MEHDI SOLEIMANIFAR

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EDUCATION

Massachusetts Institute of Technology   *Sep 2016 - May 2022*
PhD in Physics
Thesis Advisor: *Aram Harrow*
Thesis Title: *Efficiently Learning, Testing, and Simulating Quantum Many-Body Systems*

Sharif University of Technology, Iran   *Sep 2011- June 2016*
B.Sc. in Electrical Engineering and Physics

RESEARCH POSITIONS

California Institute of Technology, Pasadena, CA   *Aug 2022-present*
AWS Quantum Postdoctoral Scholar, Hosted by *John Preskill* and *Urmila Mahadev*

Simons Institute for the Theory of Computing, UC Berkeley   *May-Aug 2022*
Visiting Scholar, Participant in the Quantum Wave in Computing Program

HONORS AND AWARDS

- AWS Quantum Postdoctoral Scholarship, Caltech, 2022-2025

- Quantum Innovator in Computer Science and Mathematics, IQC Waterloo, Oct 2022

- IBM Prize for Excellent Contributed Talk, Physics of Computation Conference 40th Anniversary, 2021

- Buechner Graduate Teaching Prize, MIT, 2020

- Presidential Fellowship for Graduate Studies, MIT, 2016-2017

- National Elites Foundation Undergraduate Studies Scholarship, Iran, 2011-2016

PUBLICATIONS

* Indicates authors listed in either alphabetical order or based on equal contribution.

- Shouzen Gu*****, Mehdi Soleimanifar*****, *Power and Limitations of Linear Programming Decoder for Quantum LDPC Codes*, In preparation; forthcoming on arXiv.

- Akshar Ramkumar, Mehdi Soleimanifar, *Mixing Time of Quantum Gibbs Sampling for Random Sparse Hamiltonians*, **arXiv:2411.04454**.

- Tai-Hsuan Yang*****, Mehdi Soleimanifar*****, Thiago Bergamaschi, John Preskill, *When Can Classical Neural Networks Represent Quantum States?*, **arXiv:2410.23152**.

- Adam Bene Watts*****, David Gosset*****, Yinchen Liu*****, Mehdi Soleimanifar*****, *Quantum Advantage from Measurement-Induced Entanglement in Random Shallow Circuits*,

    – To appear in **PRX Quantum**,

    – Contributed Talk at Quantum Information Processing Conference (**QIP 2025**).

    – Preprint Available at arXiv: 2407.21203.

- Hsin-Yuan Huang*****, John Preskill*****, Mehdi Soleimanifar*****, *Certifying Almost All Quantum States with Few Single-Qubit Measurements*,

  - **Under revision in Nature Physics**,

  - In IEEE 65th Symposium on Foundations of Computer Science (**FOCS 2024**), pp 1202-07,

  - Contributed Talk at Quantum Information Processing Conference (**QIP 2024**).

- Mehdi Soleimanifar*****, John Wright*****. *Testing Matrix Product States*, in Proceedings of the 2022 ACM-SIAM Symposium on Discrete Algorithms (**SODA 2022**), 1679–1701 (2022).

- Anurag Anshu*****, David Gosset*****, Karen J. Morenz Korol*****, Mehdi Soleimanifar*****. *Improved Approximation Algorithms for Bounded-Degree Local Hamiltonians*,

  - **Physical Review Letters**, 127, 250502 (2021),

  - Contributed Talk at Quantum Information Processing Conference (**QIP 2021**).

- Anurag Anshu*****, Aram Harrow*****, Mehdi Soleimanifar*****. *Entanglement Spread Area Law in Gapped Ground States*,

  - **Nature Physics** 18, 1362–1366 (2022),

  - Contributed Talk at Quantum Information Processing Conference (**QIP 2021**).

- Anurag Anshu*****, Srinivasan Arunachalam*****, Tomotaka Kuwahara*****, Mehdi Soleimanifar*****. *Sample-Efficient Learning of Interacting Quantum Systems*,

  - **Nature Physics** 17, 931–935 (2021),

  - In IEEE 61st Annual Symposium on Foundations of Computer Science (**FOCS 2020**), Pages 685-691,

  - Contributed Talk at Quantum Information Processing Conference (**QIP 2021**).

- Aram Harrow*****, Saeed Mehraban*****, Mehdi Soleimanifar*****. *Classical Algorithms, Correlation Decay, and Complex Zeros of Partition Functions of Quantum Many-Body Systems,* In Proceedings of the 52nd Annual ACM SIGACT Symposium on Theory of Computing (**STOC 2020**), Pages 378–386.

- Mehdi Soleimanifar, Vahid Karimipour, *No-Go Theorem for Iterations of Unknown Quantum Gates*, **Physical Review A** 93, 012344 (2016).

- Mohammad Movahednasab, Mehdi Soleimanifar, Amin Gohari, Masoumeh N. Kenari, Urbashi Mitra. *Adaptive Transmission Rate with a Fixed Threshold Decoder for Diffusion-Based Molecular Communication,* **IEEE Transactions on Communications** Vol. 64, No. 1, Jan. 2016.

TEACHING AND MENTORING EXPERIENCE

Mentoring Students

Akshar Ramkumar, Summer Undergraduate Research Fellow, Caltech	*2024*
Tai-Hsuan Yang, Summer Undergraduate Research Fellow, Caltech	*2023*

Teaching Assistant

Quantum Mechanics II, MIT	*Fall 2017-2019*
Physics II, MIT	*Spring 2017*

Quantum Information Theory, Sharif University   *Fall 2015*
Probability and Statistics, Sharif University   *Spring 2014*

OUTREACH ACTIVITIES

- Volunteer at FUTURE of Physics, Caltech   *Sep 2022*
  Supporting women STEM students pursuing graduate degrees

- Mentor at the Laureates & Leaders program, MIT   *2019-2021*
  Supporting underrepresented STEM students pursuing graduate degrees.

- Invited Talk at PRISM   *Feb 2021*
  A conference hosted by MIT Undergraduate Women in Physics

- Outreach Talk on the Power of Quantum Computing, UC Santa Barbara   *Oct 2019*
  SST Science Enrichment Class for High School Students Oct 2019

PROFESSIONAL SERVICES

Conference Reviewer
STOC, FOCS, QIP, ESA, ICALP, TQC, ITCS, CCC

Journal Reviewer
Nature Physics, Nature Communications, Physical Review Letters, PRX Quantum, Physical Review A, npj Quantum Information, SIAM Journal on Computing, Quantum, Quantum Science and Technology, ACM Transactions on Quantum Computing, Communications in Mathematical Physics

Program Committee Member
QIP 2025, TQC2025

CONFERENCE TALKS

1. *Certifying Almost All Quantum States with Few Single-Qubit Measurements*, FOCS 2024, Oct 2024

2. *Testing Matrix Product States*, QIP 2022, March 2022

3. *Improved Approximation Algorithms for Bounded-Degree Local Hamiltonians*, QIP 2022, March 2022

4. *Sample-Efficient Learning of Quantum Many-body Systems*, QIP 2021, February 2021

5. *From Communication Complexity to an Entanglement Spread Area Law*, QIP 2021, February 2021

6. *Sample-Efficient Learning of Quantum Many-Body Systems*, FOCS 2020, November 2020

7. *Classical Algorithms, Correlation Decay, and Complex Zeros of Partition Functions of Quantum Many-Body Systems*, STOC 2020, June 2020

INVITED TALKS

1. *When Can Classical Neural Networks Represent Quantum States?*, AWS-Chan Group Meeting, Caltech, Nov 2024

2. *Quantum Advantage from Measurement-Induced Entanglement in Random Shallow Circuits*, CS Theory Tea, Caltech, Sep 2024

3. *Certifying Almost All Quantum States with Few Single-Qubit Measurements*, Foxconn Quantum Computing Research Center, Taipei, Taiwan, Aug 2024

4. *Machine Learning Models of Quantum States*, Google Quantum CS Seminar, June 2024

5. *Certifying Almost All Quantum States with Few Single-Qubit Measurements*, IQIM Seminar, Caltech, May 2024

6. *Certifying Almost All Quantum States with Few Single-Qubit Measurements*, Seminar at CQuIC, University of New Mexico, May 2024

7. *Testing Quantum States*, Perimeter Institute Quantum Seminars, May 2023

8. *New Features of Interacting Quantum Systems and Their Algorithmic Applications*, Quantum Innovator in Computer Science and Mathematics, IQC Waterloo, Oct 2022

9. *Sample-Efficient Learning of Quantum Many-body Systems*, Harvard-MIT Quantum Machine Learning Journal Club, November 2021

10. *Improved Approximation Algorithms for Bounded-Degree Local Hamiltonians*, PIC Seminar IBM, Yorktown Heights, June 2021

11. *New Properties of Interacting Quantum Systems with Algorithmic Applications*, IBM Physics of Computation Conference 40th Anniversary, May 2021

12. *Sample-Efficient Learning of Interacting Quantum Systems*, MIT PRISM Conference, February 2021

13. *Sample-Efficient Learning of Quantum Many-body Systems*, NTT-MIT Group Meeting, November 2020

14. *Classical Algorithms, Correlation Decay, and Complex Zeros of Quantum Partition Functions*, Simons Institute Geometry of Polynomials Reunion, September 2020

15. *From Communication Complexity to an Entanglement Spread Area Law*, IQC CS Seminar, Waterloo, December 2020

16. *Approximation Algorithms for Quantum Many-Body Systems at Finite Temperatures*, Perimeter Institute Quantum Discussions, May 2020

17. *Classical Algorithms, Correlation Decay, and Complex Zeros of Quantum Partition Functions*, Caltech IQI Seminar, August 2019

18. *The Power of Quantum Computing*, SST Science Enrichment Class for High School Students at UCSB, October 2019