

Thomas Mark (Tom) Hutchcroft

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Nationality: British

#### EMPLOYMENT

- 2025- **Gordon and Betty Moore Professor of Mathematics.** California Institute of Technology.
- 2021-2025 **Professor of Mathematics.** California Institute of Technology.
- 2021-2021 **Senior Research Associate.** University of Cambridge.
- 2017-2020 **Herchel Smith Postdoctoral Fellowship.** University of Cambridge.
- 2017-2021 **Junior Research Fellow.** Trinity College, Cambridge.

#### EDUCATION

- 2013-2017 **PhD** in mathematics, co-supervised by Omer Angel and Asaf Nachmias, University of British Columbia (UBC), Canada.
- 2015, 2016, and 2017 Research intern in the Microsoft Research Theory Group, Redmond, USA.
- 2009-2013 **BA and MMath** in mathematics, University of Cambridge.

#### GRADUATE STUDENTS

- 2023- Shiyang Shen. PhD student. Caltech.
- 2022- Minghao Pan. PhD student. Caltech.
- 2020-2025 Philip Easo. PhD student. Cambridge 2020-2021, Caltech 2021-2025.
- 2019-2023 Noah Halberstam. PhD student. Cambridge. Co-supervised by Sebastian Andres.

#### POSTDOCS MENTORED

- 2025- Yujin Kim. NSF Postdoc, Caltech.
- 2023- Lily Reeves. NSF Postdoc, Caltech.
- 2023- Seung-Yeon Ryoo. Caltech.
- 2022-2023 Marianna Russkikh. Caltech.

#### GRANTS

- 2023-2026 NSF Grant 2246494: Percolation Theory and Related Topics. \$100,000 per annum.
- 2024-2029 Packard Fellowship. \$875,000 award over five years.

## PRIZES, SCHOLARSHIPS AND OTHER HONOURS

<b>Whitehead Prize.</b>	2025
<i>Awarded annually by the London Mathematical Society to at most six early-mid career mathematicians working in or primarily educated in the United Kingdom.</i>	
<b>Packard Fellowship for Science and Engineering.</b>	2024
<i>Awarded annually to 20 people from among those working in science, engineering, and mathematics at 50 American universities.</i>	
<b>EMS Prize.</b>	2024
<i>Awarded once every four years at the European Congress of Mathematics to at most 10 mathematicians under the age of 35 that are either of European nationality or are working in Europe.</i>	
<b>JMP Young Researcher Award.</b>	2023
<i>Awarded annually by the Journal of Mathematical Physics to one author of a paper in that journal within 8 years of being granted their PhD. This prize was awarded for the paper “Sharp hierarchical upper bounds for long-range percolation on <math>\mathbb{Z}^d</math>”.</i>	
<b>Rollo Davidson Prize.</b>	2019
<i>An international prize awarded annually to early-career probabilists by the Rollo Davidson trust.</i>	
<b>Governor General’s Gold Medal, UBC</b>	2018
<i>Awarded annually to one graduating doctoral student in the university across all departments.</i>	
<b>Canadian Mathematical Society Doctoral Prize</b>	
<i>Awarded annually to one doctoral student in mathematics graduating from a Canadian university.</i>	
<b>Lorraine Schwartz Prize</b>	2017
<i>Awarded annually to a graduate or undergraduate student in probability or statistics at UBC.</i>	
<b>Microsoft Research PhD Fellowship</b>	2016
<i>A scholarship for PhD students in mathematics and computer science in the US and Canada, awarded to around ten students annually.</i>	
<b>Li Tze Fong Memorial Fellowship</b> (declined)	
<i>A scholarship for PhD students in memory of Hong Kong entrepreneur and politician Li Tze Fong.</i>	
<b>UBC Graduate Research Award</b>	2015
<i>Awarded annually to one graduate student in pure and applied mathematics in recognition of research achievements.</i>	

## SELECTED PUBLICATIONS

*Supercritical percolation on finite transitive graphs I: Uniqueness of the giant component*, with Philip Easo. **Duke Mathematical Journal**, 2024.

*Logarithmic corrections to scaling in the four-dimensional uniform spanning tree*, with Perla Sousi. **Communications in Mathematical Physics**, 2023.

*Supercritical percolation on nonamenable graphs: Isoperimetry, analyticity, and exponential decay of the cluster size distribution*, with Jonathan Hermon. **Inventiones Mathematicae**, 2020.

*Kazhdan groups have cost 1*, with Gábor Pete. **Inventiones Mathematicae**, 221, 873–891 (2020).

*Percolation on hyperbolic graphs*. **Geometric and Functional Analysis**, 29(3):766–810, 2019.

*Universality of high-dimensional spanning forests and sandpiles*. **Probability Theory and Related Fields**, 176(1-2):533–597, 2020.

*Geometric and spectral properties of causal maps*, with N. Curien and A. Nachmias. **Journal of the European Mathematical Society**, 2020.

*Non-uniqueness and mean-field criticality for percolation on nonunimodular transitive graphs*. **Journal of the American Mathematical Society**, 33 (2020), 1101-1165.

*Hyperbolic and Parabolic Unimodular Random Maps*, with O. Angel, A. Nachmias, and G. Ray. **Geometric and Functional Analysis**, 28(4):879– 942, 2018.

*Critical percolation on any quasi-transitive graph of exponential growth has no infinite clusters*,

**Comptes Rendus Mathématique**, 354(9):944–947, 2016.

*Unimodular Hyperbolic Triangulations: Circle Packing and Random Walk*, with O. Angel, A. Nachmias and G. Ray. **Inventiones Mathematicae**, 206 (2016), no. 1, 229–268.

#### SERVICE

- 2020- *Percolation Today* webinar. Founding co-organizer 2020-2024, scientific advisory board 2024-.
- 2022- Creator and co-organizer of the Los Angeles Probability Forum, a monthly event for the LA probability community.
- 2025- Associate Editor, *Duke Mathematical Journal*.
- 2024- Associate Editor, *Probability and Mathematical Physics*.
- 2022- Associate Editor, *Probability Theory and Related Fields*.
- 2021- Associate Editor, *Annales de l'Institut Henri Poincaré*.
- 2024 Served on NSF review panel.
- 2022- Various Caltech departmental and institutional committees.
- 2017-2020 Undergraduate admissions interviewer, Trinity College Cambridge.

#### TEACHING

- 2026 54th Saint Flour Probability Summer School. (Planned.)
- 2025 XXVIII Brazilian School of Probability. Five hour mini-course.  
PIMS-CRM Summer School. 24 hour lecture course.  
Hadamard lectures, Fondation Mathématique Jacques Hadamard.
- 2024 *Math 110b (Graduate Complex Analysis)*, Caltech.  
*Probability and the structure of groups*. Four hour mini-course, CMI-HIMR Summer School on Symmetry and Randomness, Bristol.  
*Universality and dimension dependence of critical phenomena: A case study on long-range percolation*. Six hour mini-course, Thematic Program on Randomness and Geometry, Fields Institute, Toronto.
- 2023 *Topics in critical percolation*. Eight hour mini-course, IMS Singapore.
- 2022, 2023 *Math 2 (Analytic): Ordinary Differential Equations*, Caltech.
- 2022 *Percolation on Finite Transitive Graphs*. Five hour mini-course, RANDNet Summer School, Eurandom, Eindhoven, the Netherlands.  
*Uniqueness and non-uniqueness in percolation theory*. Four hour mini-course, Groups Graphs and Stochastic Processes Summer School, the Rényi Institute, Hungary.  
*Random walks and uniform spanning trees*. Graduate topics course, Caltech.
- 2021 *Percolation on Nonamenable Groups, Old and New*. Four lecture mini-course, International Centre for Theoretical Sciences, India.
- 2020 *Random walks and uniform spanning trees*. Part III Master's course, Cambridge.  
*Percolation and the cost of groups*. Two lecture mini-course, Swiss Doctoral Program in Mathematics Kervaire Seminar: Groups and dynamics, Les Diablerets, Switzerland.  
Three lecture mini-course, Online Open Probability School.
- 2019 *Scaling exponents in high-dimensional spanning forests and the interlacement Aldous-Broder algorithm*. Four lecture mini-course, Fondation des Treilles, France.
- 2017-2021 Supervisor for Cambridge undergraduate courses including Analysis 1, Linear Analysis, Analysis of Functions, Applied Probability, Markov Chains, and Topics in Analysis.

Instructor, MATH 110, UBC.	2015
MATH 110 Workshop Facilitator, UBC.	2014
Math Learning Centre Tutor, UBC.	2013-2016

#### PUBLICATIONS AND PREPRINTS: FULL LIST

(Listed in reverse chronological order by appearance on the arXiv.)

- Critical long-range percolation III: The critical dimension.* Submitted. 2025
- Critical long-range percolation II: Low effective dimensions.* Submitted.
- Critical long-range percolation I: High effective dimensions.* Submitted.
- A fixed-point theorem for face maps, or deletion-tolerant random finite sets*, with Nicolas Monod and Omer Tamuz. Submitted.
- Dimension jumps at  $p_u$  for percolation in  $\infty + 1$  dimensions*, with Minghao Pan. Submitted. 2024
- A relation between isoperimetry and total variation decay with applications to graphs of non-negative Ollivier-Ricci curvature*, with Isaac Lopez. Submitted.
- Nonuniqueness at  $p_u$  via subgroup relativization*, with Minghao Pan. Submitted.
- Small-ball estimates for random walks on groups.* Submitted.
- Proof of the Diaconis–Freedman conjecture on partially-exchangeable processes*, with Noah Halberstam. Submitted.
- Pointwise two-point function estimates and a non-perturbative proof of mean-field critical behaviour for long-range percolation.* **Probability Theory and Related Fields**, to appear.
- Thick points of 4D critical branching Brownian motion*, with Nathanaël Berestycki and Antoine Jego. Proceedings of the London Mathematical Society, to appear. 2023
- The critical percolation probability is local*, with Philip Easo. Submitted.
- Uniform finite presentation for groups of polynomial growth*, with Philip Easo. **Discrete Analysis**, to appear.
- Uniqueness of the infinite tree in low-dimensional random forests*, with Noah Halberstam. **Probability and Mathematical Physics**, 2024.
- Double-exponential susceptibility growth in Dyson’s hierarchical model with  $|x - y|^{-2}$  interaction*, with Philip Easo and Jana Kurrek. **Journal of Mathematical Physics**, 2024.
- The number of ends in the uniform spanning tree for recurrent unimodular random graphs*, with Diederik van Engelenberg. **Annals of Probability**, to appear.
- Critical cluster volumes in hierarchical percolation.* **Proceedings of the London Mathematical Society**, 2025. 2022
- Logarithmic corrections to the Alexander-Orbach conjecture for the four-dimensional uniform spanning tree*, with Noah Halberstam. **Communications in Mathematical Physics**, to appear.
- Transience and anchored isoperimetric dimension of supercritical percolation clusters.* **Electronic Journal of Probability**, 2023.
- Slightly supercritical percolation on nonamenable graphs II: Growth and isoperimetry of infinite clusters.* **Probability Theory and Related Fields**, 2023.
- On the boundary at infinity for branching random walk*, with Elisabetta Candellero. **Electronic Communications in Probability**, 2023.
- Most transient random walks have infinitely many cut times*, with Noah Halberstam. **Annals of Probability**, 2023.
- Sharp hierarchical upper bounds on the critical two-point function for long-range percolation on  $\mathbb{Z}^d$ .* **Journal of Mathematical Physics** (Proceedings of the ICMP), 2022.
- Supercritical percolation on finite transitive graphs I: Uniqueness of the giant component*, with Philip 2021

Easo. **Duke Mathematical Journal**, 2024.

*The bunkbed conjecture holds in the  $p \uparrow 1$  limit*, with Alexander Kent and Petar Nizic-Nikolac. **Combinatorics, Probability and Computing**, 2023.

*High-dimensional near-critical percolation and the torus plateau*, with Emmanuel Michta and Gordon Slade. **Annals of Probability**, 2023.

*What are the limits of universality?* with Noah Halberstam. **Proceedings of the Royal Society A**, 2022.

*On the derivation of mean-field percolation critical exponents from the triangle condition*. **Journal of Statistical Physics**, 2022.

*Non-triviality of the phase transition for percolation on finite transitive graphs*, with Matthew Tointon. **Journal of the European Mathematical Society**, 2024.

*The critical two-point function for long-range percolation on the hierarchical lattice*. **Annals of Applied Probability**, 2024.

2020 *Transience and recurrence of sets for branching random walk via non-standard stochastic orders*. **Annales de l'Institut Henri Poincaré**, 2022.

*Logarithmic corrections to scaling in the four-dimensional uniform spanning tree*, with Perla Sousi. **Communications in Mathematical Physics**, 2023.

*Collisions of Random Walks in Dynamic Random Environments*, with Noah Halberstam. **Electronic Journal of Probability**, 2022.

*Power-law bounds for critical long-range percolation below the upper-critical dimension*. **Probability Theory and Related Fields** (special issue in memory of Harry Kesten), 2021.

*Continuity of the Ising phase transition on nonamenable groups*. **Communications in Mathematical Physics**, 2023.

*On the tail of the branching random walk local time*, with Omer Angel and Antal Jara. **Probability Theory and Related Fields**, 2020.

*Slightly supercritical percolation on nonamenable graphs I: The distribution of finite clusters*. **Proceedings of the London Mathematical Society**, 2022.

2019 *Non-intersection of transient branching random walks*. **Probability Theory and Related Fields**, 178, 1–23 (2020).

*Large, lengthy graphs look locally like lines*, with Itai Benjamini. **Bulletin of the London Mathematical Society**, 2021.

*Supercritical percolation on nonamenable graphs: Isoperimetry, analyticity, and exponential decay of the cluster size distribution*, with Jonathan Hermon. **Inventiones Mathematicae**, 2020.

*The  $L^2$  boundedness condition in nonamenable percolation*. **Electronic Journal of Probability**, Volume 25, (2020).

*New critical exponent inequalities for percolation and the random cluster model*. **Probability and Mathematical Physics**, 2020.

2018 *Kazhdan groups have cost 1*, with Gabor Pete. **Inventiones Mathematicae**, 221, 873–891 (2020).

*Indistinguishability of collections of trees in the uniform spanning forest*. **Annales de l'Institut Henri Poincaré**, Volume 56, Number 2 (May 2020), 917–927.

*No percolation at criticality on certain groups of intermediate growth*, with Jonathan Hermon. **International Mathematics Research Notices**, 2019.

*Locality of the critical probability for transitive graphs of exponential growth*. **Annals of Probability**, Volume 48, Number 3 (2020), 1352–1371.

*Anomalous diffusion of random walks on random planar maps*, with Ewain Gwynne. **Probability Theory and Related Fields**, 178, 567–611(2020).

*Percolation on hyperbolic graphs*. **Geometric and Functional Analysis**, 29,766–810(2019).

- Universality of high-dimensional spanning forests and sandpiles.* **Probability Theory and Related Fields**, 176, 533–597(2020).
- Coalescing random walk on unimodular graphs*, with Eric Foxall and Matthew Junge. **Electronic Communications in Probability**, Volume 23 (2018), paper no. 62, 10 pp.
- Mallows permutations as stable matchings*, with O. Angel, A. Holroyd and A. Levy. **Canadian Journal of Mathematics**, 2021.
- Statistical physics on a product of trees.* **Annales de l’Institut Henri Poincaré**, Volume 55, 2017 Number 2 (May 2019), 1001-1010.
- Non-uniqueness and mean-field criticality for percolation on nonunimodular transitive graphs.* **Journal of the American Mathematical Society**, 33 (2020), 1101-1165.
- Geometric and spectral properties of causal maps*, with N. Curien and A. Nachmias. **Journal of the European Mathematical Society**, 2020.
- Counterexamples for percolation on unimodular random graphs*, with O. Angel. **Unimodularity in randomly generated graphs**, 11–28, Contemp. Math., 719, Amer. Math. Soc., Providence, RI, 2018.
- Self-avoiding walk on nonunimodular transitive graphs.* **Annals of Probability**, Volume 47, Number 5 (September 2019), 2801-2829.
- The Hammersley-Welsh bound revisited.* **Electronic Communications in Probability**, Volume 23, (2018).
- Finitely Dependent Cycle Coloring*, with A. Holroyd and A. Levy. **Electronic Communications in Probability**, Volume 23 (2018), paper no. 64, 12 pp.
- Harmonic Dirichlet Functions on Planar Graphs.* **Discrete and Computational Geometry**, April 2019, Volume 61, Issue 3, pp 479–506.
- Mallows Permutations and Finite Dependence*, with A. Holroyd and A. Levy. **Annals of Probability**, Volume 48, Number 1 (January 2020), 343-379.
- The Component Graph of the Uniform Spanning Forest: Transitions in Dimensions 9, 10, 11, ...*, with Y. Peres. **Probability Theory and Related Fields**, 175, 141–208(2019).
- Hyperbolic and Parabolic Unimodular Random Maps*, with O. Angel, A. Nachmias, and G. Ray. 2016 **Geometric and Functional Analysis**, 28, 879–942(2018).
- Critical percolation on any quasi-transitive graph of exponential growth has no infinite clusters*, **Comptes Rendus Mathématique**, 354(9):944–947, 2016.
- Uniform Spanning Forests of Planar Graphs*, with A. Nachmias. **Forum of Mathematics Sigma**, Volume 7, 2019, e29.
- Interlacements and the Wired Uniform Spanning Forest*, **Annals of Probability**, Volume 46, 2015 Number 2 (March 2018), 1170-1200.
- Boundaries of Planar Graphs: A Unified Approach*, with Y. Peres. **Electronic Journal of Probability**, Volume 22 (2017), paper no. 100, 20 pp.
- Indistinguishability of Trees in Uniform Spanning Forests*, with A. Nachmias. **Probability Theory and Related Fields**, June 2017, Volume 168, Issue 1–2, pp 113–152.
- Collisions of Random Walks in Reversible Random Graphs*, with Y. Peres. **Electronic Communications in Probability**, 20, no. 63, 1-6, 2015.
- Wired Cycle-Breaking Dynamics for Uniform Spanning Forests.* **Annals of Probability**, 44 (2016), no. 6, 3879–3892.
- Unimodular Hyperbolic Triangulations: Circle Packing and Random Walk*, with O. Angel, A. Nachmias and G. Ray. **Inventiones Mathematicae**, 206 (2016), no. 1, 229–268.

International Congress of Mathematics, Philadelphia; Invited Speaker. (Planned.)  
 2025 Plenary Lecture, Stochastic Processes and Applications, Wrocław.  
 Hadamard Lectures, Fondation Mathématique Jacques Hadamard.  
 UBC Mathematics Department Centennial.  
 The Fifth Duke Mathematical Journal Conference, Duke.  
 UC Irvine Probability Seminar.  
 2024 UBC Probability Seminar.  
 Special Session on Random walks on groups and dynamics of group actions, AMS Sectional Meeting, UC Riverside.  
 Princeton probability seminar.  
 EMS Prize lecture, European Congress of Mathematics, Seville  
 JMP Prize Lecture, International Congress of Mathematical Physics, Strasbourg.  
 Workshop on Measurable Combinatorics, Renyi Institute, Budapest.  
 Peter Hall Lecture, University of Melbourne.  
 Fields Institute, Toronto.  
 Minvera Lectures, Columbia.  
 Seminar in Stochastic Processes, Houston TX.  
 Columbia Mathematics Colloquium.  
 2023 Workshop in Honour of Takashi Hara, IMS Singapore.  
 LU-UMN Joint Probability Seminar.  
 H.B. Keller Colloquium, Caltech (applied math and computer science department).  
 Stochastic Processes and Related Fields, RIMS, Kyoto.  
 70 years of percolation, Cambridge.  
 Geometric and Asymptotic Group Theory with Applications, Vienna.  
 Seed Seminar of Mathematics and Physics, CNRS.  
 Graduate Summer School Mini-Course, UT Austin.  
 Plenary Speaker, Southern California Probability Symposium.  
 IAS Probability Seminar.  
 17th annual workshop on Probability and Combinatorics, Bellairs Institute.  
 Sherman Memorial Lecture, University of Indiana.  
 Berkeley Probability Seminar.  
 Stanford Probability Seminar.  
 2022 Midwest Probability Colloquium.  
 USC Probability Seminar.  
 UCONN Math colloquium.  
 UCSD Group Actions Seminar.  
 Probability and the City seminar.  
 Descriptive Combinatorics, LOCAL Algorithms and Random Processes, Oberwolfach.  
 The Analysis and Geometry of Random Spaces, MSRI.  
 Chicago Mathematics Colloquium.  
 Chicago Probability Seminar.  
 2021 UCLA Probability Seminar.  
 Probability Seminar, INRIA Paris.  
 Stochastic Geometry Days, Dunkerque.  
 Stanford probability seminar.  
 Munich Oberseminar Wahrscheinlichkeitstheorie.  
 QMUL Combinatorics Study Group.  
 Spatial Networks and Percolation, Oberwolfach.  
 Progrès récents sur les marches aléatoires, CIRM.  
 Random Geometry and Statistical Physics webinar.  
 UCLA Math Colloquium.  
 Berkeley Math Colloquium.  
 Carnegie Mellon Math Colloquium.  
 Northwestern Math Colloquium.  
 2020 Caltech Math Colloquium.

University of Toronto Math Colloquium.  
 NYU Courant Colloquium.  
 Online Open Probability Summer School.  
 Oxford Discrete Mathematics and Probability Seminar.  
 UCLA Probability Seminar.  
 UBC Probability Seminar.  
 TU Graz Probability Seminar.  
 Joint Israeli Probability Seminar.  
 Random walks and Polymers: Interacting and folding, Fondation des Treilles, France. 2019  
 Group Theory Afternoon, ENS Paris.  
 Groups, Geometry, and Dynamics Seminar, ENS Lyon.  
 Action! Working Group, ENS Lyon.  
 Probability Seminar, University of Bristol.  
 Stochastic Analysis Seminar, Imperial College London.  
 Vienna Probability Seminar, Universität Wien.  
 Mathematical Physics Seminar, Université de Genève.  
 Analysis and Geometry Seminar, University of Bristol.  
 Probability Seminar, University of British Columbia.  
 Measurable, Borel, and Topological Dynamics, CIRM.  
 Probability Seminar, University of Warwick.  
 Pure Mathematics Colloquium, University of Lancaster.  
 Probability and Statistics Seminar, University of Sheffield.  
 Groups, Dynamics, and Approximation, MFO Oberwolfach, Germany.  
 Scaling Limits in Models of Statistical Mechanics, Oberwolfach, Germany. 2018  
 Random Walks on Symmetric Structures, IIAS, Jerusalem, Israel.  
 Canadian Mathematical Society Winter Meeting, Vancouver, Canada.  
 Geometric Group Theory Seminar, University of Cambridge.  
 Probability Seminar, University of Cambridge.  
 Probability Seminar, University of British Columbia.  
 Stochastic Processes and Their Applications, Gothenburg, Sweden.  
 IMS Annual Meeting on Probability and Statistics, Vilnius, Lithuania.  
 RGM Follow Up Workshop, Isaac Newton Institute, Cambridge, UK.  
 Combinatorics Seminar, University of Birmingham.  
 Combinatorics Seminar, University of Warwick.  
 Probability Seminar, Columbia University.  
 Probability Seminar, Courant Institute.  
 Seminar on Stochastic Processes, ETH Zurich.  
 Probability Seminar, Alfred Renyi Institute of Mathematics.  
 Probability Seminar, BME Budapest.  
 Strongly Correlated Random Interacting Processes, Oberwolfach.  
 Combinatorics Seminar, University of Warwick.  
 Combinatorics Seminar, University of Birmingham.  
 Probability Seminar, University of Cambridge. 2017  
 Dynamics on Random Graphs and Maps, CIRM.  
 Elegance in Probability (Russell Lyons' 60th birthday conference), Tel Aviv University.  
 Mathematical Congress of the Americas, Montreal.  
 AMS Sectional Meeting, Session on Probability Theory, Indiana University.  
 Probability Seminar, Université Paris Sud.  
 Probability Seminar, University of British Columbia. 2016  
 Northwest Probability Seminar, Microsoft Research.  
 Random Spatial Processes and Dynamics, Texas A&M.  
 Probability Seminar, University of Bath.  
 Probability Workshop, Oxford University.  
 Probability Seminar, University of Cambridge.  
 Probability Seminar, University of British Columbia.



2015 Probability and Statistical Physics Seminar, University of Chicago.  
MSR Talk Series, Microsoft Research.  
Geometric Functional Analysis and Probability Seminar, Weizmann Institute.  
Horowitz Seminar, Tel Aviv University.  
Groups, Graphs, and Stochastic Processes, Banff International Research Centre.

2014 Probability Seminar, University of British Columbia.  
Probability on Trees and Planar Graphs, Banff International Research Centre.