Chinmay Nirkhe

IBM Quantum
Aug 2022 -

Research Staff Scientist
MIT-IBM Watson AI Lab
314 Main Street Cambridge, Mass. 02142

EDUCATION

University of California, Berkeley (GPA: 3.9/4.0)
Aug 2017 - Dec 2022

Ph.D. Computer Science
Advisor: Professor Umesh Vazirani
Thesis: Lower bounds on the complexity of quantum proofs

California Institute of Technology (GPA: 3.9/4.0)
Sep 2013 - Jun 2017

B.S. Mathematics
B.S. Computer Science

PUBLICATIONS AND PREPRINTS

All works have alphabetical authorship by surname and signify equal contributions by all authors.

[8] **A distribution testing oracle separation between QMA and QCMA**

Anand Natarajan and Chinmay Nirkhe. 2022.

Publicly available pre-print: `arXiv : 2210.15380`.

[7] **NLTS Hamiltonians from good quantum codes**

Anurag Anshu, Nikolas Breuckmann, and Chinmay Nirkhe. 2022.

Plenary talk at Quantum Information Processing (QIP 2023). Invited talk at 38th Computational Complexity Conference (CCC 2023). Publicly available pre-print: `arXiv : 2206.13228`. News article published by Quanta Magazine. Simons Institute blog post.

[6] **The parametrized complexity of quantum verification**

Srinivasan Arunachalam, Sergey Bravyi, Chinmay Nirkhe, and Bryan O'Gorman. 2022.

In the proceedings of 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022). Publicly available pre-print: `arXiv : 2202.08119`.

[5] **Quantum search-to-decision and the state synthesis problem**

Sandy Irani, Anand Natarajan, Chinmay Nirkhe, Sujit Rao, and Henry Yuen. 2021.

Presented at 25th Annual Conference on Quantum Information Processing (QIP 2022). In the proceedings of 37th Computational Complexity Conference (CCC 2022). Publicly available pre-print: `arXiv : 2111.02999`.

[4] **Circuit lower bounds for low-energy states of quantum code Hamiltonians**

Anurag Anshu and Chinmay Nirkhe. 2021.

To appear in Theory of Computing 2022. In the proceedings of 13th Innovations in Theoretical Computer Science Conference (ITCS 2022). Presented at 24th Annual Conference on Quantum Information Processing (QIP 2021). Publicly available pre-print: `arXiv : 2011.02044`.

[3] **Good approximate quantum LDPC codes from spacetime circuit Hamiltonians**

Thomas Bohdanowicz, Elizabeth Crosson, Chinmay Nirkhe, and Henry Yuen. 2019.

In the proceedings of 51st ACM Symposium on the Theory of Computation (STOC 2019). Presented at 5th International Conference on Quantum Error Correction (QEC 2019). (Invited Talk) Presented at 22nd Annual Conference on Quantum Information Processing (QIP 2019). Publicly available pre-print: `arXiv : 1811.00277`.

[2] **On the complexity and verification of quantum random circuit sampling**

Adam Bouland, Bill Fefferman, Chinmay Nirkhe, and Umesh Vazirani. 2018.

Published in Nature Physics 2018. Presented at 2020 ACM Conference on Innovations in Theoretical Computer Science (ITCS 2019). Presented at 22nd Annual Conference on Quantum Information Processing (QIP 2019). Publicly available pre-print: `arXiv : 1803.04402`. News article published by UC Berkeley News.

[1] **Approximate low-weight check codes and circuit lower bounds for noisy ground states**

Chinmay Nirkhe, Umesh Vazirani, and Henry Yuen. 2018.

In the proceedings of 45th International Colloquium on Automata, Languages, and Programming (ICALP 2018). Presented at 13th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC 2018). Publicly available pre-print: `arXiv : 1802.07419`.

TALKS & PRESENTATIONS
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Why are quantum states hard to describe?
Institute for Advanced Studies, Computer Science/Discrete Mathematics Seminar, March 2023.
Stanford Q-FARM CS Seminar, March 2023.
University of Washington, CS Seminar, March 2023.
Massachusetts Institute of Technology, Math Seminar, February 2023.
Northwestern University, CS Seminar, February 2023.
University of Texas at Austin, CS Seminar, February 2023.

A classical oracle separation between QMA and QCMA
University of Warwick workshop on quantum complexity theory, July 2023.
Caltech IQIM CS Seminar, February 2023.
IQC Math and CS Seminar, December 2022.
IBM Quantum s3 meeting, November 2022.
Harvard Quantum Information Group Meeting, October 2022.

NLTS Hamiltonians from good quantum codes
Computational Complexity Conference, July 2023.
IAS Theory of Computation and Discrete Mathematics Seminar, March 2023.
Quantum Information Processing, February 2023.
QLA Meets QIT II Workshop, Chicago, Illinois, USA, November 2022.
Simons Institute for the Theory of Computing Quantum Colloquium, October 2022.
INTRIQ Biannual Meeting, Montreal, Quebec, Canada, October 2022.
Columbia University Seminar, October 2022.
CIQC Seminar, UC Berkeley, August 2022.
My PhD dissertation, UC Berkeley, August 2022.
University of Texas at Austin, September 2022.
Kavli Institute for Theoretical Physics, UCSB, September 2022.
Stanford University Institute for Theoretical Physics, August 2022.
University of Sydney, July 2022.
IBM Quantum Research Group, July 2022.

The parametrized complexity of quantum verification
Theory of Quantum Computation, July 2022.
University of Maryland QuICS Seminar, June 2022.
IBM Quantum Research Group, September 2021.

Quantum search-to-decision and the state synthesis problem
Computational Complexity Conference, July 2022.
University of Maryland QuICS Seminar, June 2022.
UC Berkeley Theory Lunch Seminar, April 2022.
Quantum Information Processing, March 2022.
University of Texas at Austin Scott Aaronson's Group Quantum Seminar, December 2021.

Circuit lower bounds for low-energy states of quantum code Hamiltonians
Innovations in Theoretical Computer Science, February 2022.
Simons Institute, Quantum Wave in Computing Reunion Workshop, July 2021.
Stanford Patrick Hayden's Group Quantum Seminar, July 2021.
Caltech Thomas Vidick's Group Quantum Seminar, March 2021.
Quantum Information Processing (QIP), February, 2021.
University of Texas at Austin and MIT Joint Quantum Seminar, December 2020.
Quantum Code Design and Architectures (The European Network) Seminar, November 2020.

Good approximate QLDPC codes from spacetime Hamiltonians
Symposium on the Theory of Computing, June 2019.
Institute for Quantum Computation, University of Waterloo Seminar, April 2019.
UC Berkeley Theory Lunch, February 2019.
Berkeley Quantum Information & Computation Center Seminar, December 2018.

On the complexity and verification of Random Circuit Sampling

Indian Symposium on Quantum Information and Technology, Pune, India, December 2019.
University of Toronto Computer Science / Quantum Information Seminar, March 2019.
IIT Kanpur Computer Science Seminar, December 2018.
Simons Institute Industry Day Lightning Talks, May 2018.
UC Berkeley Visit Days, March 2018.

Approximate low-weight check codes and circuit lower bounds for noisy ground states
Theory of Quantum Computing, July 2018.
Institute for Theoretical Physics Seminar, May 2018.
Caltech IQIM, February 2018.

Other talks
UC Berkeley Quantum Brainstorming Session, December 2021.

PAST EMPLOYMENT AND RESEARCH POSITIONS

IBM Quantum. San Jose, California and Yorktown Heights, New York. PhD Quantum Research Intern. May - December 2021.

Jane Street Capital. New York City, New York. Software Engineer Intern. Summer 2016.

Caltech Research for Course Credit, Professor Thomas Vidick. Summer and Fall 2016. Theoretical computer science research on pseudo-telepathy quantum games and certifiable randomness generation.

Twitter, Inc. San Francisco, California. Software Engineer Intern. Summer 2015.

Caltech Summer Undergraduate Research Fellowship, Professor Thomas Apostol. Summer 2014. Mathematics research on the geometry of brachistochrone and tautochrones in radially dependent force fields.

University of Washington, Professor Jacob O. Wobbrock. Fall 2012. Human computer interaction research on novel text entry systems using *Microsoft Kinect* for midair freehand gestural input. Unpublished publication: C. Nirkhe, J. Wobbrock; *The Bubble Keyboard: A Midair Freehand Gestural Text Entry Method.*

AWARDS

UC Berkeley Nominee for the ACM Doctoral Dissertation Award 2022
UC Berkeley EECS Nominee for the Microsoft Research PhD Fellowship 2019
National Science Foundation Graduate Research Fellowship Honourable Mention 2017
Thomas A. Tisch Prize for Teaching in Computational Mathematical Sciences (CMS) 2017
Associated Students of the California Institute of Technology (ASCIT) Teaching Award 2017
National Merit Semifinalist 2012

TEACHING POSITIONS

Quantum Interactive Protocols
Lecturer; University of California, Berkeley Spring 2022.
The Mathematics of Quantum Computation

Teaching Assistant; Hebrew University of Jerusalem: The 4th Winter School in Computer Science and Engineering Fall 2019.

CS 294-6: Quantum Computation

Teaching Assistant; University of California, Berkeley Fall 2019.

Trends in Theory: Quantum Computation

Teaching Assistant; University of California, San Diego Spring 2018.

CS 170: Efficient Algorithms and Intractable Problems

Teaching Assistant; University of California, Berkeley Spring 2018.

CS 38: Introduction to Algorithms

Head Teaching Assistant; California Institute of Technology Spring 2016, Spring 2017.

CS 139: Advanced Algorithms

Teaching Assistant; California Institute of Technology Winter 2017.

CS 156a: Learning Systems

Teaching Assistant; California Institute of Technology Fall 2016.

CS 21: Decidability and Tractability

Teaching Assistant; California Institute of Technology Winter 2016.

MENTORSHIP

Jiaqing Jiang Summer 2022, IBM Quantum Research intern.
Jyoti Rani Spring 2022, UC Berkeley undergraduate.
Samyak Surti Spring & Summer 2022, UC Berkeley undergraduate.
James Chen Summer & Fall 2020, UC Berkeley undergraduate.
Natalie Parham Summer & Fall 2020, UC Berkeley undergraduate.
Sahil Patel Summer & Fall 2020, UC Berkeley undergraduate.

SERVICE

Co-organizer for Simons Institute Summer 2023 Cluster on Quantum Computing.

Program committee member for QIP 2023 and AQIS 2023.

(Anonymous) reviewer for[1]

- (Conferences) CCC 2018, RANDOM 2018, TCC 2018, TQC 2018, CCC 2019, QCRYPT 2019, QIP 2019 (2), QIP 2020 (4), STOC 2020 (2), FOCS 2020, SODA 2021, ITCS 2021, STOC 2021 (3), TQC 2021, ITCS 2022 (2), QIP 2022 (3), STOC 2022 (2), FOCS 2022 (2), STOC 2023 (2), and QIC 2023.

- (Journals) Quantum (4).

REFERENCES

Professor Umesh Vazirani, University of California, Berkeley. `vazirani@cs.berkeley.edu`.
Assistant Professor Henry Yuen, Columbia University. `henry.yuen@columbia.edu`.
Assistant Professor Anurag Anshu, Harvard University. `anuraganshu@seas.harvard.edu`.
Assistant Professor Anand Natarajan, Massachusetts Institute of Technology. `anandn@mit.edu`.
Professor Sandy Irani, Simons Institute and University of California, Irvine. `irani@ics.uci.edu`.

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[1]Parentheticals denote multiplicity.

Personal Data

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