Eric Anschuetz — Curriculum Vitae

eans@mit.edu • eanschuetz.github.io • US citizen

Experience

Research

Massachusetts Institute of Technology **Cambridge, MA**
PhD student, Aram Harrow and Mikhail D. Lukin groups *2017–2023*
Investigated a variety of problems in quantum algorithms, including:
- The trainability of variational quantum algorithms
  - Using techniques from random matrix theory, Morse theory, and statistical query learning to show shallow, local variational quantum circuits are difficult to train. (arXiv 2022)
  - Using techniques from Morse theory and large deviations theory to show shallow, nonlocal variational quantum circuits are difficult to train. (ICLR 2022)
- The expressive power of quantum machine learning models using techniques from quantum foundations
  - Using quantum contextuality and the constant rank theorem to show an unconditional expressivity separation between a class of quantum recurrent models and a broad class of classical neural sequence models; also showing the first lower bound on the classical complexity of GKP state simulation. (arXiv 2022)
  - Using quantum contextuality to show an expressivity separation between a quantum generative model and certain classes of Bayesian networks. (PRX 2022)
- Algorithms for near-term quantum computers
  - Constructing a loss suitable for near-term quantum computers for ℓ_0 norm regularized regression. (PRD 2022)
  - Using coresets to improve throughput in variational quantum algorithms. (Electronics 2021)
  - Constructing GAN-like architectures where a large classical model is aided by a small quantum computer. (PRA 2019)

Zapata Computing **Cambridge, MA**
Internship *Summer 2018, 2019*
Investigated the use of near-term quantum computers for variational quantum algorithms. Designed the variational quantum factoring algorithm (QTOP 2019), as well as a method for using eigenstate thermalization to train quantum Boltzmann machines. (arXiv 2019, results presented at an invited talk at the Quantum Machine Learning and Data Analytics Workshop 2019)

Harvard University **Cambridge, MA**
Undergraduate research assistant, Mikhail D. Lukin group *2015–2017*
Helped construct the "Atom Array" Rydberg atom experiment, investigating the use of controllable optical tweezers for deterministic trapping of ultracold atoms. Wrote and implemented the initial optical tweezer control algorithm in C++, interfacing with a software-defined radio. (Science 2016)

Teaching

Massachusetts Institute of Technology **Cambridge, MA**
Teaching assistant, 8.371[J] (Quantum Information Science) *2023*
Aided in problem set creation and grading. Assisted students on assignments and in understanding the material in weekly office hours.

- **Massachusetts Institute of Technology** **Cambridge, MA**
  High School Summer Program (HSSP) lecture *2019*
  Presented lecture on ongoing research in quantum algorithms.
- **Massachusetts Institute of Technology** **Cambridge, MA**
  Teaching assistant, 8.311 (Electromagnetic Theory) *2019*
  Led weekly recitations and prepared associated online lecture notes. Assisted students on assignments and in understanding the material in weekly office hours.

Reviewing

Have reviewed submissions to:

- *ICML*
- *NeurIPS*
- *npj Quantum Information*
- *Machine Learning: Science and Technology*
- *New Journal of Physics*
- *Physical Review A*
- *Physical Review B*
- *Physical Review Letters*
- *Physical Review Research*
- *Quantum*
- *Quantum Machine Intelligence*
- *Quantum Science and Technology*

Publications

P. Gokhale, E. R. Anschuetz, C. Campbell, F. T. Chong, E. D. Dahl, P. Frederick, E. B. Jones, B. Hall, S. Issa, P. Goiporia, S. Lee, P. Noell, V. Omole, D. Owusu-Antwi, M. A. Perlin, R. Rines, M. Saffman, K. N. Smith, and T. Tomesh, SupercheQ: Quantum advantage for distributed databases (2022), arXiv:2212.03850 [quant-ph] .

E. R. Anschuetz, A. Bauer, B. T. Kiani, and S. Lloyd, Efficient classical algorithms for simulating symmetric quantum systems (2022a), arXiv:2211.16998 [quant-ph] .

J. Viszlai, T. Tomesh, P. Gokhale, E. Anschuetz, and F. T. Chong, Training quantum Boltzmann machines with coresets, in *2022 IEEE International Conference on Quantum Computing and Engineering (QCE)* (2022) pp. 292–298.

E. R. Anschuetz, H.-Y. Hu, J.-L. Huang, and X. Gao, Interpretable quantum advantage in neural sequence learning (2022b), arXiv:2209.14353 [quant-ph] .

E. R. Anschuetz, L. Funcke, P. T. Komiske, S. Kryhin, and J. Thaler, Degeneracy engineering for classical and quantum annealing: A case study of sparse linear regression in collider physics, Phys. Rev. D **106**, 056008 (2022c).

E. R. Anschuetz and B. T. Kiani, Quantum variational algorithms are swamped with traps, Nat. Commun. **13**, 7760 (2022).

M. S. Rudolph, S. Sim, A. Raza, M. Stechly, J. R. McClean, E. R. Anschuetz, L. Serrano, and A. Perdomo-Ortiz, ORQVIZ: Visualizing high-dimensional landscapes in variational quantum algorithms (2021), arXiv:2111.04695 [quant-ph] .

E. R. Anschuetz, Critical points in quantum generative models, in *International Conference on Learning Representations* (2022).

X. Gao, E. R. Anschuetz, S.-T. Wang, J. I. Cirac, and M. D. Lukin, Enhancing generative models via quantum correlations, Phys. Rev. X **12**, 021037 (2022).

T. Tomesh, P. Gokhale, E. R. Anschuetz, and F. T. Chong, Coreset clustering on small quantum computers, Electronics **10**, 1690 (2021).

J. X. Lin, E. R. Anschuetz, and A. W. Harrow, Using spectral graph theory to map qubits onto connectivity-limited devices, ACM Trans. Quantum Comput. **2**, 1 (2021).

E. R. Anschuetz and C. Zanoci, Near-term quantum-classical associative adversarial networks, Phys. Rev. A **100**, 052327 (2019).

E. R. Anschuetz and Y. Cao, Realizing quantum Boltzmann machines through eigenstate thermalization (2019), arXiv:1903.01359 [quant-ph] .

E. Anschuetz, J. Olson, A. Aspuru-Guzik, and Y. Cao, Variational Quantum Factoring, in *Quantum Technology and Optimization Problems*, edited by S. Feld and C. Linnhoff-Popien (Springer International Publishing, Cham, 2019) pp. 74–85.

M. Endres, H. Bernien, A. Keesling, H. Levine, E. R. Anschuetz, A. Krajenbrink, C. Senko, V. Vuletic, M. Greiner, and M. D. Lukin, Atom-by-atom assembly of defect-free one-dimensional cold atom arrays, Science **354**, 1024 (2016)

Talks

- *The Expressive Power of Restricted Quantum Machine Learning Architectures*, invited talk, Centre for Quantum Technologies (2023)
- *Efficient Classical Algorithms for Simulating Symmetric Quantum Systems*, invited talk, Centre for Quantum Technologies (2023)
- *The Expressive Power of Restricted Quantum Machine Learning Architectures*, invited talk, QHack (2023)
- *Contextuality for Quantum Advantage*, invited tutorial, Harvard University (2022)
- *Interpretable Quantum Advantage in Neural Sequence Learning*, invited talk, Masaryk University (2022)
- *Critical Points in Hamiltonian Agnostic Variational Quantum Algorithms*, invited talk, Quantum Research Seminars Toronto (2021)

- *Critical Points in Hamiltonian Agnostic Variational Quantum Algorithms*, invited talk, Centre for Quantum Technologies (2021)
- *Critical Points in Hamiltonian Agnostic Variational Quantum Algorithms*, invited talk, Quantum Algorithms and Applications seminar, Microsoft (2021)
- *Quantum Advantage in Basis-Enhanced Neural Sequence Models*, Quantum Techniques in Machine Learning (2021)
- *Near-Term Quantum-Classical Associative Adversarial Networks*, Quantum Techniques in Machine Learning (2020)
- *Improved Training of Quantum Boltzmann Machines*, American Physical Society March Meeting (2019)

Awards and Honors

- Graduate Research Fellow, National Science Foundation (2017)
- Dean of Science Fellow, Massachusetts Institute of Technology (2017)
- Harvard College Scholar, Harvard University (2015)

Education

- **Massachusetts Institute of Technology** — **Cambridge, MA**
  Physics — *2017–May 31, 2023*
  PhD in progress, co-advised by Aram Harrow and Mikhail Lukin, 4.00 GPA
- **Harvard University** — **Cambridge, MA**
  Physics — *2015–May 25, 2017*
  AM, 3.89 GPA, 3.95 major GPA
- **Harvard University** — **Cambridge, MA**
  Physics and mathematics joint concentration, computer science secondary — *2013–May 25, 2017*
  AB, 3.92 GPA, *magna cum laude* with Highest Honors in physics