Jasmine Brewer

Research Scientist

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Accomplished researcher with a PhD in theoretical physics from MIT and five years of postdoctoral experience at CERN and Oxford, now developing machine learning methods for quantum chemistry at Quantinuum. My research combines deep learning, reinforcement learning, and statistical inference to develop machine learning methods for complex physical systems, with recent work focused on transformer models for molecular ground-state prediction and reinforcement learning guided by Monte Carlo tree search for graph optimization. I am an independent and self-motivated researcher with demonstrated ability to conceptualize and carry out ambitious research programs, rapidly learn new tools and domains, and deliver publishable results.

Education

Ph.D. in Theoretical Physics — MIT — 2015 - 2020

Presidential Fellow of MIT and Graduate Fellow of the US National Science Foundation

Awards: *outstanding graduate in theoretical physics*

B.Sc. in Engineering Physics — University of Colorado — 2011 - 2015

Presidential scholar at the University of Colorado Boulder

Awards: *outstanding graduate for research* in the College of Engineering and *outstanding graduate in Engineering Physics*

Work Experience and Research Highlights

Quantinuum — Senior Research Scientist, AI Team — 2025 – Present

- Language models for molecular ground-state prediction — Developed transformer-based language models for quantum chemistry to generate ground-state preparation sequences across diverse conformers of a complex molecule. Designed molecular conditioning methods, custom vocabulary and tokenization, and supervised and reinforcement-learning training pipelines. Led systematic studies of molecular representations, dataset design, and rigorous evaluation protocols, including conformer-aware train/test partitioning to mitigate data leakage and the development of robust performance baselines. Collaboration with NVIDIA and a leading pharmaceutical company. *Publication finalized.* Ongoing work extends these approaches for cross-molecule generalization.
- Tree-search-guided reinforcement learning for combinatorial optimization — Developed a framework integrating Monte Carlo tree search with reinforcement learning for a large-scale graph optimization problem. Designed scalable GPU-accelerated search infrastructure and demonstrated consistent improvements over heuristic search and RL baselines. *1 publication; patent filed.*

University of Oxford — Royal Society University Research Fellowship — 2024 – 2025

- Sole principal investigator on a £1.8M research grant to lead a team on an 8-year research project. Awarded for a proposal outlining novel data-driven methods for causal inference in particle physics.

University of Oxford — Leverhulme-Peierls Research Fellow — 2023 – 2024

- Diffusion models for scientific data denoising — Developed diffusion models to remove large non-Gaussian backgrounds from high-energy physics data using image and point-cloud representations.
- Machine learning for graph-structured data — Developed statistical and computational methods to analyze graph-structured data, combining large-scale Monte Carlo simulation, numerical modelling, and graph-based inference. *3 publications.* C++ code on github.

CERN — Senior Research Fellow — 2020 – 2023

- Predictive bayesian parameter estimation — Developed technique to use Markov Chain Monte Carlo to provide reliable data-driven results in place of unavailable experimental measurements. *1 publication*. Python code on github.
- Tools for improving causal inference — Proposed targeted measurement strategies to separate large confounding effects from the underlying signal *(1 publication)* and developed a data analysis strategy that removes confounding effects on average from any measurement *(1 publication)*.

MIT — PhD Candidate, Center for Theoretical Physics — 2015 – 2020

- Developed unsupervised algorithms to separate unlabeled data into physically meaningful categories. Developed a novel Markov Chain Monte Carlo method to infer latent data structure and improve robustness to statistical fluctuations. *2 publications*. Python code on github.

Technical Skills

Machine Learning

- Transformer architectures, language models, reinforcement learning, generative modelling, diffusion models, convolutional neural networks, autoencoders
- Search and planning algorithms (Monte Carlo tree search, beam search)
- Frameworks: PyTorch (extensive), HuggingFace, TensorFlow, Keras
- GPU computing, distributed training, AWS

Molecular Modelling

- Familiarity with ML-targeted molecular representations and quantum chemistry datasets
- Experience with RDKit, PySCF, ADAPT-VQE
- Familiarity with molecular dynamics simulations, nudged elastic band calculations, and electronic structure methods

Programming

- Extensive use of Python (NumPy, SciPy, Pandas), C++, Matlab, and Mathematica. Familiarity with Fortran and C.
- Version control (Git), Bash, and Linux

Statistics and Scientific Computing:

- Bayesian inference, Markov chain Monte Carlo, high-dimensional statistics, uncertainty estimation, bootstrapping
- Linear algebra, numerical optimization, numerical integration, differential equations, fourier analysis

Selected Publications

I am a primary author on 22 publications that are published in leading international journals such as *Physical Review Letters*, *Physics Letters*, and *Journal of High Energy Physics*. I have 775 citations and an h-index of 16. A selection appears below.

5. A. Koziell-Pipe†, **J. Brewer**†, J. Guhit†, M. Farag†, K. Panchagnula, et al. "Learning to Prepare Molecular Ground States with Transformer Models." [*technical approvals completed, submission imminent*] († indicates shared lead authorship)
4. M. Doherty†, M. Puviani†, **J. Brewer**†, G. Matos, D. Amaro, B. Criger, and D.T. Stephen. "Fast stabilizer state preparation via AI-optimized graph decimation." [arXiv:2603.17743]. († indicates shared lead authorship)
3. M. Attems, **J. Brewer**, G.M. Innocenti, A. Mazeliauskas, S. Park, W. van der Schee, and U. Wiedemann. "Medium-enhanced $c\bar{c}$ radiation." *Phys. Rev. Lett. 132, 212301 (2024)*. [arXiv:2209.13600].
2. **J. Brewer**, J. Thaler, and A. Turner. "Data-driven quark and gluon jet modification in heavy-ion collisions." *Phys. Rev. C 103, L021901 (2021)*. [arXiv:2008.08596].
1. **J. Brewer**, J. Milhano, and J. Thaler. "Sorting out quenched jets." *Phys. Rev. Lett. 122, 222301 (2019)*. [arXiv:1812.05111].

Scientific Leadership

Selected Presentations — I have given 80 talks on my research in 16 countries, with audiences ranging from the general public to specialized technical experts. A recorded talk for general audiences is available here. A selection appears below.

5. Johns Hopkins Data Science and AI Institute 2026 Symposium: Artifical Intelligence and Human Learning. *Upcoming invited keynote on behalf of Quantinuum.*
4. Quantum AI 2026. *Upcoming invited keynote on behalf of Quantinuum.*
3. Quark Matter 2022. "Jet quenching and jet-medium interaction". *Invited plenary talk for 400 attendees.*
2. Large Hadron Collider Physics Conference 2021. "Heavy-ion collisions: theory". *Invited plenary talk for 1000 attendees.*
1. Initial Stages 2021. "Adiabatic Hydrodynamization". *Invited plenary talk for 500 attendees.*

Organization — I have organized 10 scientific workshops at major international conferences in AI and particle physics, including an IEEE Quantum Week workshop on *AI for Quantum: Algorithms and Applications*, spanning Generative AI, Agentic AI, Parameter transfer and scaling (upcoming September 2026).

Supervision

I have supervised 7 students at various stages in their careers, which resulted in 4 publications and 1 publication in-progress.

- Hired a Ph.D. intern to work on foundation models for quantum chemistry (Quantinuum)
- Full responsibility for proposing and supervising 2 master's dissertations (Oxford)
- Daily supervision of 2 Ph.D students (Heidelberg and MIT), 1 masters student (MIT), and 2 bachelor students (both MIT)