

Neil J. Ross | Curriculum Vitae

Department of Mathematics and Statistics, Dalhousie University
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EMPLOYMENT

Assistant Professor	Since September 2017
Department of Mathematics and Statistics, Dalhousie University	
Hartree Postdoctoral Fellow	2015-2017
Joint Center for Quantum Information and Computer Science (QuICS), University of Maryland	

EDUCATION

PhD, Mathematics, Dalhousie University	2015
Thesis title: <i>Algebraic and Logical Methods in Quantum Computation</i> Supervisor: Peter Selinger	
MSc, Mathematics, Université Paris 7 Denis Diderot	2010
Thesis title: <i>Sémantique Dénotationnelle des Combinateurs d'Interaction</i> Supervisor: Damiano Mazza	
MA, Philosophy, Université Paris 1 Panthéon-Sorbonne	2009
Thesis title: <i>Le Statut Dynamique du Paradoxe</i> Supervisor: Jean-Baptiste Joinet	

GRANTS & AWARDS

NSERC Discovery Grant	2018-2023
Computer Science	
NSERC Early Career Researcher Supplement	2018-2023
Computer Science	
NSERC Discovery Launch Supplement	2018-2019
Computer Science	
Outstanding Reviewer Award	2017
Quantum Science and Technology	
Startup Funds	2017
Dalhousie University, Halifax, Canada	
Hartree Postdoctoral Fellowship	2015-2017
Joint Center for Quantum Information and Computer Science (QuICS), College Park, USA	
Best Presentation Award	2012
2nd Alliance for Quantum Academia Student Congress (AQuA 2012), Waterloo, Canada	
Professor Michael Edelstein Memorial Graduate Distinction	2011
Department of Mathematics and Statistics, Dalhousie University, Halifax, Canada	

PUBLICATIONS

- P. Fu, K. Kishida, N.J. Ross, and P. Selinger. **A Tutorial Introduction to Quantum Circuit Programming in Dependently Typed Proto-Quipper**. *Proceedings of the 12th Conference on Reversible Computation (RC 2020)*, Oslo, Norway. Preprint available from arXiv:2005.08396.
- A.N. Glaudell, N.J. Ross, and J.M. Taylor. **Optimal Two-Qubit Circuits for Universal Fault-Tolerant Quantum Computation**. Submitted, 2020. Preprint available from arXiv:2001.05997.
- M. Amy, A.N. Glaudell, and N.J. Ross. **Number-Theoretic Characterizations of Some Restricted Clifford+T Circuits**. *Quantum*, Vol. 4, 252, 2020. Available from arXiv:1908.06076.
- S. Breiner, C.A. Miller, and N.J. Ross. **Graphical Methods in Device-Independent Quantum Cryptography**. *Quantum*, Vol. 3, 146, 2019. Available from arXiv:1705.09213.
- A.N. Glaudell, N.J. Ross, and J.M. Taylor. **Canonical Forms for Single-Qutrit Clifford+T Operators**. *Annals of Physics*, Vol. 406, pp. 54-70, 2019. Preprint available from arXiv:1803.05047.
- N.J. Ross. **The Dawn of Quantum Programming**. *Quantum Views*, Vol. 2, p. 4, 2018. Available from <https://quantum-journal.org/views/qv-2018-06-14-4/>.
- A.M. Childs, D. Maslov, Y. Nam, N.J. Ross, and Y. Su. **Toward the First Quantum Simulation with Quantum Speedup**. *Proceedings of the National Academy of Sciences*, 0027-8424, 2018. Preprint available from arXiv:1711.10980.
- A.M. Childs, D. Maslov, Y. Nam, N.J. Ross, and Y. Su. **Automated Optimization of Large Quantum Circuits with Continuous Parameters**. *npj Quantum Information*, Vol. 4, 23, 2018. Preprint available from arXiv:1710.07345.
- M. Amy, J. Chen, and N.J. Ross. **A Finite Presentation of CNOT-Dihedral Operators**. *Proceedings of the 14th International Conference on Quantum Physics and Logic (QPL 2017)*, Nijmegen, The Netherlands. Electronic Proceedings in Theoretical Computer Science 266, pp. 84-97, 2018. Available from arXiv:1701.00140.
- N.J. Ross and P. Selinger. **Optimal Ancilla-Free Clifford+T Approximation of z-Rotations**. *Quantum Information & Computation*, Vol. 16, No. 11-12, pp. 901-953, 2016. Preprint available from arXiv:1403.2975.
- D.S. Alexander, N.J. Ross, P. Selinger, J.M. Smith, and B. Valiron. **Programming the Quantum Future**. *Communications of the ACM*, Vol. 58, No. 8, pp. 52-61, 2015.
- N.J. Ross. **Optimal Ancilla-Free Clifford+V Approximation of z-Rotations**. *Quantum Information & Computation*, Vol. 15, No. 11-12, pp. 932-950, 2015. Preprint available from arXiv:1409.4355.
- N.J. Ross, P. Selinger, J.M. Smith, and B. Valiron. **Quipper: Concrete Resource Estimation in Quantum Algorithms**. Extended abstract. *12th International Workshop on Quantitative Aspects of Programming Languages and Systems (QAPL 2014)*, Grenoble, France, 2014. Available from arXiv:1412.0625.
- H. Chataing, N.J. Ross, and P. Selinger. **Report on Proto-Quipper 0.2**. Internal Report, Intelligence Advanced Research Projects Activity (IARPA), QCS Program. 76 pages. 2013.

- A.S. Green, P.L. Lumsdaine, N.J. Ross, P. Selinger, and B. Valiron. **An Introduction to Quantum Programming in Quipper**. *Proceedings of the 5th Conference on Reversible Computation (RC 2013)*, Victoria, Canada. Lecture Notes in Computer Science, Vol. 7948, pp. 110-124, Springer, 2013. Preprint available from arXiv:1304.5485.
- A.S. Green, P.L. Lumsdaine, N.J. Ross, P. Selinger, and B. Valiron. **Quipper: A Scalable Quantum Programming Language**. *Proceedings of the 34th Annual ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2013)*, Seattle, USA. ACM SIGPLAN Notices, Vol. 48, No. 6, pp. 333-342, 2013. Preprint available from arXiv:1304.3390.
- A.S. Green, P.L. Lumsdaine, N.J. Ross, P. Selinger, and B. Valiron. **Report on the Quipper Language, Version 0.5, with GFI Algorithm Implementations**. Internal Report, Intelligence Advanced Research Projects Activity (IARPA), QCS Program. 203 pages. 2013.
- D. Mazza and N.J. Ross. **Full Abstraction for Set-Based Models of the Symmetric Interaction Combinators**. *Proceedings of the 15th International Conference on Foundations of Software Science and Computation Structures (FoSSaCS 2012)*, Tallinn, Estonia. Lecture Notes in Computer Science, Vol. 7213, pp. 316-330, Springer, 2012.

PRESENTATIONS

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|---|-----------------------|
| Compiling for a Quantum Computer | March 2020 |
| Dalhousie Undergraduate Physics Society Seminar, Dalhousie University, Halifax, Canada | |
| Number-Theoretic Perspectives on Fault-Tolerant Quantum Circuits | January 2020 |
| Invited Lecture, Joint Center for Quantum Information and Computer Science (QuICS) Five-Year Anniversary Symposium, College Park, USA | |
| Topics in Quantum Compiling | November 2019 |
| Honours Seminar, Dalhousie University, Halifax, Canada | |
| The ZX-calculus | October 2019 |
| Invited Lecture, Atlantic Association for Research in the Mathematical Sciences (AARMS) Session on Hopf Algebras and Tensor Categories, 2019 Science Atlantic Conference for Mathematics, Statistics, and Computer Science, Halifax, Canada | |
| A Characterization of Integral, Real, and Gaussian Clifford+T Operators | June 2019 |
| Invited Lecture, The Mathematics Behind Quantum Information Science, Canadian Mathematical Society (CMS) Summer Meeting, University of Regina, Regina, Canada | |
| Number-Theoretic Methods in Quantum Compiling | June 2019 |
| Invited Lecture, Mathematical Techniques for Analysing Quantum Structures and Materials, Canadian Mathematical Society (CMS) Summer Meeting, University of Regina, Regina, Canada | |
| Modern Methods in Quantum Compiling | March 2019 |
| Quantum Computing for Computational Science Applications, 2019 Society for Industrial and Applied Mathematics Conference on Computational Science and Engineering (SIAM CSE 2019) Spokane, USA | |
| Topics in Quantum Compiling | September 2018 |
| Honours Seminar, Dalhousie University, Halifax, Canada | |
| Toward the First Quantum Simulation with Quantum Speedup | September 2018 |
| Quantum Programming Languages Seminar, Dagstuhl, Germany | |

Proto-Quipper: A Circuit Description Language for Quantum Computing **June 2018**
Invited plenary lecture, joint session of the 16th International Conference on Quantum Physics and Logic (QPL 2018) and the 34th Conference on the Mathematical Foundations of Programming Semantics (MFPS 2018), Dalhousie University, Halifax, Canada

Quantum Magic Games **February 2018**
Atlantic Category Theory Seminar (ATCAT), Dalhousie University, Halifax, Canada

Simulating Hamiltonian Dynamics on a Quantum Computer **November 2017**
Invited Lecture, Alibaba Quantum Seminar, Hangzhou, China

An Introduction to Quantum Programming **November 2017**
Invited Lecture, Institute of Software Seminar, Chinese Academy of Science, Beijing, China

Toward the First Quantum Simulation with Quantum Speedup **November 2017**
International Workshop on Quantum Computing and Quantum Information Processing (QCQIP 2017), Beijing, China

Toward the First Quantum Simulation with Quantum Speedup **October 2017**
Institute for Quantum Computing (IQC) Seminar, Waterloo, Canada

Topics in Quantum Compiling **October 2017**
Honours Seminar, Dalhousie University, Halifax, Canada

Toward the First Quantum Simulation with Quantum Speedup **August 2017**
IBM Research Quantum Computing Seminar, Yorktown Heights, USA

A Finite Presentation of CNOT-Dihedral Operators **July 2017**
15th International Conference on Quantum Physics and Logic (QPL 2017), Nijmegen, The Netherlands

Toward the First Quantum Simulation with Quantum Speedup **May 2017**
Canadian Institute for Advanced Research (CIFAR) Quantum Information Science Program Meeting, Banff, Canada

Quipper by Example **January 2017**
Joint Center for Quantum Information and Computer Science (QuICS) Seminar, College Park, USA

Topics in Quantum Compiling **July 2016**
Joint Quantum Institute (JQI) Summer School, College Park, USA

On the Optimization of Clifford+T Circuits **November 2015**
Joint Center for Quantum Information and Computer Science (QuICS) Seminar, College Park, USA

Clifford+T Approximations of Special Unitaries **June 2015**
Invited plenary lecture, Quantum Programming and Circuits Workshop, Waterloo, Canada

Optimal Ancilla-Free Clifford+T Approximation of z-Rotations **January 2015**
Plenary lecture, 18th Conference on Quantum Information Processing (QIP 2015), Sydney, Australia

A Formalization of the Quipper Quantum Programming Language **May 2014**
Types Meeting (TYPES 2014), Paris, France

An Introduction to Proto-Quipper **October 2013**
Quantum Lunch, Oxford University, Oxford, UK

Quantum Interaction Nets **June 2012**
2nd Alliance for Quantum Academia Student Congress (AQuA 2012), Waterloo, Canada

Full Abstraction for Set-Based Models of the Interaction Combinators **April 2012**
15th International Conference on the Foundations of Software Science and Computation Structures (FoSSaCS 2012), Tallinn, Estonia

Interaction Nets	March 2012
Atlantic Category Theory Seminar (ATCAT), Dalhousie University, Halifax, Canada	
History of Proof Theory	November 2009
Ludics Seminar, École Normale Supérieure, Paris, France	
Logic and Complexity	October 2009
Graduate Student Seminar, Université Paris 1 Panthéon-Sorbonne, Paris, France	
The Dynamics of Paradox	October 2009
Graduate Student Seminar, Université Paris 1 Panthéon-Sorbonne, Paris, France	

POSTERS

- M. Amy, A.N. Glaudell, and N.J. Ross **A Characterization of Integral, Real, and Gaussian Clifford+T Operators**. 16th International Conference on Quantum Physics and Logic (QPL 2019), Orange, USA. 2019.
- A.N. Glaudell, N.J. Ross, and J.M. Taylor. **Exact Synthesis of Almost Certainly T-Optimal Single-Qutrit Clifford+T Normal Forms**. 21st Conference on Quantum Information Processing (QIP 2018), Delft, The Netherlands. 2018.
- S. Breiner, C.A. Miller, and N.J. Ross. **Graphical Methods in Device-Independent Quantum Cryptography**. 21st Conference on Quantum Information Processing (QIP 2018), Delft, The Netherlands. 2018.
- M. Amy, J. Chen, and N.J. Ross. **A Finite Presentation of CNOT-Dihedral Operators**. 12th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC 2017), Paris, France. 2017.
- A.M. Childs, D. Maslov, Y. Nam, N.J. Ross, and Y. Su. **Automated Optimization of Large-scale Quantum Circuits with Continuous Parameters**. Joint Center for Quantum Information and Computer Science (QuICS) Stakeholder's Day, College Park, USA. 2017.
- A.M. Childs, D. Maslov, Y. Nam, N.J. Ross, and Y. Su. **Commutator Bounds for Product Formulas**. 20th Conference on Quantum Information Processing (QIP 2017), Seattle, USA. 2017.
- N.J. Ross. **Approximating Diagonal Unitaries Over the Pauli+V Gate Set**. Canadian Institute for Advanced Research (CIFAR) Quantum Information Science Program Meeting, College Park, USA. 2015.

SUPERVISION

POSTDOCTORAL SUPERVISION.....

- **Matthew Amy** **Since November 2019**
Atlantic Association for Research in the Mathematical Sciences (AARMS) Postdoctoral Fellow
co-supervised at Dalhousie University with Peter Selinger.

GRADUATE SUPERVISION.....

- **Ravinder Rai** **Since September 2019**
MSc student supervised at Dalhousie University.

- **Justin Makary** **Since September 2018**
MSc student supervised at Dalhousie University.
- **Alexandre Clément** **Fall 2018 & Winter 2019**
Project title: *Generators and Relations for the Group $U_n(\mathbb{Z}[1/\sqrt{2}])$*
Graduate intern co-supervised at Dalhousie University with Peter Selinger.

UNDERGRADUATE SUPERVISION.....

- **Owen Bennett-Gibbs** **Summer 2020**
Project title: *Quantum Circuit Complexity*
Undergraduate intern (NSERC USRA) co-supervised at Dalhousie University with Matthew Amy.
- **Christy Sabu Zacharia** **Winter 2020**
Project title: *Quantum Magic Games: An Extension of the Mermin-Peres Magic Square*
Undergraduate honours student in mathematics supervised at Dalhousie University.
- **Sarah Meng Li** **Fall 2019**
Project title: *Generators and Relations for the Group $O_n(\mathbb{Z}[1/2])$*
Undergraduate intern (FCS USRA) co-supervised at Dalhousie University with Peter Selinger.
- **Sarah Meng Li** **Summer 2019**
Project title: *Exact Synthesis of Integral Clifford+T Operators*
Undergraduate intern (Faye Sobey URA) supervised at Dalhousie University.
- **Soundarya Krishnan** **Summer 2019**
Project title: *Phase Polynomials and Lempel's Algorithm*
Undergraduate summer intern (MITACS Globalink RI) supervised at Dalhousie University.
- **Ravinder Rai** **Winter 2019**
Project title: *Classical and Quantum Graph Isomorphism*
Undergraduate honours student in mathematics supervised at Dalhousie University.
- **Adel Al-Johani** **Summer 2018**
Project title: *Exact Synthesis for n-Qubit Clifford+T Operators*
Undergraduate summer intern (MITACS Globalink RI) co-supervised at Dalhousie University with Peter Selinger.
- **Alexander Christie** **Summer 2018**
Project title: *Trace Equivalence in Three Dimensions*
Undergraduate summer intern (Faye Sobey URA) co-supervised at Dalhousie University with Peter Selinger.
- **Ravinder Rai** **Winter 2018**
Project title: *Resource Estimation in Quantum Computing*
Undergraduate honours student in physics supervised at Dalhousie University.
- **Aditya Jain** **Summer 2016**
Project title: *Concrete Resource Estimation for Quantum Simulation Algorithms*
Undergraduate summer intern co-supervised with Andrew Childs at the University of Maryland.

TEACHING

DALHOUSIE UNIVERSITY.....

- **Calculus I:** Fall 2014.
- **Calculus II:** Winter 2018.
- **Discrete Structures I:** Winter 2018, Fall 2018 & 2019.
- **Discrete Structures II:** Winter 2019 & 2020.
- **Abstract Algebra I:** Fall 2018, 2019, & 2020.
- **Topics in Logic and Computation:** Winter 2020.

UNIVERSITÉ PARIS 1 PANTHÉON-SORBONNE.....

- **Philosophy of Mind:** Fall 2009 & Winter 2010.

ACADEMIC SERVICE

CONFERENCES, WORKSHOPS, & SEMINARS.....

ATCAT Local Organizer

Since September 2018

I am the local organizer of the Atlantic Category Theory (ATCAT) Seminar.

Science Atlantic Conference Local Organizer

2019

I was a local organizer of the 2019 Science Atlantic Conference for Mathematics, Statistics, and Computer Science.

SIAM CSE 2019 Minisymposium Organizer

2019

I was an organizer of the minisymposium Quantum Computing for Computational Science Applications which took place during the 2019 SIAM Conference on Computational Science and Engineering (SIAM CSE 2019).

MFPS 2018 and QPL 2018 Local Organizer

2018

I was a local organizer of the 34th Conference on the Mathematical Foundations of Programming Semantics (MFPS 2018) and of the 15th International Conference on Quantum Physics and Logic (QPL 2018).

Program Committee Member

I was a member of the program committee of the 1st International Workshop on Programming Languages and Quantum Computing (PLaQC 2020), of the 16th, 17th, and 18th International Conference on Quantum Physics and Logic (QPL 2018, QPL 2019, & QPL 2020), and of the 12th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC 2017).

REVIEWING.....

- **Conferences:** Computer Science Logic (CSL), Design Automation and Test in Europe (DATE), Logic in Computer Science (LICS), Quantum Computing Theory in Practice (QCTIP), Quantum Information Processing (QIP), Quantum Physics and Logic (QPL), and Theory of Quantum Computation, Communication, and Cryptography (TQC).
- **Journals:** IEEE Transactions on Quantum Engineering, Journal of Automated Reasoning (JAR), Logical Methods in Computer Science (LMCS), Mathematical Reviews, Physical Review A (PRA), Quantum, Quantum Information & Computation (QIC), Quantum Information Processing (QINP), Quantum Science and Technology (QST), and Scientific Reports.

OUTREACH

AARMS-CMS Math Camp

July 2019

The Atlantic Association for Research in the Mathematical Sciences (AARMS) and Canadian Mathematical Society (CMS) Math Camp is a summer camp for promising Nova Scotian high school students held at Dalhousie University. I led a module on set theory.

Paige & Paxton

April 2016

Paige & Paxton is an outreach program fostering early childhood science education. I guided four- to seven-year-old students through science modules during a Paige & Paxton Make-a-thon.

Nova Scotia Math Circles

2012-2014

Nova Scotia Math Circles is a mathematics outreach program for which I designed presentations and delivered lectures in English and French. I gave over 50 talks in high schools and junior high schools throughout Nova Scotia.

CMS Math Camp

July 2012

The Canadian Mathematical Society (CMS) Math Camp is a summer camp for promising Nova Scotian high school students held at Dalhousie University. I led a module on graph theory with E. Roshambin.

INTERVIEWS

No Time Like the Present for Quantum Programming

April 2016

Joint Center for Quantum Information and Computer Science (QuICS) Newsletter

LANGUAGES

- o Fluent in English and French.