or all of the first-year graduate courses and proceed directly to advanced study.

Qualifying Examination

After the first year, students take two of the three qualifying exams in Real and Complex Analysis, Algebra and Topology. Well-prepared students may take these exams earlier, upon consultation with the assistant chair of graduate programs.

Language Examination

This exam consists of translating mathematics from French or German into English.

Doctoral Comprehensive Examination

During the third year, the student requests that a faculty member serve as his/her research advisor. Upon agreement of the faculty member, the student forms a comprehensive examination committee, consisting of the research advisor and at least two other faculty members. The doctoral comprehensive exam consists of a research topic and one secondary topic, chosen by the student in consultation with the comprehensive examination committee. Typically, these are based on topics courses of independent study completed by the student in the second and third years.

Teaching

In addition to their responsibilities as teaching assistants and teaching fellows, students participate in the Teaching Seminar during their first two years.

Dissertation

Upon satisfactory performance in exams, the student is admitted to candidacy for the Ph.D. and begins research for the doctoral dissertation. The dissertation must consist of original scholarly work. The doctoral committee reads and evaluates the completed dissertation and conducts an oral examination, at which the dissertation is defended in a public meeting.

Plan of Study

The typical schedule for a first-year Ph.D. student is as follows:

Fall Semester	Spring Semester
Real Analysis	Complex Analysis
Algebra I	Algebra II
Geometry-Topology I	Geometry-Topology II
Teaching Seminar	Research Seminar

Exceptionally well-prepared students may proceed directly to advanced study.

FACULTY PROFILES

AVNER ASH

Professor

Ph.D., Harvard University

Number Theory

JENNY A. BAGLIVO

Professor

Ph.D., Syracuse University

Statistics
Applied Mathematics

JOHN BALDWIN

Associate Professor

Ph.D., Columbia University

Low-dimensional Geometry
and Topology

IAN BIRINGER

Assistant Professor

Ph.D., University of Chicago

Low-dimensional Geometry
and Topology

MARTIN BRIDGEMAN

Professor

Ph.D., Princeton University

Geometry
Topology

DANIEL W. CHAMBERS

Associate Professor

Ph.D., University of Maryland

Probability
Stochastic Processes
Statistics

DAWEI CHEN

Associate Professor

Ph.D., Harvard University

Algebraic Geometry

QILE CHEN

Assistant Professor

Ph.D., Brown University

Algebraic Geometry

CHI-KEUNG CHEUNG

Associate Professor

Ph.D., University of California,
Berkeley

Complex Differential Geometry
Several Complex Variables

MAKSYM FEDORCHUK

Associate Professor

Ph.D., Harvard University

Algebraic Geometry

SOLOMON FRIEDBERG

James P. McIntyre Professor
of Mathematics

Ph.D., University of Chicago

Number Theory
Representation Theory

JOSHUA GREENE

Professor

Ph.D., Princeton University

Low-dimensional Topology

ELISENDA GRIGSBY

Associate Professor

Ph.D., University of California,
Berkeley

Low-dimensional Topology

ROBERT H. GROSS

Associate Professor

Ph.D., Massachusetts Institute
of Technology

Algebra
Number Theory
History of Mathematics

BENJAMIN HOWARD

Professor

Ph.D., Stanford University

Number Theory
Arithmetic Geometry

WILLIAM J. KEANE

Associate Professor

Ph.D., University of Notre Dame

Abelian Group Theory

DUBI KELMER

Assistant Professor

Ph.D., Tel Aviv University

Number Theory
Spectral Geometry
Dynamical Systems

BRIAN LEHMANN

Assistant Professor

Ph.D., Massachusetts Institute
of Technology

Algebraic Geometry

TAO LI

Professor

Ph.D., California Institute
of Technology

Geometry
Topology
Knot Theory

ROBERT MEYERHOFF

Professor

Ph.D., Princeton University

Geometry
Topology

RENATO MIROLLO

Professor

Ph.D., Harvard University

Dynamical Systems

MARK REEDER

Professor

Ph.D., Ohio State University

Lie Groups
Representation Theory

DAVID TREUMANN

Associate Professor

Ph.D., Princeton University

Algebraic Geometry
Representation Theory

SELECTED FACULTY PUBLICATIONS

Avner Ash, Direct sums of mod p characters of $\text{Gal}(\bar{Q}/Q)$ and the homology of $\text{GL}(n, \mathbb{Z})$. *Communications in Algebra*, 41, (2013), pp. 1751-1775.

Avner Ash and **Robert Gross**, *Elliptic Tales: Curves, Counting, and Number Theory*. Princeton University Press (2012).

Avner Ash, Resolutions of the Steinberg representation for $\text{GL}(n)$ (with P. Gunnells and M. McConnell). *Journal of Algebra*, 349, (2012), pp. 380-390.

John Baldwin, A combinatorial spanning tree model for knot Floer homology (with Levine). *Advances in Mathematics*, 231, (2012), pp. 1886-1939.

John Baldwin, On the equivalence of Legendrian and transverse invariants in knot Floer homology (with Vela-Vick, Vertesi). *Geometry and Topology*, 17, (2013), pp. 925-974.

Ian Biringer, Extending pseudo-Anosov maps to compression bodies (with J. Johnson and Y. Minsky). *Journal of Topology*, (2013), doi: 10.1112/jtopol/jtto21.

Ian Biringer, On the growth of Betti numbers of locally symmetric spaces (with M. Abert, N. Bergeron, T. Gelander, N. Nikolov, J. Raimbault, I. Samet). *Comptes Rendus Mathématique*, 349 (15-16), (2011), pp. 831-835.

Martin Bridgeman, Moments of the boundary hitting function for the geodesic flow on a hyperbolic manifold (with S.P. Tan). *Geometry and Topology*, 18(1), (2014).

Martin Bridgeman, Uniformly perfect domains and convex hulls: improved bounds in a generalization of a theorem of Sullivan (with R. Canary). *Pure and Applied Mathematics Quarterly*, 9(1), (2013).

Martin Bridgeman, Orthospectra of geodesic laminations and dilogarithm identities on moduli space. *Geometry and Topology*, 15(2), (2011), pp. 707-733.

Daniel W. Chambers and **Jenny A. Baglivo**, Earthquake forecasting using hidden Markov models (with J.E. Ebel and A.A. Kafka). *Pure and Applied Geophysics*, 169(4), (2012), pp. 625-639.

Dawei Chen, Square-tiled surfaces and rigid curves on moduli spaces. *Advances in Mathematics*, 228(2), (2011), pp. 1135-1162.

Dawei Chen, Towards Mori's program for the moduli space of stable maps. *American Journal of Mathematics*, 133, (2011), pp. 1389-1419.

Dawei Chen, Nonvarying sums of Lyapunov exponents of Abelian differentials in low genus (with M. Möller). *Geometry & Topology*, 16, (2012), pp. 2427-2479.

Qile Chen, Logarithmic stable maps to Deligne-Faltings pairs I, *Annals of Mathematics* (2) 1980 (2014), pp. 455-521.

Maksym Fedorchuk, Finite Hilbert stability of (bi)canonical curves (with J. Alper and D. Smyth). *Inventiones mathematicae*, 191, (2013), pp. 671-718.

Solomon Friedberg, Weyl group multiple Dirichlet series: type A combinatorial theory (with B. Brubaker and D. Bump). *Annals of Mathematics Studies*. Princeton University Press (2011).

Solomon Friedberg, Multiple Dirichlet series, L-functions and automorphic forms (co-edited with D. Bump and D. Goldfeld). *Progress in Mathematics*. Birkhäuser (2012).

Solomon Friedberg, Weyl group multiple Dirichlet series, Eisenstein series, and crystal bases (with B. Brubaker and D. Bump). *Annals of Mathematics*, 173, (2011), pp. 1081-1120.

David Geraghty, The Sato-Tate conjecture for Hilbert modular forms (with T. Barnet-Lamb and T. Gee). *Journal of the American Mathematical Society*, 24 (2011), pp. 411-469.

Joshua Greene, The lens space realization problem. *Annals of Mathematics*, 177(2), (2013), pp. 459-511.

Joshua Greene, Lattices, graphs, and Conway mutation. *Inventiones mathematicae*, 192, (2013), pp. 717-750.

Elisenda Grigsby, Categorized invariants and the braid group (with J. Baldwin). *Proceedings of the AMS*, 143 (2015), pp. 2801-2814.

Elisenda Grigsby, Khovanov-Seidel quiver algebras and bordered Floer homology. *Selecta Mathematica*, 20(1), (2014), pp. 1-55.

Elisenda Grigsby, On the colored Jones polynomial, sutured Floer homology, and knot Floer homology (with S. Wehrli). *Advances in Mathematics*, 223(6), (2010), pp. 2114-2165.

Robert Gross, Prime specialization in Genus 0 (with B. Conrad and K. Conrad). *Transactions of the American Mathematical Society*, 360, (2008), pp. 2867-2908.

Ben Howard, Intersection theory on Shimura surfaces II. *Inventiones mathematicae*, 183(1), (2011), pp. 1-77.

Ben Howard, Complex multiplication cycles and Kudla-Rapoport divisors. *Annals of Mathematics*, 176, (2012), pp. 1097-1171.

Dubi Kelmer, Arithmetic quantum unique ergodicity for symplectic linear maps of the multidimensional torus. *Annals of Mathematics*, 171(2), (2010), pp. 815-879.

Brian Lehmann, A cone theorem for nef curves, *Journal of Algebraic Geometry*, 21 (2012), pp.473-493.

Tao Li, An algorithm to determine the Heegaard genus of a 3-manifold. *Geometry and Topology*, 15(2), (2011), pp. 1029-1106.

Tao Li, Rank and genus of 3-manifold. *Journal of the American Mathematical Society*, 26, (2013), pp. 777-829.

Robert Meyerhoff, Mom technology and volumes of hyperbolic 3-manifolds (with D. Gabai and P. Milley). *Commentarii Mathematici Helvetici*, 86, (2011), p. 145-188.

Robert Meyerhoff, The maximal number of exceptional Dehn surgeries (with M. Lackenby). *Inventiones mathematicae*, 191, (2013), pp. 341-382.

Renato Mirolo and **J.R. Englebrecht**, Classification of attractors for coupled identical Kuramoto oscillator networks. *Chaos*, 24, 013114, (2014).

Mark Reeder, Depth-zero supercuspidal L-packets and their stability (with S. DeBacker). *Annals of Mathematics*, 169(3), (2009), pp. 795-901.

Mark Reeder, Epipelagic representations and in-variant theory. *Journal of the American Mathematical Society*, 27, (2014), pp. 437-477.

David Treumann, A categorification of Morelli's Theorem (with B. Fang, C.-C.M. Liu and E. Zaslow). *Inventiones mathematicae*, 186, (2011), pp. 79-114.

MORRISSEY COLLEGE OF ARTS & SCIENCES

The oldest and largest of the University's eight schools and colleges, the Morrissey College of Arts and Sciences offers graduate programs in the humanities, social sciences and natural sciences, leading to the degrees of Doctor of Philosophy, Master of Arts and Master of Science. In addition, numerous dual-degree options are offered in cooperation with the Carroll School of Management, the Boston College Law School, the Lynch School of Education and the Graduate School of Social Work.

With approximately 1,000 students and 400 full-time faculty, the Graduate School is small enough to know you as a person, but large enough to serve you and prepare you for a rewarding life and satisfying career.

Academic Resources

LECTURE SERIES AND SEMINARS

The Department of Mathematics hosts an annual Distinguished Lecturer series. The Distinguished Lecturer gives three lectures, and ample time is incorporated into the schedule to allow for interaction with students. Previous Distinguished Lecturers have included: John Conway, Ravi Vakil, Benson Farb, Peter Sarnak, Robert Ghrist, Bernd Sturmfels, Richard Evan Schwartz and Jordan Ellenberg.

Boston College runs a Number Theory seminar jointly with MIT (alternating between the two schools) in which outstanding researchers from all over the country present their work in a wide range of areas of Number Theory. We also have our own active research seminars in Geometry/Topology and Number Theory and Algebraic Geometry.

TEACHING SEMINAR

Excellence in teaching is an important part of the Boston College tradition. The Department of Mathematics runs a Teaching Seminar each fall to mentor and support new graduate student teachers.

DEPARTMENT SOCIAL EVENTS

The Department of Mathematics looks for opportunities to enhance the interaction between faculty and graduate students: through lunch at orientation, cookies and tea after the Teaching Seminar, the annual teaching assistant appreciation luncheon, the beginning-of-term brunch and other activities.

BOSTON AREA CONSORTIUM

The Boston Area Consortium allows graduate students to cross-register for courses at Boston University, Brandeis University and Tufts University.

BOSTON COLLEGE LIBRARIES

The University is home to eight libraries, containing 2.95 million volumes; more than 700 manuscript collections, including music, photos, art and artifacts; 625,000 e-books; and more than 600 electronic databases. O'Neill Library, Boston College's main library, offers subject-specialist librarians to help with research, to set up alerts to publications in areas of interest and to answer any research- and library-related questions.

THE BOSTON LIBRARY CONSORTIUM

The Boston Library Consortium allows Boston College students access to millions of volumes and other services at 19 area institutions in addition to the world-class resources available through the Boston College Library System.

STUDENT LIFE & CAMPUS RESOURCES

Boston College is located on the edge of one of the world's most vibrant cities. Just six miles from downtown Boston—an exciting and dynamic place to live and learn—Boston College is an easy car or “T” ride away from a booming center for trade, finance, research and education.

Home to some of New England's most prestigious cultural landmarks, including the Museum of Fine Arts, the Isabella Stewart Gardner Museum, Boston Symphony Hall and the Freedom Trail, Boston provides a rich environment for those passionate about art, music and history. For sports fans, Boston hosts a number of the country's greatest sports teams: the Celtics, Patriots, Bruins and, of course, Fenway Park's beloved Red Sox. Found within a short drive from Boston are some of New England's best recreational sites, from the excellent skiing in New Hampshire to the pristine beaches of Cape Cod.

Boston also offers a wide range of family friendly attractions, including the Children's Museum, New England Aquarium, Franklin Park Zoo and the Museum of Science. There are roughly 50 universities located in the Boston area, and the large student population adds to the city's intellectually rich and diverse community. Events, lectures and reading groups hosted by world-renowned scholars abound on area campuses, providing abundant opportunities to meet and network with other graduate students and faculty throughout the Boston area.

The University

Boston College is a Jesuit university with 14,250 students, 805 full-time faculty and more than 175,000 active alumni. Since its founding in 1863, the University has known extraordinary growth and change. From its beginnings as a small Jesuit college intended to provide higher education for Boston's largely immigrant Catholic population, Boston College has grown into a national institution of higher learning that is consistently ranked among the top universities in the nation: Boston College is ranked 31st among national universities by *U.S. News & World Report*.

Today, Boston College attracts scholars from all 50 states and over 80 countries, and confers more than 4,000 degrees annually in more than 50 fields through its eight schools and colleges. Its faculty members are committed to both teaching and research and have set new marks for research grants in each of the last 10 years. The University is committed to academic excellence. As part of its most recent strategic plan, Boston College is in the process of adding 100 new faculty positions, expanding faculty and graduate research, increasing student financial aid and widening opportunities in key undergraduate and graduate programs.

The University is comprised of the following colleges and schools: Morrissey College of Arts and Sciences, Carroll School of Management, Connell School of Nursing, Lynch School of Education, Woods College of Advancing Studies, Boston College Law School, Graduate School of Social Work and School of Theology and Ministry.

General Resources

HOUSING

While on-campus housing is not available for graduate students, most choose to live in nearby apartments. The Office of Residential Life maintains an extensive database with available rental listings, roommates and helpful local real estate agents. The best time to look for fall semester housing is June through the end of August. For spring semester housing, the best time to look is

late November through the beginning of the second semester. Additionally, some graduate students may live on campus as resident assistants. Interested students should contact the Office of Residential Life.

JOHN COURTNEY MURRAY, S.J., GRADUATE STUDENT CENTER

One of only a handful of graduate student centers around the country, the Murray Graduate Student Center is dedicated to the support and enrichment of graduate student life at Boston College. Its primary purpose is to build a sense of community among the entire graduate student population and cultivate a sense of belonging to the University as a whole. Its amenities include study rooms, a computer lab, two smart televisions, kitchen, deck and patio space, complimentary coffee and tea, and more. Throughout the year, the center hosts programs organized by the Office of Graduate Student Life and graduate student groups. The Murray Graduate Student Center also maintains an active job board (available electronically), listing academic and non-academic opportunities for employment both on and off campus.

MCMULLEN MUSEUM OF ART

Serving as a dynamic educational resource for the national and international community, the McMullen Museum of Art showcases interdisciplinary exhibitions that ask innovative questions and break new ground in the display and scholarship of the works on view. The McMullen regularly offers exhibition-related programs, including musical and theatrical performances, films, gallery talks, symposia, lectures, readings and receptions that draw students, faculty, alumni and friends together for stimulating dialogue. Located on the main campus, the McMullen Museum is free to all visitors.

CONNORS FAMILY LEARNING CENTER

Working closely with the Graduate School, the Connors Family Learning Center sponsors seminars, workshops and discussions for graduate teaching assistants and teaching fellows on strategies for improving teaching effectiveness and student learning. Each fall, the Learning Center and the Graduate School hold a one-and-a-half day “Fall Teaching Orientation” workshop

designed to help students prepare for teaching. The center also hosts ongoing seminars on college teaching, higher learning and academic life; assists graduate students in developing teaching portfolios; and provides class visits and teaching consultations, upon request. Through these and other activities, the Connors Family Learning Center plays an important role in enhancing the quality of academic life at Boston College.

FLYNN RECREATION COMPLEX

The 144,000-square-foot Flynn Recreation Complex houses a running track; tennis, basketball, volleyball, squash and racquetball courts; an aquatics center with pool and dive well; saunas and more. Its 10,000-square-foot Fitness Center offers more than 100 pieces of cardio equipment, a full complement of strength training equipment and free weights, an air-conditioned spin studio and three air-conditioned group fitness studios. During the academic year, BC Rec holds more than 80 group fitness classes per week in a variety of disciplines, including Zumba, spin, yoga, strength training, Pilates and more.

BOSTON COLLEGE CAREER CENTER

The Boston College Career Center works with graduate students at each step of their career development. Services include self-assessment, career counseling, various career development workshops, resume and cover letter critiques, and practice interviews. In addition to extensive workshop offerings, Career Center staff members are available throughout the year for one-on-one advising about any aspect of the career path. The Career Resource Library offers a wealth of resources, including books, periodicals and online databases.

ADMISSION & FINANCIAL INFORMATION

Admission Requirements

The application deadline for fall admission is January 20. Please visit bc.edu/gsas for detailed information on how to apply.

Application requirements include:

❖ Application Form:	Submitted online, via the GSAS website.
❖ Application Fee:	\$75, non-refundable.
❖ Abstract of Courses Form:	A concise overview of background and related courses completed in an intended field or proposed area of study.
❖ Official Transcripts:	Demonstrating coursework completed/degree conferral from all post-secondary institutions attended.
❖ GRE General Test:	Official score report required for all applicants.
❖ GRE Subject Test:	Official score report required for all applicants.
❖ Three Letters of Recommendation:	Preferably from undergraduate teachers of mathematics.
❖ Detailed Coursework Description:	An expanded listing of advanced math courses taken, generally including courses beyond Calculus and Linear Algebra.
❖ Proof of English Proficiency: <i>(International only)</i>	Official TOEFL/IELTS score reports accepted.

Financial Assistance

DEPARTMENT FUNDING

All applicants are considered for teaching assistantships. These positions carry a competitive stipend and full-tuition scholarships. In addition, there is the possibility for summer support for research. Continued eligibility for support is contingent upon reasonable progress toward the degree and acceptable performance of teaching assistant/teaching fellowship duties.

FEDERAL FINANCIAL AID

Graduate students can apply for federal financial aid using the FAFSA. The loans that may be available to graduate students are the Federal Direct Unsubsidized Stafford Loan and Perkins Loan, based on eligibility. If additional funds are needed, student may apply for a Grad Plus Loan. For more information, see the Graduate Financial Aid website at bc.edu/gradaid or contact the Graduate Financial Aid Office at 617-552-3300 or 800-294-0294.

OFFICE OF SPONSORED PROGRAMS

The Office of Sponsored Programs (OSP) assists both faculty and graduate students in finding sources of external funding for their projects and provides advice in the development of proposals. OSP maintains a reference library of publications from both the public and private sectors listing funding sources for sponsored projects. In the recent past, graduate students have received research support from prominent agencies, corporations and organizations such as the Fulbright Commission, the Guggenheim Foundation, the National Science Foundation, the American Political Science Association, the American Chemical Society and the American Association of University Women.





BOSTON COLLEGE

MORRISSEY COLLEGE OF ARTS AND SCIENCES

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