

Gavin S. Hartnett

PHYSICIST & MACHINE LEARNING RESEARCHER

 email  Google Scholar  Github  LinkedIn

Professional Summary

I am an experienced researcher working at the intersection of machine learning and quantum computing. As the lead of Q-CTRL's Applications and Algorithms team, I design and experimentally implement quantum algorithms, while also leveraging machine learning to improve the performance of near-term quantum computers. I have contributed to high-impact initiatives across academia, public policy, and industry, with a focus on improving the performance of quantum computers, AI/ML applications in defense, computational modeling, and red-teaming large language models. I have a strong track record of leading research teams and bridging the gap between theoretical research and software development, ensuring practical, real-world impact.

Professional Experience

Q-CTRL

Santa Monica, CA

LEAD SCIENTIST

June 2022 - present

- Team lead for the **Applications and Algorithms Team**, driving experimental demonstrations of quantum algorithms
- Improved **large-scale entangled state generation** with quantum error correction primitives
- Designed and implemented a machine learning approach for **quantum circuit layout selection**
- Developed a state-of-the-art and GPU-accelerated **photonic circuit simulation and optimization engine**
- Established a **robust quantum optimization pipeline**

The RAND Corporation

Santa Monica, CA

INFORMATION SCIENTIST

Aug. 2017 - May 2022

- Served as **AI/ML Lead** for the Tech and Narrative Lab, guiding research in AI/ML applications
- Launched and organized a **company-wide AI seminar series**, fostering cross-disciplinary collaboration
- Co-PI for a **generative modeling for social networks** project, leading to novel applications
- Researched **adversarial vulnerabilities in autonomous systems**, influencing defense against cyber threats
- Improved **object detection models using synthetic datasets**, enhancing real-world applicability
- **Modeled COVID-19 across city-scale contact networks**, providing insights for public health interventions

Large Language Model Red-Teaming

Santa Monica, CA

INDEPENDENT CONSULTING

Sept. 2022 - Oct. 2023

- Worked with Meta to red-team their language models
- Worked with OpenAI to red-team [GPT-4](#)

University of Southampton

Southampton, United Kingdom

POSTDOCTORAL RESEARCH FELLOW

Sept. 2015 - Aug. 2017

- Studied theoretical properties of black holes and quantum field theories
- Worked on multiple projects as part of an international collaboration
- Co-organized 3 seminar series
- Traveled extensively to present research and facilitate collaborations

Education

University of California, Santa Barbara

Santa Barbara, CA

PHD AND MA IN PHYSICS

Aug. 2009 - May 2015

- Adviser: Prof. Gary Horowitz
- Dissertation: [Aspects of Black Holes in Higher Dimensions](#)

Syracuse University

Syracuse, NY

BSC IN PHYSICS AND MATHEMATICS

Sept. 2005 - May 2009

- Summa Cum Laude
- Honors Thesis: [Spiral Patterns in Liquid Crystals](#)

Technical Publications

- **Achieving computational gains with quantum error correction primitives: Generation of long-range entanglement enhanced by error detection**
H. Liao, G. S. Hartnett, A. Kakkar, A. Tan, M. Hush, P. S. Mundada, M. J. Biercuk, Y. Baum.
[arXiv:2411.14638 \[quant.ph\]](#)
Preprint
- **Resource-efficient context-aware dynamical decoupling embedding for arbitrary large-scale quantum algorithms**
P. Coote, R. Dimov, S. Maity, G. S. Hartnett, M. J. Biercuk, Y. Baum.
[arXiv:2409.05962 \[quant.ph\]](#)
Preprint
- **Quantum optimization using a 127-qubit gate-model IBM quantum computer can outperform quantum annealers for nontrivial binary optimization problems**
N. Sachdeva, G. S. Hartnett, S. Maity, S. Marsh, Y. Wang, A. Winick, R. Dougherty, D. Canuto, Y. Q. Chong, M. Hush, P. S. Mundada, C. D. B. Bentley, M. J. Biercuk, Y. Baum.
[arXiv:2406.01743 \[quant.ph\]](#)
Preprint
- **Learning to rank quantum circuits for hardware-optimized performance enhancement**
G. S. Hartnett, A. Barbosa, P. S. Mundada, M. Hush, M. J. Biercuk, Y. Baum.
[arXiv:2404.06535 \[quant.ph\]](#)
Quantum 8, 1542 (2024)
- **Twisty-puzzle-inspired approach to Clifford synthesis**
N. Bao, G. S. Hartnett.
[arXiv:2307.08684 \[quant.ph\]](#)
Phys. Rev. A 109, issue 3, 032409 (2024)
- **The Karzas-Latter-Seiler Model of a High-Altitude Electromagnetic Pulse: A New Numerical Code for an Old Model**
G. S. Hartnett.
[arXiv:2402.14864 \[physics.plasm-ph\]](#)
RAND Working Paper WRA879-2
- **The hierarchical parity model**
G. S. Hartnett.
[arXiv:2208.13316 \[cond-mat.dis-nn\]](#)
Physica A: Statistical Mechanics and its Applications 617 (2023): 128679.
- **Modeling the Impact of Social Distancing and Targeted Vaccination on the Spread of COVID-19 through a Real City-Scale Contact Network**
G. S. Hartnett, E. Parker, T. R. Gulden, R. Vardavas, D. Kravitz.
[arXiv:2107.06213 \[physics.soc-ph\]](#)
Journal of Complex Networks 9.6 (2021): cnab042.
- **Protecting the Most Vulnerable by Vaccinating the Most Active**
T. R. Gulden, G. S. Hartnett, R. Vardavas, D. Kravitz.
RAND Perspective PE-A1068-1
- **Deep Generative Modeling in Network Science with Applications to Public Policy Research**
G. S. Hartnett, R. Vardavas, L. Baker, M. Chaykowsky, C. B. Gibson, F. Giroi, D. P. Kenedy, O. A. Osoba.
[arXiv:2010.07870 \[cs.LG\]](#)
RAND Working Paper WRA843-1
- **Self-Supervised Learning of Generative Spin-Glasses with Normalizing Flows**
G. S. Hartnett, M. Mohseni.
[arXiv:2001.00585 \[cs.LG\]](#)
Preprint
- **A Probability Density Theory for Spin-Glass Systems**
G. S. Hartnett, M. Mohseni.
[arXiv:2001.00927 \[cond-mat.dis-nn\]](#)
Preprint

- **Operationally Relevant Artificial Training for Machine Learning: Improving the Performance of Automated Target Recognition Systems**
G. S. Hartnett, L. Menthe, J. Léveillé, D. Baveye, L. Zhang, D. Gold, J. Hagen, J. Xu.
[RAND Report RRA683-1 \(2020\)](#)
- **Covariant Noether charges for type IIB and 11-dimensional supergravities**
O. J. C. Dias, G. S. Hartnett, J. E. Santos.
[arXiv:1912.01030 \[hep-th\]](#)
Class. Quant. Grav. 31, no. 1, 015003 (2021)
- **Adversarial Examples for Cost-Sensitive Classifiers**
G. S. Hartnett, A. J. Lohn, A. P. Sedlack.
[arXiv:1910.02095 \[stat-ML\]](#)
Workshop on Safety and Robustness in Decision Making, NeurIPS 2019
- **Holographic dual of hot Polchinski-Strassler quark-gluon plasma**
I. Bena, O. J. C. Dias, G. S. Hartnett, Benjamin. E. Niehoff, J. E. Santos.
[arXiv:1805.06463 \[hep-th\]](#)
JHEP 9, 33 (2019)
- **Replica Symmetry Breaking in Bipartite Spin Glasses and Neural Networks**
G. S. Hartnett, E. Parker, E. Geist.
[arXiv:1803.06442 \[cond-mat.dis-nn; cs.LG\]](#)
Phys. Rev. E 98, issue 2, 022116 (2018)
- **Constraining the mass of dark photons and axion-like particles through black-hole superradiance**
V. Cardoso, O. J. C. Dias, G. S. Hartnett, M. Middleton, P. Pani, J. E. Santos.
[arXiv:1801.01420 \[gr-qc\]](#)
JCAP 1803, no.03, 043 (2018)
- **Mass-deformed M2 branes in Stenzel space**
O. J. C. Dias, G. S. Hartnett, B. E. Niehoff, J. E. Santos.
[arXiv:1704.02323 \[hep-th\]](#)
JHEP 1711, 105 (2017)
- **Localised Anti-Branes in Flux Backgrounds**
G. S. Hartnett.
[arXiv:1501.06568 \[hep-th\]](#)
JHEP 1506, 007 (2015)
- **A No Black Hole Theorem**
G. S. Hartnett, G. T. Horowitz and K. Maeda.
[arXiv:1410.1875 \[hep-th\]](#)
Class. Quant. Grav. 32, no. 5, 055011 (2015)
- **Quasinormal modes of asymptotically flat rotating black holes**
O. J. C. Dias, G. S. Hartnett and J. E. Santos.
[arXiv:1402.7047 \[hep-th\]](#)
Class. Quant. Grav. 31, no. 24, 245011 (2014)
- **Holographic thermalization, quasinormal modes and superradiance in Kerr-AdS**
V. Cardoso, O. J. C. Dias, G. S. Hartnett, L. Lehner and J. E. Santos.
[arXiv:1312.5323 \[hep-th\]](#)
JHEP 1404, 183 (2014)
- **Non-Axisymmetric Instability of Rotating Black Holes in Higher Dimensions**
G. S. Hartnett and J. E. Santos.
[arXiv:1306.4318 \[gr-qc\]](#)
Phys. Rev. D 88, 041505 (2013)
- **Geons and Spin-2 Condensates in the AdS Soliton**
G. S. Hartnett and G. T. Horowitz.
[arXiv:1210.1606 \[hep-th\]](#)
JHEP 1301, 010 (2013)

Policy Publications

- **Understanding the Limits of Artificial Intelligence for Warfighters: Volume 2: Distributional Shift in Cybersecurity Datasets**
J. J. Steier, E. Van Hegewald, A. Jacques, G. S. Hartnett, L. Menthe.
[RAND Report RR-A1722-2 \(2024\)](#)
- **Cybersecurity and Supply Chain Risk Management Are Not Simply Additive**
V. A. Greenfield, J. W. Welburn, K. Schwindt, D. Ish, A. J. Lohn, G. S. Hartnett.
[RAND Report RR-A532-1 \(2023\)](#)
- **Operational Feasibility of Adversarial Attacks Against Artificial Intelligence**
L. A. Zhang, G. S. Hartnett, J. Aguirre, A. J. Lohn, I. Khan, M. Herron, and C. O'Connell.
[RAND Report RR-A866-1 \(2022\)](#)
- **Empirical Evaluation of Physical Adversarial Patch Attacks Against Overhead Object Detection Models**
G. S. Hartnett, L. Zhang, C. O'Connell, A. J. Lohn, J. Aguirre.
[arXiv:2206.12725](#)
- **Airline Security Through Artificial Intelligence**
S. McKay, G. S. Hartnett, B. Held.
[RAND Report PEA731-1](#)
- **Maintaining the Competitive Advantage in Artificial Intelligence and Machine Learning**
R. Waltzman, L. Ablon, C. Curriden, G. Hartnett, M. Holliday, L. Ma, B. Nichiporuk, A. Scobell, D. Tarraf.
[RAND Report RRA200](#)

Teaching

Pardee RAND Graduate School

Santa Monica, CA

CORE FACULTY MEMBER/PROFESSOR

2018-2022

- Introduction to Modern AI
- Introduction to Blockchain Technology

University of Southampton

Southampton, UK

LECTURER

Sept. 2015 - May 2015

- MATH1052 Differential Equations
- MATH1008 Mathematical Methods
- MATH3071 Light and Waves

University of California, Santa Barbara

Santa Barbara, CA

HEAD TEACHING ASSISTANT

Aug. 2010 - Aug. 2012

- Managed team of 40+ TA's for the entire Physics Department
- Worked with faculty and staff to assign TA's to courses

TEACHING ASSISTANT

Sept. 2009 - May 2015

- PHYS6L Introductory Physics (3 quarters)
- PHYS21 General Physics
- PHYS105 Classical Mechanics
- PHYS115 Quantum Mechanics (2 quarters)
- PHYS219 Statistical Mechanics (graduate level)

Professional Activities

FOUNDER AND ORGANIZER OF AI SEMINAR SERIES AT THE RAND CORPORATION

2018 - 2022

ORGANIZER OF GRADUATE STUDENT HIGH-ENERGY JOURNAL CLUB

2012 - 2014

REFEREE FOR

- *Ethics Reviewer for NeurIPS 2021*
- *ACM Conference on Fairness, Accountability, and Transparency (FAccT) 2020*
- *NeurIPS 2019 Workshop: Machine Learning and the Physical Sciences*
- *Journal of High Energy Physics (JHEP)*
- *Physical Letters B*

- *Classical and Quantum Gravity*
- *General Relativity and Gravitation*

Awards

2021	RAND Spotlight Award , awarded for a study assessing how AI could be used to improve the TSA baggage screening process	<i>Santa Monica, CA</i>
2020	RAND Bronze Medal Award , company-wide annual award, awarded for “vision, integrity, and leadership” in the course of a project on adversarial machine learning for cyber defense systems.	<i>Santa Monica, CA</i>
2019	RAND Spotlight Award , awarded for “developing a new game theoretic approach with Machine Learning techniques to assess cyber defense capabilities.”	<i>Santa Monica, CA</i>
2019	RAND Project Air Force Team Innovation Award , awarded for our team’s “high-risk/high-reward approach to solving a complex technical problem – understanding how machine learning-based algorithms might be vulnerable to cyber attack”	<i>Santa Monica, CA</i>
2014	Dean’s Fellowship , Competitive University-wide fellowship	<i>Santa Barbara, CA</i>
2013	James Hartle Award , Best graduate student talk	<i>Warsaw, Poland</i>
2011	Chairs Certificate of Appreciation , Outstanding service as Head TA	<i>Santa Barbara, CA</i>
2009	Syracuse University Scholar , Highest undergraduate academic honor	<i>Syracuse, NY</i>
2008	Barry Goldwater Scholarship , Most prestigious undergraduate national science award	<i>Syracuse, NY</i>