

BÁLINT VIRÁG
CURRICULUM VITAE

PERSONAL

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Date of Birth: November 2, 1973.

Citizenship: Hungarian, Canadian Landed Immigrant

EDUCATION

University of California, Berkeley, 1996-2000

Ph.D. in Statistics June 2000.

Thesis: Random walks and geometry on graphs of exponential growth.

Advisor: Yuval Peres. Eric Lehmann citation for Ph.D. thesis.

Harvard University, 1992-1996

B.A. Magna Cum Laude in Mathematics, June 1996.

Thesis: Random walk on finite convex sets of lattice points. Advisor: Persi Diaconis.

Thomas Temple Hoopes Prize awarded for outstanding honours thesis.

EMPLOYMENT HISTORY

University of Toronto, 2003-present

Professor, July 2011-present

Canada Research Chair, 2003-2013

Associate Professor (tenured), 2008-2011

Assistant professor, 2003-2008

Rényi Institute, Budapest, 2013-2015

Visiting professor, Marie Curie Research Fellowship

Senior researcher, 2016-present.

Mathematical Sciences Research Institute, spring 2005

Semester-long workshop on probability, algorithms and statistical physics.

Institut Henri Poincaré Paris, spring 2003

Visiting Researcher

Massachusetts Institute of Technology, 2000-2003

C.L.E. Moore Instructor, Department of Mathematics

Clay Mathematics Institute, summer 2000

Liftoff Program, research support.

Research Interests: Random matrices, random polynomials, random walks, randomness in groups

HONOURS, GRANTS AND AWARDS

Momentum grant of the Hungarian Academy of Sciences 2016

A \$IM research grant. Given to 11 researchers in all sciences.

John L. Synge Award of the Royal Society of Canada, 2014

“The award is given for outstanding research in any of the branches of the mathematical sciences.”

International Congress of Mathematicians, Invited speaker, 2014

European Union Marie Curie Research Fellowship, 2013-2015

Institute of Mathematical Statistics, Medallion Lecturer, 2013

ML “is an honor and an acknowledgment of a significant research contribution.”

Canadian Mathematical Society Coxeter-James Prize, 2010

For “young mathematicians who have made outstanding contributions to mathematical research.”

Rollo Davidson Prize, 2008

Awarded annually to early-career probabilists by the R.D. trustees at Cambridge University.

Sloan Research Fellow, Fall 2004-2008

Connaught Research Grant, Fall 2004-2008

NSERC Research Grant, Fall 2004-present

NSERC Discovery Accelerator grant 2009-present

Canada Research Chair, 2003-2013

NSF Research Grant, 2001-2004

Loève Fellowship in Probability, 1998-2000

Hewlett Scholarship, 1996-97

Given to Berkeley graduate students in recognition of distinguished academic record.

Putnam Mathematical Competition, 1996

Placed among the 25 highest-ranking individuals.

Hoopes Prize, 1996

Given to thirty students in the Harvard graduating class for the best honors theses.

RECENT INTERNATIONAL WORKSHOPS, CONFERENCES ORGANIZED

Graph limits, groups and stochastic processes II Renyi Institute, Budapest. Summer school. (with M. Abert, A. Backhausz, L. Lovasz, B. Szegedy) 8/2017

Random growth, random matrices and random walks. CRM Montreal, (w. L. Addario-Berry and I. Binder) 9/2016

Spectra of random graphs, CIRM Luminy, France, weeklong workshop (w. C. Bordenave and A. Guionnet), 1/2016

Fields Medal Symposium in honor of Stanislav Smirnov’s work weeklong symposium at Fields Institute, Toronto (w. G. Lawler, W. Wernert et al) 9/2015

Groups, graphs and stochastic processes II, weeklong workshop, Banff International Research Station, (w. O. Angel and M. Abert), 7/2015

Graph limits, groups and stochastic processes Renyi Insititute, Budapest. Summer school with 70 international participants. (with M. Abert, A. Backhausz, L. Lovasz, B. Szegedy) 7/2014

PUBLICATIONS

Book

- [1] *Zeros of Gaussian analytic functions and determinantal point processes*, volume 51 of *University Lecture Series*. American Mathematical Society, Providence, RI, 2009 (with J. B. Hough, M. Krishnapur, and Y. Peres).

Refereed publications

- [2] Spectral measures of factor of i.i.d. processes on vertex-transitive graphs. *Ann. Inst. Henri Poincaré Probab. Stat.*, 53(4):2260–2278, 2017 (with Á. Backhausz).
- [3] Mean quantum percolation. *J. Eur. Math. Soc.*, 19(12):3679–3707, 2017 (with C. Bordenave and A. Sen).
- [4] Holder continuity of the integrated density of states in the one-dimensional Anderson model. *Comm. Math. Phys.*, 355(3):839–863, 2017 (with E. Hart).
- [5] Dyson’s spike for random Schroedinger operators and Novikov-Shubin invariants of groups. *Comm. Math. Phys.*, 352(3):905–933, 2017 (with M. Kotowski).
- [6] Local algorithms for independent sets are half-optimal. *The Annals of Probability*, 45(3):1543–1577, 2017 (with M. Rahman).
- [7] The Sine_β operator. *Inventiones Mathematicae*, 209(1):275–327, 2017 (with B. Valkó).
- [8] The measurable Kesten theorem. *Ann. Probab.*, 44(3):1601–1646, 2016 (with M. Abért and Y. Glasner).
- [9] The Liouville property for groups acting on rooted trees. *Ann. Inst. Henri Poincaré Probab. Stat.*, 52(4):1763–1783, 2016 (with G. Amir, O. Angel, and N. Matte Bon).
- [10] Limits of spiked random matrices II. *Ann. Probab.*, 44(4):2726–2769, 2016 (with A. Bloemendal).
- [11] Universality of the stochastic airy operator. *Communications on Pure and Applied Mathematics*, 69(1):145–199, 2016 (with M. Krishnapur and B. Rider).
- [12] A Central Limit Theorem for Products of Random Matrices and GOE Statistics for the Anderson Model on Long Boxes. *Comm. Math. Phys.*, 343(3):881–919, 2016 (with C. Sadel).
- [13] Ramanujan graphings and correlation decay in local algorithms. *Random Structures Algorithms*, 47(3):424–435, 2015 (with Á. Backhausz and B. Szegedy).
- [14] Invariant Gaussian processes and independent sets on regular graphs of large girth. *Random Structures Algorithms*, 47(2):284–303, 2015 (with E. Csóka, B. Gerencsér, and V. Harangi).

- [15] Independence ratio and random eigenvectors in transitive graphs. *Ann. Probab.*, 43(5):2810–2840, 2015 (with V. Harangi).
- [16] Non-Liouville groups with return probability exponent at most $1/2$. *Electron. Commun. Probab.*, 20:no. 12, 12, 2015 (with M. Kotowski).
- [17] Kestens theorem for invariant random subgroups. *Duke Mathematical Journal*, 163(3):465–488, 2014 (with M. Abért, Y. Glasner, et al.).
- [18] Positive speed for high-degree automaton groups. *Groups Geom. Dyn.*, 8(1):23–38, 2014 (with G. Amir).
- [19] The Ginibre ensemble and Gaussian analytic functions. *International Mathematics Research Notices*, 2014(6):1441–1464, 2014 (with M. Krishnapur).
- [20] Random schrödinger operators on long boxes, noise explosion and the goe. *Transactions of the American Mathematical Society*, 366(7):3709–3728, 2014 (with B. Valkó).
- [21] Operator limits of random matrices. *Proceedings of the ICM Seoul*, 2014.
- [22] Amenability of linear-activity automaton groups. *J. Eur. Math. Soc. (JEMS)*, 15(3):705–730, 2013 (with G. Amir and O. Angel).
- [23] Limits of spiked random matrices I. *Probab. Theory Related Fields*, 156(3-4):795–825, 2013 (with A. Bloemendal).
- [24] Patterns in Sinai’s walk. *Ann. Probab.*, 41(3B):1900–1937, 2013 (with D. Cheliotis).
- [25] The right tail exponent of the Tracy–Widom β distribution. *Ann. Inst. Henri Poincaré Probab. Stat.*, 49(4):915–933, 2013 (with L. Dumaz).
- [26] Random walks veering left. *Electron. J. Probab.*, 18, 2013 (with R. Normand).
- [27] The scaling limit of the critical one-dimensional random Schrödinger operator. *Comm. Math. Phys.*, 314(3):775–806, 2012 (with E. Kritchovski and B. Valkó).
- [28] Beta ensembles, stochastic Airy spectrum, and a diffusion. *J. Amer. Math. Soc.*, 24(4):919–944, 2011 (with J. A. Ramírez and B. Rider).
- [29] Absolute continuity of the limiting eigenvalue distribution of the random Toeplitz matrix. *Electron. Comm. Probab.*, 16:706–711, 2011 (with A. Sen).
- [30] The spectrum of the random environment and localization of noise. *Probab. Theory Related Fields*, 148(1-2):141–158, 2010 (with D. Cheliotis).
- [31] Large gaps between random eigenvalues. *Ann. Probab.*, 38(3):1263–1279, 2010 (with B. Valkó).
- [32] On the girth of random Cayley graphs. *Random Structures Algorithms*, 35(1):100–117, 2009 (with A. Gamburd, S. Hoory, M. Shahshahani, and A. Shalev).
- [33] Continuum limits of random matrices and the Brownian carousel. *Invent. Math.*, 177(3):463–508, 2009 (with B. Valkó).
- [34] Random sorting networks. *Adv. Math.*, 215(2):839–868, 2007 (with O. Angel, A. E. Holroyd, and D. Romik).

- [35] Complex determinantal processes and H^1 noise. *Electron. J. Probab.*, 12:no. 45, 1238–1257, 2007 (with B. Rider).
- [36] The noise in the circular law and the Gaussian free field. *Int. Math. Res. Not. IMRN*, (2):Art. ID rnm006, 33, 2007 (with B. Rider).
- [37] Determinantal processes and independence. *Probab. Surv.*, 3:206–229, 2006 (with J. B. Hough, M. Krishnapur, and Y. Peres).
- [38] Dimension and randomness in groups acting on rooted trees. *J. Amer. Math. Soc.*, 18(1):157–192, 2005 (with M. Abért).
- [39] Amenability via random walks. *Duke Math. J.*, 130(1):39–56, 2005 (with L. Bartholdi).
- [40] Zeros of the i.i.d. Gaussian power series: a conformally invariant determinantal process. *Acta Math.*, 194(1):1–35, 2005 (with Y. Peres).
- [41] Random walks that avoid their past convex hull. *Electron. Comm. Probab.*, 8:6–16, 2003 (with O. Angel and I. Benjamini).
- [42] Brownian beads. *Probab. Theory Related Fields*, 127(3):367–387, 2003.
- [43] Fast graphs for the random walker. *Probab. Theory Related Fields*, 124(1):50–72, 2002.
- [44] Anchored expansion and random walk. *Geom. Funct. Anal.*, 10(6):1588–1605, 2000.
- [45] On the speed of random walks on graphs. *Ann. Probab.*, 28(1):379–394, 2000.
- [46] Random walks on finite convex sets of lattice points. *J. Theoret. Probab.*, 11(4):935–951, 1998.

Preprints

- [47] Circular support in random sorting networks. *arXiv:1802.08933*, 2018 (with D. Dauvergne).
- [48] A short introduction to operator limits of random matrices. *www.math.toronto.edu/balint*, 2018 (with D. Holcomb).
- [49] Tracy-Widom fluctuations in 2d random Schrodinger operators. *arXiv:1803.11208*, 2018 (with M. Kotowski).
- [50] The local limit of random sorting networks, 2017 (with O. Angel, D. Dauvergne, and A. E. Holroyd).
- [51] Operator limit of the circular beta ensemble. *arXiv:1710.06988*, 2017 (with B. Valkó).
- [52] Brownian motion as limit of the interchange process. *arXiv:1609.07745*, 2016 (with M. Rahman).
- [53] Geometry of permutation limits. *arXiv:1609.03891*, 2016 (with M. Rahman and M. Vizer).
- [54] Eigenvectors of the critical 1-dimensional random Schrodinger operator. *arXiv:1605.00118*, 2016 (with B. Rifkind).

RECENT MINICOURSES, SUMMER SCHOOLS

Operator Limits of Random matrices

Institut des Hautes Études Scientifiques summer school, Paris, 8/2017

Institute of Advanced Study summer school, Park City, 7/2017

Les Houches summer school, 8/2015

IMA Summer School in Random Matrices, Minneapolis, 6/2012

UK Easter probability meeting, Warwick, 3/2012

ICTS, Bangalore, India, 1/2012

Technical University, Budapest, 10/2011

Mean quantum percolation.

Random processes and optimal configurations in analysis

CIMPA School, Buenos Aires 7/2015

Spectra of graphs and graph limits

Leipzig spring school, 4/2011

Agora workshop, Chateau de Goutelas, France, 2/2011.

Zeros of Gaussian Analytic Functions

AMS-MSA Joint Meetings, Boston, 1/2012

SELECTED INVITED LECTURES**Entropy and expansion**

Renyi Institute research seminar, December, 2017.

Toronto probability seminar, December 2017.

Random sorting networks

CIRM Luminy, workshop on random walks with memory, June 2017.

Northeast Probability Colloquium, New York City, November 2016.

Random matrices and canonical systems

CIRM Luminy workshop on Random matrices and determinantal processes, March 2017.

The Sine- β operator

BIRS workshop on β -ensembles and universality, April, 2016.

Frontier Probability Days, University of Utah, May 2016.

Dyson's Spike and the spectral measure of groups

Princeton probability day, March, 2015.

The annual Birnbaum Lecture, UW Seattle, October 2015.

Operator Limits of Random Matrices

Elegance in probability, Tel Aviv, September 2017.

Invited lecture, International Congress of Mathematicians, Seoul, August, 2014.

Universality of the Stochastic Airy Operator

IMS Medallion Lecture, Boulder, July 2013.

Mean Quantum Percolation

Charles River Probability Lectures, Cambridge, MA, November 2013.

BIRS Workshop on Quantum Many-Body Systems, Banff, November 2013.

The sound of random graphs.

Colloquium, Max Planck Institute, Leipzig. January 2013.

CMS winter meeting, Montreal, December 2012.

Vancouver Probability Summer School invited lecture. June, 2012.
University of Athens probability seminar, December 2012.
AMS Eastern Sectional Meeting, Rochester, NY. September, 2012.

Spectrum of random walks and the lamplighter group.

Renyi Institute Research Seminar, Budapest. April, 2013.

Independent sets in random graphs.

Limits of Discrete Structures, Oberwolfach Arbeitsgemeinschaft. Short expository talk. April 2013.

Random operators at the edge.

CMS winter meeting, Montreal, December 2012.

Operator limits of random matrices.

ELTE Department of stochastics, Budapest, December 2012.

2012 Athens probability colloquium, main lecture

Integrable systems, growth processes and KPZ universality, BIRS September 2012.

The top eigenvalue of the random Toeplitz matrix

Technical University, Budapest, July, 2012

CMS Winter meeting, Toronto, December 2011

Speed of random walks and automaton groups

Renyi Institute Research Seminar, Budapest. December 2012. MSRI Workshop on Quantitative Geometry, September, 2011. Renyi Institute Colloquium, Budapest, May 2011

The measurable Kesten theorem

Workshop on Invariant Random Subgroups, SDE-Boker, Israel, February 2012

Oberwolfach workshop, September 2010

Probability Seminar, Technical University of Budapest, November, 2010

Limits of spiked random matrices

Sparse Random Structures: Analysis and Computation, BIRS, Banff, January, 2010.

MSRI conference on random matrices, December 2011.

Random Schrödinger operators and random matrices

Oberwolfach workshop on random Schroedinger operators, October, 2011

Current Developments in Mathematics Conference, Harvard University, November, 2009

Western Mathematical Physics Meeting (Caltech), February 2010

Statistical Mechanics on Random Structures, BIRS, Banff, November 2009

Chebyshev Institute Colloquium, St Petersburg Russia, April 2011

Amenability of automaton groups

University of Wisconsin, Madison Mathematics Colloquium September, 2009.

CRM Conference in new directions in random spatial processes, Montreal, May 2009

Erwin Schrödinger Institute, Vienna, November, 2008

Steklov Institute Probability Seminar, St Petersburg Russia, April 2011

The Ginibre ensemble and Gaussian analytic functions

Technical University, Budapest, March 2009

MIT Probability Seminar, November 2008

Large Gaps Between Random Eigenvalues

Harvard Probability Seminar, November, 2008

Probabilistic approach to Geometry, Kyoto, July, 2008

Oberwolfach workshop in Stochastic Analysis, July, 2008
Foundations of Computational Mathematics, Hong Kong, June, 2008
EURANDOM Probability Seminar, April, 2008

Determinantal processes

Statistical Society of Canada, Vancouver, June, 2009.

Scaling Limits of Random Matrices

Brownian motion and Random matrices workshop, American Institute of Mathematics, December 2009

Bonn, Hausdorff Institute, January, 2008

Princeton Mathematics Colloquium, November, 2007

Institute for Advanced Study / PCMI Colloquium, July, 2007

NYU Probability Seminar, March 2007

Midwest Probability Colloquium, November, 2006

Stochastic Processes and Applications, Plenary Lecture, Paris, July, 2006

Girth of Random Cayley Graphs

SMF Conference on the geometry of Groups, Luminy, February 2007

MSRI Probability Seminar, April, 2005

Noise Limits for Complex Eigenvalues

CMS Meeting, Victoria, December, 2005.

Conference on Hydrodynamic Limits, Budapest, August, 2005.

Zeros of the i.i.d. Gaussian power series

25th European Meeting of Statisticians, Opening lecture, August 2006

University of Paris, Orsay, Probability seminar, March 2005

AMS Annual Meeting, Phoenix, January 2004.

Latin American Congress in Probability, Uruguay, March 2004.

Mathematics Colloquium, University of Toronto, November 2003.

Self-similar walks and amenability

Sixth world congress, Bernoulli Society / 67 annual meeting, IMS. July, 2005.

Geometric Group Theory, Random Walks, and H. Analysis, Cortona, Italy, June 2004.

Geometric and Analytic Aspects of Stochastic Processes, Banff, April 2004.

Groups and Probability, Budapest, June 2003.

Random tree-automorphisms

Waterloo Mathematics Colloquium, October 2005.

SUPERVISION

POSTDOCTORAL FELLOWS

Dimitris Cheliotis (2004-2007) Currently faculty at Athens University.

Benedek Valko (2005-2008) Full professor at University of Wisconsin, Madison

Manjunath Krishnapur (2006-2009) Currently faculty at the Indian Insitute of Science, Bangalore

Gideon Amir (2007-2010) Currently faculty at Bar-Ilan Unviersity, Israel

Gabor Pete (Coxeter Lecturer, 2008-2011) Currently at the Renyi Insitute of Mathematics, Budapest

Viktor Harangi (2012-14) Currently at Renyi Insitute, Budapest.

Janosch Ortmann (2012-15) Currently at Université du Québec à Montréal

Raoul Normand (2012-2013) Currently at NYU Shanghai.

Tom Alberts (2008-2011) Currently at the University of Utah.

PHD STUDENTS

Guangyu Fu PhD 2006, Thesis title: Random walks and random polynomials. Currently director, Financial Engineering at Scotiabank, Toronto.

Alex Bloemendal, PhD. 2011, Limits of spiked random matrices. Currently at the Broad Institute of MIT and Harvard.

Eric Hart (2009-2014) Random Schrödinger operators with singular noise distribution.

Ben Rifkind (2009-2014) Dynamics of stochastic operators and KPZ dimension formulas. The scaling limit of the eigenvector of 1-D random Schrodinger operators.

Andrew Stewart (2010-2016) Central limit theorem for free group bridges.

Danny MacDonald (2012-2013) Random Sorting Networks (did not finish).

Mustazee Rahman (2011-2015) Graph limits and belief propagation. Currently Applied Mathematics Postdoc at MIT.

Michal Kotowski (2012-2016) Return probability exponents. Lazy sorting networks. Currently at the University of Warsaw.

Marcin Kotowski (2012-2016) Dyson's spike and the spectral measure of groups. Currently at the University of Warsaw

Duncan Dauvegne (2015-present) Random sorting networks. Last passage percolation.

Laure Dumaz, (fall, 2008) visiting from Ecole Normale Supérieure, Paris. Project title: Large deviations for the Tracy-Widom β distribution. Currently at Universite Paris-Dauphine.

Pierre Tarrago, (fall, 2010) visiting from Ecole Normale Supérieure, Paris. Project title: Measures associated with random matrices. Currently at CIMAT.

Raoul Normand (2011) (Visiting for one year from Paris 6) Multifractal spectrum of tridiagonal operators. Currently at NYU Shanghai.

Hongzhou Lin, (fall, 2012) visiting from Ecole Normale Supérieure, Paris. Project title: Isoperimetric inequalities for eigenvectors on trees.

MASTERS STUDENTS

Efstratios Ioannidis (MA 2004) (informal supervision) Thesis title: Towards and understanding of last encounter routing in ad hoc networks

Michael Andrushchenko Project title: Central limit theorems for the GUE ensemble

Eckhard Schlemm (2007-2008) Provisional thesis title: First passage formulas in one dimension

Kyle Thompson (summer 2010) Determinantal processes spheres

Anjie Zhou (summer 2008) Project title: Stochastic analysis and its connection to PDEs

Charles Zhi Hao Li (spring, summer, 2009) Project title: The volume of the Birkhoff polytope

Gergely Odor (spring, 2017) Resistance limits of graphs.

UNDERGRADUATE RESEARCH PROJECTS

Alexander Chestopalov Project title: Random walks in random environments and flows

Mu Cai Project title: Stochastic analysis of the Brownian Carousel.

Janet Li Project title: Continuum percolation models

Kai Yang (summer 2010) Project title: Mixing of Markov Chains

Kai Yang (fall 2011) Erdos-Renyi random graphs

Kai Yang (winter 2012) Compressed sensing

Danny Cao (summer 2012) Eigenvalues of graphs (USRA project)

Danny Cao (winter 2012) Eigenvalues of graphs (Reading course)