

## Address

Department of Mathematical Sciences  
Durham University  
Lower Mountjoy, DH1 3LE Durham, U.K.  
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## Education

### University of California Santa Cruz

Ph.D. 2010-2014

Thesis title: *Quantitative spectral gap for thin groups of hyperbolic isometries*

Advisor: Alexander Gamburd

### University of Cambridge

C.A.S.M. (Part III), Distinction, 2007-2008

B.A. Mathematics, First Class, 2004-2007

## Appointments

Professor, Durham University, July 2021-present.

(Parental leave 01/04/2021-04/18/2021)

Assistant Professor, Durham University, September 2017-June 2021.

Associate Research Scientist, Yale University, July 2017-August 2017.

Gibbs Assistant Professor, Yale University, July 2015-June 2017.

Member, School of Mathematics, Institute for Advanced Study Princeton,  
September 2014-July 2015.

## Awards

Philip Leverhulme Prize, 2023

Von Neumann Fellowship, IAS Princeton, 2023

Whitehead prize (London Math. Society) 2021

ERC Starting Grant UBIQGAP ‘The ubiquity of optimal spectral gaps’,  
€1,437,000, 2020

LMS Scheme 2 grant for Alex Gamburd’s visit to UK, £1,440, 2018

N.S.F. award DMS-1701357 “Thin counting in moduli spaces” (Algebra and  
Number Theory), total amount \$145,295, 2017

University of California Chancellor’s Fellowship, \$54,000 2010

M.T. Meyer Scholarship, University of Cambridge, 2005-2008

International Physics Olympiad, Bronze medal, 2004

## Journal articles

23. *Strongly convergent unitary representations of limit groups*. With Lars Louder.  
**Journal of Functional Analysis**, vol 288, no. 6, 2025.  
(includes an Appendix written jointly with W. Hide)
22.  *$SL(4, \mathbb{Z})$  is not purely matricial field*. With Mikael de la Salle.  
**Comptes Rendus Mathématique**, Volume 362 (2024), pp. 903-910.
21. *Explicit spectral gap for Schottky subgroups of  $SL(2, \mathbb{Z})$* . With Irving Calderón.  
**Journal of the European Mathematical Society**, to appear.
20. *Quantum Unique Ergodicity for Cayley graphs of quasirandom groups*, with J. Thomas and Y. Zhao.  
**Communications in Mathematical Physics**, Commun. Math. Phys. 402, 3021–3044 (2023)..
19. *Random Unitary Representations of Surface Groups II: The large  $n$  limit*.  
**Geometry and Topology**, to appear.
17. *Near optimal spectral gaps for hyperbolic surfaces*, with W. Hide.  
**Annals of Mathematics**, 198(2): 791-824 (September 2023). DOI: 10.4007/annals.2023.198.2.6 .
16. *Matrix Group Integrals, Surfaces, and Mapping Class Groups II:  $O(n)$  and  $Sp(n)$* , with D. Puder.  
**Math. Annalen**, <https://doi.org/10.1007/s00208-022-02542-1>. (2022)
15. *A random cover of a compact hyperbolic surface has relative spectral gap  $\frac{3}{16} - \varepsilon$* , with F. Naud and D. Puder.  
**Geometric and Functional Analysis (GAFA)**, 32 (3). pp. 595-661 (2022).
14. *Core surfaces*, with D. Puder.  
**Geometriae Dedicata**, 216(4):46 (2022).
13. *Random Unitary Representations of Surface Groups I: Asymptotic expansions*.  
**Communications in Mathematical Physics** vol. 391, pages 119–171 (2022)
12. *Explicit spectral gaps for random covers of Riemann surfaces*, with F. Naud.  
**Publications mathématiques de l’IHÉS** 132, pages 137–179 (2020).
11. *Kesten-McKay law for the Markoff surface mod  $p$* , with M. de Courcy-Ireland.  
**Annales Henri Lebesgue** Volume 4 (2021), pp. 227-250.
10. *Surface words are determined by word measures on groups*, with D. Puder.  
**Israel Journal of Mathematics**, 241, pages 749–774 (2021).
9. *On Selberg’s Eigenvalue Conjecture for moduli spaces of abelian differentials*,  
**Compositio Mathematica** 155(12): 2354-2398 (2019)
8. *The cycle structure of a Markoff automorphism over finite fields*, with A. Cerbu, E. Gunther, L. Peilen.  
**Journal of Number Theory** (2019)
7. *An asymptotic formula for integer points on Markoff-Hurwitz varieties*, with A. Gamburd and R. Ronan.  
**Annals of Mathematics** 190(3): 751-809 (2019)
6. *Counting saddle connections in a homology class modulo  $q$* , with R. Rühr.  
(includes an Appendix by R. Gutiérrez-Romo)  
**Journal of Modern Dynamics** 15: 237-262 (2019)
5. *Matrix Group Integrals, Surfaces, and Mapping Class Groups I:  $U(n)$* , with D. Puder,  
**Inventiones mathematicae** 218(2): 341-411 (2019)
4. *Counting one sided simple closed geodesics on Fuchsian thrice punctured projective planes*.

I.M.R.N. rny112, <https://doi.org/10.1093/imrn/rny112> (2018)

3. *Uniform congruence counting for Schottky semigroups in  $SL_2(\mathbb{Z})$* , with H. Oh and D. Winter. (includes an Appendix written jointly with J. Bourgain and A. Kontorovich)

**Journal für die reine und angewandte Mathematik (Crelle's Journal)** (753): 89-135 (2019)

2. *Arithmetic, zeros, and nodal domains on the sphere*,

**Communications in Mathematical Physics** 338, No. 3, 919-951 (2015)

1. *Quantitative spectral gap for thin groups of hyperbolic isometries*,

**Journal of the European Mathematical Society (JEMS)** No. 1, 151-187 (2015)

## Conference articles

1. *Automorphism-invariant positive definite functions on free groups*, with B. Collins and D. Puder.

**Proceedings of the 27th International Conference on Operator Theory** (2021) arXiv:1906.01518

## Conference and Colloquium talks

Stanford University, *Bay Area Algebraic Number Theory and Arithmetic Geometry Day*, 04/26/2014

Rutgers University, *A.M.S. Eastern Sectional Meeting*, 11/14/2015

M.S.R.I., Berkeley, *Advances in Homogeneous Dynamics* workshop, 05/12/2015

I.A.S. Princeton, *Emerging topics workshop: 'Quantum chaos and fractal uncertainty principle'*, 10/11/2017

*27th International Conference in Operator Theory*, Timișoara, Romania, 07/05/2018

*Groups and Geometry in the South East* (Warwick University), 06/01/2018

University of St Andrews, *Colloquium*, 11/29/2018

C.R.M. Montreal, *Workshop: Free Probability: the theory, its extensions*, 03/05/2019

H.I.M. Bonn, *Transfer operators in number theory and quantum chaos*, 02/04/2020

University of Paderborn, *Spectra and dynamics on (locally) symmetric spaces*, 02/14/2022

Princeton University, *Colloquium*, 04/06/2022

Northwestern University, *Laplacians on random hyperbolic surfaces and on random graphs*, 06/02/2022

Technion (Haifa), *Summer School 'Paroles Paroles'*, 4 lectures, 17-21 July 2022

University of Zurich, *Groups and Dynamics* (meeting of Swiss Math Soc.), 09/15/2022

Institut Henri Poincaré, *Combinatorics of finite index subgroups*, 11/03/2022

LMS Regional Meeting, *Invited talk*, Warwick, 03/27/2023

North British Geometric Group Theory meeting, Glasgow, 04/21/2023

Burton Randol Memorial, CUNY, 10/19/2023

Yau Mathematical Sciences Center, *Colloquium*, 11/17/2023

Rutgers *Colloquium* 11/29/2023

I.A.S. Princeton *Member's Colloquium* 01/29/2024

Yale, *Mathematics Colloquium* 02/28/2024

Princeton, *Visions in Arithmetic and Beyond: Celebrating Peter Sarnak*, 06/03/2024

Manchester, *British Mathematical Colloquium*, *Invited Morning Talk*, 06/19/2024

Sevilla, *European Congress of Mathematicians*, *Invited Talk*, 07/19/2024

ICMS Edinburgh, *UK Workshop on Spectral Theory*, 09/09/2024  
Sheffield, Pure Mathematics Colloquium, 10/09/2024  
C.I.R.M. Luminy (Marseille), *Random hyperbolic surfaces and random graphs*, 11/25/2024  
Bristol, Mathematics Colloquium, 01/27/2025  
Cardiff, *Operator Algebras in the South*, 03/07/2025  
Imperial College London, Oxford-Imperial random systems CDT summer event, 06/23/2025

## Invited seminar talks

Yale University, Group Actions and Dynamics seminar, 02/10/2014  
Stanford University, Number Theory seminar, 05/23/2014  
Institute for Advanced Study, Princeton, Postdoctoral talk, 10/01/2014  
Rutgers University, Number Theory seminar, 10/14/2014  
University of Wisconsin-Madison, Number Theory seminar, 11/06/2014  
Bryn Mawr College, Number Theory seminar, 01/28/2015  
Boston College, Number Theory seminar, 03/12/2015  
Institute for Advanced Study, Princeton, Spectral Geometry seminar, 04/06/2015  
M.I.T., Analysis Seminar, 10/13/2015  
Yale University, Geometry and Topology Seminar, 01/26/2016  
U.I.U.C, Number Theory Seminar, 03/03/2016  
Yale University, Group Actions and Dynamics Seminar, 04/04/2016  
Penn State University, Dynamics Seminar, 09/19/2016  
U. Chicago, Dynamics Seminar, 10/31/2016  
U. Chicago, Danny Calegari's topics class on scl, 11/01/2016  
University of Bristol, Ergodic Theory and Dynamical Systems Seminar, 12/15/2016  
Tel Aviv University, Number Theory Seminar, 01/04/2017  
Temple University, Geometry and Topology Seminar, 04/05/2017  
I.A.S. Princeton, Analysis/Math. Physics seminar, 04/19/2017  
University of Rome II (Tor Vergata), Seminar, 09/20/2017  
Cardiff University, Analysis Seminar, 10/23/2017  
Warwick University, Ergodic Theory and Dynamical Systems seminar, 11/7/2017  
Warwick University, Geometry and Topology seminar, 11/9/2017  
Glasgow University, Geometry and Topology seminar, 11/13/2017  
Durham University, Colloquium, 11/20/2017  
Weizmann Institute of Science, Midrasha on groups (2 talks), 01/10/2018  
Durham University, Geometry and Topology seminar, 01/18/2018  
Cambridge University, Geometry and Topology seminar, 01/31/2018  
University of Manchester, Analysis and Dynamics Seminar, 04/16/2018  
Loughborough University, Dynamical Systems Seminar, 05/23/2018  
University of Bristol, Ergodic Theory and Dynamical Systems Seminar, 05/24/2018  
R.I.M.S. Operator Algebras Seminar, Kyoto, Japan, 10/02/2018  
University of Vienna, Geometry and Analysis on Groups Seminar (2 talks), 11/13/2018  
University of Leeds, Geometry seminar, 11/21/2018

Institut Henri Poincaré, ‘Plat’ seminar, Paris, 03/13/2019  
FRUMAM, ‘Teich’ seminar, Marseille, 03/29/2019  
University of Oxford, Topology seminar, 06/10/2019  
Durham University, Arithmetic study group, 11/19/2019  
Zurich Ergodic Theory and Dynamical Systems seminar, 05/18/2020  
Montreal Analysis Seminar, 07/15/2020  
U.C. Berkeley Probabilistic Operator Algebras Seminar, 03/29/2021  
London Geometry and Topology Seminar, 05/14/2021  
Tel Aviv, Doron Puder’s seminar, 05/25/2021, 06/01/2021 (2 talks)  
IRMA (Strasbourg), Analysis seminar, 06/22/2021  
University of Michigan, Geometry seminar, 07/12/2021  
Durham University Research day, 09/24/2021  
Tel Aviv, Groups and Dynamics seminar 10/21/2021  
Brown University Algebra and Number Theory seminar 11/01/2021  
NYC Joint Number Theory Seminar 11/04/2021  
Spectral Geometry in the Clouds 11/22/2021  
Yale University, Group Actions and Dynamics Seminar, 02/21/2022  
Irish Geometry Seminar 03/01/2022  
Warwick Ergodic Theory and Dynamical Systems seminar, 03/08/2022  
London Number Theory Seminar 03/23/2022  
University of Wisconsin-Madison, Analysis seminar, 09/27/2022  
U.C. Berkeley Probabilistic Operator Algebras seminar, 11/18/2022  
Bristol University Geometry and Topology seminar, 01/24/2023  
Princeton University, special seminar, two lectures 10/25, 11/01/2023  
Caltech, Geometry and Topology seminar (online) 11/10/2023  
M.I.T. Probability seminar, 12/11/2023  
Temple University, Geometry and Topology Seminar, 03/27/2024  
Maryland (UMD) Dynamics Seminar, 04/25/2024  
U.C. Berkeley Probabilistic Operator Algebras Seminar, 10/21/2024  
University of Oxford, Functional Analysis seminar, 05/10/2025  
Queen’s University Belfast, special seminar (INI Satellite on groupoid  $C^*$ -algebras), 07/07/2025

### **PhD student supervision**

Will Hide 2020-2024  
Ewan Cassidy 2021-present  
Anitej Banerjee 2022-present

### **Postdoc mentoring**

Irving Calderón 2021-2025  
Joe Thomas 2021-present

### **Conference/workshop organization**

(With Tuomas Sahlsten) Mini-workshop on random surfaces, (online workshop), September 2020.  
Durham Symposium 2023: Spectral gaps, August 7-11 2023.  
In preparation: Spectral gaps 2025: Portoroz, Slovenia, Sept 2025.

## Departmental responsibilities

Analysis research group lead, from inception (2023-)  
Progression and Promotion Committee (2024-)  
Founding organizer of Durham Spectra/Moduli seminar, October 2021-  
Organizer of Pure Mathematics Colloquium, July 2019-July 2020  
Internal examiner, Ph.D. thesis of Robert Little (May 2019)  
Internal examiner, Ph.D. thesis of John Blackman (July 2020)

## External service

External examiner, Ph.D. thesis of Stephen Cantrell, Warwick (June 2020)  
Reader, Ph.D. thesis of Pratyush Sarkar, Yale (April 2022)  
Grant review panel for DFG Collaborative Research Center (September 2022)  
External Examiner, Master's thesis of Yaron Brodsky, Tel Aviv University (Oct 2022)

## Professional qualifications

Postgraduate Certificate in Learning and Teaching in Higher Education, Durham University (2020)  
Fellow of the UK Higher Education Academy

## Teaching experience

### Lecturer

Durham University, *Complex Analysis*, Epiphany 2018-Easter 2020.  
Yale University, *Number theory*, Spring 2017  
Yale University, *Group expansion and number theory*, Spring 2017  
Yale University, *Linear Algebra with Applications*, Fall 2016  
Yale University, *Spectral Geometry*, Spring 2016  
Yale University, *Introduction to Functional Analysis*, Spring 2016  
Yale University, *Ordinary Differential Equations*, Fall 2015  
UC Santa Cruz, *Calculus with applications*, August 2013  
UC Santa Cruz, *Calculus with applications*, August 2012

### Teaching assistant

UC Santa Cruz, *Various undergraduate classes*, 2012-2014

## Reviews and opinions

For many venues including all top journals.

## **Non academic work**

From 2008-2010 I worked as a software engineer (Manchester, UK, and Irvine, CA, USA).