

Ben Bartlett

PhD candidate in applied physics at Stanford University

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Education

Ph.D. Applied Physics • Stanford University • 2017 – 2022 (expected)

Advisor: Shanhui Fan

Research interests: optical computing, quantum information, nanophotonics, machine learning

M.S. Electrical Engineering • Stanford University • 2017 – 2021 (expected)

Focus: quantum technologies, photonics, machine learning (Advisor: Shanhui Fan)

B.S. Physics and Computer Science • California Institute of Technology • 2013 – 2017

Focus: computational physics, particle physics, quantum information (Advisor: Maria Spiropulu)

Employment

Stanford Pre-Collegiate Studies | Stanford, CA | 06.2019 – 08.2019

Physics instructor

Designed and taught a course for gifted high school students covering a broad range of physics topics

AT&T Foundry / INQNET | Palo Alto, CA | 06.2017 – 09.2017

Engineering intern, quantum networks

Developed a parallelized quantum network simulator for communication over noisy quantum channels

SLAC National Accelerator Lab | Menlo Park, CA | 06.2016 – 09.2016

Engineering intern, Technology Innovation Directorate

Wrote the functional testing suite for the camera readout boards on the Large Synoptic Survey Telescope

CERN | Geneva, Switzerland | 06.2015 – 12.2015

Undergraduate researcher

Developed a vertex reconstruction algorithm for the CMS detector which uses high precision timing data to improve resolution by a factor of ~ 160

California Institute of Technology | Pasadena, CA | 03.2014 – 06.2016*Undergraduate researcher*

Research on the evolution of the Earth-Moon orbital system and the possibility of a constant day length during the Precambrian era due to resonant thermally-driven tidal interactions

Consulting and industry collaborations

Toyota Research Institute of North America | 2020 – Present

Designing optical processors and metasurfaces

GenXComm, Inc. | 2019 – 2020

Optical neural networks and electro-optic activation functions

Skills

Programming: *Fluent:* Python, Mathematica, TypeScript, NumPy/SciPy, Matplotlib, \LaTeX

Experienced: PyTorch, TensorFlow, JavaScript, QuTiP, rllib, ray

Familiar: Julia, C

Passable: Haskell, C++, Visual Basic, Bash, MATLAB, ROOT

Software: Adobe Illustrator / InDesign / Photoshop / Premiere / Audition, Sphinx, Doxygen, TypeDoc, Final Cut Pro, AutoCAD, Autodesk Inventor

Laboratory: optical lithography, nanofabrication, free-space optics, vacuum systems

Selected coursework

- Quantum physics (11 courses)
- Electromagnetism (8 courses)
- Computational physics (5)
- Experimental physics (5)
- Machine learning (4)
- Quantum and modern optics (4)
- Quantum information (3)
- Special and general relativity (3)
- Theory of computation (3)
- History and philosophy of science (3)
- Combinatorics (3)
- Information theory (2)
- Statistical mechanics (2)
- Astrophysics (2)
- Unusual computing systems (2)

Honors and awards

2018 Hertz Foundation Fellowship (finalist)

2015 Jean J. Dixon Undergraduate Research Fellowship

2014 Physics 11 Research Fellowship

- 2013 National Merit Scholar
- 2012 Davison Fellows Scholar (honorable mention)
- 2012 1st place nationally in physics: US Junior Science and Humanities Symposium
- 2012 4th place globally in physics: Intel International Science and Engineering Fair

Patents

1. B. Bartlett, A. Dutt, and S. Fan, "A scalable design for a photonic quantum computer using a fiber ring and a single coherently controlled atom", US Patent Application 63/087,661, Stanford OTL #20-399 (2020)

Publications

1. B. Bartlett, A. Dutt, and S. Fan, "Deterministic photonic quantum computation in a synthetic time dimension", *arXiv:2101.07786 [quant-ph]* (2021) [\[link\]](#)
2. B. Bartlett and S. Fan, "Photonic quantum programmable gate arrays", *Conference on Lasers and Electro-Optics, OSA Technical Digest*, JM4G.8 (2020) [\[link\]](#)
3. I.A.D. Williamson, T.W. Hughes, M. Minkov, B. Bartlett and S. Fan, "Tunable nonlinear activation functions for optical neural networks", *Conference on Lasers and Electro-Optics, OSA Technical Digest*, SM1E.2 (2020) [\[link\]](#)
4. B. Bartlett and S. Fan, "Universal programmable photonic architecture for quantum information processing", *Physical Review A*, 101, 042319 (2020) [\[link\]](#)
5. M.M.P. Fard, I.A.D. Williamson, M. Edwards, K. Liu, S. Pai, B. Bartlett, M. Minkov, T.W. Hughes, S. Fan, and T. Nguyen, "Experimental realization of arbitrary activation functions for optical neural networks", *Optics Express*, 28, 12138-12148 (2020) [\[link\]](#)
6. I.A.D. Williamson, T.W. Hughes, M. Minkov, B. Bartlett, S. Pai, and S. Fan, "Reprogrammable Electro-Optic Nonlinear Activation Functions for Optical Neural Networks" [*Invited paper*], *IEEE Journal of Selected Topics in Quantum Electronics*, 26 (1), 1-12 (2019) [\[link\]](#)
7. S. Pai, B. Bartlett, O. Solgaard, and D.A.B. Miller (2019), "Matrix optimization on universal unitary photonic devices", *Physical Review Applied*, 11, 064044 (2019) [\[link\]](#)
8. B. Bartlett, "A distributed simulation framework for quantum networks and channels", *arXiv:1808.07047 [quant-ph]* (2018) [\[link\]](#)
9. B.C. Bartlett, and D.J. Stevenson, "Analysis of a Precambrian resonance-stabilized day length", *Geophysical Research Letters*, 43, 5716-5724 (2016) [\[link\]](#)
10. B. Bartlett, L. Gray, A. Bornheim, and M. Spiropulu, "Time-based vertex reconstruction in the Compact Muon Solenoid", *CMS Analysis Note*, CMS AN -2016/367 (2015) [\[link\]](#)

Presentations

1. B. Bartlett, "How to train your photons: adventures in optical machine learning" [*Invited*], QHACK 2021, (online event), February 2021
2. B. Bartlett and S. Fan, "Photonic quantum programmable gate arrays", CLEO 2020: Photonic NISQ Technologies, (online event), May 2020
3. B. Bartlett and S. Fan, "Universal programmable photonic architecture for quantum information processing" [*Invited*], U.C. Davis Quantum Journal Club, Davis, CA, January 2020
4. B. Bartlett and S. Fan, "Universal programmable photonic architecture for quantum information processing", Q-FARM Seminar Series, Stanford, CA, November 2019
5. B. Bartlett and S. Fan, "Universal programmable photonic architecture for quantum information processing" [*Invited*], Caltech Quantum Machine Learning and Quantum Computation Frameworks (QMLQCF), Pasadena, CA, November 2019
6. B. Bartlett, "A 'generative' model for computing electromagnetic field solutions", Stanford University Photonics Retreat, Marshall, CA, April 2019
7. B. Bartlett, "Multi-agent reinforcement learning for unit control in the programming strategy game Screeps", Stanford MS&E 338 presentations, Stanford, CA, June 2019
8. B. Bartlett, "A 'generative' model for computing electromagnetic field solutions", Stanford CS229 presentations, Stanford, CA, December 2018
9. B. Bartlett, "Hardware-level simulations of nanophotonic neural networks", Stanford CS230 presentations, Stanford, CA, June 2018
10. B. Bartlett, "QuTiP lecture: photon scattering in quantum optical systems", QuTiP Lecture Series, (online at qutip.org), April 2018
11. B. Bartlett, "A practical framework for simulating quantum networking protocols over noisy information channels", Intelligent Quantum Networks and Technologies Symposium, Palo Alto, CA, September 2017
12. S. Herrmann, "Electrical manufacturing readiness", LSST Camera - Corner Raft Manufacturing Readiness Review, July 2016 (presentation featuring my work)
13. M. Spiropulu, "Precision timing in calorimetry". CPAD Instrumentation Frontier Meeting, Arlington, TX, October 2015 (presentation featuring my work)
14. B. Bartlett, L. Gray, A. Bornheim, and M. Spiropulu, "Timing simulation studies summary", Caltech@CMS, Geneva, Switzerland and Pasadena, CA, August 2015
15. B. Bartlett, L. Gray, A. Bornheim, and M. Spiropulu, "Di-photon vertexing with the High-Granularity Calorimeter", CMS HGCAL Meeting, Geneva, Switzerland, July 2015
16. B. Bartlett and D.J. Stevenson, "Analysis of a Precambrian resonance-stabilized day length", American Geophysical Union Fall Meeting, San Francisco, CA, December 2014
17. B. Bartlett, "Unidirectionalization of particulate distributions in isotropic $D+D \rightarrow {}^3\text{He}+n$ reactions utilizing differential ion velocities", Intel International Science and Engineering Fair, Pittsburgh, PA, May 2012

Science outreach publications

1. [B. Bartlett](#), “LGBTQ+STEM – Anyone Can Be a Scientist”, *Nature Research Device & Materials Engineering Community*, go.nature.com/35zH7Nw (2020)

Teaching experience

Primary instructor:

2019 Topics in Physics (Stanford Pre-Collegiate Studies)

Teaching assistant:

2018 Ph113: Computational Physics (Stanford)

2016 CS1: Introduction to Computer Programming (Caltech)

Tutoring:

2014-17 Dean’s office tutor for 17 classes at Caltech, including quantum mechanics, computational physics, complexity theory, discrete math, waves, statistical mechanics, relativity, electromagnetism, linear algebra, calculus

Open-source software contributions

- **neuroptica**: a flexible simulation package for optical neural networks
 - Repository: github.com/fancompute/neuroptica (★ 122 † 24)
 - Lead developer (2018 – present): I programmed the majority of the simulation framework and have been responsible for maintaining the library.
- **SQUANCH**: A distributed simulation framework for quantum networks and channels
 - Repository: github.com/att-innovate/squanch (★ 31 † 4)
 - Lead developer (2017 – present): I designed the simulation framework, which has been used in multiple publications, and have been responsible for its maintenance.
- **QuTiP**: Quantum Toolbox in Python
 - Repository: github.com/qutip/qutip (★ 965 † 423)
 - Contributor (2018): I wrote the `qutip.scattering` module, which computes scattering in arbitrarily driven quantum systems and was listed as a major feature in the 4.3 release.

Personal software side projects

- **ising-compiler**: a Python package which compiles arbitrary logical circuits into a system of interacting spins. When cooled to absolute zero, the computation result is encoded in the ground state of the spins.
 - Repository: github.com/fancompute/ising-compiler (★ 46 † 2)
- **neural-maxwell**: an unsupervised machine learning model for computing approximate electromagnetic field solutions in a cavity containing arbitrary permittivity distributions

- Repository: github.com/bencbartlett/neural-maxwell (★ 31 † 14)
- **qpqa**: TensorFlow-based simulations of photonic quantum programmable gate arrays
 - Repository: github.com/fancompute/qpqa (★ 65 † 10)
- **Overmind**: a bot written in TypeScript for the programming strategy game Sreeps
 - Repository: github.com/bencbartlett/overmind (★ 320 † 99)
- **Animator5D**: simple library for rendering 5-dimensional (x, y, z, t, color) scatterplot animations with matplotlib
 - Repository: github.com/bencbartlett/Animator5D (★ 81 † 5)

Service

- Reviewer for scientific journals:
 - Physical Review Letters
 - Physical Review A
 - Photonics Research
 - Optics Express
 - Communication Physics
 - Optics Letters
 - OSA Continuum
- Server administrator for the Fan group computing cluster

Professional memberships

2020-Present Optical Society of America
2021-Present American Physical Society

Extracurriculars

2016-17 Caltech Computing Education Committee
2016-17 Caltech physics league
2015-17 Caltech chamber music
2015-16 Ruddock House social team
2013-17 PRISM (Caltech LGBTQ association)