Benjamin Howard

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Research Interests

Number theory and arithmetic geometry.

Academic Positions

Professor, Boston College	2012–present
Associate Professor, Boston College	2008–2012
Assistant Professor, Boston College	2005–2008
Dickson Instructor, University of Chicago	2004–2005
NSF Postdoctoral Research Fellow, Harvard University	2002–2004
Clay Mathematics Institute Liftoff Fellow, Stanford University	2002

Degrees

Ph.D. Stanford University (advisor: Karl Rubin)	2002
B.S. University of Chicago	1997

Awards, Distinctions, and Grants

National Science Foundation research grant DMS-1801905	2018–2021
National Science Foundation grant DMS-1601028 Conference on *L-functions and arithmetic*, co-PI with B. Mazur, R. Pollack, C. Popescu	2016-2017
National Science Foundation research grant DMS-1501583	2015–2018
National Science Foundation research grant DMS-1201480	2012–2015
National Science Foundation research grant DMS-0901753	2009–2012
Alfred P. Sloan Research Fellowship	2007–2009
National Science Foundation research grant DMS-0556174	2006–2009
National Science Foundation postdoctoral grant DMS-0202505	2002–2004
Clay Mathematics Institute Liftoff Fellow	2002
Paul R. Cohen Memorial Prize for Excellence in Mathematics	1997
Phi Beta Kappa	1997

Publications

On the averaged Colmez conjecture. Submitted.

On the Ekedahl-Oort stratification of Shimura curves. Submitted.

Modularity of generating series of divisors on unitary Shimura varieties. Joint with J. Bruinier, S. Kudla, M. Rapoport, and T. Yang. Submitted.

Modularity of generating series of divisors on unitary Shimura varieties II: arithmetic applications. Joint with J. Bruinier, S. Kudla, M. Rapoport, and T. Yang. Submitted.

Arithmetic of Borcherds products. Joint with K. Madapusi Pera. Submitted.

Linear invariance of intersections on unitary Rapoport-Zink spaces. *Forum Math.* In press.

A Gross-Kohen-Zagier formula for Heegner-Drinfeld cycles. Joint with A. Shnidman. *Adv. Math.* 351 (2019), 117-194

Faltings heights of abelian varieties with complex multiplication. Joint with F. Andreatta, E. Goren, and K. Madapusi Pera. *Annals of Math.* 187, No. 2 (2018), 391-531.

Rapoport-Zink spaces for spinor groups. Joint with G. Pappas. *Compos. Math.* 153, No. 5 (2017), 1050-1118.

Height pairings on orthogonal Shimura varieties. Joint with F. Andreatta, E. Goren, and K. Madapusi Pera. *Compos. Math.* 153, No. 3 (2017), 474-534.

Heights of Kudla-Rapoport divisors and derivatives of L-functions. Joint with J. Bruinier and T. Yang. *Invent. Math.* 201, No. 1 (2015), 1-95.

Complex multiplication cycles and Kudla-Rapoport divisors II. *Amer. J. Math.* 137, No. 3 (2015), 639-698.

On the supersingular locus of the $\mathrm{GU}(2,2)$ Shimura variety. Joint with G. Pappas. *Algebra & Number Theory* 8, No. 7 (2014), 1659-1699.

Complex multiplication cycles and Kudla-Rapoport divisors. *Annals of Math.* 176 (2012), 1097-1171.

Intersections of Hirzebruch-Zagier divisors and CM cycles. Joint with T. Yang. Springer Lecture Notes in Mathematics #2041 (2012).

Singular moduli refined. Joint with T. Yang. In *Arithmetic Geometry and Automorphic Forms*, Advanced Lectures in Mathematics #19 (2011), 367-406.

Deforming endomorphisms of supersingular Barsotti-Tate groups. In *Arithmetic Geometry and Automorphic Forms*, Advanced Lectures in Mathematics #19 (2011), 309-366.

Intersection theory on Shimura surfaces II. *Invent. Math.* 183, No. 1 (2011), 1-77.

Intersection theory on Shimura surfaces. *Compos. Math.* 145, No. 2 (2009), 423-475.

Twisted Gross-Zagier theorems. *Canad. J. Math.* 61, No. 4 (2009), 828-887.

Central derivatives of L-functions in Hida families. *Math. Ann.* 339, No. 4 (2007), 803-818.

Variation of Heegner points in Hida families. *Invent. Math.* 167, No. 1 (2007), 91-128.

Special cohomology classes for modular Galois representations. *J. Number Theory* 117, No. 2 (2006), 406-438.

Bipartite Euler systems. *J. Reine Angew. Math.* 597, (2006), 1-25.

Anticyclotomic Iwasawa theory of CM elliptic curves. Joint with A. Agboola. *Ann. Inst. Fourier* 56, No. 4 (2006) 1001–1048.

Anticyclotomic Iwasawa theory of CM elliptic curves II. Joint with A. Agboola. *Math. Res. Let.* 12, No. 5 (2005) 611–622.

The Iwasawa theoretic Gross-Zagier theorem. *Compos. Math.* 141, No. 4 (2005), 811–846.

Derived p-adic heights and p-adic L-functions. *Amer. J. Math.* 126, No. 6 (2004), 1315–1340.

Iwasawa theory of Heegner points on abelian varieties of GL_2-type. *Duke Math. J.* 124, No. 1 (2004), 1–45.

The Heegner point Kolyvagin system. *Compos. Math.* 140, No. 6 (2004), 1439–1472.

Appendix to *Kolyvagin Systems* by B. Mazur and K. Rubin. *Memoirs of the AMS* #799 (2004).

Service to the university and profession

Organizer (with H. Darmon, E. Eischen, D. Loeffler, C. Skinner, S. Zerbes, W. Zhang) MSRI semester on *Algebraic cycles, L-values, and Euler systems.* Spring 2023.

Organizer (with B. Mazur, C. Popescu, R. Pollack, A. Silverberg), conference *L-functions and Arithmetic* (a.k.a. Rubinfest), Harvard University, June 13-16, 2016. Funded by NSF, Number Theory Foundation, and Clay Mathematics Institute.

Organizer (with G. Kings, R. Sujatha, and O. Venjakob), workshop *Algebraische Zahlentheorie*, Mathematisches Forschungsinstitute, Oberwolfach, Germany, 2011 and 2014.

Organizer (with B. Brubaker, S. Friedberg, K. Madapusi Pera, B. Poonen, A. Sutherland, Z. Yun, W. Zhang), BC-MIT Number Theory Seminar, 2008-present.

Boston College Morrissey School of Arts and Sciences promotion and tenure committee, 2014-16.

Associate Editor, *Manuscripta Mathematica*, 2014-present.

Ph.D. students

Andrew Phillips, Boston College, 2015

Cihan Coylu, Boston College, 2017

Maria Fox, Boston College, 2019

Hao Li, Boston College, ongoing

Invited Talks

U.W. Madison AMS special session on Arithmetic of Shimura varieties	September 2019
Johns Hopkins Number Theory Seminar	March 2019
Workshop on Arithmetic of Shimura Varieties, Mathematisches Forschungsinstitute, Oberwolfach, Germany	January 2019
Current Developments in Mathematics, Harvard University (2 lectures)	November 2018
Arithmetic Algebraic Geometry (on the occasion of M. Rapoport's 70th birthday) Universität Bonn, Germany	October, 2018
Harvard University Number Theory Seminar	September 2018
Bellairs Workshop in Number Theory (2 lectures), Bellairs Research Institute, Barbados	May, 2018

Duke University Number Theory Seminar	October, 2016
Harvard University Number Theory Seminar	September, 2015
Programme on Arithmetic Geometry and Automorphic Representations, Erwin Schrödinger Institute for Mathematical Physics, Vienna	May, 2015
Workshop on Kudla's programme, Centre de Recherches Mathématiques, Montreal	April, 2015
Princeton/IAS Number Theory Seminar	March, 2015
Automorphic forms, Shimura varieties, Galois Representations, and L-functions MSRI, Berkeley	December, 2014
Johns Hopkins/U. Maryland Number Theory Day	November, 2014
Workshop on Arithmetic of Eisenstein Series, Technische Universität Darmstadt, Germany	September, 2014
Workshop on Automorphic Forms and Arithmetic, Pohang Mathematics Institute, POSTECH, South Korea	August, 2014
University of Michigan Number Theory Mini-workshop	August, 2014
Workshop on the Gan-Gross-Prasad Conjecture, (two lectures), Institute Mathématiques de Jussieu, Paris	June, 2014
Workshop: Arithmetic intersection theory and Shimura varieties, Hausdorff Research Institute for Mathematics, Bonn, Germany	February, 2014
Northwestern University Number Theory Seminar	December 2013
University of Chicago Number Theory Seminar	December 2013
Columbia-CUNY-NYU Joint Number Theory Seminar	November 2013
Arithmetic intersection theory on Shimura varieties, (ten lectures), Bellairs Research Institute, Barbados	May 2013
University of British Columbia Number Theory Seminar	March 2013
Harvard University Number Theory Seminar	September 2012
Workshop on Reductions of Shimura Varieties, Mathematisches Forschungsinstitute, Oberwolfach, Germany	July 2012
Workshop on p-adic Modular Forms and Arithmetic, UCLA,	June 2012
Workshop on Arithmetic of Orthogonal and Unitary Shimura Varieties, Banff International Research Station, Banff, Canada	June 2012
University of Texas, Austin Number Theory seminar	April 2012
Workshop on Cohomology of Shimura Varieties, Fields Institute, Toronto	March 2012
Thematic Program on Galois Representations, (six lectures), Fields Institute, Toronto	January 2012
Palmetto Number Theory Series, Clemson University	December 2011
Midwest Number Theory Day, U. Wisconsin, Madison	November 2011
Michigan State Number Theory Seminar	October 2011
Workshop on Periods of Automorphic Forms and Application to L-functions, Columbia University	September 2011
Workshop on L-functions and Iwasawa Theory, (three lectures), University of Michigan	May 2011
Quebec-Vermont Number Theory Seminar, McGill University	January 2011

Boston University Number Theory Seminar	September 2010
Workshop on Arithmetic Cycles on Shimura Varieties and Automorphic Forms, University of Illinois at Chicago	May 2010
Columbia-CUNY-NYU Number Theory Seminar	March 2010
University of Toronto Number Theory Seminar	January 2010
Workshop on Cycles and Special Values of L-series, Centre de Recerca Matemática, Barcelona, Spain	December 2009
Harvard University Seminar on Unitary Shimura Varieties (two lectures)	November 2009
Harvard University Number Theory Seminar	October 2009
Summer program on Shimura varieties (six lectures), Morningside Center of Mathematics, Beijing, China	July 2009
Workshop on Algebraische Zahlentheorie, Mathematisches Forschungsinstitute, Oberwolfach, Germany	June 2009
Quebec-Vermont number theory seminar, McGill University	May 2009
Southern California Number Theory Day, Caltech	February 2009
Northwestern University Number Theory Seminar	February 2009
University of Maryland Number Theory Seminar	November 2008
University of Wisconsin Number Theory Seminar	October 2008
Boston University Number Theory Seminar	September 2008
Arbeitsgemeinschaft Arithmetische Geometrie, Mathematisches Institut der Universität Bonn	June 2008
Recent Developments in Number Theory: Selmer Groups, L-functions, and Galois Deformations, UCLA	March 2008
Workshop on Automorphic Forms, Geometry, and Arithmetic. Mathematisches Forschungsinstitute Oberwolfach, Germany	February 2008
University of Toronto Number Theory Seminar	January 2008
Canadian Mathematical Society Winter Meeting	December 2007
Maine/Quebec Conference on Number Theory and Related Topics	September 2007
Harvard University Number Theory Seminar	April 2007
University of Michigan Number Theory Seminar	April 2007
Duke University Algebraic Geometry Seminar	November 2006
Boston University Number Theory Seminar	October 2006
Fellowship of the Ring Seminar, Brandeis University	May 2006
Séminar de Théorie des Nombres, Institute de Mathématiques de Jussieu	March 2006
Séminar Forms Automorphes, Institute de Mathématiques de Jussieu	March 2006
Graduate Student Number Theory Seminar, Institute de Mathématiques de Jussieu	March 2006
Five Colleges Number Theory Seminar, Amherst, MA	February 2006
Workshop on Intersection of Arithmetic Cycles and Automorphic Forms, Centres des Recherches Mathematiques, Montreal	December 2005
Workshop on Arakelov theory and Modular Forms, University of Maryland	October 2005
Open Questions and Recent Developments in Iwasawa Theory, Boston University	June 2005
University of Illinois Champagne-Urbana Number Theory Seminar	March 2005

McMaster University Number Theory Seminar	February 2005
Midwest Number Theory Conference, University of Chicago	October 2004
LMS Durham Symposium: *L-functions and Galois Representations*	July 2004
University of Michigan Number Theory Seminar	February 2004
Boston University Number Theory Seminar	January 2004
Quebec-Vermont Number Theory Seminar (Concordia University)	January 2003
Harvard University Number Theory Seminar	October 2002
Stanford University Number Theory Seminar	October 2001