

Anuj Apte

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Education

University of Chicago

Candidate for PhD in Physics

Research Interests: Deep Learning, AI for Science & Quantum Physics and Applications

Chicago, IL

2022–2025

University of Chicago

M.S in Physics

Selected Coursework:

Machine Learning for Molecular Modelling · Quantum Information and Computation

Implementation of Quantum Processors · Quantum Complexity Theory

Chicago, IL

2020–2022

Massachusetts Institute of Technology

B.S. in Physics and Philosophy with minor in Music and Mathematics, GPA: 4.9/5.0

Selected Coursework:

Quantum Field Theory I,II & III · General Relativity · Differential Geometry · Statistical Mechanics

Cambridge, MA

2016–2020

Research Experience

Department of Physics, University of Chicago

Graduate Research Fellow

- Currently developing Equivariant Neural Networks for Quantum systems
- Discovered a new class of phase transitions due to breaking of categorical symmetries
- Studied the physics of topological quantum computing and error correction

Chicago, IL

07/2020–Current

Applied Research, JP Morgan Chase

Summer Research Associate

- Conducted parallelized GPU simulation of quantum algorithms
- Devised new quantum algorithm for problems in combinatorial optimization using Chebyshev interpolation

New York, NY

06/2024–09/2024

IBM Corporation

Research Intern

- Developed a deterministic technique for mitigation of measurement errors
- Built mitigation software tool for incorporation into Qiskit runtime

Yorktown Heights, NY

05/2023–08/2023

Xanadu Quantum Technologies

Research Resident

- Designed algorithm and software package for faster simulations of Gaussian quantum circuits
- Demonstrated 100x speedup of circuit simulation for GKP qubit preparation

Toronto, ON

05/2022–08/2022

NASA Quantum AI Lab

Research Intern

- Developed theory for surprising behavior of QAOA circuits at large depth
- Studied performance of pulse-level VQE with supercomputer simulations

Mountain View, CA

06/2021–09/2021

MIT Department of Nuclear Science and Engineering

Researcher

- Studied Kohn anomalies in topological Weyl semi-metals using Quantum Field Theory
- Developed theory for topological signatures in neutron scattering from nodal semi-metals

Cambridge, MA

02/2019–06/2020

Kavli Institute for Astrophysics

Researcher

- Devised a framework to calculate inclined inspiral trajectories into Kerr black holes
- Implemented C++ code to compute trajectories and CUDA code to compute gravitational waves

Cambridge, MA

12/2016–02/2018

Skills

Languages: Python, C++, CUDA, Mathematica

Libraries and Tools: PyTorch, JAX, Git, Slurm, AWS EC2, Qiskit, Cirq, PennyLane

Publications

- [1] **Apte, A.**, Ashmore, A., Cordova, C., Huang, T.-C., “Deep learning lattice gauge theories”. In: *arXiv preprint arXiv:2405.14830* (2024).
- [2] **Apte, A.**, Córdoba, C., Lam, H. T., “Obstructions to gapped phases from noninvertible symmetries”. In: *Physical Review B* 108.4 (2023), p. 045134.
- [3] De Prins, R., Yao, Y., **Apte, A.**, Miatto, F. M., “A Quadratic Speedup in the Optimization of Noisy Quantum Optical Circuits”. In: *Quantum* 7.4 (2023), p. 1097.
- [4] Kremenetski, V., **Apte, A.**, Hogg, T., Hadfield, S., Tubman, N. M., “Quantum Alternating Operator Ansatz (QAOA) beyond low depth with gradually changing unitaries”. In: *arXiv preprint arXiv:2305.04455* 7.4 (2023), p. 1097.
- [5] **Apte, A.**, Marwaha, K., Murugan, A., “Non-Convex Optimization by Hamiltonian Alternation”. In: *arXiv preprint arXiv:2206.14072* 7.4 (2022), p. 1097.
- [6] Liu, M., Liu, J., Liu, R., Makhanov, H., Lykov, D., **Apte, A.**, Alexeev, Y., “Embedding learning in hybrid quantum-classical neural networks”. In: *2022 IEEE International Conference on Quantum Computing and Engineering (QCE)*. Vol. 7. 4. IEEE. Verein zur Forderung des Open Access Publizierens in den Quantenwissenschaften, 2022, pp. 79–86.
- [7] Nguyen, T., Tsurimaki, Y., Pablo-Pedro, R., Bednik, G., Liu, T., **Apte, A.**, Andrejevic, N., Li, M., “Topological signatures in nodal semimetals through neutron scattering”. In: *New Journal of Physics* 24.1 (2022), p. 013016.
- [8] Nguyen, T., Han, F., Andrejevic, N., Pablo-Pedro, R., **Apte, A.**, Tsurimaki, Y., Ding, Z., Zhang, K., Alatas, A., Alp, E. E., “Topological singularity induced chiral Kohn anomaly in a Weyl semimetal”. In: *Physical review letters* 124.23 (2020), p. 236401.
- [9] **Apte, A.**, Hughes, S. A., “Exciting black hole modes via misaligned coalescences. I. Inspiral, transition, and plunge trajectories using a generalized Ori-Thorne procedure”. In: *Physical Review D* 100.8 (2019), p. 084031.
- [10] Hughes, S. A., **Apte, A.**, Khanna, G., Lim, H., “Learning about black hole binaries from their ringdown spectra”. In: *Physical Review Letters* 123.16 (2019), p. 161101.
- [11] Lim, H., Khanna, G., **Apte, A.**, Hughes, S. A., “Exciting black hole modes via misaligned coalescences. II. The mode content of late-time coalescence waveforms”. In: *Physical Review D* 100.8 (2019), p. 084032.

Honors and Awards

- Awarded **Nambu Fellowship** for being the highest-rated applicant to the Ph.D. Program
- **Phi Beta Kappa** inductee from the Class of 2020 at Massachusetts Institute of Technology
- **Silver Medal** in International Physics Olympiad 2015 held in Mumbai, India
- **Gold Medal** in Asian Physics Olympiad 2015 held in Hangzhou, China
- Awarded **NTSE** Scholarship by the Human Resources Department, Government of India