

Abel Lawrence Peirson

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Education

- Stanford University** — *Ph.D in Physics* 2017 - Mar 2023
- Thesis: High Energy Polarization Statistics and Geometry.
 - GPA: 4.0 (in required coursework).
- University of Oxford** — *MPhys in Physics* 2017
- First Class Honours with Distinction – top 10% of graduating class.
 - College: Christ Church

Fellowships, Honors & Awards

- Stanford Data Science Scholar (\$100k+)** — Stanford, USA 2021
- Future Investigator in NASA Earth and Space Science and Technology FINESST (\$160k+)** — Stanford, USA 2019
- Hooke and Roach prizes for most outstanding member of Christ Church across the sciences** — Oxford, UK 2017
- Oxford International Strategy Scholarship** — Oxford, UK 2016
- Christ Church Academic Scholarship** — Oxford, UK 2014-2017
- Gold, British Physics Olympiad** — London, UK 2013

Research

- Google Brain** — Google Research, CA June 2022 - Present
with Rohan Anil, Ehsan Amid, and Prof. Manfred K. Warmuth
- Explored layerwise Bregman exponential families for preconditioning SGD with local Fisher approximations.
 - Helped implement MLCommons algorithmic efficiency benchmarking.
- Kavli Institute for Particle Astrophysics and Cosmology** — Stanford University, CA July 2018 - Present
with Prof. Roger Romani
- Set current state of the art in X-ray polarization recovery using Simulation-based inference.
 - Improved NASA IXPE polarization sensitivity by > 30% (code adopted as official data analysis pipeline).
 - Created quadratic program + nested sampling approach to fit gravitational microlenses.
 - Designed testable (and fittable) emission models to explain observed polarization in relativistic plasma jets.
- Wu Tsai Neurosciences Institute** — Stanford University, CA Mar 2018 - Jun 2018
with Prof. Shaul Druckmann
- Developed biologically inspired recurrent neural network to reproduce 2D path integration in the drosophila fly brain.
- NeuroAI Lab** — Stanford University, CA Dec 2017 - Mar 2018
with Prof. Dan Yamins
- Unsupervised learning: found transfer-learning with shear transformations of images does not improve classification accuracies.
- Department of Physics** — University of Oxford, UK Sep 2016 - May 2017
with Prof. Garret Cotter
- Placed limits on whether the Cherenkov Telescope Array will constrain the existence of axion-like particles.
- CLIC Test Facility** — CERN, Switzerland June - Aug 2016
with Prof. Philip Burrows
- Improved CTF3's Quadrupole scan and reduced uncertainty in the beam energy spread.

Selected Experience

Google Research, Brain Team — Mountain View, CA
Student Researcher

June - Sep 2022

- Working with Rohan Anil and Ehsan Amid on practical optimization for deep learning.

G-Research — London, UK
Quantitative Researcher

June - Sep 2021

- Quantitative research intern working on forecasting capital markets.

Peirson & Freedman — Stanford, CA
Co-founder

Aug 2018 - Present

- Conceived and designed iOS app *Dank Learning* that uses RNNs to generate memes. [[Webpage](#)]

Publications

Refereed: **10 first / second author papers**, 13 collaboration papers (see publication list).

Metrics (10/1/22): **h-index: 7, citations: 124**. Journals: ApJ (Letters), Science, Nature, NIMA, Neurips (workshops).

Recent & Upcoming Presentations

— Invited —

IXPE: Science so far, IAUS 375: The Multimessenger Chakra of Blazar Jets, Dec 2022

X-ray Polarimetry: A data intensive science, Stanford Data Science Seminar, 2022

Tests of gravitational milli-lensing in the blazar PKS 1413+135, Max Planck Institute for Radio Astronomy, 2022

Optimal Signal Extraction for IXPE and an Application to Blazars, Naval Research Laboratory Colloquium, 2021

Towards Optimal Signal Extraction for IXPE, Third Science Collaboration Meeting (SCM03), 2021

The Polarization Behavior of Synchrotron Self-Compton Emission in Blazars, Understanding the Multiwavelength Blazar Variability - Workshop, Stanford, 2019

AI in Design, Used Future: Symposium by Current Obsession, Pratt Institute NY, 2018

— Contributed —

Relativistic Jets in the Era of X-ray Polarimetry, Columbia THEA Seminar, Nov 2022

Fishy: Local Fisher Approximation via Shampoo, Google Brain Weekly, Nov 2022

Blazar rotations with IXPE, KIPAC Tea, Oct 2022

A Geometric Model for Blazar Rotations, Meeting of the European Astronomical Society, 2020

Media

NASA Blog, Meet IXPE Scientist Abel Lawrence Peirson, 2022 [[Webpage](#)]

The NVIDIA AI Podcast, Episode 68, 2018 [[Recording](#)]

Telescope & Computing Allocations

ALMA — High-frequency radio observations of IXPE targets, 7-14 day (Co-I) 2021

Nordic Optical Telescope — Multi-band polarization observations of IXPE targets, 87ks (Co-I) 2021

NuStar — Multi-Energy X-ray observations of IXPE blazar targets, 140ks (Co-I) 2021

Swift — Monitoring IXPE blazar targets with Swift, 240ks (Co-I) 2020

Google Cloud Platform — Parametric Density Estimation with Uncertainty using Deep Ensembles, \$1000 2020

XMM-Newton — Exploring the Synchro-Compton transition in CGRaBS J0211+1051, 57ks (Co-I) 2019

Open Source Software (★500+)

MLCommons Algorithmic Efficiency: Benchmark and competition for neural network training. [[Code](#)][[Webpage](#)]

ixpeobssim: Simulation and analysis framework for the Imaging X-ray Polarimetry Explorer. [[Code](#)][[Webpage](#)]

MulensModel: Python package for modelling gravitational microlensing events. [[Code](#)][[Paper](#)][[Webpage](#)]

SSCpol: Polarized relativistic jet simulation in C with Python wrapper. [[Code](#)][[Paper](#)]

Dank Learning: ‘Show and Tell’ image captioning for meme generation in Tensorflow. [[Code](#)][[Paper](#)][[Webpage](#)]

Software experience: Python — C/C++ — JAX — PyTorch — Tensorflow

Outreach and Service

Wonderfest — Bay Area, CA

June 2019 - June 2020

Science Envoy

- Selected as one of 10 graduate students from Stanford and Berkeley to communicate science to public audiences.

Stanford Diversity and First Generation Office — Stanford, CA

Oct 2018 - June 2020

First Generation and Low Income Student Mentor

- Mentoring undergraduates from underprivileged backgrounds in all matters of student life.

Stanford Astronomical Society — Stanford, CA

Oct 2018 - Oct 2019

Organizing Member

- Organizing and leading stargazing events for local schools and the public.

Stanford Science Pen Pals — Stanford, CA

Oct 2018 - Oct 2019

Pen Pal

- Corresponding about science with 5th graders from a low-income school in Catalonia.

Mentoring

Jack Dinsmore (graduate) — Polarization leakage in the IXPE gas pixel detector

2022-Present

Josephine Wong (graduate) — Simultaneous polarization fitting of the Crab nebula and pulsar

2021-Present

Teaching

Stanford PHYS113 — *Computational Physics* (Lecturer and Teaching Assistant)

Winter 2021

Stanford PHYS100 — *Introduction to Observational Astrophysics* (Teaching Assistant)

Spring 2019

Selected Graduate Coursework

- **APPHYS293** (Theoretical Neuroscience)
- **CS379C** (Computational Models of the Neocortex)
- **CS238** (Decision Making Under Uncertainty)
- **STATS207** (Time Series)
- **CS224N** (Natural Language Processing)
- **CS230** (Deep Learning)
- **CME212** (Advanced Software Development)
- **EE364a & b** (Convex Optimization I & II)
- **PHYS266** (Statistical Methods in Physics)
- **AA 214** (Numerical Methods for Compressible Flows)
- **CS361** (Engineering Design Optimization)
- **EE263** (Linear Dynamical Systems)

First and Co-Authored Publications

- Fishy: Layerwise Fisher Approximation for Higher-Order Neural Network Optimization*
A.L.Peirson, E.Amid, Y.Chen, V.Feinberg, M.K.Warmuth, R.Anil [Neurips HITY workshop](#) submitted, 2022
- Testing High-Energy Emission Models for Blazars with X-ray Polarimetry*
A.L.Peirson, I.Liodakis, R.W.Romani [ApJ](#), **931**, 59, 2022
- A Deep Ensemble Approach to X-ray Polarimetry*
A.L.Peirson, R.W.Romani [Neurips ML4PS workshop](#), 2021
- New Tests of Millilensing in the Blazar PKS 1413+135* [[Code](#)]
A.L.Peirson, I.Liodakis, A.C.S.Readhead et al. [ApJ](#), **927**, 24, 2022
- Towards Optimal Signal Extraction for Imaging X-ray Polarimetry*
A.L.Peirson, R.W.Romani. [ApJ](#), **920**, 40, 2021
- Deep Ensemble Analysis for Imaging X-ray Polarimetry*
A.L.Peirson, R.W.Romani, H.L.Marshall, J.F.Steiner, L.Baldini. [NIMA](#), **986**, 2020
- The Polarization Behavior of Relativistic Synchrotron Self-Compton Jets* [[Code](#)]
A.L.Peirson, R.W.Romani. [ApJ](#), **885**, 1, 2019
- Prospects for Detecting X-ray Polarization in Blazar Jets*
I.Liodakis, A.L.Peirson, R.W.Romani. [ApJ](#), **880**, 1, 2019
- The Polarization Behavior of Relativistic Synchrotron Jets*
A.L.Peirson, R.W.Romani. [ApJ](#), **864**, 2, 2018
- Dank Learning: Generating Memes Using Deep Neural Networks* [[Code](#)][[Techcrunch](#)][[The Next Web](#)]
A.L.Peirson & E.M.Tolunay, [1806.04510](#), 2018

Publications

- Benchmarking Neural Network Training Algorithms*
G.E.Dahl, et al. incl. A.L.Peirson [JMLR](#), in prep., 2022
- Vela pulsar wind nebula X-rays are polarized to near the synchrotron limit*
F.Xie, et al. (IXPE collaboration, incl. A.L.Peirson) [Nature](#), accepted, 2022
- Observations of 4U 1626-67 with the Imaging X-ray Polarimetry Explorer*
H.L.Marshall, et al. (IXPE collaboration, incl. A.L.Peirson) [ApJ](#), accepted, 2022
- The X-ray Polarization View of Mrk 421 in an Average Flux State as Observed by IXPE*
L.Di Gesu, et al. (IXPE collaboration, incl. A.L.Peirson) [ApJ Letters](#), accepted, 2022
- Polarized Blazar X-rays imply Particle Acceleration in Shocks*
I.Liodakis, et al. (IXPE collaboration, incl. A.L.Peirson) [Nature](#), accepted, 2022
- Polarized X-rays from a Magnetar*
R.Taverna, et al. (IXPE collaboration, incl. A.L.Peirson) [Science](#), accepted, 2022
- X-ray Polarization Detection of Cassiopeia A with IXPE*
J.Vink, et al. (IXPE collaboration, incl. A.L.Peirson) [ApJ](#), accepted, 2022
- Angling for X-ray Pulsar Geometry with Polarimetry*
V.Doroshenko, et al. (IXPE collaboration, incl. A.L.Peirson) [Nature Astronomy](#), accepted, 2022
- Polarized X-rays Constrain The Disk-Jet Geometry in a Black Hole X-ray Binary*
H.Krawczynski, et al. (IXPE collaboration, incl. A.L.Peirson) [Science](#), accepted, 2022
- Simultaneous Space and Phase Resolved X-ray Polarimetry of the Crab Pulsar and Nebula*
N.Bucciantini, et al. (IXPE collaboration, incl. A.L.Peirson) [Nature Astronomy](#), accepted, 2022
- Limits on X-ray Polarization at the Core of Centaurus A as Observed with the Imaging X-ray Polarimetry Explorer*
S.R.Ehlert, et al. (IXPE collaboration, incl. A.L.Peirson) [ApJ](#), accepted, 2022
- The Relativistic Jet Orientation and Host Galaxy of the Peculiar Blazar PKS 1413+135*
A.C.S.Readhead et al. (incl. A.L.Peirson) [ApJ](#), **907**, 61, 2020
- Transverse Beam Phase-Space Measurement Experience at CTF3*
D.Gamba, L.Martin et al. (incl. A.L.Peirson) [IPAC2017](#), 2017

Whitepapers & Textbooks

Neural Network Analysis of X-ray Polarimeter Data

A.L.Peirson, *The Handbook of X-ray and Gamma Ray Astrophysics*, [Springer Nature](#), 2022

The X-ray Polarization Probe Mission Concept

K.Jahoda et al. (incl. **A.L.Peirson**) *Decadal Survey on Astronomy and Astrophysics*, [1907.10190](#), 2020