## Address

Department of Mathematical Sciences
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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.
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.

## Journal articles

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)**, to appear.

14. *Core surfaces,* with D. Puder.
**Geometriae Dedicata**, to appear.

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, with 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* $\mathrm{SL}_2(\mathbf{Z})$*,* with H. Oh and D. Winter, with an appendix joint with J. Bourgain and A. Kontorovich,
**Journal für die reine und angewandte Mathematik (Crelles 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

## Preprints

*6. Quantum Unique Ergodicity for Cayley graphs of quasirandom groups,* with J. Thomas arXiv:2107.05292

*5. Near optimal spectral gaps for hyperbolic surfaces,* with W. Hide arXiv:2107.05292

4. *Extension of Alon's and Friedman's conjectures to Schottky surfaces*, with F. Naud. arXiv:2106.02555

3. *Random Unitary Representations of Surface Groups II: The large n limit.* arXiv:2101.03224

*2. The asymptotic statistics of random covering surfaces,* with D. Puder arXiv:2003.05892

*1. Matrix Group Integrals, Surfaces, and Mapping Class Groups II:* $\mathrm{O}(n)$ *and* $\mathrm{Sp}(n)$*,* with D. Puder. arXiv:1904.13106

## Awards

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

## 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, Timişoara, 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

## 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

## PhD student supervision

Will Hide 2020-present

Ewan Cassidy 2021-present

## Postdoc mentoring

Irving Calderón 2021-present

Joe Thomas 2021-present

## Conference/workshop organization

(With Tuomas Sahlsten) Mini-workshop on random surfaces, (e-workshop), September 2020.

## Departmental responsibilities

Founder and 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)

## 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

Analysis & PDE, Annals of Math., Comm. Math. Phys., Compositio Math., Discrete and Computational Geometry, Duke Math Journal, Experimental Math., G.A.F.A., Geometry and Topology, I.M.R.N., Inventiones Math., Israel Journal of Math., J.E.M.S., J.A.M.S., Pacific Journal of Math.

## Non academic work

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