# Abhinav Deshpande

Doctoral candidate

*3106 Atlantic Bldg.*
*University of Maryland*
*College Park, MD 20742*
✉ *abhinavd@umd.edu*
*adeshpande.gitlab.io*

## Education

2015 – present **Ph.D in Physics**, *University of Maryland*, College Park, USA, GPA: 3.97/4
Adviser: Prof. Alexey V. Gorshkov

2010 – 2015 **Integrated B.Sc-M.Sc in Physics**, *Indian Institute of Technology (IIT) Kanpur*, Kanpur, India, GPA: 9.8/10
M.Sc project adviser: Prof. Saikat Ghosh

## Experience

2015 – present **Research Assistant**, *Department of Physics, University of Maryland*, College Park
Affiliations:
- Joint Center for Quantum Information and Computer Science (QuICS)
- Joint Quantum Institute (JQI)

Jul 2020 – present **Independent contractor**, *Xanadu Quantum Technologies*, Toronto
Working on improving the evidence for hardness of a restricted version of Gaussian boson sampling

Jun – Aug 2019 **Visitor**, *Institute for Quantum Information and Matter, California Institute of Technology*, Pasadena
Worked with Prof. Fernando Brandão and Prof. Manuel Endres on cross-entropy benchmarking in Rydberg atoms

May – Jul 2014 **Visiting Scientist**, *Max Planck Institute for Quantum Optics*, Munich
Worked in the group of Prof. Ignacio Cirac with Prof. Anne E. B. Nielsen on fractional quantum Hall states

May – Jul 2013 **Summer Intern**, *Technische Universität (TU) Dortmund*, Dortmund
Worked with Dr. Dieter Suter on experimental NMR quantum computing

## Research Interests

Complexity theory and applications to physics, Quantum optimization, Classical simulation of quantum systems, Verification of quantum computers, Hamiltonian simulation

## Awards and Achievements

2017 NSF travel grant of $500 to attend *Quantum Information Processing (QIP) 2017*

2015 Dean's Fellowship, Graduate School, University of Maryland
Awarded to outstanding incoming graduate students (amount: $5000)

2015 General Proficiency Medal, IIT Kanpur
Awarded for best academic performance in the physics department

2013 Working Internships in Science and Engineering, German Academic Exchange Service (DAAD)
Awarded $2800 to fund a summer internship at TU Dortmund

2010 – 2013 Academic Excellence Award, IIT Kanpur
Awarded for being among the top 7% out of 820 students across all disciplines (won three consecutive years)

2010 Rank 54, Joint Entrance Examination
Out of approximately 472,000 nation-wide applicants to the Indian Institutes of Technology

2010 Gold medal, Indian Association of Physics Teachers
Awarded to the top 35 out of 30,000 in the Indian National Physics Olympiad

2010 – 2015 Fellow, *Kishore Vaigyanik Protsahan Yojana*, Department of Science and Technology, Government of India
Awarded $8000 under a scheme to "attract exceptionally highly motivated students for pursuing basic science courses and research careers in science."

2008 National Talent Search Scholarship, Government of India
Awarded to 1000 high-school students across India based on an examination and interview (amount: $200)

## Publications

13. M. C. Tran, A. D., A. Y. Guo, A. Lucas, and A. V. Gorshkov,
"Optimal state transfer and entanglement generation in power-law interacting systems", arXiv:2010.02930

12. A. D., A. V. Gorshkov, B. Fefferman,
"The importance of the spectral gap in estimating ground-state energies", arXiv:2007.11582

11. A. Y. Guo, A. D., S.-K. Chu, Z. Eldredge, P. Bienias, D. Devulapalli, Y. Su, A. M. Childs, A. V. Gorshkov,
"Implementing a fast unbounded quantum fanout gate using power-law interactions", arXiv:2007.00662

10. O. Shtanko, A. D., P. S. Julienne, and A. V. Gorshkov,
"Limits on classical simulation of free fermions with dissipation", arXiv:2005.10840

9. M. C. Tran, C.-F. Chen, A. Ehrenberg, A. Y. Guo, A. D., Y. Hong, Z.-X. Gong, A. V. Gorshkov, and A. Lucas,
"Hierarchy of linear light cones with long-range interactions", Physical Review X **10**, 031009 (2020); arXiv:2001.11509

8. Z. Eldredge, L. Zhou, A. Bapat, J. R. Garrison, A. D., F. T. Chong, and A. V. Gorshkov,
"Entanglement bounds on the performance of quantum computing architectures", Physical Review Research **2**, 033316 (2020); arXiv:1908.04802

7. N. Maskara*, A. D.*, A. Ehrenberg, M. C. Tran, B. Fefferman, and A. V. Gorshkov,
"Complexity phase diagram for interacting and long-range bosonic Hamiltonians", arXiv:1906.04178

6. G. Pagano, A. Bapat, P. Becker, K. S. Collins, A. De, P. W. Hess, H. B. Kaplan, A. Kyprianidis, W. L. Tan, C. Baldwin, L. T. Brady, A. D., F. Liu, S. Jordan, A. V. Gorshkov, and C. Monroe,
"Quantum approximate optimization of the long-range Ising model with a trapped-ion quantum simulator", Proceedings of the National Academy of Sciences, 202006373 (2020); arXiv:1906.02700

* These authors contributed equally.

5. V. V. Orre, E. A. Goldschmidt, A. D., A. V. Gorshkov, V. Tamma, M. Hafezi, and S. Mittal, "Interference of temporally distinguishable photons using frequency-resolved detection", Physical Review Letters **123**, 123603 (2019); arXiv:1904.03222

4. A. Bapat, Z. Eldredge, J. R. Garrison, A. D., F. T. Chong, and A. V. Gorshkov, "Unitary entanglement construction in hierarchical networks", Physical Review A **98**, 062328 (2018); arXiv:1808.07876

3. A. D., B. Fefferman, M. C. Tran, M. Foss-Feig, and A. V. Gorshkov, "Dynamical phase transitions in sampling complexity", Physical Review Letters **121**, 030501 (2018); arXiv:1703.05332

2. A. D. and A. E. B. Nielsen, "Lattice Laughlin states on the torus from conformal field theory", Journal of Statistical Mechanics: Theory and Experiment 2016 (1), 013102; arXiv:1507.04335

1. S. M. Roy, A. D., and N. Sakharwade, "Remote tomography and entanglement swapping via von Neumann-Arthurs-Kelly interaction", Physical Review A **89**, 052107; arXiv:1308.2852

See also: Google Scholar, arXiv, ORCID

## Talks

- *Complexity phase diagrams*: (upcoming) CS seminar at IQC, University of Waterloo, 2020
- *The importance of the spectral gap in estimating ground-state energies*: (upcoming) Q-Turn workshop, quantum information theory seminar at University College London, and JQI-QuICS-CMTC seminar, 2020
- *Sampling-complexity phase diagrams*: IQI seminar, California Institute of Technology, 2019
- *Complexity phase transition in interacting and long-range bosonic Hamiltonians*: APS March Meeting, 2019
- *Sampling from ground states of local Hamiltonians*: talk at Workshop on Challenges in Quantum Computation, Simons Institute, 2018
- *Complexity of sampling as an order parameter*: JQI-QuICS-CMTC seminar, 2017

## Posters

- *Complexity phase transition in interacting and long-range bosonic Hamiltonians*: QIP 2019 and TQC 2019
- *Sampling from ground states of local Hamiltonians*: QIP 2019
- *Quantum computational supremacy with Ion Traps*: STAQ Kickoff, Duke University
- *Quantum computational supremacy with Cavity Quantum Electrodynamics*: QuICS Stakeholders' day 2018 and Quantum Machine Learning Workshop 2018
- *Complexity of sampling as an order parameter*: QIP 2017, QuICS Stakeholders' day 2017, and Workshop on Computational Complexity and High-Energy Physics 2017

## Service and Outreach

Reviewed/sub-reviewed for: Quantum Information & Computation, Quantum Information Processing, NSF, Physical Review A, PRX Quantum, NPJ Quantum Information, TQC 2020, Science Advances, QIP 2018

| | |
|---|---|
| Jun 2019 | Volunteer at TQC 2019 + NISQ conference and workshop |
| Aug 2017 – Jan 2019 | Co-organized (with Dr. Jeremy Young) the JQI-QuICS-CMTC seminar at the University of Maryland |
| 2018 | Volunteer at the USA Science and Engineering Festival for the JQI and the American Physical Society (APS) |
| 2017 | Volunteer at QIP 2017 |
| Oct 2016 – Feb 2018 | Part of the Mental Health Task Force, a team formed to raise awareness about mental health in the physics community |
| 2016 | Volunteer at Maryland Day for the JQI |
| 2015 | Member of core grading committee, International Physics Olympiad 2015, Mumbai |
| 2012 | Member of core grading committee, Asian Physics Olympiad 2012, New Delhi |

## Mentoring

| | |
|---|---|
| Jun – Aug 2018 | Co-supervised (with Prof. Alexey V. Gorshkov) Nishad Maskara, a Caltech undergraduate, through the SURF program. Co-authored a paper "Complexity phase diagram for interacting and long-range bosonic Hamiltonians" |
| 2012 – 2013 | Served as an Academic Mentor in the Counselling Service of IIT Kanpur, tutoring students on academic probation |

## Press

| | |
|---|---|
| 2020 | "New Quantum Information Speed Limits Depend on the Task at Hand", press release |
| 2019 | "Stretched photons recover lost interference", press release |
| 2018 | "Complexity test offers new perspective on small quantum computers", press release |

## Skills

| | |
|---|---|
| **Languages:** | English \| Kannada \| Hindi \| Marathi |
| **Programming:** | Julia \| Python \| Mathematica \| MATLAB \| FORTRAN \| C |
| **Others:** | Git \| Bash \| Jekyll \| LaTeX |