

Nathaniel Johnston

Department of Mathematics and Computer Science
Mount Allison University
62 York St.
Sackville, New Brunswick, Canada E4L 1E2

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506-364-2633
njohnston@mta.ca
www.njohnston.ca

Degrees and Academic Positions

- **University of Guelph** Guelph, ON
Adjunct Professor 2016 – present
- **Mount Allison University** Sackville, NB
Assistant Professor 2015 – present
- **Institute for Quantum Computing** Waterloo, ON
Postdoctoral Fellow 2012 – 2015
– Supervisors: John Watrous and Ashwin Nayak
- **University of Guelph** Guelph, ON
Ph.D. Mathematics 2008 – 2012
– Advisor: David W. Kribs
– Thesis: Norms and Cones in the Theory of Quantum Entanglement
– Graduated with a 99.3% average
- **University of Guelph** Guelph, ON
M.Sc. Mathematics 2007 – 2008
– Advisors: John Holbrook and David W. Kribs
– Thesis: Stabilized Distance Measures and Quantum Error Correction
– Graduated with a 98.3% average
- **University of Guelph** Guelph, ON
B.A.H. Mathematics 2003 – 2007
– Graduated with a Major in Mathematics and a Minor in Statistics
– Graduated with Honours, a 98.6% cumulative average, and Dean’s Honour List each year

Awards, Grants & Honours

Governor General’s Academic Gold Medal	2013
NSERC Postdoctoral Fellowship (PDF)	2012 – 2014
Brock Doctoral Scholarship	2008 – 2012
NSERC Canada Graduate Scholarship (CGS D)	2008 – 2011
Ontario Graduate Scholarship (OGS) (declined)	2008
Mathematics Graduate Scholarship	2008
NSERC Canada Graduate Scholarship (CGS M)	2007
Ontario Graduate Scholarship (OGS) (declined)	2007
Governor General’s Academic Silver Medal	2007
Mathematics Graduation Prize	2007
College of Physical and Engineering Sciences Graduation Prize	2007

NSERC Undergraduate Student Research Award	2007
Class of 1970 Scholarship	2006
Moffat Mathematics & Statistics Award	2006
NSERC Undergraduate Student Research Award	2006
Dean's Scholarship	2005
Moffat Mathematics & Statistics Award	2005
Dean's Scholarship	2004
Ted Newton Memorial Scholarship	2004
WebCT Conferencing Prize	2004
Board of Governors' Scholarship	2003 – 2006
University of Guelph Entrance Scholarship	2003

Teaching Experience

- **Advanced Linear Algebra (MATH 3221)**
Instructor

Mount Allison University
Winter 2016
- **Linear Algebra (MATH 2221)**
Instructor

 - Received a 4.71 student evaluation (on a 1 to 5 scale)

Mount Allison University
Fall 2015
- **Multivariable Calculus (MATH 2111)**
Instructor

 - Received a 4.91 student evaluation (on a 1 to 5 scale)

Mount Allison University
Fall 2015
- **Selected Topics in Quantum Information (QIC 890/891)**
Lecturer for Module 2: Entanglement Detection

 - Created assignment and module notes, and taught the module

University of Waterloo
Summer 2014
- **Advanced Calculus I (MATH*2200)**
Sessional Lecturer

 - Created assignments, examinations, course notes, and taught the course
 - Received a 4.71 student evaluation (on a 1 to 5 scale)

University of Guelph
Fall 2011
- **Set Theory (MATH*2000)**
Sessional Lecturer

 - Created assignments, examinations, and taught the course
 - Received a 4.62 student evaluation (on a 1 to 5 scale)

University of Guelph
Fall 2010
- **Calculus (MATH*1210)**
Teaching Assistant

 - Led weekly labs guiding students through difficult problems

University of Guelph
Winter 2010
- **Set Theory (MATH*2000)**
Teaching Assistant

 - Led seminars guiding students through difficult problems and reviewing course material

University of Guelph
Fall 2006, Fall 2007
- **Math Help Desk**
Teaching Assistant

 - Provided one-on-one and group tutoring to students in first and second year math courses

University of Guelph
Sept. 2005 – Apr. 2011

Peer-Reviewed Journal Articles

22. C. Napoli, T. R. Bromley, M. Cianciaruso, M. Piani, N. Johnston, and G. Adesso. Robustness of coherence: An operational and observable measure of quantum coherence, *Physical Review Letters*, 116:150502, 2016.
 - Selected as an Editors’ Suggestion.
 - An article was written about it in the [Daily Mail](#).
21. M. Piani, M. Cianciaruso, T. R. Bromley, C. Napoli, N. Johnston, and G. Adesso. Robustness of asymmetry and coherence of quantum states. *Physical Review A*, 93:042107, 2016.
 - Selected as an Editors’ Suggestion.
20. N. Johnston and D. W. Kribs. Duality of entanglement norms. *Houston Journal of Mathematics*, 41(3):831–847, 2015.
19. S. Bandyopadhyay, A. Cosentino, N. Johnston, V. Russo, J. Watrous, and N. Yu. Limitations on separable measurements by convex optimization. *IEEE Transactions on Information Theory*, 61(6):3593–3604, 2015.
18. S. Arunachalam, N. Johnston, and V. Russo. Is absolute separability determined by the partial transpose? *Quantum Information & Computation*, 15(7 & 8):694–720, 2015.
17. J. Chen and N. Johnston. The minimum size of unextendible product bases in the bipartite case (and some multipartite cases). *Communications in Mathematical Physics*, 333(1):351–365, 2015.
16. N. Johnston. The structure of qubit unextendible product bases. *Journal of Physics A: Mathematical and Theoretical*, 47:424034, 2014.
15. G. Gutoski and N. Johnston. Process tomography for unitary quantum channels. *Journal of Mathematical Physics*, 55:032201, 2014.
14. N. Johnston. Separability from spectrum for qubit–qudit states. *Physical Review A*, 88:062330, 2013.
13. J. Chen, H. Dawkins, Z. Ji, N. Johnston, D. W. Kribs, F. Shultz, and B. Zeng. Uniqueness of quantum states compatible with given measurement results. *Physical Review A*, 88:012109, 2013.
12. N. Johnston. Non-positive partial transpose subspaces can be as large as any entangled subspace. *Physical Review A*, 87:064302, 2013.
11. N. Johnston. Non-uniqueness of minimal superpermutations. *Discrete Mathematics*, 313:1553–1557, 2013.
10. N. Johnston, Ł. Skowronek, and E. Størmer. Generation of mapping cones from small sets. *Linear Algebra and Its Applications*, 438:3062–3075, 2013.
9. N. Johnston and E. Størmer. Mapping cones are operator systems. *Bulletin of the London Mathematical Society*, 44:738–748, 2012.
8. N. Johnston and D. W. Kribs. Quantum gate fidelity in terms of Choi matrices. *Journal of Physics A: Mathematical and Theoretical*, 44:495303, 2011.

7. N. Johnston. Characterizing operations preserving separability measures via linear preserver problems. *Linear and Multilinear Algebra*, 59:1171–1187, 2011.
6. N. Johnston, D. W. Kribs, V. I. Paulsen, and R. Pereira. Minimal and maximal operator spaces and operator systems in entanglement theory. *Journal of Functional Analysis*, 260:2407–2423, 2011.
5. N. Johnston and D. W. Kribs. A family of norms with applications in quantum information theory II. *Quantum Information & Computation*, 11:104–123, 2011.
4. N. Johnston and D. W. Kribs. Generalized multiplicative domains and quantum error correction. *Proceedings of the American Mathematical Society*, 139:627–639, 2011.
3. N. Johnston and D. W. Kribs. A family of norms with applications in quantum information theory. *Journal of Mathematical Physics*, 51:082202, 2010.
– Selected for the Virtual Journal of Quantum Information.
2. M.-D. Choi, N. Johnston, and D. W. Kribs. The multiplicative domain in quantum error correction. *Journal of Physics A: Mathematical and Theoretical*, 42:245303, 2009.
1. N. Johnston, D. W. Kribs, and V. I. Paulsen. Computing stabilized norms for quantum operations. *Quantum Information & Computation*, 9:16–35, 2009.

Conference Proceedings

5. N. Johnston. The minimum size of qubit unextendible product bases. In *Proceedings of the 8th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC)*, 2013. doi:10.4230/LIPIcs.TQC.2013.93
4. N. Johnston. Norm duality and the cross norm criteria for quantum entanglement. *Linear and Multilinear Algebra (Proceedings of the 11th Workshop on Numerical Ranges and Numerical Radii)*, 2013. doi:10.1080/03081087.2012.753595
3. N. Johnston and D. W. Kribs. A family of norms with applications in entanglement theory. In *Proceedings of the 2011 ICO International Conference on Information Photonics (IP)*, 2011. doi:10.1109/ICO-IP.2011.5953727
2. N. Johnston and D. W. Kribs. Schmidt operator norms and entanglement theory. In *Fourth International Conference on Quantum, Nano and Micro Technologies*, pages 92–95, 2010.
– Selected as one of the best papers of the conference.
1. N. Johnston, D. W. Kribs, and C.-W. Teng. An operator algebraic formulation of the stabilizer formalism for quantum error correction. *Acta Applicandae Mathematicae*, 108:687–696, 2009.

Book Chapters

2. N. Johnston. Some Beautiful and Difficult Questions about Cellular Automata. In *Designing Beauty: The Art of Cellular Automata*, A. Adamatzky and G. J. Martinez (eds.), Springer International Publishing, pages 59–63, 2016.
1. N. Johnston. The B36/S125 “ 2×2 ” Life-like cellular automaton. In *Game of Life Cellular Automata*, A. Adamatzky (ed.), Springer-UK, pages 99–114, 2010.

Unpublished Papers

4. J. Chen, N. Johnston, C.-K. Li, and S. Plosker. *Quantifying the coherence of pure quantum states*. E-print: [arXiv:1601.06269](https://arxiv.org/abs/1601.06269) [quant-ph], 2016.
3. N. Johnston, R. Mittal, V. Russo, and J. Watrous. *Extended nonlocal games and monogamy-of-entanglement games*. E-print: [arXiv:1510.02083](https://arxiv.org/abs/1510.02083) [quant-ph], 2015.
2. N. Johnston. *The complexity of the puzzles of “Final Fantasy XIII-2”*. E-print: [arXiv:1203.1633](https://arxiv.org/abs/1203.1633) [cs.CC], 2012.
1. N. Johnston. *Partially entanglement breaking maps and right CP-invariant cones*. Unpublished notes, 2008.

Presentations

- **Absolute Separability and the Spectra of Entanglement Witnesses**
Workshop on Quantum Marginals and Numerical Ranges (Guelph) August 2015
5th Int. Conference on Matrix Analysis and Applications December 2015
- **Qubit Unextendible Product Bases**
2014 SIAM Conference on Discrete Mathematics (Minneapolis) June 2014
- **Preservers of UPBs and Local Distinguishability of Quantum States**
Canadian Mathematical Society Summer 2014 Meeting (Winnipeg) June 2014
- **The Separability Problem and its Variants in Entanglement Theory**
Math–Physics Colloquium (U. of New Brunswick) November 2015
Quantum Information & Geometric Statistics Seminar (U. of Guelph) April 2015
Mathematics Colloquium (U. of Louisiana) March 2014
Analysis Seminar (U. of Western Ontario) February 2014
- **Separability from Spectrum for Qubit–Qudit States**
Canadian Mathematical Society Winter 2013 Meeting (Ottawa) December 2013
- **Process Tomography for Unitary Quantum Channels**
Quantum Information & Geometric Statistics Seminar (U. of Guelph) September 2013
- **Unextendible Product Bases as Mixed Integer Programs**
2013 Mixed Integer Programming Workshop (Poster – Wisconsin) June 2013
- **On the Minimum Size of Unextendible Product Bases**
18th Conference of the International Linear Algebra Society (Rhode Island) June 2013
- **The Minimum Size of Qubit Unextendible Product Bases**
8th Conference on Theory of Quantum Computation (U. of Guelph) May 2013
- **Non-Uniqueness of Minimal Superpermutations**
Ottawa–Carleton Discrete Mathematics Days (Ottawa) May 2013
- **Uniqueness of Quantum States Compatible with Measurement Results**
Workshop on Mathematical Methods of Quantum Tomography (Poster – Toronto) February 2013
Tuesday Theory Lunch (IQC, Waterloo) January 2013
- **The NPPT Bound Entanglement Problem**
Summer Research Workshop on Quantum Information Science (China) July 2012
- **Right CP-Invariant Cones of Superoperators**
7th Workshop on Matrices and Operators (China) July 2012

- **Duality of Entanglement Norms**
11th Workshop on Numerical Ranges and Numerical Radii (Taiwan) July 2012
- **The Quantum Separability Problem**
Quantum Information & Geometric Statistics Seminar (U. of Guelph) July 2012
- **Isometries of Locally Unitarily Invariant Norms**
International Conference on Mathematics and Statistics (Memphis) May 2012
- **Complete Positivity and CP-Invariance in Q.I.T.**
Canadian Mathematical Society Winter 2011 Meeting (Toronto) December 2011
Quantum Information & Geometric Statistics Seminar (U. of Guelph) November 2011
- **Quantum Gate Fidelity in Terms of Choi Matrices**
Tuesday Theory Lunch (IQC, Waterloo) March 2011
Quantum Information & Geometric Statistics Seminar (U. of Guelph) March 2011
- **Applications of a Family of Norms in Entanglement Theory**
Institute for Quantum Information Science Seminar (U. of Calgary) February 2011
- **Minimal and Maximal Operator Spaces and Operator Systems**
14th Workshop on Quantum Information Processing (Poster – Singapore) January 2011
Quantum Information & Geometric Statistics Seminar (U. of Guelph) November 2010
- **Linear Preserver Problems in Quantum Information Theory**
Quantum Information & Geometric Statistics Seminar (U. of Guelph) October 2010
- **Schmidt Norms for Quantum States**
Quantum Computation & Information Group Seminar (U. of Bristol) May 2010
Tuesday Theory Lunch (IQC, Waterloo) December 2009
Quantum Information & Geometric Statistics Seminar (U. of Guelph) November 2009
- **The Multiplicative Domain in Quantum Error Correction**
Canadian Quantum Information Student Conference (Toronto) August 2009
4th Workshop, TQC 2009 (Poster – Waterloo) May 2009
Canadian Mathematical Society Winter 2008 Meeting (Ottawa) December 2008
Quantum Information & Geometric Statistics Seminar (U. of Guelph) July 2008
- **Completely Bounded Norms in Quantum Information**
Quantum Information & Geometric Statistics Seminar (U. of Guelph) August 2007

Participation in Workshops and Conferences

- **5th Int. Conference on Matrix Analysis and Applications** Fort Lauderdale, USA
Nova Southeastern University December 17 – 20, 2015
- **Workshop on Quantum Marginals and Numerical Ranges** Guelph, Canada
University of Guelph August 17 – 21, 2015
- **DIMACS Conf. on Challenges of Identifying Integer Sequences** New Brunswick, USA
Rutgers University October 9 – 10, 2014
- **2014 SIAM Conference on Discrete Mathematics** Minneapolis, USA
June 16 – 19, 2014
- **Canadian Mathematical Society Summer 2014 Meeting** Winnipeg, Canada
June 7 – 9, 2014
- **Canadian Mathematical Society Winter 2013 Meeting** Ottawa, Canada
December 7 – 9, 2013

- **2013 Mixed Integer Programming Workshop**
University of Wisconsin–Madison Madison, USA
June 22 – 25, 2013
- **18th Conference of the International Linear Algebra Society** Providence, USA
June 3 – 7, 2013
- **8th Conference on Theory of Quantum Computation**
University of Guelph Guelph, Canada
May 21 – 23, 2013
- **Ottawa–Carleton Discrete Mathematics Days** Ottawa, Canada
University of Ottawa May 9 – 10, 2013
- **Workshop on Mathematical Methods of Quantum Tomography** Toronto, Canada
Fields Institute February 19 – 22, 2013
- **Summer Research Workshop on Quantum Information Science** Taiyuan, China
Taiyuan University of Technology July 17 – 27, 2012
- **7th Workshop on Matrices and Operators** Harbin, China
Harbin Engineering University July 13 – 16, 2012
- **11th Workshop on Numerical Ranges and Numerical Radii** Kaohsiung, Taiwan
National Sun Yat-sen University July 9 – 12, 2012
- **International Conference on Mathematics and Statistics** Memphis, USA
University of Memphis May 15 – 18, 2012
- **Operator Structures in Quantum Information Theory** Banff, Canada
Banff International Research Station February 26 – March 2, 2012
- **Canadian Mathematical Society Winter 2011 Meeting** Toronto, Canada
December 10 – 12, 2011
- **14th Workshop on Quantum Information Processing** Sentosa, Singapore
Centre for Quantum Technologies January 10 – 14, 2011
- **Heilbronn Quantum Algorithms Day** Bristol, United Kingdom
University of Bristol May 18, 2010
- **Canadian Q.I. Student Conference (co-organizer)** Toronto, Canada
Fields Institute August 22 – 23, 2009
- **Workshop on Operator Structures in Quantum Information** Toronto, Canada
Fields Institute July 6 – 10, 2009
- **Workshop on Trends and Developments in Linear Algebra** Trieste, Italy
International Centre for Theoretical Physics June 22 – 26, 2009
- **4th Workshop on Theory of Quantum Computation** Waterloo, Canada
Institute for Quantum Computing May 11 – 13, 2009
- **Canadian Mathematical Society Winter 2008 Meeting** Ottawa, Canada
Carleton University December 4 – 6, 2008
- **36th Canadian Operator Symposium** Toronto, Canada
Fields Institute May 20 – 24, 2008
- **Workshop on Noncommutative Dynamics and Applications** Toronto, Canada
Fields Institute July 16 – 20, 2007
- **35th Canadian Operator Symposium** Guelph, Canada
University of Guelph June 5 – 9, 2007
- **Seventh Canadian Summer School on Quantum Information** Waterloo, Canada
Institute for Quantum Computing May 27 – 31, 2007

Other Research Experience

- **NSERC Undergraduate Student Research Award** University of Guelph
Quantum Computing *May 2007 – Aug. 2007*
 - Searched for new methods of quantum error correction.
 - Implemented an algorithm for estimating the completely bounded norm of linear maps.
- **NSERC Undergraduate Student Research Award** University of Guelph
Quantum Computing *May 2006 – Aug. 2006*
 - Searched for new methods of quantum error correction.

Academic Service and Contributions

- Refereed papers for the following journals:
 - Communications in Mathematical Physics
 - Discrete Mathematics
 - Electronic Journal of Linear Algebra
 - International Journal of Quantum Information
 - Journal of Mathematical Physics
 - Journal of Operator Theory
 - Journal of Physics A: Mathematical and Theoretical
 - Journal of the Korean Mathematical Society
 - Linear Algebra and its Applications
 - Linear and Multilinear Algebra
 - Physica Scripta
 - Physical Review A
 - PLOS ONE
 - Proceedings of the American Mathematical Society
 - Quantum Information & Computation
 - Quantum Information Processing
 - Scientific Reports
 - SIAM Journal on Matrix Analysis and Applications
- Refereed submissions to the following conferences:
 - 16th Workshop on Quantum Information Processing (QIP 2013, subreviewer)
- Designed the [January 2015 cover](#) of the College Mathematics Journal
- Reviewer for Mathematical Reviews.
August 2011 – present
- Editor-in-Chief of the [On-Line Encyclopedia of Integer Sequences](#).
April 2011 – present

- Creator of [QETLAB](#), a MATLAB package for exploring quantum entanglement.
- Creator and maintainer of [ConwayLife.com](#), a widely-used website containing over 1,000 articles about cellular automata.
- Language Editor for the Central European Journal of Mathematics.
December 2008 – April 2014
- Student representative for the University of Guelph Department of Mathematics & Statistics Graduate Committee.
September 2010 – August 2012
- Ontario Representative of the Canadian Mathematical Society Student Committee.
October 2008 – June 2010

Technical Skills

- Markup Languages
 - CSS, \LaTeX , (X)HTML
- Programming Languages
 - ASP, C, Java, Javascript, PHP, Python, SQL, Visual Basic
- Specialized Software
 - Maple, MATLAB, MediaWiki, MySQL