

ADAM BOULAND

POSTDOCTORAL RESEARCHER, COMPUTER SCIENCE

University of California at Berkeley
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INTERESTS Quantum computation, computational complexity theory, and connections with physics.

EDUCATION **Massachusetts Institute of Technology**, Cambridge, MA

Ph.D. in Computer Science, September 2017

Thesis title: The Space Around BQP

Advisor: Scott Aaronson, GPA: 5.0/5.0

University of Cambridge, Cambridge, UK

M.Phil. in Advanced Computer Science, 2011 (Advisor: Anuj Dawar)

M.A.St. in Mathematics, 2010

Yale University, New Haven, CT

B.S. Computer Science & Mathematics, Physics, 2009

Summa Cum Laude, Distinction in Both Majors, GPA: 4.0/4.0

AWARDS

Invited paper, SICOMP special issue for FOCS, 2017

NSF Graduate Research Fellowship, 2011-2016

Marshall Scholar, UK Government, 2009-2011

George J. Schulz Prize, Yale Physics Department, 2009

Deforest Prize, Yale Mathematics Department, 2009

Howard L. Schulz Prize, Silliman College, Yale, 2009

Senior High Scholarship Award, Yale Science and Engineering Association, 2009

Junior High Scholarship Award, Yale Science and Engineering Association, 2008

Barry M. Goldwater Scholar, US Government, 2008

Junior Inductee into Phi Beta Kappa, Yale Chapter, 2007

Member, Johns Hopkins Study of Exceptional Talent

POSITIONS

Postdoctoral Researcher, Theory Group, Dept. of EECS, UC Berkeley, Sept. 2017-Present

Research in quantum computational complexity theory. Advised by Umesh Vazirani.

Research Visitor: U. Bristol, Aug. 2016 (Host: Ashley Montanaro), Tokyo Institute of Technology, Dec. 2016 (Host: Tomoyuki Morimae), Joint Center for Quantum Information and Computer Science (QuICS), University of Maryland, Aug. 2015 (Host: Stephen Jordan), Centre for Quantum Technologies (CQT), Singapore, Jan.-Apr. 2014, Jun.-Aug. 2015 (Host: Miklos Santha).

Undergraduate Research in Algorithms, Yale University, 2009

Designed algorithms to improve multi-way sparse cuts in graphs. Advised by Daniel Spielman.

Undergraduate Cosmology Research, Yale, Stanford, 2008-2009

Created software to analyze cosmic microwave background anisotropies and galaxy cluster surveys. Advised by Richard Easther (Yale) and Risa Wechsler (Stanford).

TEACHING

Mentor, MIT SPUR and UROP programs for undergraduate research, Summers 2012, 2013, 2014 and subsequent semesters. Mentored undergraduate students on research projects in theoretical computer science and theoretical physics. Projects resulted in three publications. Students and projects included:

- Xue Zhang: Quantum Computing with Commuting Gate Sets (Summer 2014-Spring 2015)
- Mitchell Lee: Quantum Computing with Hidden Variables (Summer-Fall 2013)
- Hyun Sub Hwang: Quantum vs. Classical Oracles (Summer 2013)
- Lynn Chua: Psi-Epistemic Theories (Summer-Fall 2012)
- Mark Velednitsky: Graph Isomorphism and Crossing Number (Summer 2012)

Teaching Assistant, Quantum Complexity Theory, MIT Subject 6.845, Fall 2014

Grader, Quantum Complexity Theory, MIT Subject 6.845, Fall 2012

PUBLICATIONS

S. Ben-David, A. Bouland, A. Garg and R. Kothari. “Classical Lower Bounds from Quantum Upper Bounds.” In submission (2018).

A. Bouland, B. Fefferman, C. Nirkhe, and U. Vazirani. “Quantum Supremacy and the Complexity of Random Circuit Sampling.” In submission. arXiv: 1803.04402 (2018).

A. Bouland and M. Ozols. “Trading Inverses for an Irrep in the Solovay-Kitaev Theorem.” To appear in *Proc. Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC’18)*. arXiv: 1712.09798 (2018).

A. Bouland, D. Koh and J. Fitzsimons. “Complexity Classification of Conjugated Clifford Circuits.” To appear in *Proc. Conference on Computational Complexity (CCC’18)*. arXiv:1709.01805 (2017).

S. Aaronson, A. Bouland, G. Kuperberg and S. Mehraban. “The Computational Complexity of Ball Permutations.” In *Proc. 49th ACM Symposium on the Theory of Computation (STOC’17)*. arXiv:1610.06646 (2017).

A. Bouland, L. Chen, D. Holden, J. Thaler, and P. N. Vasudevan. “On the Power of Statistical Zero Knowledge.” In *Proc. 58th Annual IEEE Symposium on Foundations of Computer Science (FOCS’17)*. arXiv:1609.02888 (2017).

N. Bao, A. Bouland, A. Chatwin-Davies, J. Pollack and H. Yuen. “Rescuing Complementarity with Little Drama.” *Journal of High Energy Physics* 2016:26. arXiv: 1607.05141 (2016).

I. Arad, A. Bouland, D. Grier, M. Santha, A. Sundaram, and S. Zhang. “On the Complexity of Probabilistic Trials for Hidden Satisfiability Problems.” In *Proc. 41st International Symposium on Mathematical Foundations of Computer Science (MFCS ’16)*. arXiv:1606.03585 (2016).

A. Bouland, L. Mančinska and X. Zhang. “Complexity Classification of Two-Qubit Commuting Hamiltonians.” In *Proc. 31st Conference on Computational Complexity (CCC’16)*. arXiv:1602.04145 (2016).

N. Bao, A. Bouland and S. Jordan. “Grover Search and the No-Signaling Principle.” *Physical Review Letters* 117, 120501. arXiv: 1511.00657 (2016).

S. Aaronson, A. Bouland, J. Fitzsimons and M. Lee. “The Space ‘Just Above’ BQP.” In *Proc. 2016 ACM Conference on Innovations in Theoretical Computer Science (ITCS’16)*. arXiv: 1412.6507 (2016).

A. Bouland and S. Aaronson. “Generation of Universal Linear Optics by Any Beamsplitter.” *Physical Review A* 89, 062316. Editor’s Suggestion. arXiv:1310.6718 (2014).

S. Aaronson, A. Bouland, L. Chua and G. Lowther. “Psi-Epistemic Theories: The Role of Symmetry.” *Physical Review A* 88, 032111. Editor’s Suggestion. arXiv:1303.2834 (2013).

A. Bouland, A. Dawar and E. Kopczyński. “On Tractable Parameterizations of Graph Isomorphism.” In *Proc. 7th International Symposium on Parameterized and Exact Computation (IPEC)* (2012).

A. Bouland, R. Easther and K. Rosenfeld. “Caching and Interpolated Likelihoods: Accelerating Cosmological Monte Carlo Markov Chains”. *Journal of Cosmology and Astroparticle Physics* 2011(05). arXiv: 1012.5299 (2011).

EXPOSITORY WRITINGS

“Establishing Quantum Advantage.” XRDS: Crossroads, The ACM Magazine for Students. Volume 23 Issue 1, Fall 2016, Pages 40-44 (2016).

ORAL PRESENTATIONS

“Classical Lower Bounds from Quantum Upper Bounds.” S. Ben-David, A. Bouland, A. Garg and R. Kothari. Presented as a contributed talk at *Quantum Information Processing (QIP) 2018*, Delft, Netherlands, January 2018. To appear as an invited talk at *Conference on the Theory of Quantum Computation, Communication and Cryptography TQC 2018*, Sydney, Australia, July 2018.

“Quantum Supremacy and the Complexity of Random Circuit Sampling.” A. Bouland, B. Fefferman, C. Nirkhe, and U. Vazirani. Google quantum information seminar, Los Angeles, CA, April 2018. Stanford Institute for Theoretical Physics (SITP) seminar, Stanford, CA, May 2018. MIT Quantum Information seminar, Cambridge, MA, May 2018.

“Quantum Advantage from Sampling Problems.” Stanford/Google X workshop on Quantum Information, Mountain View, CA, November 2017.

“The Space Below BQP.” Quantum Innovators in Math and Computer Science Workshop, Institute for Quantum Computing, Waterloo, Canada, September 2017.

“The Space Around BQP.” MIT Thesis Defense, June 30, 2017

“On the Power of Statistical Zero Knowledge.” A. Bouland, L. Chen, D. Holden, J. Thaler and P. Vasudevan. UT Austin Theory Colloquium, May 2017.

“Grover Search and the No-Signaling Principle.” N. Bao, A. Bouland and S. Jordan. Stanford Institute for Theoretical Physics Seminar, Stanford, CA, February 2017. U. Bristol Quantum Information seminar, Bristol. UK, August 2016.

“Equivalence of Adiabatic and Circuit Based Quantum Computing” and “Why physicists should care about the complexity zoo.” It from Qubit Summer School Focus Lectures. Waterloo, Canada, July 2016.

“Complexity Classification of Two-Qubit Commuting Hamiltonians.” A. Bouland, L. Mančinska and X. Zhang. Presented as a contributed talk at Quantum Information Processing (QIP) 2016, Banff, Canada, January 2016. QuICS Seminar, University of Maryland, September 2015. Centre for Quantum Technologies - Computer Science Seminar, Singapore, August 2015.

“The Space ‘Just Above’ BQP.” S. Aaronson, A. Bouland, J. Fitzsimons and M. Lee. Invited talk, The space around BQP [workshop], Tokyo, Japan, December 2015.

“Generation of Universal Linear Optics by Any Beamsplitter.” A. Bouland and S. Aaronson. Presented as a contributed talk at Quantum Information Processing (QIP) 2015, Sydney, Australia, January 2015. Centre for Quantum Technologies - Computer Science Seminar, Singapore, February 2014.

SERVICE & OUTREACH

Reviewer or Subreviewer for: Computer Science & Math Venues: Symposium on the Theory of Computing (STOC), Foundations of Computer Science (FOCS), Computational Complexity Conference (CCC), Symposium on Discrete Algorithms (SODA), International Colloquium on Automata, Languages and Programming (ICALP), Innovations in Theoretical Computer Science (ITCS), Theory of Computing (ToC), Symposium on Theoretical Aspects of Computer Science (STACS), International Conference on Randomization and Computation (RANDOM), Theory of Cryptography Conference (TCC), International Symposium on Mathematical Foundations of Computer Science (MFCS), Information Processing Letters (IPL), IEEE Transactions on Neural Networks and Learning Systems (TNNLS), Computing and Combinatorics Conference (COCOON), Mathematical Reviews (MathSciNet), SIAM Review (SIREV). **Physics & Quantum Computing Venues:** Quantum Information Processing (QIP), Physical Review Letters (PRL), Physical Review A (PRA), Nature Partner Journal Quantum Information (NPJQI), Quantum, Proceedings of the Royal Society A (P. R. Soc. A), Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC), Quantum Information & Computation (QIC), Quantum Information Processing (QINP).

Co-organizer, Quantum CS (QuaCS) group meeting, 2015-2017 (joint with Robin Kothari)