

CURRICULUM VITAE

LAURA MANČINSKA

CONTACT INFORMATION

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RESEARCH INTERESTS

Primary:

- **Quantum information processing:** quantum computing, quantum information, quantum cryptography
- **Complexity theory:** interactive proof systems, communication complexity

Secondary:

- **Cryptography:** device-independent protocols, secret sharing schemes
- **Graph theory:** algebraic graph theory, graph invariants and homomorphisms
- **Mathematical physics:** foundations of quantum mechanics, quantum thermodynamics

EDUCATION

- 2009 – 2013 **PhD in Quantum Information,**
Department of Combinatorics & Optimization, University of Waterloo
- Thesis: *“Separable state discrimination using local quantum operations and classical communication”*
 - Advisors: Prof. Andrew Childs and Prof. Debbie Leung
 - Affiliation: Institute for Quantum Computing
- 2007 – 2009 **Master of Mathematics (MMath degree),**
Department of Combinatorics & Optimization, University of Waterloo
- Thesis: *“Characterization of non-universal two-qubit Hamiltonians”*
 - Advisors: Prof. Andrew Childs and Prof. Debbie Leung
 - Affiliation: Institute for Quantum Computing
- 2004 – 2006 **Bachelor of Computer Science,** University of Latvia
- Advisor: Dr. Natalja Kurbatova
 - Thesis: *“Protein structure comparison based on fold evolution”*

RESEARCH EXPERIENCE

Current appointment

- Position **Senior Research Associate** with *Prof. Ashley Montanaro*
- Start date January 2016
- Organization School of Mathematics, University of Bristol
- Address University Walk, Bristol, BS8 2QD, United Kingdom
- Phone +44 (0)117 928 9854 (Prof. Ashley Montanaro)

Past appointments and research experience

- Sept 2015 **Visiting Researcher**,
QuTech, Delft University of Technology, Netherlands
Hosted by: *Prof. Stephanie Wehner*
- 2013 – 2015 **Research Fellow** with *Prof. Stephanie Wehner*,
Centre for Quantum Technologies, National University of Singapore
- April 2015 **Visiting Researcher**,
Centre for the Mathematics of Symmetry and Computation,
University of Western Australia
Hosted by: *Prof. Gordon Royle*
- May – Jun 2013 **Visiting Researcher**,
Institute for Quantum Computing, University of Waterloo
Hosted by: *Prof. Richard Cleve and Prof. Debbie Leung*
- 2007 – 2013 **Research Assistant** with *Prof. Andrew Childs and Prof. Debbie Leung*,
University of Waterloo and Institute for Quantum Computing
- 2006 **Summer Internship** with *Prof. Andris Ambainis and Prof. Debbie Leung*
University of Waterloo and Institute for Quantum Computing
- 2004 – 2007 **Undergraduate Research Seminar** on automata and quantum computing
led by *Prof. Rūsiņš Freivalds*,
Institute of Mathematics and Computer Science, University of Latvia

TEACHING EXPERIENCE

- 2016 **Tutorial Instructor** for “Math 11007: Calculus 1”,
University of Bristol
- 2015 **Lecturer** on “World War II Cryptography” at “Generation Q Camp”,
Centre for Quantum Technologies, National University of Singapore
- 2014 **Lecturer** for “QT5198: Graduate Seminar on Quantum Information”,
National University of Singapore
- 2011 – 2012 **Tutorial Instructor** for “Math 239: Introduction to Combinatorics”,
University of Waterloo
- 2008 **Lecturer** at “Quantum Cryptography School for Young Students”,
Institute for Quantum Computing, University of Waterloo
- 2007 – 2013 **Teaching Assistant** at the University of Waterloo for
- “Math 115: Linear Algebra for Engineers”
 - “CO481/CS467/PHYS467: Introduction to Quantum Information Processing” (3 times)
 - “CO 227: Introduction to Optimization”
 - “CO 255: Introduction to Optimization (Advanced Level)”

STUDENT SUPERVISION

- 2015 **Co-supervision** of Master's student Eddie Schoute (with Prof. Stephanie Wehner)
Delft University of Technology
- Thesis title: Shortcuts to quantum network routing
 - Publication in preparation.
- 2013 – 2014 **Co-supervision** of PhD student Nelly Huei Ying Ng (with Prof. Stephanie Wehner)
National University of Singapore
- Publication: *Journal of Physics A: Mathematical and Theoretical* **47**, 424027, 2014.

OUTREACH ACTIVITIES

- 2015 **Speaker** at Quantum Symposium (outreach event for arts students)
Centre for Quantum Technologies, Singapore
- Talk: “The magic of quantum entanglement”
- 2015 **Lecturer** at “Generation Q Camp” (workshop for secondary school students)
Centre for Quantum Technologies, Singapore
- Lecture topic: “World War II Cryptography”
 - Official website ([link](#)), CQT highlight ([link](#)), Facebook page ([link](#))
- 2008 **Lecturer** at “Quantum Cryptography School for Young Students” ([link](#))
Institute for Quantum Computing, University of Waterloo

PROFESSIONAL SERVICES

- ◆ **Program committee member** for the following conferences
 - *The 11th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2016)*
 - *The 19th Conference on Quantum Information Processing (QIP 2016)*
This is the main quantum computing conference , its acceptance rate fluctuates around 20%.
 - *The 42nd International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM 2016)*
- ◆ **Organizer** of the Quantum Workshop ([link](#)) in the IMS program “Inverse Moment Problems: the Crossroads of Analysis, Algebra, Discrete Geometry and Combinatorics” (9–13 Dec 2014)
- ◆ **Reviewer** for the following journals
 - *Journal of Mathematical Physics*
 - *IEEE Transactions of Information Theory*
 - *International Journal of Quantum Information*
 - *Quantum Information Processing*
 - *New Journal of Physics*
- ◆ **Reviewer** for the following conferences
 - *Theory of Quantum Computation, Communication and Cryptography (TQC 2015)*
 - *IEEE Annual Conference on Computational Complexity (CCC 2015)*
 - *Quantum Information Processing (QIP), 2014 – 2015*

ACHIEVEMENTS

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| 2013 | IQC Achievement Award,
Institute for Quantum Computing, University of Waterloo |
| 2011 | Outstanding Teaching Assistant Award,
Department of Combinatorics & Optimization, University of Waterloo |
| 2006 | Best student poster award
32 nd International Conference on Current Trends in Theory and Practice of
Computer Science (SOFSEM 2006), Czech Republic |
| 2005 | Ada Lovelace award,
Faculty of Physics and Mathematics, University of Latvia |
| 2005 | 14th place in the ACM International Collegiate Programming Contest
¼ final (Western region) |

INVITED TALKS

- ◆ **Complexity classification of two-qubit commuting Hamiltonians.**
Heilbronn and QALGO quantum algorithms meeting, Cambridge, United Kingdom (15 Apr 2016).
- ◆ **Quantum graph parameters.**
Workshop on Zero-error Information, Operators, and Graphs, Barcelona, Spain (25 Nov 2015).
- ◆ **Graph homomorphisms for quantum players.**
Quantum Information Theory Seminar, University of Bristol, United Kingdom (3 Jun 2015).
- ◆ **Unbounded entanglement can be needed to achieve the optimal success probability.**
The 10th Conference on Theory of Quantum Computation, Communication and Cryptography (TQC 2015), Brussels, Belgium (21 May 2015).
- ◆ **Limits to catalysis in quantum thermodynamics.**
Seminar at the Institute for Quantum Computing, University of Waterloo, Canada (5 Mar 2015).
- ◆ **Unbounded entanglement can be needed to achieve the optimal success probability.**
Seminar at the Department of Computer Science and Engineering, IIT Kanpur, India (11 Dec 2014).
- ◆ **Unbounded entanglement can be needed to achieve the optimal success probability.**
Colloquium at the Institute for Quantum Computing, University of Waterloo, Canada (9 Jun 2014).
- ◆ **Quantum random access codes.**
Physics and Applied Physics Seminar, Nanyang Technological University, Singapore (27 Mar 2014).
- ◆ **The LOCC framework and its asymptotic limit.**
CIFAR meeting, Edmonton, Canada (15 Jun 2013).
- ◆ **A generalization of Kochen-Specker sets.**
Quantum Discussions Seminar, Perimeter Institute, Waterloo, Canada (24 Sept 2012), pirsa.org/12090073.
- ◆ **A framework for bounding nonlocality.**
Workshop on Operator Structures in Quantum Information Theory, Banff, Canada (2 Mar 2012).

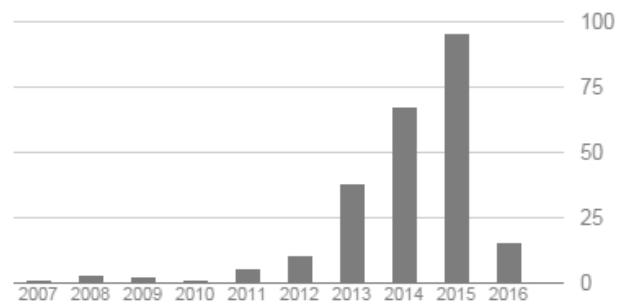
CONTRIBUTED CONFERENCE TALKS

- ◆ **Limits to catalysis in quantum thermodynamics.**
3rd Working Group meeting of the COST Action MP1209, Belfast, United Kingdom (19 Aug 2014).
- ◆ **Unbounded entanglement can be needed to achieve the optimal success probability.**
41st International Colloquium on Automata, Languages, and Programming (ICALP 2014), Copenhagen, Denmark (27 May 2014).
- ◆ **Graph homomorphisms for quantum players.**
Featured talk at the 9th Conference on Theory of Quantum Computation, Communication and Cryptography (TQC 2014) (21 May 2014).

SELECTED PUBLICATIONS

Out of a total of 23 publications both in CS conferences like CCC and ICALP as well as journals on information theory (e.g. *IEEE Trans. Inf. Theory*) and mathematical physics (e.g. *Comm. Math. Phys.* and *Phys. Rev. A*). Total of **240 citations** (retrieved from Google Scholar on 28th of February, 2016).

Citations per year



- ◆ **Unbounded entanglement can be needed to achieve the optimal success probability.**

Laura Mančinska, Thomas Vidick.

Proceedings of the 41st International Colloquium on Automata, Languages, and Programming (ICALP 2014), LNCS 8572, 835–846, 2014, [arXiv:1402.4145](#) (7 citations).

For the first time, we show that there exist nonlocal tasks with classical inputs and outputs at which quantum parties can perform increasingly better by sharing a quantum system of increasingly larger size. In particular, we present a one-round two-party nonlocal game with two classical inputs and a countably infinite number of classical outputs. Although no error-free strategy exists for this game, the players can succeed with probability arbitrarily close to one by using entangled states of increasingly larger dimension.

- ◆ **Everything you always wanted to know about LOCC (but were afraid to ask).**

Eric Chitambar, Debbie Leung, Laura Mančinska, Maris Ozols, Andreas Winter.

Communications in Mathematical Physics 328(1), 303–326, 2014, [arXiv:1210.4583](#) (52 citations).

Presented at QIP 2013 as a contributed talk (approximately 20% acceptance rate).

We study the class of quantum operations which can be implemented by distant parties that are restricted to local quantum operations and classical communication (LOCC). While LOCC emerges as the natural class of operations in many important quantum information tasks, its mathematical structure is complex and difficult to characterize. Our first contribution is to put forth precise definitions that allow for analysis of asymptotic resources and a characterization of the most general LOCC protocols. Additionally, we show the existence of an open ball around the completely depolarizing map that consists entirely of LOCC maps. Finally, we show that the set of two-party LOCC maps is not closed thus resolving a long-standing open question.

- ◆ **Entanglement can increase asymptotic rates of zero-error classical communication over classical channels.**

Debbie Leung, Laura Mančinska, William Matthews, Maris Ozols, Aidan Roy.

Communications in Mathematical Physics 311, 97–111, 2012, [arXiv:1009.1195](#) (31 citations).

Presented at QIP 2011 as a featured talk (5 to 6% acceptance rate for featured talks).

In this paper we show for the first time, by explicit examples, that entanglement can be used to increase asymptotic zero-error capacity, even to the extent that it is equal to the Shannon capacity of the channel. This is particularly surprising in the light of the fact that the rate at which classical data can be sent over a classical channel with arbitrarily small, but non-zero, error probability (the Shannon capacity) cannot be increased by entanglement assistance. Our examples are based on the exceptional simple root systems E_7 and E_8 .

LIST OF PUBLICATIONS

(The order of the authors is generally alphabetical, with a couple of exceptions where the physics convention of non-alphabetical ordering is adopted.)

Quantum computing

- 1. Complexity classification of two-qubit commuting Hamiltonians.**
Adam Bouland, Laura Mančinska, Xue Zhang.
To appear in the *Proceedings of the 31st IEEE Conference on Computational Complexity (CCC'16)*
[arXiv:1602.04145](#).
Presented at QIP 2013 as a contributed talk.
- 2. Deciding the existence of perfect entangled strategies for nonlocal games.**
Laura Mančinska, David E. Roberson, Antonios Varvitsiotis.
Submitted to the *Chicago Journal of Theoretical Computer Science*, 2015, [arXiv:1506.07429](#).
- 3. Graph homomorphisms for quantum players.**
David Roberson, Laura Mančinska.
To appear in the *Journal of Combinatorial Theory, Series B*, 2016, [arXiv:1212.1724](#).
Presented at TQC 2014 as a featured talk.
- 4. Limits to catalysis in quantum thermodynamics.**
Nelly Huei Ying Ng, Laura Mančinska, Cristina Cirstoiu, Jens Eisert, Stephanie Wehner.
Journal of Physics A: Mathematical and Theoretical **47**, 424027, 2014, [arXiv:1405.3039](#).
- 5. Maximally entangled state in pseudo-telepathy games.**
Laura Mančinska.
Computing with New Resources, LNCS **8808**, 200–207, 2014.
- 6. A unified view on Hardy's paradox and the CHSH inequality.**
Laura Mančinska, Stephanie Wehner.
Journal of Physics A: Mathematical and Theoretical **47(42)**, 424027, 2014, [arXiv:1407.2320](#).
- 7. Graph-theoretical bounds on the entangled value of non-local games.**
André Chailloux, Laura Mančinska, Giannicola Scarpa, Simone Severini.
Proceedings of the 9th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2014), LIPIcs **27**, 67–75, 2014, [arXiv:1404.3640](#).
- 8. Unbounded entanglement can be needed to achieve the optimal success probability.**
Laura Mančinska, Thomas Vidick.
Proceedings of the 41st International Colloquium on Automata, Languages, and Programming (ICALP'14), LNCS **8572**, 835–846, 2014, [arXiv:1402.4145](#).
- 9. When asymptotic LOCC offers no advantage over finite LOCC.**
Hong Hao Fu, Laura Mančinska, Debbie Leung.
Physical Review A **89**, 052310, 2014, [arXiv:1312.5350](#).
- 10. Bounds on entanglement assisted source-channel coding via the Lovasz theta number and its variants.**
Toby Cubitt, Laura Mančinska, David Roberson, Simone Severini, Dan Stahlke, Andreas Winter.
IEEE Transactions on Information Theory, **60(11)**, 7330–7344, 2014, [arXiv:1310.7120](#).
Presented at TQC 2014 as a contributed talk.
- 11. Everything you always wanted to know about LOCC (but were afraid to ask).**
Eric Chitambar, Debbie Leung, Laura Mančinska, Maris Ozols, Andreas Winter.
Communications in Mathematical Physics **328(1)**, 303–326, 2014, [arXiv:1210.4583](#).
Presented at QIP 2013 as a contributed talk.

12. **Interpolatability distinguishes LOCC from separable von Neumann measurements.**
Andrew M. Childs, Debbie Leung, Laura Mančinska, Maris Ozols.
Journal of Mathematical Physics 54, 112204, 2013, [arXiv:1306.5992](#).
13. **New separations in zero-error channel capacity through projective Kochen-Specker sets and quantum coloring.**
Laura Mančinska, Giannicola Scarpa, Simone Severini.
IEEE Transactions on Information Theory 59(6), 4025–4032, 2013, [arxiv:1207.1111](#).
Presented at AQIS 2012 as a short talk.
14. **A framework for bounding nonlocality of state discrimination.**
Andrew M. Childs, Debbie Leung, Laura Mančinska, Maris Ozols.
Communications in Mathematical Physics 323(3), 1121–1153, 2013, [arXiv:1206.5822](#).
15. **Entanglement can increase asymptotic rates of zero-error classical communication over classical channels.**
Debbie Leung, Laura Mančinska, William Matthews, Maris Ozols, Aidan Roy.
Communications in Mathematical Physics 311, 97–111, 2012, [arXiv:1009.1195](#).
Presented at QIP 2011 as a featured talk.
16. **Characterization of universal two-qubit Hamiltonians.**
Andrew M. Childs, Debbie Leung, Laura Mančinska, Maris Ozols.
Quantum Information and Computation 11, 19–39, 2011, [arXiv:1004.1645](#).
17. **Quantum Random Access Codes with Shared Randomness.**
Laura Mančinska, Maris Ozols, Debbie Leung, Andris Ambainis. 2008, [arXiv:0810.2937](#).

Automata theory

18. **Permutation groups and the strength of quantum finite automata with mixed states.**
Rūsiņš Freivalds, Maris Ozols, Laura Mančinska.
Theoretical Computer Science 410, 1923–1931, 2009.
19. **Improved constructions of mixed state quantum automata.**
Rūsiņš Freivalds, Maris Ozols, Laura Mančinska.
Proceedings of the Probabilistic and Quantum Algorithms Workshop, TUCS General Publication 45, 13–27, 2007.
20. **Principles of optimal probabilistic decision tree construction.**
Maris Ozols, Laura Mančinska, Ilze Dzelme-Bērziņa, Rubens Agadžanjans, Ansis Rosmanis.
Proceedings of the 2006 International Conference on Foundations of Computer Science (FCS 2005).
21. **Limitations of unary finite automata.**
Laura Mančinska, Maris Ozols, Renāte Praude, Agnese Zalcmane.
Proceedings of the Student Research Forum at Software Seminar 2006.
22. **Size of nondeterministic and deterministic automata for certain languages.**
Raitis Ozols, Rūsiņš Freivalds, Laura Mančinska, Maris Ozols. *Proceedings of the 2005 International Conference on Foundations of Computer Science (FCS 2005)*.

Bioinformatics

23. **Protein structure comparison based on fold evolution.**
Natalja Kurbatova, Laura Mančinska, Juris Viksna.
Proceedings of the German Conference on Bioinformatics, 2007.