

# Shelby Kimmel

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## Education

- 2009-2014 **Massachusetts Institute of Technology**, Cambridge, MA  
Ph.D. in Physics. Advised by Edward Farhi.  
Thesis Title: Cumulative Effects in Quantum Algorithms and Quantum Process Tomography
- 2004-2008 **Williams College**, Williamstown, MA  
B.A. in Astrophysics. Advised by William Wootters. GPA 3.96/4.0  
Thesis Title: Quantifying the Entanglement Cost of Nonlocal Measurements

## Research Interests

I design and analyze quantum algorithms, which take advantage of the laws governing small physical systems in order to solve computational problems. I also create efficient and accurate ways of characterizing errors in quantum devices, helping experimentalists to build the first generation of quantum computers. I sometimes think about quantum complexity theory and quantum information theory.

## Positions

- 2018-present **Middlebury College**, *Middlebury, VT*  
Assistant Professor of Computer Science
- 2017-2018 **Middlebury College**, *Middlebury, VT*  
Visiting Assistant Professor of Computer Science
- 2014-2017 **University of Maryland**, *College Park, MD*  
Hartree Postdoctoral Fellow at the Joint Center for Quantum Information and Computer Science (QuICS)
- 2009-2014 **Massachusetts Institute of Technology**, *Cambridge, MA*  
Research Assistant, Center for Theoretical Physics  
Advised by Edward Farhi
- 2012, 2013,  
Summers **Raytheon BBN Technologies**, *Cambridge, MA*  
Graduate Intern with the Quantum Information Processing Group  
Advised by Marcus P. da Silva
- 2011,  
Summer **University of Waterloo**, *Waterloo, ON*  
Research Assistant, Institute for Quantum Computing  
Advised by Andrew Childs
- 2008-2009 **Gochang-Buk High School**, Gochang, Jeollabuk-do, South Korea  
Fulbright English Teaching Assistant

## Teaching Experience

- 2017-present **Middlebury College, Middlebury, VT**
- Quantum Computing (CSCI 333), Spring 2018
  - Algorithms and Complexity (CSCI 302), Fall 2017
  - Math Foundations of Computer Science (CSCI 200), Fall 2017, Spring 2018
- 2016 **University of Maryland, College Park, MD**
- Discussion Section Instructor, Object Oriented Programming I (CMSC 131), Fall 2016. Taught 40 students for 2 hr/wk, using a mix of short lectures, small group activities, and coding exercises. Helped students debug code during drop-in help sessions.
  - Guest Lecturer, Object Oriented Programming I (CMSC 131), Fall 2016
  - Co-Teacher, Introduction to Quantum Information Processing (CMSC 858K), Fall 2016. Taught 4 week of classes.
- 2010-2014 **Massachusetts Institute of Technology, Cambridge, MA**
- Teaching Assistant, Introduction to Electricity and Magnetism (8.02), Spring 2011. Facilitated active learning activities during class.
  - Writing Teaching Assistant, Quantum Mechanics III (8.06), Spring 2012, 2014. Guided students through the process of writing a research paper.
- 2010-2013 **Tutoring Plus, Cambridge, MA**
- Middle School Tutor. Tutored students from economically disadvantaged backgrounds in math and writing.
- 2008-2009 **Gochang-Buk High School, Gochang, Jeollabuk-do, South Korea**
- Conversational English Instructor
- 2005-2008 **Williams College, Williamstown, MA**
- Writing Tutor. Worked with my peers (across disciplines) to edit and improve their writing.

## Undergraduate Research Advising

- 2018 Lizeth Lucero (Middlebury '21), Coding a Semidefinite Program Solver for Quantum Query Complexity
- 2018 Kai DeLorenzo and Teal Witter (both Middlebury '20.5), Quantum Algorithms for Graph Problems Involving Paths
- 2017 Will Kirby (Williams College, '17), Improvements to Robust Phase Estimation
- 2016 Andrew Zhao (University of Maryland, Physics, '19), Phase estimation using anisotropic compressed sensing.
- 2016 Mark Hubbert (University of Maryland, Physics, '19), Single qubit calibration with experimentally motivated cost
- 2015 Hardik Bansal (IIT Kanpur, Computer Science, '17), Distinguishing Non-local Entanglement

## Awards and Grants

2018-2019	Army Research Office (ARO) Short Term Innovative Research (STIR) Grant, \$60,000.
2014-2017	Hartree Postdoctoral Fellowship, QuICS, University of Maryland
2013, 2015	Quantum Information Processing Conference Travel Grant (~\$750)
2013	Graduate Women of Excellence Award (1 of 50), MIT
2012	Best Student Paper Track A (1 of 2), International Colloquium on Automata, Languages, and Programming (ICALP) (For “Quantum Adversary (Upper Bound.”)
2012	Best Scientific Poster (1 of 2), QIP (For “The Quantum Query Complexity of Read-Many Formulas.”)
2009-2011	NSF Interdisciplinary Quantum Information Science and Engineering (iQuISE) Traineeship, \$30,000 plus tuition for 3 years.
2011	Best Talk (1 of 3), Women in Physics Canada (For “Super-polynomial Quantum Speed-ups in Boolean Formulas.”)
2009	American Physical Society Apker Award Finalist (national award for undergraduate research; 1 of 3)

## Professional Service

- **Workshops:** Co-organizer, Workshop on QMA(2) and the Complexity of Entanglement, 2016, University of Maryland, College Park, MD
- **Program Committee:** Quantum Information Processing (QIP) 2018, Theory of Quantum Computing (TQC) 2017, Asian Quantum Information Science (AQIS) 2016
- **Journal Referee:** Theory of Computing, Nature Communications, Quantum (<http://quantum-journal.org/>), Physical Review A, Quantum Information and Computation, International Journal of Quantum Information
- **Conference Referee:** STOC, FOCS, SODA, ESA, QIP, TQC
- **Grant Proposal Reviewer:** NSF Review Panel (2018), Army Research Office (ARO) reviewer (2018)
- **Sorter:** American Physical Society March Meeting (2014, 2016)

## Recent Invited Talks (For a complete list, see [shelbykimmel.com](http://shelbykimmel.com))

2018	National Academy of Engineering’s Frontiers of Engineering Symposium. Lexington, MA. “Quantum Algorithms: Promise and Perspective”
2018	Southwest Quantum Information Theory (SQUINT) Workshop. Santa Fe, NM. “Quantum vs Classical Proofs.”
2018	Middlebury College Rifelj Faculty Lecture Series. Middlebury College “Infinity Machines: Will Quantum Computers Live up to the Hype?” with Paul Hess
2018	American Mathematical Society (AMS) Spring Eastern Sectional Meeting. Boston, MA. “Quantum Algorithms for Connectivity: Applications and Analysis.”
2017	IBM ThinkQ Conference, Yorktown Heights, NY. “Characterizing Coherent Errors Efficiently, Robustly, and Simply.”

- 2017 Canadian Institute for Advance Research (CIFAR) Quantum Information Science Meeting, Niagara-on-the-Lake, ON. “Path Detection: A Quantum Computing Primitive.”
- 2017 University of Austin. Austin, TX. Computer Science Colloquium. “Path Detection: A Quantum Computing Primitive.”
- 2016 University of Copenhagen Center for the Mathematics of Quantum Theory (QMATH) Center Kick-Off Conference. Copenhagen, Denmark. “What does the effective resistance of electrical circuits have to do with quantum algorithms?”
- 2016 Schrodinger Sessions (a workshop to introduce quantum mechanics to science fiction writers). College Park, MD. “Quantum Algorithms.”

## Publications

Depending on the topic of the research, I publish in both computer science conference proceedings and journals and in physics journals. Physics journals are more prestigious than physics conference proceedings. Additionally, in physics papers, author order is often important; generally, the first author is the lead author. For my computer science publications, the author order is typically alphabetical.

- M. Jarret, S. Jeffery, **S. Kimmel**, A. Piedrafita. Quantum Algorithms for Connectivity and Related Problems. Accepted to *ESA (European Symposium on Algorithms)*. arXiv:1804.10591
- I. Roth, R. Kueng, **S. Kimmel**, Y.-K. Liu, D. Gross, J. Eisert, M. Kliesch. Recovering quantum gates from few average gate fidelities. Accepted to *Physical Review Letters*. arXiv:1803.00572
- **S. Kimmel**, S. Kolkowitz. No-go for quantum seals. arXiv:1802.10007
- S. Jeffery, **S. Kimmel**. Quantum Algorithms for Graph Connectivity and Formula Evaluation. *Quantum* vol. 26, 2017.
- K. Rudinger, **S. Kimmel**, D. Lobser, P. Maunz. Experimental demonstration of cheap and accurate phase estimation. *Physical Review Letters* 118 (19), 190502. 2017.
- **S. Kimmel**, C. Y. Y. Lin, G. H. Low, M. Ozols, T. J. Yoder. Hamiltonian Simulation with Optimal Sample Complexity. *Nature Partner Journals Quantum Information*, vol 3, no 13, 2017.
- **S. Kimmel**, Y.-K. Liu. Quantum Compressed Sensing Using 2-Designs. *Proceedings of SAMPTA (Sampling Theory and Applications)* 2017, pp 345-349, 2017.
- E. Farhi, **S. Kimmel**, K. Temme. A Quantum Version of Schöning's Algorithm Applied to Quantum 2-SAT. *Quantum Information and Computation*. Vol 16, no 13-14. 2016. pp1212-1227.
- B. Fefferman, **S. Kimmel**. Quantum vs Classical Proofs and Subset Verification. Accepted to *MFCS (Mathematical Foundations of Computer Science)* 2018. Arxiv:1510.06750. 2015.
- **S. Kimmel**, C. Y. Y. Lin, H. H. Lin. Oracles with Costs. *Proceedings of Theory of Quantum Computing 2015*. pp 1-26.
- B. R. Johnson, M. P. da Silva, C. A. Ryan, **S. Kimmel**, J. M. Chow, T. A. Ohki. Demonstration of Robust Quantum Gate Tomography via Randomized Benchmarking. *New Journal of Physics* 17 (11), 113019. 2015.
- **S. Kimmel**, G. H. Low, T. J. Yoder. Robust calibration of a universal single-qubit gate set via robust phase estimation. *Physical Review A* 92 (6), 062315. 2015
- **S. Kimmel**, M. P. da Silva, C. Ryan, B. Johnson, T. Ohki. Robust Extraction of Tomographic Information via Randomized Benchmarking. In *Physical Review X*, 2014, vol 4, n 1, pp 011050.
- A. M. Childs, **S. Kimmel**, R. Kothari. The Quantum Query Complexity of Read-Many Formulas. *Proceedings of ESA 2013*, pp 337-348.

- **S. Kimmel.** Quantum Adversary (Upper) Bound. *Chicago Journal of Theoretical Computer Science*, vol 2013 n 4. And *Proceedings of International Colloquium on Automata, Languages, and Programming (ICALP)*. 2012 pp 557-568.
- B. Zhan, **S. Kimmel**, A. Hassidim. Super-polynomial Quantum Speed-ups for Boolean Evaluation Trees with Hidden Structure. *Proceedings of ITCS (Innovations in Theoretical Computer Science)*, pp 249-265. 2012
- S. Bandyopadhyay, G. Brassard, **S. Kimmel**, W. Wootters. Entanglement Cost of Nonlocal Measurements. *Physical Review A*. vol 80, n 1, pp 012313, 2009.
- J. Pasachoff, **S. Kimmel**, M. Druckmuller, V. Rusin, M. Saniga. The April 8, 2005 Eclipse White-light Corona. *Solar Physics*. vol 238, n 2, pp 261-270, 2006

## Service

- 2017-present **Middlebury College, Middlebury, VT**
- Advisor for WICS++ (Women in Computer Science club) 2017-present
  - Center for Careers and Internships Advisory Committee, 2018-present
- 2014-2016 **University of Maryland, College Park, MD**
- Mentored undergraduate and graduate women through the UMD Women in Physics Mentoring Program
- 2009-2014 **Massachusetts Institute of Technology, Cambridge, MA**
- Organized graduate/undergraduate women in physics mentoring program
  - Mentored undergraduate women each year of graduate school
  - Planned a networking seminar for women in physics (2012)
  - Coordinated Graduate Women at MIT (GWAMIT) mentoring program. Helped to recruit 200 alumni, professors, and graduate students to the program, matched participants through surveys, managed a committee of 8 people, and planned bi-yearly dinners.
  - Organized Online Personal Branding event at the GWAMIT Empowerment Conference (2010)

## Pedagogical and Professional Development

- 2018-present Universal Design for Learning, Faculty Collaborative Group, Middlebury College
- 2018-present Whiteness Discussion Group, Middlebury College
- 2017-present STEM Pedagogy Faculty Group, Middlebury College
- 2017-present Faculty Reading Group on Grading, Middlebury College
- 2010-2011 Graduate Student Teaching Certificate Program, MIT