

Xiaodi Wu

Assistant Professor

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Research interests

- Quantum Information and Computation, Quantum Cryptography, Quantum Programming Languages, Mathematical Optimization, Theory of Computation,

Research positions

- 06/2017–
present **Assistant Professor**, *University of Maryland*, College Park, MD.
Department of Computer Science and Institute for Advanced Computer Studies
Fellow of the Joint Center for Quantum Information and Computer Science (QICS)
- 09/2015–
06/2017 **Assistant Professor**, *University of Oregon*, Eugene, OR.
Department of Computer and Information Science.
- 09/2013–
09/2015 **Postdoctoral Associate**, *Massachusetts Institute of Technology*, Cambridge, MA.
Advisor: Aram Harrow and Scott Aaronson.
- 01/2014–
05/2014 **Simons Research Fellow**, *Simons Institute for the Theory of Computing*, *University of California*, Berkeley, CA, Advisor: Umesh Vazirani.
- Summer
2009,2010 **Research Assistant**, *Institute for Quantum Computing*, *University of Waterloo*, Waterloo, Canada, Advisor: John Watrous.

Education

- 09/2008–
12/2013 **Ph.D. in Computer Science**, *University of Michigan*, Ann Arbor, MI, *GPA: 4.0/4.0*.
Thesis title: *Space-efficient Simulations of Quantum Interactive Proofs*. Advisor: Prof Yaoyun Shi.
- 08/2004–
07/2008 **B.S. in Mathematics and Physics**, *Tsinghua University*, Beijing, China, *GPA: 91/100*.
Thesis title : *Structure Properties of Codeword Stabilized Quantum Error-Correcting Codes*

Honors & Awards

- 02/2014 Plenary talk at the 17th Conference on Quantum Information Processing (QIP* 2014).
- 02/2013 Simons-Berkeley Research Fellowships (Spring 2014).
- 06/2012 Special issue of the 27th Conference on Computational Complexity (CCC 2012).
- 01/2012 Rackham Predoctoral Fellowship: departmental nominee, University of Michigan.
- 11/2011 Featured talk at the 15th Conference on Quantum Information Processing (QIP* 2012).
- 12/2009 Member of Tau Beta Pi, Engineering Honored Society.
- 06/2008 Distinguished Undergraduate Degree Thesis, Tsinghua University.
- 06/2008 Chi-Sun YEH Prize (highest award to undergraduate physics majors), Tsinghua University.
- 06/2007 Microsoft Young Fellow Scholarship.

*QIP is the most prestigious and competitive conference in theoretical aspects of quantum information science. Annually out of ~ 220 submissions, ~ 9 are selected as featured talks, ~ 25 as contributed talks and the ~ 4 best results as plenary talks.

Teaching experience

- Instructor **Introduction to Quantum Information Processing (CMSC 657)**, *University of Maryland*, graduate-level CS course, Fall 2018.
- Instructor **Introduction to Quantum Computation (CMSC 457)**, *University of Maryland*, undergraduate-level CS course, Spring 2018.
- Instructor **Complexity Theory (CMSC 652)**, *University of Maryland*, graduate-level CS major course, Fall 2017.
- Instructor **Intermediate Data Structure (CIS 313)**, *University of Oregon*, undergraduate-level CS major course, Winter 2016, Fall 2016, Winter 2017.
- Instructor **Introduction to Quantum Information Processing (CIS 410/510)**, *University of Oregon*, undergraduate/graduate level course, Spring 2016, Spring 2017.
- Teaching Assistant **Computational Complexity (EECS 574)**, *University of Michigan*, Ann Arbor, graduate-level course, Fall 2010.
- Teaching Assistant **Discrete Mathematics (EECS 203)**, *University of Michigan*, Ann Arbor, undergraduate-level course, Winter 2010.

Patent

- Oct. 2016 **“Physical Randomness Extractors”**, *Kai-Min Chung, Yaoyun Shi, Xiaodi Wu, US Patent 9,471,280.*

Professional service

- PC Member
- ◇ The 9th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2014).
 - ◇ The 20th Annual Conference on Quantum Information Processing (QIP 2017).
 - ◇ The 21th Annual Conference on Quantum Information Processing (QIP 2018).
- Reviewer
- ◇ *Conferences*: STOC, FOCS, QIP, SODA, CCC, ICALP, ITCS, CRYPTO, CCS, AsiaCrypt, TCC, and ISAAC for multiple years.
 - ◇ *Journals*: SIAM Journal of Computing, Nature Communications, Quantum Information and Computation, International Journal of Quantum Information, Theoretical Computer Science, Theory of Computing, IEEE Transaction on Information Theory, and Physical Review Letter.
 - ◇ *Grants*: Natural Sciences and Engineering Research Council of Canada (NSERC)

Grants

- NSF CRII: AF: Theoretical Problems in Quantum Computation, PI, NSF-CCF-1755800, 2018-2020.
- DOE Quantum Algorithms from the Interplay of Simulation, Optimization, and Machine Learning, in Advanced Scientific Computing Research (ASCR): Quantum Algorithms Teams program, Co-PI, 2018-2021.

Publications

(The authors of papers in theoretical computer science are listed by the alphabetical order of the last name unless explicitly described.)

Journals

- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Limitations of semidefinite programs for separable states and entangled games*, accepted by Communications in Mathematical Physics, 2018.
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*. IEEE Transaction on Information Theory, Volume: 63, Issue: 9, pp. 5628 – 5641, 2017.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *An improved semidefinite programming hierarchy for testing entanglement*, Communications in Mathematical Physics, Volume 352, Issue 3, pp 881–904, 2017. Also available at arXiv:1506.08834.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. Theoretical Computer Science, 598:51–63, 2015.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. Computational Complexity, 22(2):385-428, 2013, the **special issue** of CCC 2012.
- ◇ (by contribution) **Xiaodi Wu** and Runyao Duan, *Exact Quantum Search by Parallel Unitary Discrimination Schemes*, Physical Review A, **78**, 012303 (2008). Selected for the July 2008 issue of Virtual Journal of Quantum Information.
- ◇ (by contribution) **Xiaodi Wu** and Gui Lu Long, *Verifier-based Algorithm for Unsorted Database Search Problem*, International Journal of Quantum Information, vol.**5** no.**4**, pp **597 - 604** (2007).
- ◇ (by contribution) **Xiao-di Wu**, Yong-tao Huang, Xin-kun Ma, *Data processing and software realization of wave-lengths of spectrum during CCD measurement*, Experimental Technology and Management, vol.**24**, no.**4** p**48-51** (2006).

Peer-reviewed Conferences with Published Proceedings

- ◇ (by contribution) Mingsheng Ying, Shenggang Ying, and **Xiaodi Wu**, *Invariants of Quantum Programs: Characterizations and Generation*, to appear at the 44th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2017).
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*. In Proceedings of the ACM 48th Annual Symposium on the Theory of Computing (STOC) 2016, available at arXiv:1508.01797.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Tight SoS-degree bounds for approximate Nash equilibria*. In Proceedings of the Computational Complexity Conference (CCC) 2016.
- ◇ Kai-Min Chung, **Xiaodi Wu**, and Henry Yuen, *Parallel repetition for entangled k -player games via fast quantum search*. In Proceedings of the Computational Complexity Conference (CCC) 2015 , also available at arXiv:1501.00033, 2015.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. In Proceedings of the 39th International Colloquium on Automata, Languages and Programming (ICALP 2012), pp. 798–809.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. In Proceedings of the 27th Annual IEEE Conference on Computational Complexity (CCC 2012), pp. 21–31.

Peer-reviewed Conferences without Published Proceedings

- ◇ Yi-Hsiu Chen, Kai-Min Chung, Ching-Yi Lai, Salil P. Vadhan, and **Xiaodi Wu**, *Computational Notions of Quantum Min-Entropy*, at the 7th International Conference on Quantum Cryptography (QCrypt 2017). also available at arXiv: 1704.07309.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Limitations of semidefinite programs for separable states and entangled games*, at the 20th Conference on Quantum Information Processing (QIP 2017).
- ◇ Kai-Min Chung, Yaoyun Shi, and **Xiaodi Wu**, *General randomness amplification with non-signaling security*, at the 20th Conference on Quantum Information Processing (QIP 2017).
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*, at the 19th Conference on Quantum Information Processing (QIP 2016), available at arXiv:1508.01797.
- ◇ Kai-Min Chung, Yaoyun Shi, and **Xiaodi Wu**, *Physical Randomness Extractors*, appeared as a **plenary talk** at the 17th Conference on Quantum Information Processing (QIP 2014), also available at arXiv:1402.4797v2.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. **Contributed talk** at the 15th Workshop on Quantum Information Processing (QIP 2012), also available at arXiv:1112.0808, 2011.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. **Featured talk** at the 15th Workshop on Quantum Information Processing (QIP 2012), available at arXiv:1011.2787, 2010.
- ◇ Zhengfeng Ji and **Xiaodi Wu**, *Non-Identity Check Remains QMA-Complete for Short Circuits*, **contributed talk** at the 9th Asian Conference on Quantum Information Science (AQIS09), also available at arXiv:0906.5416, 2009.

Manuscripts

- ◇ Fernando G. S. L. Brandao, Amir Kalev, Tongyang Li, Cedric Yen-Yu Lin, Krysta M. Svore, **Xiaodi Wu**, *Quantum SDP Solvers: Large Speed-ups, Optimality, and Applications to Quantum Learning*, under submission, also available at arXiv:1710.02581v2, 2017.
- ◇ Tongyang Li and **Xiaodi Wu**, *Quantum query complexity of entropy estimation*, under submission, 2017.
- ◇ **Xiaodi Wu**, Penghui Yao, and Henry Yuen , *Raz-McKenzie simulation with the inner product gadget*, under submission, 2017. also available at ECC TR17-010.
- ◇ Aram Harrow, Maris Ozols, Tianyi Peng, and **Xiaodi Wu**, *Simulating large quantum circuits on a small quantum computer*, manuscript, 2016.
- ◇ **Xiaodi Wu** and Henry Yuen, *On the limits of communication with non-local resources*, manuscript, 2015.
- ◇ Kai-Min Chung, Xin Li, and **Xiaodi Wu**, *Multi-Source Randomness Extractors Against Quantum Side Information, and their Applications*, manuscript, also available at arXiv:1411.2315, 2014.
- ◇ Yaoyun Shi, Wei Yu, and **Xiaodi Wu**, *Limits of Quantum One-way Communication by Matrix Hypercontractive Inequalities*, manuscript, 2013.
- ◇ **Xiaodi Wu**, *Parallelized Solution to Semidefinite Programmings in Quantum Complexity Theory*, Technical Report, also available at arXiv:1009.2211, 2010.
- ◇ **Xiaodi Wu**, *Equilibrium Value Method for the proof of QIP=PSPACE*, manuscript, available at arXiv:1004.0264, 2010.

Invited Talks

- 07/2017 **Quantum query complexity of entropy estimation.**
Microsoft Quantum Algorithms Workshop, Redmond.
- 04/2017 **Quantum query complexity of entropy estimation.**
Microsoft Research, Redmond.
- 03/2017 **General randomness amplification with non-signaling security.**
IQI Seminar, Caltech.
- 01/2017 **General randomness amplification with non-signaling security.**
The 20th Workshop on Quantum Information Processing (QIP 2017).
- 08/2016 **Limitations of monogamy, Tsirelson-type bounds, and other semidefinite programs in quantum information.**
QMA(2) Workshop, QUICS, University of Maryland
- 02/2016 **Device-independent Quantum Cryptography.**
Oregon Crypto Meeting, Oregon State University
- 12/2015 **Limitations of monogamy, Tsirelson-type bounds, and other semidefinite programs in quantum information.**
IQI Seminar, Caltech
- 06/2015 **Randomness Extraction in the Presence of Quantum Side Information.**
1st Trustworthy Quantum Information Workshop, Ann Arbor, USA
- 05/2015 **New Upper and Lower Bounds for Entanglement Testing.**
Microsoft Research, Redmond.
- 05/2015 **Randomness Extraction in the Presence of Quantum Side Information.**
Simon's Institute for the Theory of Computing, UC Berkeley.
- 02/2015 **The Power and Limits of Quantum Computers.**
Colloquium, Department of Computer and Information Science, University of Oregon.
- 11/2014 **Improved Entanglement Detection with Tools from Algebraic Geometry.**
Colloquium, Institute for Quantum Computing, University of Waterloo.
- 11/2014 **Multi-Source Randomness Extractors Against Quantum Side Information.**
Theory Seminar, Virginia Commonwealth University, Richmond.
- 07/2014 **Physical Randomness Extractors.**
Gordon Research Seminar, Advances in Quantum Information Science, Stonehill College.
- 03/2014 **Physical Randomness Extractors.**
University of Michigan, Ann Arbor
- 02/2014 **Physical Randomness Extractors.**
IQI Seminar, Caltech.
- 05/2013 **Robust Full Randomness Extraction from Any Weak Source.**
Quantum Information Processing Seminar, MIT.
- 04/2013 **Equilibrium Value Method for Optimization Problems and its Applications in Quantum Computation,** IQI Seminar, Caltech.
- 04/2013 **Applications of Sum of Squares in Quantum Information.**
University of California, San Diego.
- 07/2012 **Epsilon-net method for optimizations over separable states..**
The 39th International Colloquium on Automata, Languages and Programming (ICALP'12).

- 06/2012 **Parallel approximation of min-max problems with applications to classical and quantum zero-sum games.** .
The 27th Annual IEEE Conference on Computational Complexity (CCC'12).
- 03/2012 **Epsilon-net method for optimizations over separable states.**
Tsinghua University.
- 12/2011 **Epsilon-net method for optimizations over separable states.**
The 15th Workshop on Quantum Information Processing (QIP'12).
- 12/2011 **Parallel approximation of min-max problems with applications to classical and quantum zero-sum games.**
The 15th Workshop on Quantum Information Processing (QIP'12).