# Andi Gu

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## EDUCATION

**Harvard University**                                                                                                    Cambridge, MA
*Quantum Science and Engineering (PhD)*                                                                              *August 2022 -*

**University of California, Berkeley**                                                                                     Berkeley, CA
*Bachelor of Arts in Computer Science and Physics; GPA: 4.0/4.0 (Highest Distinction)*                    *August 2018 - May 2022*
  **Thesis**: Black Box Hamiltonian Learning

## RESEARCH EXPERIENCE

**Quantum Computing Research Fellowship**                                         Los Alamos National Lab, Los Alamos, NM
*Advised by Prof. Patrick Coles*                                                                                 *May 2021 - Present*

- **Optimizers for variational hybrid quantum-classical algorithms**: Developed novel adaptive, shot frugal optimizer and demonstrated its success on a number of chemical structure problems (VQE)
- **Hamiltonian learning**: Ongoing work on methods to learn the parameters for the Hamiltonian of a black box physical system using quantum and classical machine learning techniques

**Quantum Nanoelectronics Lab**                                                                           UC Berkeley, Berkeley, CA
*Advised by Prof. Irfan Siddiqi*                                                                          *September 2020 - Present*

- **Noise mitigation**: Applying restricted Boltzmann machines and Monte Carlo techniques to build accurate estimators for operator expectation values and tested these noise mitigation techniques to demonstrate shot frugality on VQE for $H_2$, LiH, and $BeH_2$

**Supernova Cosmology Project**                                              Lawrence Berkeley National Lab, Berkeley, CA
*Advised by Prof. Saul Perlmutter and Prof. Xiaosheng Huang*                                            *August 2019 - Present*

- **Strong gravitational lens detection**: Designed, implemented, and tested various deep neural network architectures for the identification of gravitational lenses
  - Developed models with fewer parameters and better performance than current state of the art models, and applied these models to discover over 1500 new strong lens candidates.
  - Applied methodologies for learning with class imbalances and sparse data, such as adaptive discriminative domain adaptation (ADDA), generative adversarial networks (GANs), and variational autoencoders (VAEs)
- **Fast bayesian inference for lens modeling**: Developed a novel modeling code in TensorFlow that achieved a 100-fold speed increase over existing codes, and introduced a novel technique for uncertainty estimation using variational inference and Hamiltonian Monte Carlo
  - Successfully applied the lensing code to 12 lenses observed using the Hubble Space Telescope, achieving unprecedented modeling speed

**Lee Teng Fellowship**                                                                                Argonne National Lab, Chicago, IL
*Advised by Dr. Uli Wienands*                                                                                    *May - August 2020*

  - **Beamline simulation**: Ran simulations of Argonne's 'Advanced Photon Source' (APS) to better understand behavior of high charge ($\sim$ 20nC) particle beams
    · Developed a new workflow for the APS Upgrade team to run parallel simulations with varying parameter configurations
    · Analyzed simulation outputs to characterize necessary conditions for beam stability and high accelerator efficiency

## PUBLICATIONS

1. **A. Gu**, X. Huang, W. Sheu, G. Aldering, A. S. Bolton, K. Boone, A. Dey, A. Filipp, E. Jullo, S. Perlmutter, D. Rubin, E. F. Schlafly, D. J. Schlegel, Y. Shu, and S. H. Suyu. "`GIGA-Lens`: Fast Bayesian Inference for Strong Gravitational Lens Modeling." ArXiv:2202.07663 [Astro-Ph], Aug. 2021.

2. **A. Gu**, A. Lowe, P. Dub, P. Coles, and A. Arrasmith. "Adaptive Shot Allocation for Fast Convergence in Variational Quantum Algorithms." ArXiv:2108.10434 [Quant-Ph], Aug. 2021.

3. J. Calvey, T. Berenc, A. Brill, L. Emery, T. Fors, **A. Gu**, K. Harkay, T. Madden, N. Sereno, and U. Wienands. "Plan for Operating the APS-Upgrade Booster with a Frequency Sweep", in Proc. IPAC'21, Campinas, SP, Brazil, May 2021, pp. 201-204. doi:10.18429/JACoW-IPAC2021-MOPAB046

4. X. Huang, C. Storfer, **A. Gu**, et al. "Discovering New Strong Gravitational Lenses in the DESI Legacy Imaging Surveys." The Astrophysical Journal, vol. 909, no. 1, Mar. 2021, p. 27. doi:10.3847/1538-4357/abd62b

5. **A. Gu** "A Method for Single-Image Identification of Graphene." URL `https://andigu.github.io/assets/pdf/GrapheneIdentification.pdf`, Sep. 2019.

## Work Experience

**Physics 111A Instrumentation Lab Undergraduate Teaching Assistant**                                       UC Berkeley, Berkeley, CA
*Supervised by course instructors Dr. Amin Jazaeri and Dr. Mathias Reinsch*                                       *May 2021 - August 2021*
   Received a perfect rating for teaching effectiveness from all end-of-semester survey respondents

**Course Grader**                                       UC Berkeley, Berkeley, CA
*Math 104 Real Analysis, Physics 89 Mathematical Physics, Physics 5A Introduction to Mechanics*                                       *August 2020 - May 2021*

**Gridware**                                       San Francisco, CA
*Research Intern*                                       *December 2019 - February 2020*

**Salesforce**                                       San Francisco, CA
*Software Engineer Intern*                                       *May - August 2019*

## Presentations and Posters

**Invited Talk at the QED-C Poster Sessions**                                       Arlington, VA
*Adaptive Shot Allocation for Fast Convergence in Variational Quantum Algorithms*                                       *June 2022*

**Invited Talk at the KIPAC Cosmology Seminar**                                       Stanford, CA
*`GIGA-Lens`: A Fast Differentiable Bayesian Lens Modeling Framework*                                       *April 2022*

**Invited Talks at the LBNL NERSC Machine Learning and Data Seminar**                                       Berkeley, CA
*`GIGA-Lens`: A Fast Differentiable Bayesian Lens Modeling Framework*                                       *April 2022*

**Presented Poster for the UC Berkeley Undergraduate Physics Poster Session**                                       Berkeley, CA
*Hamiltonian Learning with Unitary Dynamics*                                       *March 2022*

**Invited Talk at the Supernova Cosmology Project Undergraduate Research Forum**                                       Berkeley, CA
*Modeling Strong Gravitational Lenses Discovered in DESI Legacy Imaging Surveys with the Hubble Space Telescope*                                       *September 2021*

**Presentation for the Information Science & Technology Institute Summer School Symposium**                                       Los Alamos, NM
*Learning Properties of Physical Systems from Quantum Circuit Data*                                       *August 2021*

**Presented Poster for the UC Berkeley Undergraduate Physics Poster Session**                                       Berkeley, CA
*Restricted Boltzmann Machines for Quantum State Tomography*                                       *May 2021*

**Presentation for the 2020 Lee Teng Symposium**                                       Chicago, IL
*Tracking Studies with Frequency Ramp for the APS-U Booster*                                       *August 2020*

## Awards & Honors

- UC Berkeley Physics Department Citation, awarded to the top graduating senior in the physics department (Spring 2022)
- Phi Beta Kappa Member
- H2H8 Research Grant (Spring 2021 – Spring 2022)
- Electrical Engineering & Computer Science Departmental Award (Fall 2021)
- Berkeley Physics Undergraduate Research Scholar (Spring 2021, Fall 2021)
- Western Union Foundation Global Scholarship (Fall 2019 – Spring 2020)
- Grand prize winner (from over 100 participants) at Jane Street's San Francisco ETC (Summer 2019)
- Overall third place winner (from over 700 participants) at CalHacks 2018, as well as the winner of best Google hack. Collaborated with Google on a case study for Google Cloud Platform.
- Edward Frank Kraft Award (Fall 2018)
- Broadridge Scholarship (Fall 2018 – Spring 2022)

## Technical Skills

- Machine learning and probabilistic programming: TensorFlow, JAX, TensorFlow Probability, and NumPyro
- Computational quantum physics: Qiskit, QuTiP, Pennylane, Cirq, TensorFlow Quantum
- General purpose scientific computing: NumPy, SciPy, scikit-learn, Matplotlib, MPI
- Web development: React.js, React Native, Node.js, Flask, Django