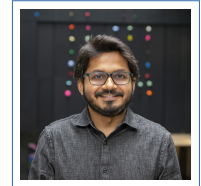# Anirban Chowdhury

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Google Scholar https://scholar.google.com/citations?user=J_YlQ2oAAAAJ

Employment

11-03-2024 – **Staff Research Scientist**, IBM, 1101 Kitchawan Road, Yorktown Heights, NY 10598, USA.

Job description: Innovate and generate new ideas in the space of quantum algorithms and theory of quantum computation. Contribute to advancing theoretical foundations for demonstrating quantum computational advantage.

01-09-2020 – **Postdoctoral Fellow**, Institute for Quantum Computing and Department of Combina-
29-02-2024 torics & Optimization, University of Waterloo, 200 University Ave W, Waterloo, ON N2L3G1, Canada .

Job description: Develop new quantum algorithms and analyze computational complexity of simulating quantum systems. Publish scientific articles and give technical presentations. Supervise graduate students. Worked on a project on studying computational complexity of thermal properties of quantum systems funded by the Army Research Office.
Hours worked: full-time

16-09-2019 – **Postdoctoral Researcher**, Département de physique, Université de Sherbrooke, 2500
31-08-2020 Bd de l'Université, Sherbrooke, QC J1K2R1, Canada.

Job description: Develop new quantum algorithms for simulating physical systems. Publish scientific papers and give conference talks. Participate in academic activities at the university.

29-05-2018 – **Graduate Student**, Theoretical Division, Los Alamos National Laboratory, P.O. Box
28-08-2019 1663, Los Alamos, NM 87545, USA.

Job description: Conducted research in quantum algorithms for simulating physical systems. Published scientific papers and gave technical presentations in the lab and at international conferences.
Hours worked: part-time

08-01-2018 – **Research Intern**, Microsoft Corporation, One Microsoft Way, Redmond, WA 98052,
07-03-2018 USA.

Job description: Developed a new algorithm for near-term quantum devices to prepare certain states useful for simulating properties of materials. I used mathematical techniques and computer programming for this work. I also participated in regular activities and internal meetings at Microsoft focussed on work in quantum technologies. This work led to a US patent (Document ID: US 20200349457 A1, Date published: 2020-11-05)
Hours worked: full-time

04-01-2016 – 24-03-2017	**Student Researcher**, New Mexico Consortium, 4200 W. Jemez Rd, Suite 301, Los Alamos, NM 87544, USA.
	Job description: Investigated quantum algorithms for characterizing and speeding up random walks and Markov processes, with relevance to improving simulation of physical processes. Published a scientific paper. Presented talks and posters in academic conferences.
	Hours worked: part-time
12-08-2013 – 22-12-2015, 24-08-2017 – 21-12-2017	**Teaching Assistant**, University of New Mexico, Global Education Office, MSC06 3650, University of New Mexico, Albuquerque, NM 87131, USA.
	Job description: Teaching assitant for a graduate course in quantum mechanics. Organized problem sessions where students discuss and solve problems related to course material. Hold office hours where students ask questions related to homework and course material. Also graded homework assignments and aided in designing homework questions. Supervised and assisted undergraduate students in physics laboratory experiments. Duties involved setting up experimental equipment, providing instrucitons and evaluating student performance.
	Hours worked: part-time

Research Interests

quantum algorithms, quantum simulation, quantum complexity, classical algorithms for quantum systems

Education

2013–2019	**PhD in Physics**, University of New Mexico, Date of completion: 24-Jun-2019. Degree received: 13-Dec-2019.
	Dissertation: Quantum algorithms with applications to physics simulations
2013–2016	**MS in Physics**, University of New Mexico, Degree received: 13-May-2016.
2008–2013	**BS-MS**, Indian Institute of Science Education and Research Pune, Degree received: 26-May-2013.
	Thesis: Quantum measurements with post-selection

Publications

Published articles

1. Adam Bene Watts, Anirban Chowdhury, Aidan Epperly, J. William Helton, Igor Klep, *Relaxations and Exact Solutions to Quantum Max Cut via the Algebraic Structure of Swap Operators,* Quantum 8, 1352 (2024)

2. Sergey Bravyi, Anirban Chowdhury, David Gosset, Vojtech Havlicek and Guanyu Zhu, *Quantum complexity of the Kronecker coefficients*, PRX Quantum 5, 010329 (2024)

3. Sergey Bravyi, Anirban Chowdhury, David Gosset and Pawel Wocjan, *Quantum Hamiltonian complexity in thermal equilibrium,* Nat. Phys. 18, pp. 1367–1370 (2022)

4. Anirban N. Chowdhury, Rolando D. Somma and Yigit Subasi, *Computing partition functions in the one-clean-qubit model,* Phys. Rev. A 103, 032422 (2021)

5. Anirban Narayan Chowdhury and Rolando D. Somma, *Quantum algorithms for Gibbs sampling and hitting-time estimation,* Quant. Inf. Comp. Vol. 17, No. 1/2, pp. 0041-0064 (2017)

6. Anirban N. Chowdhury, Mandar Patil, Daniele Malafarina and Pankaj S. Joshi, *Circular geodesics and accretion disks in Janis-Newman-Winicour and Gamma metric,* Phys. Rev. D 85, 104031 (2012)

Preprints

1. Mason L. Rhodes, Sam Slezak, Anirban Chowdhury, Yigit Subasi, *On additive error approximations to #BQP,* arXiv:2411.02602 (2024)

2. Anirban Chowdhury, Ewout van den Berg, Pawel Wocjan, *Controlization Schemes Based on Orthogonal Arrays,* arXiv:2407.09382 (2024)

3. Chen-Fu Chiang, Anirban Chowdhury and Pawel Wocjan, *Space-efficient Quantization Method for Reversible Markov Chains,* arXiv:2206.06886 (2022)

4. Anirban N. Chowdhury, Guang Hao Low and Nathan Wiebe, *A variational quantum algorithm for preparing quantum Gibbs states,* arXiv:2002.0005 (2020)

5. Anirban Narayan Chowdhury, Yigit Subasi and Rolando D. Somma, *Improved implementation of reflection operators,* arXiv:1803.02466 (2018)

Citations

(Source: Google Scholar as of August, 2024)

- Total: 450
- Since 2019: 382

Patents

Guang Hao Low, Nathan Wiebe and Anirban Chowdhury, *Variational quantum Gibbs state preparation,* Document ID: US 20200349457 A1, Date published: 2020-11-05

Invited Talks

Aprl 2024	**London TQFT Journal Club, Queen Mary University**, London, UK (remote). *Quantum counting and the symmetric group*
Mar 2024	**Fundamental Limitations to Quantum Computation**, Banff, Canada . *Relaxations to local Hamiltonian problems*
Jun 2023	**University of Waterloo**, Waterloo, Canada. *Approximation algorithms for dense quantum Hamiltonians using convex relaxations*
May 2023	**Indian Institute of Science Education and Research**, Pune, India. *Quantum Hamiltonian Complexity in thermal equilibrium*
Feb 2023	**Virgnia Tech**, Blacsburg, USA. *Quantum simulation and complexity of thermal physics*
Dec 2022	**École de technologie supérieure (ÉTS) Montréal**, Montreal, Canada. *Quantum computing for quantum physics and beyond*

Mar 2022	**The Institute for Fundamental Study**, Phitsanulok, Thailand (remote).
	Complexity of approximating quantum many-body physics in thermal equilibrium
Mar 2022	**Technology Innovation Institute**, Abu Dhabi, UAE (remote).
	Approximating quantum many-body physics in thermal equilibrium
Feb 2022	**Los Alamos National Laboratory**, Los Alamos, USA (remote).
	Approximating the free energy of dense quantum Hamiltonians using convex relaxations
Feb 2022	**University of New Mexico**, Albuquerque, USA (remote).
	Approximating the free energy of dense quantum Hamiltonians using convex relaxations
Jan 2022	**IPAM Quantum Numerical Linear Algebra Workshop**, Los Angeles, USA (remote).
	Classical and quantum algorithms for estimating traces and partition functions
	Recording: `https://www.youtube.com/watch?v=xiwpH9i3m5g`
Apr 2021	**University of Bristol**, Bristol, UK (remote).
	Computing partition functions with one clean qubit
Mar 2020	**University of Waterloo**, Waterloo, Canada.
	Simulating thermal physics on quantum computers
Aug 2019	**Los Alamos National Laboratory**, Los Alamos, USA.
	Improved quantum simulation algorithms using a linear combination of unitaries

Contributed Conference Talks

Oct 2022	**Southwest Quantum Information and Technology Workshop**, Berkeley, USA.
	Classical and quantum algorithms for trace-estimation
Jul 2022	**Theory of Quantum Computation, Communication and Cryptography**, Urbana, USA.
	On the complexity of quantum partition functions
	Recording: `https://youtu.be/j1jlPPKBvNc?t=4260`
Mar 2022	**Quantum Information Processing**, Pasadena, USA.
	On the complexity of quantum partition functions
Jun 2020	**Theory of Quantum Computation, Communication and Cryptography Conference**, Latvia (remote).
	Computing partition functions with one clean qubit
Nov 2019	**INTRIQ meeting**, Bromont, Canada.
	Simulating thermal physics on quantum computers
Feb 2019	**American Physical Society March Meeting**, Boston, USA.
	Improved implementation of reflection operators
Feb 2018	**Southwest Quantum Information and Technology Workshop**, Santa Fe, USA.
	Improved quantum algorithms using linear combination of unitaries
Mar 2016	**American Physical Society March Meeting**, Baltimore, USA.
	Quantum algorithms for hitting-time estimation

Professional Activities

- Reviewer for Physical Review A, New Journal of Physics, ACM Transactions in quantum information processing, Quantum Information Processing journal, npj Quantum Information, Nature Communications, Quantum journal, PRX Quantum and Physical Review X
- Program Committee member for QIP 2025
- Subreviewer for scientific conferences including QIP 2022 and 2023, FOCS 2021, TQC 2020, 2022 and 2023, ICALP 2023
- Co-organizer of Perimeter Institute Quantum Discussions seminar series, 2022
- Session chair for TQC 2020

Mentorship

Co-supervised Masters students for their research essays as part of the Perimeter Scholars International program.

Programming and Software

- Python, Mathematica and MATLAB for numerical simulations
- LaTeX for technical writing
- Familiarity with HTML, CSS

Academic Honours & Awards

2018-2019	Graduate Research Assistantship, Los Alamos National Laboratory
2017	National Science Foundation (NSF) travel award
2015	UNM Graduate and Professional Students Association (GPSA) Professional Development Grant
2012	Selected for the Visiting Students Program in physics at Harishchandra Research Institute, Allahabad, India
2011	Visiting Students Research Program (VSRP), Tata Institute of Fundamental Research, Mumbai, India
2008–2013	Recipient of the Innovation in Science Pursuit for Inspired Research (INSPIRE) Scholarship for Higher Education, administered by the Department of Science & Technology, Government of India

Other Research Experience

2012	**Study of quantum games**, *Indian Institute of Science Education & Research Pune*, Advisor: T. S. Mahesh.
2011	**Field theory in light-cone gauge**, *Indian Institute of Science Education & Research Pune*, Advisor: Sudarshan Ananth.

2011 **Synchronization in nanomechanical oscillators**, *Indian Institute of Science Education & Research Pune*, Advisor: G. Ambika.

2010 **Theories of extra dimensions**, *Indian Association for the Cultivation of Science*, Advisor: Soumitra Sengupta.

References

Available on request