Address

Department of Mathematical Sciences
Durham University
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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

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

17. *Near optimal spectral gaps for hyperbolic surfaces,* with W. Hide
Annals of Mathematics, to appear.

16. *Matrix Group Integrals, Surfaces, and Mapping Class Groups II:* $\mathrm{O}(n)$ *and* $\mathrm{Sp}(n)$, with D. Puder.
Math. Annalen, to appear.

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, 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 (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

Preprints

5. Strongly convergent unitary representations of limit groups. With Lars Louder, contains appendix with Will Hide.arXiv:22210.08953
4. Quantum Unique Ergodicity for Cayley graphs of quasirandom groups, with J. Thomas and Y. Zhao arXiv:2107.05292
3. Extension of Alon's and Friedman's conjectures to Schottky surfaces, with F. Naud. arXiv:2106.02555
2. Random Unitary Representations of Surface Groups II: The large n limit. arXiv:2101.03224
1. The asymptotic statistics of random covering surfaces, with D. Puder arXiv:2003.05892

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 chao*s, 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

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**

PhD student supervision

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

Postdoc mentoring

Irving Calderón 2021-present
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.

Departmental responsibilities

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

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).