Samuel Lai

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Statement

I am an astrophysics researcher specialising in accretion onto compact objects. By combining high performance computing with novel data processing techniques and multiwavelength spectroscopic observations, my work enhances our understanding of black holes and their environments.

Education

Mar 2021 – Feb 2024 **Australian National University**, *Australia*
Research School of Astronomy & Astrophysics
Website: https://www.anu.edu.au/
- Astrophysics PhD

Sept 2018 – Nov 2019 **University College London**, *United Kingdom*
Department of Physics & Astronomy
Website: https://www.ucl.ac.uk
- Astrophysics MSc
- Distinction, 87.85/100.00

Sept 2014 – June 2018 **University of California – Los Angeles**, *United States*
College of Letters and Science
Website: https://www.ucla.edu
- Astrophysics BSc
- Magna Cum Laude, 3.87/4.00 GPA

Research

Feb 2024 – Present **Sparse VLBI Image Reconstruction with Deep Learning**
Team: Dr. Nithyanandan Thyagarajan, Dr. Ivy Wong

Sept 2020 – Present **Ancient Supermassive Actively-Accreting Black Holes**
Mentor(s): Dr. Christopher Onken, A/Prof. Christian Wolf, and Dr. Fuyan Bian
Thesis Title: *High-Redshift Ultraluminous Quasi-Stellar Objects*

Nov 2015 – Sept 2020 **Dust-Contaminated White Dwarfs with Infrared Excess**
Mentor(s): Dr. Siyi Xu (许偲艺), assistant astronomer at Gemini Observatory

Oct 2018 – Nov 2019 **Emission from Black Hole Event Horizon**
Mentor(s): Dr. Ziri Younsi and Prof. Kinwah Wu
Thesis Title: *Black Hole Jet Simulation and Images*

Jul 2017 – June 2018 **Harmonic Analysis of Gravitational Wave Power in Binary System; Simulation of Stochastically-Driven Coupled Oscillator Grid**
Mentor(s): Prof. Kenneth Young, emeritus professor at CUHK
Thesis Title: *Gravitational waves from a binary system: A detailed analysis of orbital decay*

Apr 2017 – Aug 2018 **Galactic Morphology by Surface Brightness and Isophotal Contours**
Mentor(s): Dr. Michael Rich, research astronomer at UCLA

Relevant Work Experience

Feb 2024 – Present **Commonwealth Scientific and Industrial Research Organisation**, CERC Postdoctoral Fellow
Website: https://www.csiro.au/en/

July 2022 – Feb 2024 **Australian National University**, RSAA Publications Officer
ANU 2.3m Time Allocation Committee
Website: https://rsaa.anu.edu.au/research/publications

Aug – Oct 2021 **European Southern Observatory**, PhD Studentship Programme
Website: https://www.eso.org/

Jan – June 2020 **Gemini Observatory**, Short-term Research Scholar
Website: https://www.gemini.edu/

June – Aug 2013 **Cluster Technology Limited**, Software Trainee
Website: https://www.clustertech.com
- Project Management Team

June – Aug 2012
- Software Development Team

Primary Author Publications

2025 **Very-Long Baseline Interferometry Imaging with Closure Invariants using Image Diffusion**
Authors: **Samuel Lai**, Nithyanandan Thyagarajan, O. Ivy Wong, Foivos Diakogiannis
Publications of the Astronomical Society of Australia, submitted

Deep learning VLBI image reconstruction with closure invariants
Authors: **Samuel Lai**, Nithyanandan Thyagarajan, O. Ivy Wong, Foivos Diakogiannis, Lucas Hoefs
Monthly Notices of the Royal Astronomical Society, 536, 1. doi:10.1093/mnras/stae2607

2024 **Supermassive black holes are growing slowly by z ~ 5**
Authors: **Samuel Lai**, Christopher A Onken, Christian Wolf, Fuyan Bian, Xiaohui Fan
Monthly Notices of the Royal Astronomical Society, 531, 2. doi:10.1093/mnras/stae1301

XQz5: a new ultraluminous z ~ 5 quasar legacy sample
Authors: **Samuel Lai**, Christopher A Onken, Christian Wolf, Fuyan Bian, Xiaohui Fan

Monthly Notices of the Royal Astronomical Society, 527, 2. doi:10.1093/mnras/stad3474

2023 **Virial Black Hole Mass Estimates of Quasars in the XQ-100 Legacy Survey**
Authors: **Samuel Lai**, Christopher A Onken, Christian Wolf, Fuyan Bian, Guido Cupani, Sebastian Lopez, Valentina D'Odorico
Monthly Notices of the Royal Astronomical Society, 526, 3. doi:10.1093/mnras/stad2994

Characterising SMSS J2157–3602, the most luminous known quasar, with accretion disc models
Authors: **Samuel Lai,** Christian Wolf, Christopher A Onken, Fuyan Bian
Monthly Notices of the Royal Astronomical Society, 521, 3682. doi:10.1093/mnras/stad651

2022 **Chemical Abundance of z ~ 6 quasar broad-line regions in the XQR-30 sample**
Authors: **Samuel Lai,** Fuyan Bian, Christopher A Onken, Christian Wolf, Chiara Mazzucchelli, Eduardo Banados, Manuela Bischetti, Sarah E I Bosman, George Becker, Guido Cupani, Valentina D'Odorico, Anna-Christina Eilers, Xiaohui Fan, Emanuele Paolo Farina, Masafusa Onoue, Jan-Torge Schindler, Fabian Walter, Feige Wang, Jinyi Yang, Yongda Zhu
Monthly Notices of the Royal Astronomical Society, 513, 1801. doi:10.1093/mnras/stac1001

2021 **Infrared Excesses around Bright White Dwarfs from Gaia and unWISE. II.**
Authors: **Samuel Lai**, Erik Dennihy, Siyi Xu, Atsuko Nitta, Scot Kleinman, S.K. Leggett, Amy Bonsor, Simon Hodgkin, Alberto Rebassa-Mansergas, Laura K. Rogers
Astrophysical Journal, 920, 156. doi:10.3847/1538-4357/ac1354

Awards and Prizes

2021	**Mt. Stromlo Student Seminars** – Best Science Talk	Australian National University
2019	**Harrie Massey Prize** – Best Overall Astrophysics MSc	University College London
	Mathematical and Physical Sciences Dean's Commendation	

Teaching and Outreach

2024 **Discovery of J0529–4351**
Interviews: BBC, ABC, Associated Press, 7News
Radio: Triple J Hack, SpaceTime with Stuart Gary, Canadian National Radio, 2CC, 6PR
CSIRO Summer Studentship Programme
Student: Amelie Read

2023 **Astronomy Australia Ltd. ESO Blog (Link)**
ASTR3002/ASTR6002 – Galaxies and Cosmology Course
ESO Studentship
Student: Yanina Bonilla Lopez
ASTR3005 – Astrophysics Research Course
Student: Ashley Hai Tung Tan
ANU 2.3m Telescope Training
Student: Neelesh Amrutha

2022 **ANU 2.3m Telescope Training**
Students: Jemma Pilossof, Cassidy Grae Mihalenko
ASTR3005 – Astrophysics Research Course
Student: Zachary Steyn
ASTR3002/ASTR6002 – Galaxies and Cosmology Course
Discovery of J1144-4308

2020 **Journey through the Universe 2020 – Gemini Observatory**
JWST Proposal Workshop

2019 **Public Talk – ICS High School Astronomy Club**
Public Talk – ICS High School Chemistry

Talks/Presentations

Aug 2025	Sydney, Australia	2025 URSI Asia-Pacific Radio Science Conference
July 2025	Adelaide, Australia	Astronomical Society of Australia (ASA) Annual Science Meeting
June 2025	Athens, Greece	IAUS 397: UniversAI
May 2025	Online	NgEHT AI Working Group Monthly Meeting
Jan 2025	Online	NgEHT AI Working Group Monthly Meeting
May 2025	Perth, Australia	CSIRO Bolton Symposium
Dec 2024	Perth, Australia	CSIRO Journal Club
Aug 2024	Melbourne, Australia	University of Melbourne **Invited** Colloquium
June 2024	Online	Astronomical Society of Australia (ASA) Annual Science Meeting
Mar 2024	Perth, Australia	CSIRO Space & Astronomy Colloquium
Feb 2024	Canberra, Australia	PhD End-of-Thesis Talk
Jan 2024	Hong Kong	Hong Kong Polytechnic University **Invited** Colloquium
Sept 2023	Online	ASA Early Career Researcher Symposium (https://www.youtube.com/watch?v=QsKj_t5zjnU)
July 2023	Sydney, Australia	Astronomical Society of Australia (ASA) Annual Science Meeting
March 2023	Canberra, Australia	RSAA Journal Club
September 2022	Online	Gemini Observatory Journal Club
September 2022	Tucson, Arizona	University of Arizona Extragalactic Group
September 2022	Tucson, Arizona	Steward / NOIRLab Galaxy Group
September 2022	Sedona, Arizona	Giant Magellan Telescope Community Science Meeting
March 2022	Online	XQR-30 WP3
July 2022	Canberra, Australia	PhD Thesis Presentation
July 2022	Tasmania, Australia	Astronomical Society of Australia (ASA) Annual Science Meeting[1]

February 2022	Online	European Southern Observatory TMT
November 2021	Online	Mt. Stromlo Student Seminars
September 2019	London, United Kingdom	MSc Thesis Defense

Public Codes

2025 **DIReCT/GenDIReCT**
Authors: **Samuel Lai**
Purpose: Perform VLBI image reconstruction with deep learning models (vision transformer/generative diffusion model).
GitHub/Zenodo

2023 **PyQSpecFit: Python-based Quasar Spectral Fit Code**
Authors: **Samuel Lai**
Purpose: Sensibly model emission features in rest-frame optical and ultraviolet quasar spectra.
GitHub/Zenodo

BADFit: Black hole Accretion Disc Fitting Code
Authors: **Samuel Lai**
Purpose: Model the large-scale multi-wavelength quasar spectral energy distribution with ray-traced thin and slim accretion disc synthetic spectra in order to constrain black hole properties.
GitHub/Zenodo

1 Poster