Curriculum Vitae - Patrick Rall

Email: patrickjrall@gmail.com, patrickjrall@ibm.com
Website: `http://patrickrall.com/`
Residence: Brookline, MA

Since December 2021: Quantum Research Staff Member
at the **MIT-IBM Watson AI Lab, Cambridge MA**

Education

2016 - 2021: **University of Texas at Austin**
PhD in Physics
Advised by Scott Aaronson

2012 - 2016: **California Institute of Technology**
BS in Physics with a Minor in Computer Science
Advised by John Preskill

Research

Sep 6 2024: Andrew Eddins, Minh C. Tran, PR. **Lightcone shading for classically accelerated quantum error mitigation** arXiv:2409.04401.

Sep 5 2024: John M. Martyn, PR. **Halving the Cost of Quantum Algorithms with Randomization** arXiv:2409.03744.

Jul 29 2024: Andrew Cross, Zhiyang He, PR, Theodore Yoder. **Linear-Size Ancilla Systems for Logical Measurements in QLDPC Codes** arXiv:2407.18393.

Aug 24 2023: Elisa Bäumer, Vinay Tripathi, Derek S. Wang, PR, Edward H. Chen, Swarnadeep Majumder, Alireza Seif, Zlatko K. Minev. **Efficient Long-Range Entanglement using Dynamic Circuits** arXiv:2308.13065. PRXQuantum 5 030339.

Aug 16 2023: Sergey Bravyi, Andrew W. Cross, Jay M. Gambetta, Dmitri Maslov, PR, Theodore J. Yoder. **High-threshold and low-overhead fault-tolerant quantum memory** arXiv:2308.07915. Nature 627, 778-782.

Feb 12 2023: Willers Yang, PR. **Harnessing the Power of Long-Range Entanglement for Clifford Circuit Synthesis** arXiv:2302.06537. IEEE TQE.2024.3402085. Poster at TQC and QCE 2023.

Oct 4 2022: PR, Chunhao Wang, Pawel Wocjan. **Thermal State Preparation via Rounding Promises** Quantum 7, 1132. Poster at QIP and TQC 2023.

Jul 18 2022: PR, Bryce Fuller. **Amplitude Estimation from Quantum Signal Processing**. Quantum 7, 937. arXiv:2207.08628. Invited colloquium at Penn State University.

Oct 27 2021: Jason Pollack, PR, Andrea Rocchetto. **Understanding holographic error correction via unique algebras and atomic examples**.
JHEP06 56, arXiv:2110.14691.

Sep 29 2021: Logan Hillberry, Matthew Jones, David Vargas, PR, Nicole Yunger Halpern, Ning Bao, Simone Notarnicola, Simone Montangero, Lincoln Carr
Entangled quantum cellular automata, physical complexity, and Goldilocks

rules. Quantum Sci. Technol. 6 045017.

Mar 17 2021: **Faster Coherent Quantum Algorithms for Phase, Energy, and Amplitude Estimation**. Quantum 5, 566. arXiv:2103.09717. Talk at TQC2021.

Apr 14 2020: **Quantum Algorithms for Estimating Physical Quantities using Block-Encodings**. Phys. Rev. A 102, 022408. arXiv:2004.06832.

Aug 28 2019: Scott Aaronson, PR. **Quantum Approximate Counting, Simplified**. arXiv:1908.10846. Presented at SOSA20.

Jan 25 2019: PR, Daniel Liang, Jeremy Cook, William Kretschmer. **Simulation of Qubit Quantum Circuits via Pauli Propagation**.
Phys. Rev. A 99, 062337. arXiv:1901.09070. Poster presentation at SQuInT 2019.

Fall 2018: **Qumquat: An experimental high-level quantum programming language.** ↬ Github.

Apr 15 2018: **Simulating Quantum Circuits by Shuffling Paulis**. arXiv:1804.05404. Conference talks at APS March Meeting 2018, and the Discrete Phase Space Methods workshop, Bad Honnef, August 2018.

Aug 30 2017: **Fractal Properties of Magic State Distillation**. arXiv:1708.09256. Conference talk at the 3rd International Conference for Young Quantum Information Scientists (YQIS) 2017.

Feb 22 2017: **Signed quantum weight enumerators characterize qubit magic state distillation**. arXiv:1702.06990

Teaching

Spring 2019: TA for **Quantum Complexity Theory**.
Scott Aaronson (UT Austin). Graduate course.

2018: TA for the **Quantum Computing Freshman Research Initiative (FRI)**.
Brian La Cour (UT Austin). Three semester course with optics laboratory component.

Spring 2017: TA for **Introduction to Quantum Information Science**.
Scott Aaronson (UT Austin). Junior-level undergraduate course.

Fall 2016: TA for **General Physics II** - Zhen Yao (UT Austin)

Skills

Programming languages: C, Python, Javascript, Haskell, Rust, HTML, CSS, LaTeX
Software: Git, OpenGL, CUDA, Django, Apache, OpenMP
Computing: Arch Linux, Ubuntu Linux, CentOS, Mac OS X, Windows
Languages: English and German

Pre-Graduate Research Experience

2016-17: PR, Iskren Vankov. **Quantum Circuit Simulator.**
An implementation of arXiv:1601.07601. Advised by David Gosset. ↬ Github

2015: **Quantum Cellular Automata for the Analysis of Entanglement Complexity in Quantum Many-Body Systems.**
Advised by Nicole Yunger Halpern and Ning Bao. At Caltech, Pasadena. ⇒ Manuscript

2014: High-sensitivity pump-probe spectroscopy to investigate ultrafast phase transi-

tions in Ca_2RuO_4. Advised by David Hsieh and Hao Chu. At Caltech, Pasadena.

2013: Laksh Bhasin, PR. **A Brute-Force Approach to Fiber-Optic Sensors: Achieving High-Precision Results with Low-Resolution SLED-Based Spectrometers.** Advised by Patrick Leyendecker. At DLR Oberpfaffenhofen. ⇒ Manuscript

2011: Fengning Ding, Jason Liu, PR. **Orbit Determination of 1951 Lick**
At SSP 2011. ⇒ Manuscript

2010, 2012: **Evaluation of Jet Reconstruction Algorithms for a Measurement of the Top-Quark Mass in the** $t\bar{t} \to \text{lepton} + \text{jets}$ **Channel at ATLAS**
Advised by Richard Nisius. At Max-Planck Institute for Physics, Munich. ⇒ Manuscript

High School Education

Munich International School - **International Baccalaureate** - Class of 2012

Last update: October 2024