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Education

Dec. 2014	PH.D. in Mathematics, University of British Columbia. *Advisor*: David Brydges.
2010	M.SC. in Mathematics, University of British Columbia. *Advisor*: David Brydges.
2008	B.SC. HON. in Mathematical Physics, University of Saskatchewan.

Employment

2020 –	ASSISTANT PROFESSOR, University of Durham.
2017 – 2020	SENIOR RESEARCH ASSOCIATE, University of Bristol.
2015 – 2017	POSTDOCTORAL SCHOLAR/VISITING ASSISTANT PROFESSOR, University of California, Berkeley.
May–Aug. 2015	VISITING SCHOLAR, Institute for Applied Mathematics, Universität Bonn.
Feb.–May 2015	POSTDOCTORAL SCHOLAR, Institute for Computational and Experimental Research Mathematics, Brown University.

Publications

Preprints

HAMMOND, H. AND HELMUTH, T. Directed Spatial Permutations on Asymmetric Tori. 31 pp. [arXiv]

HELMUTH, T. AND MANN, R. Efficient algorithms for approximating quantum partition functions at low temperature. 12 pp. [arXiv]

BAUERSCHMIDT, R., CRAWFORD, N., AND HELMUTH, T. Percolation transition for random forests in $d \geq 3$. 60 pp. [arXiv]

Published and in press

HELMUTH, T., LEE, H., PERKINS, W., RAVICHANDRAN, M., AND WU, Q. Approximation algorithms for the random-field Ising model. To appear in SIAM Journal on Discrete Mathematics. 20pp. [arXiv]

BORGS, C., CHAYES, J., HELMUTH, T., PERKINS, W., AND TETALI, P. Efficient sampling and counting algorithms for the Potts model on $\mathbb{Z}^d$ at all temperatures. *Random Struct. Algorithms* **63**: 130-170. 2023. [arXiv]

An extended abstract of this work appeared in *STOC 2020*.

HELMUTH, T. JENSSEN, M., AND PERKINS, W. Finite-size scaling, phase coexistence, and algorithms for the random cluster model on random graphs. *Ann. Henri Poincaré B* **59**(2): 817-848. 2023. [arXiv]

BAUERSCHMIDT, R., AND HELMUTH, T. Spin systems with hyperbolic symmetry: a survey. *Proceedings of the ICM, 2022.* 17 pp. [arXiv]

HELMUTH, T., PERKINS, W., AND PETTI, S. Correlation decay for hard spheres via Markov chains. *Ann. Appl. Probab.* **32**(3), 2063-2082. 2022. [arXiv]

HELMUTH, T. AND MANN, R. Efficient algorithms for approximating quantum partition functions. *J. Math. Phys.* **62**(2) 022201, 2021. [arXiv]

BAUERSCHMIDT, R., CRAWFORD, N., HELMUTH, T., AND SWAN, A. Random spanning forests and hyperbolic symmetry. *Commun. Math. Phys.* **381** 1223-1261, 2021. [arXiv]

BRYDGES, D. C., HELMUTH, T., AND HOLMES, M. The continuous-time lace expansion. *Commun. Pure Appl. Math.*, 74: 2251-2309. [arXiv]

BAUERSCHMIDT, R., HELMUTH, T., AND SWAN, A. The geometry of random walk isomorphism theorems. *Ann. Henri Poincaré B* **57**(1), 408-454, 2021. [arXiv]

HELMUTH, T. AND SHAPIRA, A. Loop-erased random walk as a spin system observable. *J. Stat. Phys.* **181**(4), 1306–1322, 2020. [arXiv]

HELMUTH, T., PERKINS, W., AND REGTS, G. Algorithmic Pirogov–Sinai Theory. *Probab. Theory Relat. Fields.* **176**, 851-895, 2020. [arXiv]
An extended abstract of this work appeared in *STOC 2019*.

BAUERSCHMIDT, R., HELMUTH, T., AND SWAN, A. Dynkin isomorphism and Mermin–Wagner theorems for hyperbolic sigma models and recurrence of the two-dimensional vertex-reinforced jump process. *Ann. Probab.* **47**(5), 3375-3396, 2019. [arXiv]

HAMMOND, A. AND HELMUTH, T. Self-attractive self-avoiding walk. *Probab. Theory Relat. Fields.* **175**(3-4), 677-719, 2019. [arXiv]

HELMUTH, T. Dimensional reduction for generalized continuum polymers. *J. Stat. Phys.* **165**(24), 24-43, 2016. [arXiv]

HELMUTH, T. Loop-weighted walk. *Ann. Henri Poincaré D* **3**, 55-119, 2016. [arXiv]

HELMUTH, T. Ising model observables and non-backtracking walks. *J. Math. Phys.* **55**(8), 1–28, 2014. [arXiv]

HELMUTH, T. AND PATRICK, G.W. Two rolling disks or spheres. *Discrete Contin. Dyn. Syst. Ser. S* **3**(1), 129–140, 2009.

HELMUTH, T., SPITERI, R., AND SZMIGIELSKI, J. One-dimensional magnetotelluric inversion with radiation boundary conditions. *Can. Appl. Math. Q.* **15**(4), 419–444, 2007.

Grants, Awards, & Fellowships

2022 Annals Henri Poincaré B prized article award (2020-2021) for the article *The geometry of random walk isomorphism theorems*, AIHP Vol. 57, No. 1, 408-454, joint with R. Bauerschmidt and A. Swan.

2021 – 2023 SQuaRE 'Connections between computational and physical phase transitions', American Institute

for Mathematics. Co-I.

2021 SQuaRE 'The independence polynomial of hypergraphs', American Institute for Mathematics. Co-I.

2018 Focused research grant, Heilbronn Institute for Mathematical Research. PI.

2018 Early career researcher travel grant, London Mathematical Society. PI.

2017 US Junior Oberwolfach fellowship, National Science Foundation.

2015 – 2017 Postdoctoral fellowship, National Science and Engineering Research Council. PI.

2012 – 2014 Graduate fellowship, University of British Columbia.

2010 – 2012 CGS-D scholarship, National Science and Engineering Research Council.

2008 – 2010 CGS-M scholarship, National Science and Engineering Research Council.

Teaching

Durham University

Michaelmas 2022 Markov Chains II.

Epiphany 2022 Financial Mathematics, block IV.

Michaelmas 2021 Markov Chains II.

Michaelmas 2020 Probability III/IV.

University of California, Berkeley

Spring 2017 Introduction to Combinatorics.

Fall 2016 Ordinary differential equations.

Spring 2016 Ordinary differential equations.

University of British Columbia

Fall 2012 Differential Calculus with Applications to Life Sciences.

Summer 2011 Integral Calculus with Applications to Commerce and Social Sciences.

Invited Conference Lectures[1]

2024 Statistical Mechanics Beyond 2D, Institute for Pure and Applied Mathematics (UCLA), May 6, 2024

2022 Reinforcement and Statistical Mechanics mini-workshop, TU Munich, Nov. 11.

Large Scale Stochastic Dynamics, Oberwolfach, Sep. 14.

Quantum Fields and Probability, Mittag-Leffler Institute, Aug. 11.

UIC Tripods Mini-workshop on Probability, Inference, and Algorithms, University of Illinois at Chicago, May 18.

2021 International Congress on Mathematical Physics, 'Probability and Random Structures' session, Geneva/online, Aug. 6.

2020 ~~Hokkaido workshop 'Universality and Scaling Limits in Probability and Statistical Mechanics', July 13 – July 17.~~

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[1]Events struck out indicate cancellations related to COVID-19

~~Haifa workshop 'Challenges in probability and statistical mechanics', June 1 — 5.~~

~~Workshop 'Discrete Probability in Spetses', Apr. 21 — 25.~~

2019   American Institute of Mathematics workshop 'Self-interacting processes, supersymmetry, and Bayesian statistics', Sep. 24.

Oberwolfach workshop 'Large Scale Stochastic Dynamics', Sep. 20.

SAMBa 2019 workshop, University of Bath, Jul. 9.

Random maps and matrices from a geometric perspective workshop, ENS de Lyon, May 21.

Simons Institute for the Theory of Computing workshop 'Deterministic Counting, Probability, and Zeros of Partition Functions', Mar. 21.

2018   Algorithmic and Combinatorial Aspects of Partition Functions workshop, University of Amsterdam, Aug. 23.

Göteborg Workshop, 'Probabilistic approaches to quantum spin systems', Apr. 16.

2017   Oberwolfach mini-workshop 'Cluster Expansions: from Combinatorics to Analysis, through Probability', Feb. 8.

2016   Bay Area Discrete Math Day #33, University of California Davis, Oct. 1.

Trends in Mathematical Crystallization Workshop, University of Warwick, May 4.

2015   Expansion Methods in Statistical Mechanics Workshop, University of Utrecht, Jul. 3.

2014   Gradient random fields workshop, Warwick EPSRC Symposium on Statistical Mechanics, May 27.

Invited Seminar Lectures

2023   Oxford probability seminar, May 31.

Geneva mathematical physics seminar, Mar. 27.

One World probability seminar (held online), Mar. 1.

2022   Bath probability seminar, Bath University, Dec. 12.

2021   Algorithms and Complexity in Durham seminar, Durham University (held online), Dec. 7.

Stochastic analysis seminar, Imperial College London, Oct. 26.

Informal probability seminar, University College London (held online), Jul. 9.

Joint probability seminar, University of Bristol / Queen Mary / University of Warwick (held online), Jul. 7.

Probability seminar, University of Vienna (held online), Jun. 1.

SMAQ seminar, University of L'Aquila / Gran Sasso Science Institute (held online), May 24.

Analysis and probability seminar, Université Paris-Dauphine (held online), May 18.

Combinatorics study group, Queen Mary University of London (held online), Mar. 5.

International Association of Mathematical Physics seminar (held online), Feb. 23.

Probability and dynamics seminar, University of Victoria (held online), Jan. 11.

2020   Munich probability seminar, TUM/LMU (held online), Nov. 23.

Probability seminar, Universita Pisa (held online), Sep. 29.

Horwitz Seminar, Tel Aviv University (held online), Jun. 22.

Percolation Today webinar (held online), Jun. 2.

2019   Probability seminar, Universitá Roma Tre, Dec. 12.

Probability seminar, ICJ/UMPA Lyon, Nov. 28.

Mathematical physics seminar, Université de Genève, Nov. 12.

Statistics Seminar, Durham University, May 7.

Stochastics Seminar, TU Budapest, Apr. 11.

Probability Seminar, University of Zurich / ETH, Feb. 27.

Mathematical Colloquium, University of Victoria, Jan. 10.

Probability Seminar, University of British Columbia, Jan. 4.

2018   Newton Institute SRQ Seminar, University of Cambridge, Dec. 3.

Probability Seminar, University of Oxford, Nov. 12.

Horwitz Seminar, Tel Aviv University, Jun. 18.

Stochastics Seminar, TU Budapest, May. 31.

Probability Seminar, University of Bath, May 24.

Statistical Sciences Seminar, University College London, May 10.

Probability Seminar, KTH Royal Institute of Technology, Apr. 23.

Stochastics Seminar, TU Budapest, Mar. 29.

Probability Seminar, University of Cambridge, Mar. 6.

Statistical Mechanics Seminar, University of Warwick, Feb. 22.

2017   Probability Seminar, University of Bristol, Oct. 20.

Probability Seminar, Universidad Nacional Autónoma de México, Aug. 9.

Mathematical Physics and Probability Seminar, University of California Davis, May 10.

Probability Seminar, University of California Berkeley, May 3.

Stochastics Seminar, University of Utah, Apr. 7.

2016   Mathematical Physics and Probability Seminar, University of California Davis, Nov. 30.

Mathematics Colloquium, University of Oregon, Oct. 10.

Algebra/Geometry/Combinatorics Seminar, San Francisco State University, Sep. 14.

Mathematical Physics and Probability Seminar, University of California Davis, Jun. 2.

2015   Applied Math and Mathematical Physics Seminar, University of Saskatchewan, Dec. 21.

Oberseminar Stochastics, Universität Bonn, Jul. 16.

SFB 1060 Collaborative Research Center Seminar, Universität Bonn, Jun. 16.

Center of Mathematical Sciences & Applications Seminar, Harvard University, Apr. 23.

2014   Mathematical Physics and Probability Seminar, University of California Davis, Nov. 17.

Probability Seminar, University of Kansas, Nov. 12.

Probability Seminar, University of California Berkeley, Oct. 29.

Workshop Organization

2024   Lead organizer of the Banff International Research Station workshop 'Frontiers of Statistical Mechanics and Theoretical Computer Science'.

2021   Co-organizer of the online workshop 'Frontiers of Statistical Mechanics and Theoretical Computer Science 2021'. Workshop webpage.

2020   Co-organizer of the online workshop 'Uniqueness methods in statistical mechanics: recent developments and algorithmic applications'. Workshop webpage.

2018   Organizer of the workshop 'High-dimensional critical phenomena in random environments' at the University of Bristol'. Workshop webpage.

Service, Activities, Outreach, Training

2022	Postgraduate certificate in Academic Practice, Durham University.
2022	Fellowship with Advance HE (FHEA).
2022	External examiner for M.Sc. thesis of Ben Xiao at Univ. Victoria, British Columbia.
2020 –	Co-organizer, with Katie Gittins, of the Mathematical Sciences chapter of the first-generation scholar support network at Durham University.
2017 – 2020	Co-organizer of the University of Bristol probability seminar.
2019	Contributor to 'Maths Poems', a chapbook resulting from a series of interdisciplinary workshops between mathematicians and poets.
2016 – 2017	Committee member for Bay Area Discrete Math days.
Spring 2016	Co-organizer of the UC Berkeley probability seminar.
2009 – 2012	Committee member of the Mathematics Graduate Committee at the University of British Columbia.
2011	Completed the Instructional Skills Workshop, an internationally recognized workshop to enhance teaching effectiveness.
2011	Committee member for the Pacific Institute for Mathematical Sciences Young Researcher's Conference.