

Personal *Address:* Electrical Engineering / 3740 McClintock Ave / Los Angeles CA 90089-2565
Telephone: 415-683-0805, 213-740-7229
Internet: ben.reichardt@usc.edu / www-bcf.usc.edu/~breichar

Education 2006 Ph.D. in Computer Science, University of California, Berkeley
2001 B.S. in Mathematics, with Distinction & Dept. Honors, Stanford University

Research interests

Quantum algorithms, Fault-tolerant quantum computation, Cryptography, Quantum information theory, Geometry of minimal surfaces

Experience

Assistant Professor University of Southern California: Department of Electrical Engineering , 2012 –

Assistant Professor University of Waterloo: School of Computer Science and Institute for Quantum Computing, 2008 – 2011

Postdoctoral fellow California Institute of Technology
Institute for Quantum Information, 2006 – 2008

Academic service

- Conference program committee: Conference on Computational Complexity (CCC) 2013, Quantum Information Processing (QIP) '09, '08, Theory of Quantum Computation, Communication and Cryptography (TQC) '09
- Journal referee: SICOMP, TCS, J. Phys. A, Phys. Rev. Lett., Phys. Rev. A, QIC, IJQI, ...
- Conference referee: FOCS, STOC, ICALP, QIP, ICS, CATS, CCC

Invited conference talks

2013 Quantum Information Processing (QIP)
QCrypt
Heilbronn Quantum Algorithms Day
Workshop on Quantum Hamiltonian Complexity
CIFAR Quantum Information Processing Meeting

2012 QIS Workshop in Computer and Natural Sciences
DIQIP-QCS Meeting
Workshop on Recent Progress in Quantum Algorithms

2011 Quantum Information Processing (QIP) invited tutorial speaker

2010 American Physical Society (APS) March Meeting
Quantum Information Processing (QIP)

2008 Workshop on Quantum Algorithms & Complexity Theory (WQACT)
Quantum Information Processing (QIP)

2007 Asian Conference on Quantum Information Science (AQIS)
Mathfest

2006 Quantum Information Processing (QIP)
NIST Workshop on Trapped Ion Quantum Computing

2004 Bay Area Theory Symposium (BATS)

Refereed conference papers

- Innovations in Theoretical Computer Science (ITCS) 2013
- European Symposium on Algorithms (ESA) '12
- Foundations of Computer Science (FOCS) '11, '09, '07, '06
- Symposium on Theory of Computation (STOC) '08, '04
- Symposium on Discrete Algorithms (SODA) '11 (×2)
- Quantum Information Processing (QIP) '12, '09, '07
- International Conference on Automata, Languages and Programming (ICALP) '06
- Theory of Quantum Computation, Communication and Cryptography (TQC) '11
- Workshop on Selected Areas in Cryptography (SAC) '02

Grants, awards and fellowships

- 2013 NSF CAREER award
- 2012 Three-year US Army Research Office (ARO) grant, \$120K/year
- 2009 Five-year Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant, \$29,000/year (Principal investigator)
- 2009 Three-year US Army Research Office (ARO) grant, \$200K/year (8 PIs)
- 2009 MITACS grant \$173,000 (10 PIs)
- 2001 Awarded National Science Foundation & DOD NDSEG Graduate Fellowships
- 2001 Phi Beta Kappa
- 1997 Member U.S. Physics Olympiad Team, and National Merit Scholar

Seminars and other talks

- 2013 USC
- 2012 U. Waterloo, Caltech, USC, Institute of Photonic Sciences (IFCO)
- 2011 UC Berkeley, USC, U. de Montréal, Dagstuhl, Sandia National Labs, HRL Labs
- 2010 Caltech, NIST
- 2009 UC Berkeley, U. New Mexico, Perimeter Institute, U. Waterloo, Inst. for Advanced Study (Princeton), Caltech, MIT, Canadian Inst. for Advanced Research (CIFAR), Kavli Inst. for Theoretical Physics (KITP), HRL Laboratories
- 2008 National University of Singapore, UC Berkeley, UC Davis, U. Waterloo, USC
- 2007 USC, NEC Labs, U. Waterloo
- 2006 MIT, UC Berkeley, U. New Mexico, ARO/NSA/DTO Quantum Algorithms program review
- 2005 Caltech, UC Berkeley, U. Toronto, U. Waterloo, NIST, Bell Labs, CIFAR, DARPA Quantum Information Science and Technology (QuIST) program review
- 2004 Quantum computation and information theory @ Banff International Research Station

Publication List

- 2013
1. Classical command of quantum systems
B. Reichardt, F. Unger, U. Vazirani
Nature **496**:456-460, 2013.
arXiv: 1209.0448 and 1209.0449 [quant-ph].
 2. Universal fault-tolerant quantum computation with only transversal gates and error correction
A. Paetzniak, B. Reichardt
Physical Review Letters **111**:090505, 2013.
arXiv:1304.3709 [quant-ph].
- 2012
3. Systematic distillation of composite Fibonacci anyons using one mobile quasiparticle
B. Reichardt
Quantum Information & Computation **12**:876-892, 2012.
arXiv:1206.0330 [quant-ph].
 4. Fault-tolerant ancilla preparation and noise threshold lower bounds for the 23-qubit Golay code
A. Paetzniak, B. Reichardt
Quantum Information & Computation **12**:1034-1080, 2012.
In *11th Asian Quantum Information Science Conference (AQIS)* 2011. arXiv:1106.2190.
 5. Span programs and quantum algorithms for *st*-connectivity and claw detection
A. Belovs, B. Reichardt
To appear in *European Symposium on Algorithms (ESA)*, 2012.
arXiv:1203.2603 [quant-ph].
 6. Span-program-based quantum algorithm for evaluating formulas
B. Reichardt, R. Špalek
Theory of Computing, **8**(13):291-319, 2012.
Earlier version in *Proc. Symp. on Theory of Computing (STOC)*, 2008, p. 103-112.
arXiv:0710.2630, 42 pages
- 2011
7. Quantum query complexity of state conversion
T. Lee, R. Mittal, B. Reichardt, R. Špalek, M. Szegedy
In *Proc. 52nd IEEE Symp. on Foundations of Computer Science (FOCS)* 2011,
pages 344-353.
Also appeared in *Workshop on Quantum Information Processing (QIP)* 2012.
arXiv:1011.3020.
 8. Reflections for quantum query algorithms
B. Reichardt
In *Proc. 22nd ACM-SIAM Symp. on Discrete Algorithms (SODA)* 2011, pages 560-569.

arXiv:1005.1601.

9. Faster quantum algorithm for evaluating game trees

B. Reichardt

Extended abstract in *Proc. 22nd ACM-SIAM Symp. on Discrete Algorithms (SODA)* 2011, pages 546-559.

arXiv:0907.1623, 25 pages.

10. Span-program-based quantum algorithm for evaluating unbalanced formulas

B. Reichardt

In *Conf. on Theory of Quantum Computation, Communication and Cryptography (TQC)* 2011, arXiv:0907.1622 [quant-ph], 28 pages.

2010

11. Approximating Turaev-Viro 3-manifold invariants is universal for quantum computation

G. Alagic, S. Jordan, R. Koenig, B. Reichardt

Physical Review A **82**(4):040302, 2010. arXiv:1003.0923 [quant-ph], 4 pages.

12. Quantum computation with Turaev-Viro codes

R. Koenig, G. Kuperberg, B. Reichardt

Annals of Physics 325(12):2707-2749, 2010. arXiv:1002.2816 [quant-ph].

13. Span programs and quantum query algorithms

B. Reichardt

Technical Report TR10-110, *Electronic Colloquium on Computational Complexity*, 2010, 34 pages. Submitted.

14. Least span program witness size equals the general adversary lower bound

B. Reichardt

Technical Report TR10-075, *Electronic Colloquium on Computational Complexity*, 2010, 18 pages. Submitted.

15. Any AND-OR formula of size N can be evaluated in time $N^{1/2+o(1)}$ on a quantum computer

A. Ambainis, A. Childs, B. Reichardt, R. Špalek, S. Zhang

In *Proc. 48th IEEE Foundations of Computer Science (FOCS)*, 2007, 19 pages

FOCS 2007 special issue of *SIAM Journal on Computing* **39**(6):2513-2530, 2010.

2009

16. Span programs and quantum query complexity: The general adversary bound is nearly tight for every boolean function

B. Reichardt

arXiv:0904.2759 [quant-ph], 2009, 70 pages

Extended abstract in *Proc. 50th IEEE Foundations of Computer Science (FOCS)*, 2009, pages 544-551.

17. Error-detection-based quantum fault-tolerance threshold

B. Reichardt

Algorithmica, **55**(3):517-556, 2009

18. Quantum universality by distilling certain one- and two-qubit states with stabilizer operations
B. Reichardt
Quantum Information and Computation **9**:1030-1052, 2009, arXiv: quant-ph/0608085
19. On parallel composition of zero-knowledge proofs with black-box quantum simulators
R. Jain, A. Kolla, G. Midrijānis, B. Reichardt
Quantum Information and Computation **9**:513-532, 2009, arXiv: quant-ph/0607211
20. Exact entanglement renormalization for string-net models
R. Koenig, B. Reichardt, G. Vidal
Physical Review B **79**, 195123, 2009, arXiv:0806.4583 [cond-mat.str-el], 6 pages
- 2008 21. Proof of the Double Bubble Conjecture in \mathbf{R}^n
B. Reichardt
Journal of Geometric Analysis **18**(1):172-191, 2008
arXiv:0705.1601 [math.MG], DOI 10.1007/s12220-007-9002-y
- “Fault-tolerant quantum computation” & “Quantum search” (with Lov Grover)
Articles in *Encyclopedia of Algorithms*, M.-Y. Kao (ed.), Springer, 2008.
- 2007 22. Every NAND formula of size N can be evaluated in time $N^{1/2+o(1)}$ on a quantum computer
A. Childs, B. Reichardt, R. Špalek, S. Zhang
arXiv: quant-ph/0703015, 2007, 14 pages
- 2006 23. Error-detection-based quantum fault-tolerance against discrete Pauli noise
B. Reichardt
Ph.D. thesis, University of California, Berkeley, 2006, 195 pages, arXiv: quant-ph/0612004
24. Postselection threshold against biased noise
B. Reichardt
In *Proc. 47th IEEE Foundations of Computer Science (FOCS)*, 2006, pages 420-428
arXiv: quant-ph/0608018
25. Fault-tolerance threshold for a distance-three quantum code
B. Reichardt
In *Proc. Int. Conf. on Automata, Languages and Programming (ICALP) '06*, LNCS 4051, 2006, pages 50-61, arXiv: quant-ph/0509203
- 2005 26. Quantum universality from magic states distillation applied to CSS codes
B. Reichardt
Quantum Information Processing **4**:251-264, 2005, arXiv: quant-ph/0411036
27. Quantum error correction of systematic errors using a quantum search framework
B. Reichardt, L. Grover
Physical Review A **72**:042326, 2005, 5 pages, arXiv: quant-ph/0506242

- 2004 28. The quantum adiabatic optimization algorithm and local minima
B. Reichardt
In *Proc. 36th ACM Symp. on Theory of Computing (STOC)*, 2004, pages 502-510.
29. Improved ancilla preparation scheme increases fault-tolerance threshold
B. Reichardt
arXiv: quant-ph/0406025, 2004, 4 pages
- 2003 30. Proof of the Double Bubble Conjecture in \mathbf{R}^4 and certain higher dimensional cases
B. Reichardt, C. Heilmann, Y. Lai, A. Spielman
Pacific Journal of Mathematics **208**(2):347-366, 2003
- 2002 31. Markov truncated differential cryptanalysis of Skipjack
B. Reichardt, D. Wagner
In *Proc. 9th Selected Areas in Cryptography (SAC)*, LNCS 2595, 2002, pages 110-128