

# Benjamin Linowitz

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## CONTACT INFORMATION:

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## EMPLOYMENT:

<b>Oberlin College</b> Assistant Professor	Fall 2016 - present
<b>University of Michigan</b> NSF Postdoctoral Research Fellow / RTG Postdoctoral Assistant Professor	2012 - 2016

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## EDUCATION:

<b>Ph.D. in Mathematics</b> , Dartmouth College Advisor: Tom Shemanske Thesis: <i>Selectivity in central simple algebras and isospectrality</i>	May 2012
<b>M.A. in Mathematics</b> , Dartmouth College	May 2009
<b>M.A. in Mathematics</b> , University of Pennsylvania Advisor: Ted Chinburg Thesis: <i>An exposition of the AKS polynomial time primality testing algorithm</i>	May 2006
<b>B.A. in Mathematics</b> , University of Pennsylvania <i>Summa Cum Laude with Honors in Mathematics</i>	May 2006

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## HONORS AND AWARDS:

<b>Simons Collaboration Grant</b> (\$42,000)	2017 - 2022
<b>Project NExT Fellow</b> (Green 16)	2016 - 2017
<b>NSF Postdoctoral Research Fellowship</b> (\$120,000)	2013 - 2016
<b>NSF Algebra and Number Theory Award DMS - 1500710</b> (co-PI with M. Agarwal and L. Thompson) Awarded \$19220 to support the <i>2015 Automorphic Forms Workshop</i>	March 2015
<b>Number Theory Foundation Award</b> (co-PI with M. Agarwal and L. Thompson) Awarded \$4920 to support the <i>2015 Automorphic Forms Workshop</i>	March 2015

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## PUBLICATIONS (ACCEPTED OR PUBLISHED):

**Brauer equivalent number fields and the geometry of quaternionic Shimura varieties**, B. Linowitz, to appear in *Q. J. Math.*

- Counting and effective rigidity in algebra and geometry**, B. Linowitz, D. B. McReynolds, P. Pollack and L. Thompson, *Invent. Math.* 213 (2018), no. 2, 697-758.
- Counting isospectral manifolds**, M. Belolipetsky and B. Linowitz, *Adv. Math.* 321 (2017), 69-79.
- Bounded gaps between primes and the length spectra of arithmetic hyperbolic 3-orbifolds**, B. Linowitz, D. B. McReynolds, P. Pollack and L. Thompson, *C. R. Math. Acad. Sci. Paris* 355 (2017), no. 11, 1121-1126.
- Counting problems for geodesics on arithmetic hyperbolic surfaces**, B. Linowitz, *Proc. Amer. Math. Soc.* 146 (2018), no. 3, 1347-1361.
- Systoles of arithmetic hyperbolic surfaces and 3-manifolds**, B. Linowitz, D. B. McReynolds, P. Pollack and L. Thompson, *Math. Res. Lett.* 24 (2017), no. 5, 1497-1522.
- On the isospectral orbifold-manifold problem for nonpositively curved locally symmetric spaces**, B. Linowitz and J. Meyer, *Geom. Dedicata* 188 (2017), 165-169.
- Bounds for arithmetic hyperbolic reflection groups in dimension 2**, B. Linowitz, *Transform. Groups* 23 (2018), no. 3, 743-753.
- Parameterizing Shimura subvarieties of  $A_1$  Shimura varieties and related geometric problems**, B. Linowitz and M. Stover, *Arch. Math. (Basel)* 107 (2016), no. 3, 213-226.
- Local Selectivity of Orders in Central Simple Algebras**, B. Linowitz and T. Shemanske, *Int. J. Number Theory* 13 (2017), no. 4, 853-884.
- Locally equivalent correspondences**, B. Linowitz, D. B. McReynolds and N. Miller, *Ann. Inst. Fourier (Grenoble)* 67 (2017), no. 2, 451-482.
- The length spectra of arithmetic hyperbolic 3-manifolds and their totally geodesic surfaces**, B. Linowitz, J. Meyer and P. Pollack, *New York J. Math.* 21 (2015), 955-972.
- Systolic surfaces in arithmetic hyperbolic 3-manifolds**, B. Linowitz and J. Meyer, *In the Tradition of Ahlfors-Bers, VII*, 215-223, *Contemp. Math.*, 696, Amer. Math. Soc., Providence, RI, 2017.
- Selective orders in central simple algebras and isospectral families of arithmetic manifolds**, B. Linowitz, *Manuscripta Math.* 147 (2015), no. 3, 399 - 413.
- A non-commutative analogue of the Odlyzko bounds and bounds on performance for space-time lattice codes**, B. Linowitz, M. Satriano and R. Vehkalahti, *IEEE Trans. Inf. Theory*, vol. 61, no. 4, pp. 1971-1984, April 2015.
- Small isospectral and nonisometric orbifolds of dimension 2 and 3**, B. Linowitz and J. Voight, *Math. Z.*, vol. 281, no. 1 (2015), pp. 523-569.

- Families of mutually isospectral Riemannian orbifolds**, B. Linowitz, Bull. London Math. Soc. (2015) 47 (1): 47-54.
- The sign changes of Fourier coefficients of Eisenstein series**, B. Linowitz and L. Thompson, Ramanujan J., 37 (2015), no. 2, 223-241.
- On fields of definition of arithmetic Kleinian reflection groups. II**, M. Belolipetsky and B. Linowitz, Int. Math. Res. Not. IMRN (2014), no. 9, 2559-2571.
- Characterizing Hilbert modular cusp forms by coefficient size**, B. Linowitz, Kyushu J. Math. 68 (2014) no. 1, 105-111.
- A newform theory for Hilbert Eisenstein series**, T. Atwill and B. Linowitz, Ramanujan J. 30 (2013), no. 2, 257-278.
- Isospectral Towers of Riemannian Manifolds**, B. Linowitz, New York J. Math. 18 (2012), 451-461.
- Decomposition theorems for twists of Hilbert modular newforms**, B. Linowitz, Funct. Approx. Comment. Math. 47 (2012), part 2, 157-172.
- Embedding orders in central simple algebras**, B. Linowitz and T. Shemanske, J. Théor. Nombres Bordeaux, 24 (2012), no. 2, 405-424.
- Selectivity in quaternion algebras**, B. Linowitz, J. Number Theory 132 (2012), no. 7, 1425-1437.
- Modular forms on noncongruence subgroups and Atkin-Swinnerton-Dyer relations**, L. Fang, J. Hoffman, B. Linowitz, A. Rupinski and H. Verill, Exp. Math. 19 (2010), no. 1, 1-27.

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**PUBLICATIONS (SUBMITTED):**

- Systole inequalities for arithmetic locally symmetric spaces**, S. Lapan, B. Linowitz and J. Meyer
- Areas of totally geodesic surfaces of hyperbolic 3-orbifolds**, B. Linowitz, D. B. McReynolds and N. Miller
- The Fourier coefficients of Eisenstein series newforms**, B. Linowitz and L. Thompson
- Fake quadrics**, B. Linowitz, M. Stover and J. Voight

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**UNDERGRADUATE MENTORING:**

- 2017-2018: Nicholas Wilcox**, Honor's Student. Project Title: Elliptic Curve Cryptography
- Fall 2017: Yuan (Charles) Cui**, Private Reading Course on Primality Testing.

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**TEACHING EXPERIENCE:**

Oberlin College

<i>FYSP 028: Cryptography</i>	Fall 2018
<i>Math 231: Multivariable Calculus</i>	Fall 2018
<i>Math 327: Group Theory</i>	Spring 2018
<i>Math 231: Multivariable Calculus</i>	Spring 2018
<i>Math 134: Calculus II</i>	Fall 2017
<i>Math 232: Linear Algebra</i>	Spring 2017
<i>Math 327: Group Theory</i>	Spring 2017
<i>FYSP 028: Cryptography</i>	Fall 2016
<i>Math 327: Group Theory</i>	Fall 2016

#### University of Michigan

<i>Math 175: Introduction to Cryptology</i>	Fall 2012, 2013, 2014
<i>Math 567: Introduction to Coding Theory</i>	Winter 2013

#### Dartmouth College

<i>Math 31: Abstract Algebra</i>	Summer 2011
<i>Math 22: Linear Algebra</i>	Spring 2011
<i>Math 2: Calculus with Algebra and Trigonometry</i>	Winter 2010

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#### RESEARCH PRESENTATIONS:

<b>Some recent results on the spectral theory of arithmetic locally symmetric spaces</b>	July 2018
Number Theory Seminar, Universidad Nacional de Córdoba - Argentina.	
<b>Brauer Equivalent Number Fields</b>	March 2018
The 32nd Automorphic Forms Workshop, Tufts University	
<b>Can you hear the shape of a drum?</b>	January 2018
Colloquium, California State University, San Bernardino.	
<b>Geodesics on hyperbolic surfaces, quaternion algebras, and the Chebotarev density theorem in short intervals</b>	January 2018
Joint Mathematics Meetings AMS Special Session: "A Showcase of Number Theory at Liberal Arts Colleges"	
<b>You cannot hear the shape of a hyperbolic drum</b>	August 2017
Colloquium, Universidad de los Andes, Bogotá, Colombia.	
<b>Totally geodesic surfaces in arithmetic hyperbolic 3-manifolds</b>	June 2017
32nd Summer Conference on Topology and its Applications, University of Dayton.	
<b>Systoles of arithmetic hyperbolic manifolds</b>	March 2017
Spring Topology and Dynamical System Conference, Jersey City University.	
<b>Bounds on the arithmetic genus of Hilbert modular varieties</b>	July 2016
Building Bridges: Workshop on Automorphic Forms, University of Sarajevo.	
<b>Selective orders in central simple algebras</b>	May 2016
Langenhop Lecture and Conference, Southern Illinois University at Carbondale.	
<b>You cannot hear the shape of a hyperbolic drum</b>	October 2015
Number Theory Seminar, Universidad Nacional de Córdoba - Argentina.	

- Classification of fake quadrics** August 2015  
Computational Aspects of Algebraic Geometry, Automorphic Forms, and Number Theory, Tsinghua Sanya International Mathematics Forum.
- Selectivity in central simple algebras** June 2015  
12th Brauer Group Meeting, Pingree Park Mountain Campus of Colorado State University.
- Can an orbifold be isospectral to a manifold?** May 2015  
Spring Topology and Dynamics Conference, Bowling Green State University.
- Isospectral surfaces of small volume** April 2015  
Colloquium, University of Oklahoma.
- Effective rigidity in spectral geometry** April 2015  
Geometry Seminar, University of Oklahoma.
- Can an orbifold be isospectral to a manifold?** April 2015  
AMS Special Session on the Geometry of Manifolds, Singular Spaces, and Groups, Michigan State University.
- Effective rigidity in spectral geometry** November 2014  
Geometry Seminar, University of Michigan.
- Effective rigidity in spectral geometry** October 2014  
Ahlfors-Bers Colloquium VI
- Counting central division algebras** October 2014  
Algebra, Number Theory and Combinatorics Seminar, University of Texas at Austin.
- Counting central division algebras** September 2014  
Group Theory, Lie Theory and Number Theory Seminar, University of Michigan.
- Quaternion orders and isospectral hyperbolic surfaces** August 2014  
ICM 2014 Satellite Conference on Integral Quadratic Forms, Seoul, Korea.
- The sign changes of Fourier coefficients of Eisenstein series** July 2014  
Building Bridges: Workshop on Automorphic Forms, Bristol, UK.
- Counting central division algebras** May 2014  
Number Theory Seminar, Dartmouth College.
- Quaternion orders and isospectral hyperbolic surfaces** March 2014  
AMS southeastern spring sectional meeting special session on Geometric Topology and Number Theory.
- You cannot hear the shape of a hyperbolic drum** March 2014  
Colloquium, Central Michigan University.
- Quaternion orders and isospectral hyperbolic surfaces** December 2013  
International Conference on the Algebraic and Arithmetic Theory of Quadratic Forms, Puerto Natales, Patagonia, Chile.
- Isospectral surfaces of small volume** April 2013  
Geometry Seminar, Purdue University.
- When the product of eigenforms is an eigenform** March 2013  
The 27th Automorphic Forms Workshop, University College Dublin
- You cannot hear the shape of a hyperbolic drum** February 2013  
VIGRE Seminar, University of Georgia.
- Embedding orders in central simple algebras** February 2013  
Algebra Seminar, University of Georgia.

<b>Lattice-theoretic methods in spectral geometry</b> Joint Mathematics Meetings AMS Special Session on the Arithmetic of quadratic forms and lattices.	January 2013
<b>Quaternion orders and arithmetic hyperbolic geometry</b> Quebec-Maine Number Theory Conference	September 2012
<b>Coefficient growth for Hilbert modular forms</b> Building Bridges: The 1 <sup>st</sup> EU-US conference on Automorphic Forms and related topics, Aachen University	August 2012
<b>A newform theory for Hilbert Eisenstein series</b> The 26th Automorphic Forms Workshop, University of British Columbia	April 2012
<b>Quaternion orders and arithmetic hyperbolic geometry</b> Algebra Seminar, Wesleyan University	March 2012
<b>Quaternion orders and isospectral surfaces of small volume</b> Colloquium, Miami University	January 2012
<b>Quaternion orders and arithmetic hyperbolic geometry</b> Number Theory Seminar, University of Georgia	January 2012
<b>Selectivity in Quaternion Algebras</b> Joint Mathematics Meetings	January 2012
<b>A newform theory for Hilbert Eisenstein series</b> Maine-Quebec Number Theory Conference	October 2011
<b>Decomposition theorems for Hilbert modular forms</b> The Upstate New York Number Theory Conference	May 2011
<b>Decomposition theorems for Hilbert modular forms</b> The 25th Automorphic Forms Workshop, Oregon State University	March 2011
<b>Selectivity in quaternion algebras</b> Arithmetic of quadratic forms and integral lattices Instituto de matematica y fisica, Universidad de Talca, Chile	December 2010
<b>Embedding orders into central simple algebras</b> Special session on the arithmetic of quadratic forms and integral lattices Joint meeting of the AMS and Sociedad de matematica de Chile	December 2010
<b>Embedding orders into central simple algebras</b> Algebra Seminar, Wesleyan University	September 2010
<b>Embeddings and optimal embeddings in quaternion algebras</b> Canadian Number Theory Association XI meeting	July 2010
<b>Selectivity in quaternion algebras</b> Maine-Quebec Number Theory Conference	October 2009

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**INVITED LECTURE SERIES:**

<i>Grupos aritméticos</i> Academia Nacional de Ciencias, Córdoba, Argentina This was a weeklong Spanish language course, co-taught with Roberto Miatello and Emilio Lauret, focused on the geometry of arithmetic groups. I gave three that dealt with the study of arithmetic hyperbolic surfaces and 3-manifolds.	July 2018
<i>The geometry of arithmetic hyperbolic 3-manifolds</i>	September-November 2015

Universidad Nacional de Córdoba - Argentina

This was a series of 11 lectures which introduced the audience to the construction of arithmetic hyperbolic 3-manifolds and the techniques used in the study of their topology and geometry. Particular attention was paid to applications in spectral geometry.

*Computing with quaternion algebras in Sage and Magma*

Fall 2011

Dartmouth College

These lectures, aimed at advanced undergraduates, introduced the Sage and Magma computer algebra systems with an eye towards the arithmetic of orders in quaternion algebras.

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## PROFESSIONAL DEVELOPMENT:

**Annual Legacy of R.L. Moore Conference**

June 2012, 2013, 2014

These workshops promote the design and implementation of effective methods of teaching and learning at all educational levels through the use of inquiry based learning (IBL) methods.

**Ohio MAA - IBL Workshop**

October 2013

This workshop, led by Carol Schumacher of Kenyon College, introduced participants to the use of inquiry based learning (IBL) methods in the classroom and discussed the contexts in which IBL is effective and practical.

**Authorship of Student Projects Based on Primary Historical Sources**

April 2012

This workshop, hosted by New Mexico State University, provided instruction for the development of student project assignments based on primary historical sources.

**Teaching Seminar**

Summer 2009

Intensive summer-long training course taken by Dartmouth's graduate students who have advanced to candidacy. Includes reading and discussion of material on the philosophy and science of learning and teaching. Participants also design and execute two week-long enrichment workshops for high school students to gain hands-on teaching experience.

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## TALKS ON MATH PEDAGOGY:

**Teaching a first year seminar on cryptography using IBL**

January 2018

MAA Session on Innovative Teaching Practices in Number Theory,  
2018 Joint Mathematics Meetings, San Diego, CA.

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## SYNERGISTIC ACTIVITIES:

**Undergraduate level talks**

*How I became a mathematician & What the h\*ck does number theory have to do with geometry and topology?*

Wake Forest University REU

August 2017

*The ABC Conjecture*  
 Departmental Spring Banquet, Ohio Wesleyan University April 2017  
 Duquesne University Undergraduate Math Colloquium October 2016  
 University of Michigan Math Club September 2014  
 Central Michigan Univ. SUMMR Conference (keynote speaker) July 2013  
 Kalamazoo College October 2012

*A Modular Forms Approach to Quadratic Forms*  
 University of Michigan Math Club November 2013

### Michigan Math and Science Scholars

*Ann Arbor, MI* June 2014

The Michigan Math and Science Scholars program offers high school students the opportunity to gain exposure to current developments and research in the sciences by taking a two week long course with a University of Michigan faculty member. During the last two weeks of June 2014 I taught a course titled *The Mathematics of Cryptography*. This course used inquiry-based learning methods to develop the elementary number theory necessary to understand the RSA cryptography system.

**Faculty Advisor**, Honors Freshman Orientation July 2013, 2014

**Judge**, MAA Undergraduate Poster Session January 2014

**REU Mentor**, University of Michigan Summer 2013

Joseph Richey and Noah Shuttly

*Project title:* Polynomial identities on eigenforms  
 Paper published in the *Journal of Number Theory*.

Weston Ungemach

*Project title:* A bound on isospectral families and applications

### University of Michigan Math Circle Lectures

*Prime Number Patterns I* April 11, 2013

*Prime Number Patterns II* April 18, 2013

*Probability and Paradoxes I* November 13, 2014

*Probability and Paradoxes II* November 20, 2014

The University of Michigan Math Circle aims to increase the quality and quantity of students who become mathematics educators and researchers by inviting area high school and middle school students to the University of Michigan for lectures on and discussions about mathematics.

### Wolverine Express

*Pontiac High School, Pontiac, MI* February 2013

The Wolverine Express is a school visitation program in which a diverse group of University of Michigan faculty members visit high schools in under-resourced areas in order to promote academic success and college aspiration.

### CONFERENCES ORGANIZED:

**The Length and Laplace Spectra of Riemannian Manifolds** March 2019



Special session at the AMS meeting at the University of Hawaii

**Mathematical Research Communities** Summer 2018

*I am a co-organizer of a 20-person conference at the 2018 Mathematical Research Communities program. The title of our conference is “Number Theoretic Methods in Hyperbolic Geometry”.*

**AIM SQuaRE on Towards the Classification of Arithmetic Hyperbolic Reflection Groups**, San Jose, CA Summer 2018

*This AIM SQuaRE will be a small workshop with five mathematicians (including myself). I wrote a proposal which led to full funding of the workshop by the American Institute of Mathematics.*

**Collaborate@ICERM**, Providence, RI Summer 2017

*This will be a small workshop with four mathematicians. I wrote a proposal which led to full funding of the workshop by ICERM.*

**29th Automorphic Forms Workshop**, University of Michigan March 2015

**Interactions Between Geometry, Group Theory and Number Theory**, Special session at the AMS meeting at Michigan State University, March 2015

**Geometric Structures And Representation Varieties (GEAR) NSF Junior Retreat**, University of Michigan (local organizing committee) May 2014

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**SERVICE:**

**MAA Basic Library List Committee**

2018 - Present

**Referee**

Acta Arithmetica, Algebra & Number Theory, American Mathematical Monthly, Bulletin of the London Mathematical Society, Complex Variables and Elliptic Equations, Integers, International Journal of Number Theory, International Mathematics Research Notices, Journal of Number Theory, Journal of Pure and Applied Algebra, Journal of the Ramanujan Mathematical Society, Journal Théorie des Nombres Bordeaux, Manuscripta Mathematica, Mathematics Magazine, The Ramanujan Journal, Transactions of the American Mathematical Society

**Mathematical Reviews**

Reviewer, June 2011 - Present

**Ph.D. defense committee member**

Dianbin Bao, Temple University, 2017

**GEAR Research Network member**, “RNMS: Geometric Structures and Representation Varieties,” supported by NSF Grants DMS-1107452, 1107263, 1107367.