# Ben Bartlett, Ph.D.

Physicist specializing in programmable photonics, quantum information, and optical computation

## Summary

I am a physicist with extensive software engineering experience interested in optical computing. I have worked in the intersection of ML and photonics and am fascinated by physical computing systems.

## Contact

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## Skills

**Programming:**
*Fluent:* Python, Mathematica, TypeScript, QuTiP, NumPy/SciPy/Matplotlib, LaTeX
*Experienced:* PyTorch, TensorFlow, JavaScript, GLSL, meep
*Familiar:* C++, C, Julia, rllib, ray
*Passable:* Haskell, MATLAB, Kotlin

**Software:**
Blender, Ableton Live, AutoCAD, Autodesk Inventor, Illustrator, Final Cut Pro, ffmpeg, LyX, Sphinx, Doxygen, TypeDoc

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

**Mathematical:**
quantum physics, electrodynamics, linear algebra, machine learning, complexity theory, general relativity, nonlinear optics, numerical methods

**Miscellaneous:**
scientific visualization and animation *[portfolio]*, generative art, music production, sound design

## Selected honors

**2018: Hertz Fellowship Finalist**
2015: Jean J. Dixon Fellowship
2012: Davidson Fellows Finalist
2012: CERN research award
2012: 4th in physics, International Science and Engineering Fair
2012: 1st in physics, National JSHS

## Education

**Stanford University** • Ph.D. Applied Physics • 2017 – 2022
› Dissertation: *Photonic computing architectures for classical and quantum information processing* [link]
› Advised by Prof. Shanhui Fan; research in optical computing, machine learning, quantum information, nanophotonics, nanofabrication, quantum optics

**Stanford University** • M.S. Electrical Engineering • 2019 – 2022

**Caltech** • B.S. Physics + Computer Science • 2013 – 2017

## Employment

**PsiQuantum** • *Quantum computer architect* • Palo Alto, CA • 2022 – present
Large-scale simulation of photonic components for a fault-tolerant quantum computer

**X Development (Google X)** • *PhD residency* • Mountain View, CA • 2021 – 2022
Undisclosed project involving electromagnetics, machine learning, distributed computing

**AT&T Foundry / INQNET** • *Quantum networks* • Palo Alto, CA • 2017
Developed a parallelized quantum network simulator with channel noise models

**SLAC National Accelerator Lab** • *Engineering intern* • Menlo Park, CA • 2016
Wrote testing system for camera readout boards on the Large Synoptic Survey Telescope

**CERN** • *Undergraduate researcher* • Geneva, Switzerland • 2015 – 2016
Developed a vertex reconstruction algorithm for the CMS, improving resolution by ~160×

## Patents

› 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", USPTO 63/087,661 (2020)
› B. Bartlett, A. Dutt, and S. Fan, "Systems and methods for deterministic photonic quantum computing in a synthetic time dimension", WO 2022/076982 A1 (2022) [link]

## Selected publications (of 17 total, >580 citations)

› Pai, et al. "Experimentally realized in situ backpropagation for deep learning in photonic neural networks", ***Science***, 380, 398-404 (2023) [link] [press coverage]
› Bartlett, et al. "Deterministic photonic quantum computation in a synthetic time dimension", ***Optica***, 8, 1515-1523 (2021) [link] [press coverage]
› Bartlett, et al. "Universal programmable photonic architecture for quantum information processing", *Physical Review A,* 101, 042319 (2020) [link]
› Fard, et al. "Experimental realization of arbitrary activation functions for optical neural networks", *Optics Express*, 28, 12138-12148 (2020) [link]
› Pai, Bartlett, et al. "Matrix optimization on universal unitary photonic devices", *Physical Review Applied*, 11, 064044 (2019) [link]
› Williamson, et al. "Reprogrammable Electro-Optic Nonlinear Activation Functions for Optical Neural Networks" *[Invited]*, *IEEE JSTQE*, 26 (1), 1-12 (2019) [link]

## Open-source software contributions (* lead developer)

› `neuroptica`* (★ 182 ⑂ 39): a flexible simulation package for optical neural networks
› `SQUANCH`* (★ 42 ⑂ 10): distributed simulation framework for quantum networks
› `QuTiP` (★ 1.5k ⑂ 630): the Quantum Toolbox in Python
› `meep` (★ 993 ⑂ 543): popular open-source electromagnetics simulation package
› `3D-printed-mirror-array`* (★ 2.4k ⑂ 143): generates custom 3D-printable hexagonal mirror arrays capable of reflecting sunlight into arbitrary patterns
› `Overmind`* (★ 497 ⑂ 146): a multi-agent bot for a competitive online strategy game
› `ising-compiler`* (★ 49 ⑂ 2): compiles Boolean circuits into adiabatically cooled spins
› `neural-maxwell`* (★ 54 ⑂ 20): ML model for computing electromagnetic field solutions
› `qpga`* (★ 98 ⑂ 18): TensorFlow-based simulations of photonic programmable gate arrays
› `psiblend`*: library for visualizing photonic circuits in Blender, used at PsiQuantum