

# Abel Lawrence Peirson

Kavli Institute for Particle Astrophysics and Cosmology, Stanford CA 94305

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## Education

- Stanford University** — *Ph.D in Physics* 2017 - Sep 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 (\$160k+)** — Stanford, USA 2019
- Roach Prize for the most outstanding undergraduate across the sciences** — Oxford, UK 2017
- Hooke Prize for the most outstanding member of Christ Church in 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

- 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 Bayesian deep learning and computer vision.
  - Improved NASA IXPE polarization sensitivity by > 30% (Code adopted as official data analysis pipeline).
  - Created fast 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 path integration in the drosophila fly brain.
- NeuroAI Lab** — Stanford University, CA Dec 2017 - Mar 2018  
*with Prof. Dan Yamins*
- Found transfer-learning certain affine transformations of images does not improve accuracies in object classification, using RotNet and ImageNet datasets.
- Department of Physics** — University of Oxford, UK Sep 2016 - May 2017  
*with Prof. Garret Cotter*
- Modelled blazar spectra and investigated how they change travelling across different intergalactic media.
  - 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*
- Used beam dispersion to improve CTF3's Quadrupole scan and reduce uncertainty in the beam energy spread.
  - Designed and implemented new fitting program to enhance beam analysis pipeline.
- Plasma and Fusion Laboratory** — University of Science and Technology of China, Hefei June - Aug 2015  
*with Prof. Xuan Sun*
- Improved plasma confinement in the KMAX axisymmetric tandem mirror machine by applying a bias voltage.

## Selected Experience & Outreach

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- G-Research** — London, UK June - Sep 2021  
*Quantitative Researcher*
- Quantitative research intern working on forecasting capital markets.
- Peirson & Freedman** — Stanford, CA Aug 2018 - Present  
*Co-founder*
- Conceived and designed iOS app [Dank Learning](#) that uses neural networks to generate memes.
- Wonderfest** — Bay Area, CA June 2019 - June 2020  
*Science Envoy*
- Selected as one of 10 graduate students from Stanford and Berkeley.
  - Communicated science to public audiences as part of the Bay Area-wide Wonderfest program
- Stanford Diversity and First Generation Office** — Stanford, CA Oct 2018 - Oct 2020  
*First Generation and Low Income Student Mentor*
- Mentoring undergraduates from underprivileged backgrounds in all matters of student life.

## Selected Invited Talks

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

## Telescope & Computing Allocations

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| <b>ALMA</b> — High-frequency radio observations of IXPE targets, 7-14 day (Co-I)                           | 2021 |
| <b>Nordic Optical Telescope</b> — Multi-band polarization observations of IXPE targets, 87ks (Co-I)        | 2021 |
| <b>NuStar</b> — Multi-Energy X-ray observations of IXPE blazar targets, 140ks (Co-I)                       | 2021 |
| <b>Swift</b> — Monitoring IXPE blazar targets with Swift, 240ks (Co-I)                                     | 2020 |
| <b>Google Cloud Platform</b> — Parametric Density Estimation with Uncertainty using Deep Ensembles, \$1000 | 2020 |
| <b>XMM-Newton</b> — Exploring the Synchro-Compton transition in CGRaBS J0211+1051, 57ks (Co-I)             | 2019 |

## Open Source Software (★494+)

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- 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 skills*: Python — C/C++ — PyTorch — Tensorflow

## Graduate Coursework

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

## Teaching

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

Winter 2021

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

Spring 2019

## Peer-Reviewed Publications

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[10] *Testing High-Energy Emission Models for Blazars with X-ray Polarimetry*

A.L.Peirson, I.Liodakis, R.W.Romani [ApJ](#), 2022 (Accepted)

[9] *A Deep Ensemble Approach to X-ray Polarimetry*

A.L.Peirson, R.W.Romani [Neurips ML4PS workshop](#), 2021

[8] *New Tests of Millilensing in the Blazar PKS 1413+135*

A.L.Peirson, I.Liodakis, A.C.S.Readhead et al. [ApJ](#), 927, 24, 2022

[7] *Towards Optimal Signal Extraction for Imaging X-ray Polarimetry*

A.L.Peirson, R.W.Romani. [ApJ](#), 920, 40, 2021

[6] *The Relativistic Jet Orientation and Host Galaxy of the Peculiar Blazar PKS 1413+135*

A.C.S.Readhead et al. [ApJ](#), 907, 61, 2020

[5] *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

[4] *The Polarization Behavior of Relativistic Synchrotron Self-Compton Jets* [[Code](#)]

A.L.Peirson, R.W.Romani. [ApJ](#), 885, 1, 2019

[3] *Prospects for Detecting X-ray Polarization in Blazar Jets*

I.Liodakis, A.L.Peirson, R.W.Romani. [ApJ](#), 880, 1, 2019

[2] *The Polarization Behavior of Relativistic Synchrotron Jets*

A.L.Peirson, R.W.Romani. [ApJ](#), 864, 2, 2018

[1] *Transverse Beam Phase-Space Measurement Experience at CTF3*

D.Gamba, L.Martin, A.L.Peirson Serratosa et al. [IPAC2017](#), 2017

## Whitepapers & Other Publications

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[3] *Neural Network Analysis of X-ray Polarimeter Data*

A.L.Peirson, *The Handbook of X-ray and Gamma Ray Astrophysics*, Springer Nature, 2022

[2] *The X-ray Polarization Probe Mission Concept*

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

[1] *Dank Learning: Generating Memes Using Deep Neural Networks* [[Code](#)][[Techcrunch](#)][[The Next Web](#)]

A.L.Peirson, E.M.Tolunay, [1806.04510](#), 2018