Aniruddha A. Bapat

Chicago, IL
+1 (626) 755-6249
ani1729@gmail.com

Education

2016 – 2021 **Ph.D., Physics**, *University of Maryland, College Park*, advised by Stephen P. Jordan and Alexey V. Gorshkov.
Thesis: *Design and optimization in near-term quantum computation*

2015 – 2016 **M.Sc., Physics**, *Freie Universität Berlin*, advised by Petra Imhof
Thesis: *A molecular dynamics study of the site-dependent interaction of a polyglutamine fibril with an attached biotinylated residue*

2010 – 2014 **B.S. (with Honor), Physics**, *California Institute of Technology, Pasadena*

Publications

Papers & Preprints

1. Mathew, E, Gupta, N, Kadam, S., **AB**, Stryker, J, Davoudi, Z & Raychowdhury, I. Tensor-network toolbox for probing dynamics of non-Abelian gauge theories. *arXiv preprint arXiv:2501.18301.* `https://arxiv.org/abs/2501.18301` (2025).

2. Nagano, L., **AB** & Bauer, C. W. Quench dynamics of the Schwinger model via variational quantum algorithms. *Physical Review D* **108,** 034501 (2023).

3. **AB**, Childs, A. M., Gorshkov, A. V. & Schoute, E. Advantages and limitations of quantum routing. *PRX Quantum* **4,** 010313 (2023).

4. Devulapalli, D., Schoute, E., **AB**, Childs, A. M. & Gorshkov, A. V. Quantum routing with teleportation. *arXiv preprint arXiv:2204.04185* (2022).

5. Sewell, T., **AB** & Jordan, S. Estimating gate complexities for the site-by-site preparation of fermionic vacua. *arXiv preprint arXiv:2207.01692* (2022).

6. **AB**, Schoute, E., Gorshkov, A. V. & Childs, A. M. Nearly optimal time-independent reversal of a spin chain. *Physical Review Research* **4,** L012023 (2022).

7. Brady, L. T., Baldwin, C. L., **AB**, Kharkov, Y. & Gorshkov, A. V. Optimal protocols in quantum annealing and quantum approximate optimization algorithm problems. *Physical Review Letters* **126,** 070505 (2021).

8. Brady, L. T., Kocia, L., Bienias, P., **AB**, Kharkov, Y. & Gorshkov, A. V. Behavior of analog quantum algorithms. *arXiv preprint arXiv:2107.01218* (2021).

9. **AB**, Childs, A. M., Gorshkov, A. V., King, S., Schoute, E. & Shastri, H. Quantum routing with fast reversals. *Quantum* **5,** 533 (2021).

10. Eldredge, Z., Zhou, L., **AB**, Garrison, J. R., Deshpande, A., Chong, F. T. & Gorshkov, A. V. Entanglement bounds on the performance of quantum computing architectures. *Physical Review Research* **2,** 033316 (2020).

11. Pagano, G., **AB**, Becker, P., Collins, K. S., De, A., Hess, P. W., Kaplan, H. B., Kyprianidis, A., Tan, W. L., Baldwin, C., *et al.* Quantum approximate optimization of the long-range Ising model with a trapped-ion quantum simulator. *Proceedings of the National Academy of Sciences* (2020).

12. **AB** & Jordan, S. P. Approximate Optimization of MAXCUT with a local spin algorithm. *arXiv:2008.06054* (2020).

13. **AB** & Jordan, S. P. Bang-bang control as a design principle for classical and quantum optimization algorithms. *Quantum Information & Computation* **19,** 424–446 (2019).

14. **AB**, Eldredge, Z., Garrison, J. R., Deshpande, A., Gorshkov, A. V., Chong, F. T., *et al.* Unitary entanglement construction in hierarchical networks. *Physical Review A* **98,** 062328 (2018).

15. Alagic, G., **AB** & Jordan, S. P. Classical simulation of Yang-Baxter gates. *9th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2014), Leibniz International Proceedings in Informatics (LIPIcs)* **27,** 161–175 (2014).

Patents

16. Brady, L. T., Gorshkov, A. V., Baldwin, C. L., **AB**, Kharkov, Y., Bienias, P. D. & Kocia, L. *Performing bang-anneal-bang quantum optimization* WO 2022/241146A1. 2022.

17. Gorshkov, A. V., **AB**, Schoute, E. & Childs, A. *Performing state reversal on a quantum spin chain* US2022/02696A1. 2022.

Professional Experience

2023 – 2024 **Quantitative Researcher**, *Optiver US, LLC*, Chicago, IL

- Alpha generation research and development of low-latency trading strategies in US Futures markets. Extensive experience with data management (SQL, pandas), statistical inference, A/B testing, and tree-based learning models.
- Implemented strategy improvements into production code (Python, C++), with estimated impact $>$ \$5k/day

2021 – 2023 **Postdoctoral Scholar**, *Lawrence Berkeley National Laboratory*, Berkeley, CA

- Designed an efficient tensor network implementation of 1-d quantum chromodynamics on lattices up to 200 sites in iTensor Julia. Paper: [1].
- Developed a noise-resilient quantum simulation algorithm for 1d quantum electrodynamics (Qulacs, Qiskit). Paper: [2].
- Organized the Division seminar on quantum computing and high-energy physics
- Provided mentorship on two undergraduate research projects

2020 **Research Mentor**, *REU-CAAR program, University of Maryland*, College Park, MD

Mentored undergraduates Samuel King and Hrishee Shastri on a summer research project in the CS department. Paper: [9]

2016 – **Graduate Research Assistant**, *University of Maryland*, College Park, MD

- Developed the theory of optimal control of variational optimization/state preparation algorithms (QAOA, VQE). Papers: [7, 8, 11, 13]. Patent: [16].
- Served as theory lead on trapped-ion quantum simulation experiments with the Monroe Lab at UMD (paper), in which I wrote software to compute QAOA angle curves, ran exact DMRG simulation using OpenMPS, and modeled noise in the ion trap system for our problem. Paper: [11].
- Designed efficient quantum information transfer protocols on quantum architectures with connectivity constraints. Papers: [3, 4, 6, 9, 10, 14]. Patent: [17].

2019 **Graduate Research Intern**, *Microsoft*, Redmond, WA

Paper: [12].

- Developed a fast, quantum-inspired optimization algorithm for MaxCut problems and implemented it in Python
- Benchmarked against the "Biq Mac" benchmarking instances, the algorithm was competitive with the commercial solver Gurobi in speed and solution optimality.

2018 **Graduate Research Intern**, *USRA/NASA Ames Research Center*, Mountain View, CA

Designed a QAOA circuit to solve the Grover search problem for multiple marked items. Wrote a classical simulator that predicts the performance of QAOA on Grover-type problem instances.

2015 – 2017 **Masters' Research Assistant**, *Focus Area NanoScale, Freie Universität*, Berlin, Germany

Modeled and ran molecular dynamics simulations of the growth-inhibiting mechanism of a biotinylated residue attached to a polyglutamine fibril, and conducted preliminary analysis on its applicability as a drug for the "CAG triplet" neurodegenrative disorders.

Honors & Awards

2021 **USRA Q2B Applied NISQ Computing Award for Best Paper**

For the paper: "Behavior of Analog Quantum Algorithms"

2016 – 2018 **QuICS Lanczos Graduate Fellowship**, *University of Maryland*

2014 **Center for International Cooperation Research Grant**, *Freie Universität, Berlin*

2013 **Friends of UTokyo Global Leadership Award**, *University of Tokyo Research Internship Program*

2011 **William Lowell Putnam Mathematics Competition top 500**

Ranked among top 500 exam takers in the US.

2010 **Kishore Vaigyanik Protsahan Yojana (KVPY) Scholarship**, *Department of Science and Technology, Government of India*

2010 **Gold medal**, *4th International Olympiad on Astronomy and Astrophysics (IOAA), Beijing, China*

2007, 2010 **C.L. Bhat Memorial Award**, *Indian National Astronomy Olympiad*
Awarded to the student with the best overall performance in the national training program.

2009 **Silver medal**, *3rd IOAA, Tehran, Iran*

2008 **2nd place**, *Indian National Mathematics Olympiad*

2008 **Bronze medal**, *13th International Astronomy Olympiad (IAO), Trieste, Italy*

2007 **Gold medal**, *12th IAO, Simeiz, Ukraine*

2005 **Young Physics Ambassador of India**, *World Year of Physics symposium, Taiwan*

Talks & Posters

2022 **Quantum simulation using variational techniques**
– Invited talk at the University of Pittsburgh
– Invited talk at Birla Institute of Technology and Science, Goa

2020 **Nearly optimal time-independent state reversal of a spin chain**
(Poster)
– Winter Conference on Quantum Information Science and Fundamental Physics in Aspen, CO.
– TQC

2020 **Performance and scaling of the local tensor optimzation algorithm**
(Talk)
– FAR-QC Optimization Thrust seminar
– Microsoft Quantum seminar

2019 **Optimal state preparation via QAOA on the long-ranged tranverse field Ising model**
(Poster)
– FAR-QC Grant Meeting
– STAQ Kickoff Meeting.

2019 **Bang-bang control as a design principle for heuristic optimization**
(Talk)
– SQuInT.

2019 **Quantum computing: optimization and state preparation**,
Invited talk at the Tata Research, Design, and Development Centre (TRDDC), Pune

2018 **QAOA on the Grover search problem with multiple marked items**
(Poster)
– NASA Student Intern Poster Session.

2018 **Bang-bang control of classical and quantum optimization algorithms**, (Poster)
– Quantum Information Processing (QIP)

2017 **Bang-bang control of classical and quantum optimization algorithms**, (Poster)
– IBM ThinkQ
– 4th Conference on Quantum Error Correction (QEC)
– Adiabatic Quantum Computing Conference (AQC)
– QuICS Stakeholder's Day

2017 **Quantum algorithms and architectures**,
Invited talk at the Tata Research, Design, and Development Centre (TRDDC), Pune

2013 **Novel phase transitions in a driven, damped optical cavity**, *University of Tokyo Research Internship Program (UTRIP) seminar*
Oral presentation.

2012 **Quantum non-universality of Yang-Baxter gates**, (Talk)
– Southern California Conference on Undergraduate Research
– Annual SURF seminar

2011 **Clamping losses in nanomechanical resonators**, *Annual SURF Seminar*
Oral presentation.

Teaching

2020 **Graduate Teaching Assistant**, *CMSC 657: Introduction to Quantum Information Processing @ UMD*

2014 **Undergraduate Tutorship**
Tutored fellow students one-on-one on various topics in physics, mathematics, computer science, and astronomy.

2013 **Undergraduate Teaching Assistant**, *Ph6: Sophomore Physics Laboratory @ Caltech*
Graded reports and supervised students during lab hours.

2012 **Teaching Assistant**, *Ay1: The Evolving Universe @ Caltech*
Graded sets and exams, designed and taught an independent mini-course, supervised individual projects.

2012 **Organizer, Tutor**, *Ramanujan Math Talent Nurture Camp*
Designed, organized and taught at math training program for advanced students in middle school.

Leadership

2021 **Quantum Computing For High-Energy Physics Seminar**, *Co-organizer*
Started and co-organized seminar in the Physics Division at Berkeley Lab.

2017 **QuICS Reading Group on Quantum Algorithms**, *Organizer*
Weekly reading group for UMD students interested in quantum information.

2013 – 2014 **Organization of the Associated Students of the Indian Subcontinent (Caltech)**, *Webmaster and event organizer.*

2012 – 2014 **Health Advocate Program (Caltech)**, *Emergency Medical Responder (EMR)*
Red Cross certification awarded.

2012 – 2014 **Executive Committee, Dabney House (Caltech)**, *Treasurer, Secretary*

2011 – 2014 **Upperclassman Counselor (Caltech)**
Part of Caltech's on-campus mental health and support network.

2011 – **Swanand Foundation**, *Co-founder*
Not-for-profit organization aimed at nurturing students with potential.

2011 – 2014 **Board of Control (Caltech)**, *Student House representative*
Student hearing body for academic violations of the Caltch Honor Code.

2011, 2012 **Caltech Harvey Mudd Math Competition**, *Organizer*

Mentorship

Students mentored:

- Hrishee Shastri
- Sam King
- Nicole Dong
- Sam DeCoster
- Mason Wittman
- Riley Peterlinz
- Sulaiman Alvi

Skills & Interests

Programming	Python, Julia, C++, LaTeX, Mathematica, iTensor	*(Proficient)*
	Matlab, GROMACS	*(Familiar)*
QC languages	Qiskit, Cirq, OpenFermion	*(Familiar)*
Languages	English, Marathi, Hindi	*(Fluent)*
	Japanese, German	*(Beginner)*
Interests	Vocal music, ukulele, badminton, amateur astronomy, homebrewing	