Curriculum Vitae

Harald HELFGOTT

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Personal data

Name :	Harald Andrés HELFGOTT
Date/place of birth :	November 25, 1977 in Lima, Peru
Citizenship :	Peruvian
Degrees :	PhD in Mathematics, Princeton, 2003
	Habilitation, Paris-Sud (Orsay), 2011

Education

1998–
2003
PhD student at Princeton University. Advisors : H. Iwaniec and P. Sarnak. Thesis jury : H. Iwaniec, N. Katz, P. Sarnak, A. Wiles. Thesis title :

Root numbers and the parity problem

1994–
1998
Undergraduate student at Brandeis University. Graduated summa cum laude, with highest honours in mathematics and computer science. Title of B.A. thesis :

Edge effects on local statistics in lattice dimers :
a study of the Aztec diamond (finite case)

Professional activity

2014–	Directeur de Recherche 2ème classe (Senior Researcher, 2nd class) CNRS, Université de Paris VI/VII
2010–2014	Chargé de Recherche 1ère classe (Researcher, 1st class) CNRS, École Normale Supérieure
2009–2011	Reader, University of Bristol (on leave 2010-2011)
2006–2009	Lecturer, then Senior Lecturer (2008–2009), University of Bristol
2004–2006	Post-doctoral fellow, CRM-ISM-Université de Montréal Research Assistant Professor (post-doctoral position), Concordia University
2003–2004	Gibbs Assistant Professor (post-doctoral position), Yale University
1998–2003	Research and Teaching Assistant, Princeton University
1997–1998	Undergraduate research assistant, MIT
1995–1997	Undergraduate teaching assistant, Brandeis University

Research subjects

Analytic number theory, group theory, additive combinatorics, Diophantine geometry, probabilistic number theory.

Prizes

2014	Gabriel Lamé Chair (France/Russia : Saint Petersburg State University)
2013	Honorary Professor (Universidad Nacional Mayor de San Marcos, Lima, Peru, and Universidad Nacional San Antonio Abad, Cusco, Peru)
2011	Adams Prize (Cambridge University)
2010	Whitehead Prize (London Mathematical Society)
2008	Philip Leverhulme Prize
2007	Advanced Research Fellowship (EPSRC)

Courses taught

Sept–Nov 2014	Анализ и теория чисел	postgraduate	Saint-Petersburg
Oct–Nov 2012	Teoría de grupos	postgraduate	UAM (Madrid)
Feb 2012	Leçons d'arithmétique	master's	ENS
Nov–Dec 2009	Galois theory	undergraduate	Bristol
Aug–Dec 2006	Group theory	undergraduate	Bristol
Aug–Dec 2005	Ordinary differential equations	undergraduate	Concordia
Aug–Dec 2004	Ordinary differential equations	undergraduate	Concordia
Jan–May 2004	Arithmetic	postgraduate	Yale
Aug–Dec 2003	Introduction to number theory	undergraduate	Yale
Aug–Dec 2003	Multivariable calculus	undergraduate	Yale
Jan–May 2003	Multivariable calculus	undergraduate	Princeton

Extracurricular courses taught

Jul 2014	Growth in groups and applications	IHÉS (Bures-sur-Yvette)
Apr 2012	Crecimiento y diámetro en los grupos finitos	USACH (Santiago, Chili)
Mar 2012	Téoría analítica de números	IMPA (Lima, Peru)
Jan 2011	La croissance dans les groupes	EPFL (Lausanne, Suisse)
Oct 2010	Ideas analíticas en la teoría de números	UNMSM (Lima, Peru)
Sep 2010	Ideas analíticas en la teoría de números	UMSA (La Paz, Bolivia)
Aug 2010	Growth in linear algebraic groups	TIFR (Mumbai, India)
Mar–Apr 2008	A brief course in arithmetic combinatorics	IMSc (Chennai, India)
Sep 2007	Azar y aritmética. Combinatoria aditiva	U. de Huamanga (Peru)
Summer 2007	Azar y aritmética	UNMSM (Lima, Peru)
Feb 2007	Probabilidades e Teoria dos Números	IMPA (Brazil)
Jun 2005	Normas, desigualdades y dualidad	U. de la Habana (Cuba)
Mar 2004	Ideas geométricas en la teoría de números	IMCA (Lima, Peru)

Articles

Pure mathematics

28. On the dimension of additive sets (with P. CANDELA), preprint.

27. Random generators of the symmetric group : diameter, mixing time and spectral gap (with Á. SERESS et A. ZUK), to appear in *J. of Algebra*.

26. The ternary Goldbach conjecture is true, preprint.

25. Major arcs for Goldbach's problem, preprint.

24. Numerical verification of the ternary Goldbach conjecture up to 8.875e30 (with D. PLATT), *Experiment. Math.* **22** (2013), no. 4, 406–409.

23. Growth in groups : ideas and perspectives, to appear in *Bull. Am. Math. Soc.*

22. On growth in an abstract plane (with N. GILL and M. RUDNEV), to appear in *Proc. Amer. Math. Soc.*

21. Minor arcs for Goldbach's problem, preprint.

20. Bounds on the diameter of Cayley graphs of the symmetric group (with J. BAMBERG, N. GILL, T. HAYES, Á. SERESS, P. SPIGA), *J. Algebraic. Combin.* **40** (2014), no. 1, 1–22.

19. Square-free values of $f(p)$, f cubic, *Acta. Math.* **213** (2014), no. 1, 107–135.

Th3. Groupes, courbes et croissance, habilitation thesis, Paris-Sud (Orsay).

18. On the diameter of permutation groups (with Á. SERESS), *Annals of Math.* **179** (2014), no. 2, 611–658.

17. Deterministic methods to find primes (as *D. H. J. Polymath*, with T. TAO et E. CROOT), *Math. Comp.* **81** (2012), no. 278, 1233–1246.

16. Growth in solvable subgroups of $GL_r(\mathbb{Z}/p\mathbb{Z})$ (with N. GILL), *Math. Annalen* **360** (2014), no. 1–2, 157–208.

15. Growth of small generating sets in $SL_n(\mathbb{Z}/p\mathbb{Z})$ (with N. GILL), *Int. Math. Res. Notices*, Vol. 2011, 4226–4251 .

14. An explicit incidence theorem in $\mathbb{F}_p$ (with M. RUDNEV), *Mathematika*, 57 (2011), no. 1, 135–145.

13. Improving Roth's theorem in the primes (with A. de ROTON), *Int. Math. Res. Notices*, Vol. 2011, 767–783.

12. Growth in $SL_3(\mathbb{Z}/p\mathbb{Z})$, *J. Eur. Math. Soc. (JEMS)*, vol. 13, no. 3, pp. 651–851.

11. Power-free values, repulsion between points, different beliefs and the existence of error, *Anatomy of Integers*[1], 81–88, Amer. Math. Soc., Providence, RI, 2008.

10. How small must ill-distributed sets be ? A two-dimensional large sieve (with A. VENKATESH), *Analytic number theory : essays in honor of Klaus Roth*, 224–234, Cambridge U. Press, 2009.

9. Growth and generation in $SL_2(\mathbb{Z}/p\mathbb{Z})$, *Annals of Math.* **167** (2008), no. 2, 601–623.

8. Power-free values, large deviations and integer points on irrational curves, *J. Théor. Nombres Bordeaux* **19** (2007), 433–472.

7. The parity problem for irreducible polynomials, submitted, 11 pages.

6. The parity problem for reducible polynomials, *J. London Math. Soc. (2)* **73** (2006), no. 2, 415–435.

5. Integral points on elliptic curves and 3-torsion in class groups (with A. VENKATESH), *J. Amer. Math. Soc.* **19** (2006), no. 3, 527–550.

4. Root numbers and ranks over global function fields (with B. CONRAD and K. CONRAD), *Adv. Math.* **198** (2005), 684–731.

3. On the square-free sieve, *Acta Arith.* **115** (2004), 349–402.

2. On the behaviour of root numbers in families of elliptic curves, submitted, 65 pages.

Th2. *Root numbers and the parity problem*, PhD thesis, Princeton University, May 2003.

1. Enumeration of tilings of diamonds and hexagons with defects (with I. M. GESSEL), *Electron. J. Combin.* **6** (1999), no. 1, R16, 26 pp.

Th1. *Edge effects on local statistics in lattice dimers*, B.A. thesis, Brandeis University, May 1998.

Expository monographs – pure mathematics

M1. *Azar y aritmética, Monografías del Instituto de Matemática y Ciencias Afines*, 50. Instituto de Matemáticas y Ciencias Afines (IMCA), Lima, Peru, 2010.

Popularization and exposition – pure mathematics
    Note : these three expository articles, while not identical, have some material in common.

PE3. The ternary Goldbach problem, to appear in *Proc. ICM.*

PE2. La conjecture de Goldbach ternaire. Translated by M. Bilu, revised by the author. *Gaz. Math.* no. 140 (2014), 5–18.

PE1. La conjetura débil de Goldbach, *Gac. R. Soc. Mat. Esp.* **16** (2013), no. 4.

Pedagogy and history

PH3. A modern vision of the work of Cardano and Ferrari on quartics, (with M. HELFGOTT) *CONVERGENCE, an online journal of the Mathematical Association of America*, July 2009.

PH2. A noncalculus proof that Fermat's principle of least time implies the law of refraction (with M. HELFGOTT), *Am. J. Phys.* **70** (2002), no. 12, 1224–1225.

PH1. Maxima and minima before Calculus (with M. HELFGOTT), *Pro Mathematica* XII (1998), nos. 23–24, 135–158. (with M. HELFGOTT) *CONVERGENCE, an online journal of the Mathematical Association of America*, July 2009.

Computer Science
    Note : I am no longer active in this field.

I3. Lossless image compression by block matching (with J. A. STORER), *Comput. J.* **40** (1997), no. 2/3, 137–145.

I2. Asymmetry in Ziv/Lempel '78 Parsing (with M. COHN), 320–328, in : *Compression and complexity of sequences : proceedings, 1997*[1], IEEE, Los Alamitos, CA, IEEE Computer Society Press, 1997.

I1. On Maximal Parsings of Strings (with M. COHN), 291-299, in : *Proceedings DCC '1997 : Data Compression Conference*[1], IEEE, Los Alamitos, CA, 1997.

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    1. Conference proceedings.

Plenary talks and other selected lectures

8/2014	The ternary Goldbach problem, invited lecture, ICM 2014, Seoul, Korea.
8/2014	The ternary Goldbach problem, plenary talk, Eleventh Algorithmic Number Theory Symposium ANTS-XI, GyeongJu, Korea.
6/2014	Conjecture de Goldbach, Colloque Jeunes Chercheurs, Université de Bordeaux 1. Series of three plenary talks.
5/2014	The ternary Goldbach problem, CANT (Combinatorial and Analytic Number Theory) 2014, New York, USA. Series of four plenary talks.
4/2014	The ternary Goldbach conjecture, British Mathematical Colloquium 2014, Queen Mary University London. Morning talk.
05/2013	The ternary Goldbach conjecture, Mathematische Arbeitstagung 2013, Max Planck Institute for Mathematics, Bonn, Germany.
4/2010	Growth in linear algebraic groups, Analytic Number Theory, Göttingen, Germany. Series of three plenary talks.

Other talks at conferences and colloquia

10/2014	The ternary Goldbach problem, Clay Workshop in Analytic Number Theory, Oxford, UK.
9/2014	The ternary Goldbach problem, Colloquium, Chebyshev Laboratory, Saint Petersburg State University, Russia.
7/2014	The ternary Goldbach problem, First Joint International Meeting RSME-SCM-SEMA-SIMAI-UMI, Bilbao, Spain.
6/2014	Growth in groups : ideas and perspectives, Mathematics Colloquium, Göttingen, Germany.
6/2014	Die schwache Goldbachsche Vermutung, Marburg-Gießen Kolloquium, Marburg, Germany.
5/2014	Random generators of the symmetric group : diameter, mixing time and spectral gap, Workshop : Finding Algebraic Structures in Extremal Combinatorial Configurations, IMPA, UCLA, USA.
5/2014	Growth in groups : ideas and perspectives, MSRI, Berkeley, USA.
5/2014	The ternary Goldbach conjecture, Helvetic Algebraic Geometry, Château Mercier, Sierre, Switzerland.
2/2014	La conjetura débil de Goldbach, ICMAT, Madrid, Spain.
2/2014	The ternary Goldbach problem, Automorphic forms and arithmetic, Göttingen, Germany.
10/2013	The ternary Goldbach problem, Analytic number theory, MFO (Mathematisches Forschungsinstitut Oberwolfach), Oberwolfach, Germany.
08/2013	The ternary Goldbach problem, Workshop on Combinatorics, Number Theory and Dynamical Systems, IMPA (Instituto Nacional de Matemática Pura e Aplicada), Rio de Janeiro, Brazil.
06/2013	La conjecture ternaire de Goldbach, Etienne Fouvry 60th birthday conference, CIRM, Luminy, France.
11/2012	Towards the ternary Goldbach conjecture, Conference on Zeta functions, Moscow Independent University.
11/2012	Hacia la conjetura ternaria de Goldbach, Coloquio de matématicas, Universidad Autónoma de Madrid, Spain.
10/2012	Higher-dimensional sieves, Arithmetic Geometry, Centro di Ricerca Matematica Ennio de Giorgi, Scuola Normale Superiore, Pisa, Italy.
7/2012	On the diameter of permutation groups, Additive Combinatorics in Paris, Institut Henri Poincaré, Paris.
6/2012	Minor arcs for Goldbach's problem, Analytic methods for diophantine problems, Mathematisches Institut, Göttingen, Germany.
6/2012	Minor arcs for Goldbach's problem, Annual Meeting of the Canadian Number Theory Association, Lethbridge, AB, Canada.
3/2012	The diameter of permutation groups, International Number Theory Conference in Memory of Alf van der Poorten, Newcastle, Australia.

Other talks at conferences and colloquia (cont.)

12/2011	Growth in permutation groups, International Meeting on Number Theory, Harish-Chandra Research Institute, Allahabad, India.
12/2011	Grupos y diámetros : ideas y perspectivas, Séminario IMPA/CNRS, IMPA, Rio de Janeiro, Brazil.
6/2011	Growth in groups : an overview, Young workshop in arithmetics and combinatorics, Madrid, Spain.
5/2011	Growth in solvable groups, Resonances in mathematical physics, Peyresq, France.
3/2011	Finding primes deterministically, Discrete analysis, Newton Institute, Cambridge, UK.
3/2011	Finding primes deterministically, Colloquium, Durham University, UK.
2/2011	Growth in solvable groups, Group Actions in Analytic Number Theory, Lausanne, Switzerland.
1/2011	Growth and expansion in groups, Group Actions in Analytic Number Theory, Lausanne, Switzerland (three talks).
12/2010	Comment améliorer le théorème de Roth sur les nombres premiers, Arithmétique Lille-Litoral 2010, Lille, France.
8/2010	Improving Roth's theorem in the primes, ICM-Zeta satellite conference, IMSc, Chennai, India.
6/2010	Growth in solvable groups, Conference on Zeta functions, Moscow Independent University, Russia.
5/2010	Growth and expansion : an overview, Expansion in Groups, Imperial College, Londres, UK.
4/2010	Growth in finite simple groups, Number theory days, ETHZ, Zurich, Switzerland.
3/2010	Growth in simple groups of Lie type, Conference in honor of Laci Babai's 60th Birthday, OSU, Columbus, Ohio, USA.
3/2010	Growth in simple groups of Lie type, Workshop on graphs and arithmetic, CRM, Montréal, QC, Canada.
11/2009	Growth of small subsets in $\mathrm{SL}_n(\mathbb{F}_p)$, Géométrie, dynamique et représentations des groupes, CIRM, Luminy, France.
7/2009	Exponential sums and the large sieve, Activités analytiques et additives à Lille, U. de Lille 1, France.
11/2008	Growth in $\mathrm{SL}_3(\mathbb{F}_p)$, Discrete rigidity phenomena in additive combinatorics, MSRI, Berkeley, CA, USA.
4/2008	Growth in $\mathrm{SL}_3(\mathbb{F}_p)$, Groups and geometries, Oberwolfach, Germany.
4/2008	Growth in $\mathrm{SL}_3(\mathbb{F}_p)$, Clay-Fields conference on additive combinatorics, number theory and harmonic analysis, Fields Institute, Toronto, ON, Canada.
4/2008	Growth in $\mathrm{SL}_3(\mathbb{F}_p)$, Analytic number theory, Oberwolfach, Germany
2/2008	Growth in linear algebraic groups : an approach via incidence, Expanders in pure and applied mathematics, Institute for Pure and Applied Mathematics, UCLA, Los Angeles, CA, USA.
7/2007	$p^3 + 2$ is square-free infinitely often, Diophantine equations via analytic number theory, University of Bristol, UK.
5/2007	$p^3 + 2$ is square-free infinitely often, School and conference on analytic number theory, International Centre for Theoretical Physics, Trieste, Italy.
9/2006	$p^3 + 2$ is square-free infinitely often, India-UK number theory conference, Institute of Mathematical Sciences, Chennai (Madras), India.
4/2006	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Workshop on additive combinatorics, CRM (Centre de Recherches Mathématiques), Montréal, QC, Canada.
3/2006	Power-free values, points on curves, large deviations and modularity, Anatomy of Integers, CRM (Centre de Recherches Mathématiques), Montréal, QC, Canada.
12/2005	Larger and better sieves ?, Workshop on gaps between primes, AIM, Palo Alto, CA, USA.
11/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Workshop on Lie groups, representations and discrete mathematics, Institute for Advanced Studies, Princeton, NJ, USA.

Other talks at conferences and colloquia (cont.)

10/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Colloque en l'honneur d'Henryk Iwaniec, Bordeaux, France.
7/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Journées arithmétiques, Marseille, France.
6/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Canadian Mathematical Society summer meeting, Waterloo, ON, Canada.
5/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Conférence en théorie analytique des nombres, Université Laval, QC, Canada.
4/2005	Growth and generation in $\mathrm{SL}_2(\mathbb{Z}/p\mathbb{Z})$, Conference in Honor of Paul Monsky, Brandeis, Waltham, MA, USA.
12/2004	Power-free values of polynomials with prime arguments, CMS winter meeting, Montréal, QC, Canada.
11/2004	Power-free values of polynomials and integer points on irrational curves, Diophantine approximation and analytic number theory, Banff International Research Station, Banff, AB, Canada.
4/2004	Integral points on elliptic curves and 3-torsion in class groups, AMS sectional meeting, Lawrenceville, NJ, USA.
4/2004	On the behavior of root numbers in families of elliptic curves, Atelier sur la théorie spectrale et les formes automorphes, Montréal, QC, Canada.
12/2003	Elliptic curves, square-free numbers and class groups, Brandeis-Harvard-MIT-Northeastern joint mathematics colloquium, Brandeis U., Waltham, MA, USA.
5/2003	Root numbers, the square-free sieve and elliptic curves, Workshop on automorphic L-functions, Fields Institute, Toronto, ON, Canada.
6/2001	The average of the Moebius function on polynomials and the average root number of a family of elliptic curves, Premières journées du Nord sur les nombres premiers, Lille I, France.
5/2001	The average of μ on integers represented by a polynomial of degree greater than two and its relation to the average root number in families of elliptic curves, Seaway number theory conference, Carleton University, Ottawa, ON, Canada.
7/2000	Curvas elípticas y números primos, XX Coloquio de la Sociedad Matemática Peruana, Lima, Perú.

More than 55 invited talks at seminars.

Supervision of graduate students and post-docs

2013–	1 doctoral student (Alisa Sedunova) at Paris-Sud (Orsay)
2012–2014	1 Postdoc (Pablo Candela) at Paris (FSM/ENS)
2010–2014	Supervision of master's level students, École Normale Supérieure, Paris
2006–2010	1 Postdoc (Nick Gill), 1 doctoral student (Dave Mendes da Costa) Bristol University, UK

I have also advised undergraduates on independent study and research projects, starting in 2004 (Nahid Walji, at Yale).

Conference organization

2015	AGRA 2015 (Aritmética, grupos y análisis), summer school, Cusco, Peru. Coorganisers (scientific committee) : G. Tornaría, C. G. Moreira.
2015	Growth, symbolic dynamics and combinatorics of words in groups, conférence, ENS, Paris, France. Coorganisers : A. Erschler, K. Juschenko.
2014	Arithmetic and allied subjects on the banks of the Neva, Saint-Petersburg, Russia. Coorganiser (scientific committee) : K. Juschenko.
2012	AGRA (Aritmética, grupos y análisis), summer school, Santiago, Chili. Coorganisers : A. Navas, C. G. Moreira.
2010	AQUA (Analytic questions in arithmetic), summer school, Tata Institute, Mumbai, Inde. Coorganisers : A. Gorodnik, J. Sengupta.

Administrative tasks and good citizenship

2013–	Member of the editorial board at *Revista Matemática Iberoamericana*
2013–	Corresponding member of the *Academia Nacional de Ciencias del Perú.*
2012/13	Directed the student seminar on analytic number theory at ENS
2008/09	Coorganised working groups on number theory and ergodic theory at Bristol
2005	Organised an additive-combinatorics working group at Montréal
2005/06	Coorganised an analytic number theory working group at Montréal
2004/05	Organised the number-theory seminar at Yale University

Member of doctoral and habilitation committees.

Member of a hiring committee.

Referee for several mathematical journals (including *Ann. of Math.* and *Invent. Math.*), for *Engineering and Physical Sciences Research Council (EPSRC)* (project evaluation) and for *Mathematical reviews.*

Computing experience

Programming : C, Scheme.

Tools : SAGE, PARI, Gnuplot, LaTeX, various mathematical packages.
Usage of interval arithmetic and validated numerics.

Languages

Spanish :	Mother tongue. Used in professional contexts.
English, French, German :	Fluent. Used in professional contexts.
Esperanto :	Fluent.
Russe :	Advanced intermediate. Used in professional contets.
Classical Greek :	Intermediate.
Quechua, Polish :	Basic knowledge.