School of Chemistry and Physics
Astrophysics Research Group

QUT Astrophysics Research Group

Group Overview Presentation 2026

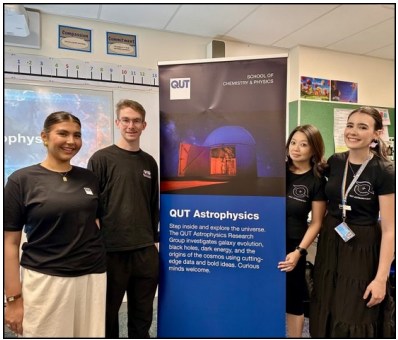
Dr Michael Cowley

Acknowledgement of Country

We acknowledge the Turrbal and Yugara peoples, as the First Nations owners of the lands from which we join you today. We pay respect to their Elders, lores, customs and creation spirits. We recognise that these lands have always been places of teaching, research and learning. We also acknowledge the important role that Aboriginal and Torres Strait Islander people play within our community. We extend our respect to Elders and Traditional Owners of all the lands from which each of you is joining.

QUT Astrophysics Research Group

- Research spans extragalactic astrophysics and cosmology, including galaxy evolution, supermassive black holes, and dark energy
- Active contributors to major international surveys and collaborations: ASKAP-EMU, DESI, ZFIRE, ZFOURGE, and MINERVA
- Subscriber of Astronomy Australia Limited (AAL), connecting us to telescope and HPC access and the broader Australian astronomy community
- `https://research.qut.edu.au/qutastrophysics/`



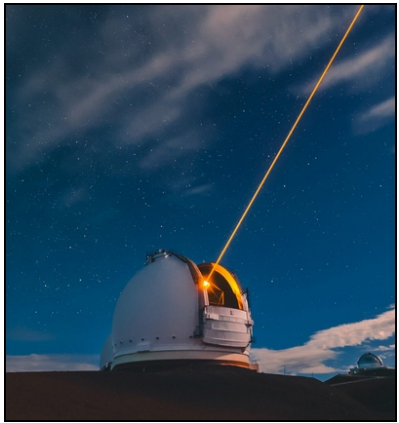
ZFOURGE: FourStar Galaxy Evolution Survey

- Deep near-infrared imaging survey using the FourStar instrument on the 6.5m Magellan telescope, yielding precise photometric redshifts ($\sigma_z < 2\%$) for galaxies at $1 < z < 4$
- Catalogues of $>$70,000 galaxies across three legacy fields (CDFS, COSMOS, UDS), providing a benchmark for galaxy properties
- Underpins science spanning galaxy stellar mass functions, high-z AGN demographics, and protoclusters in the early Universe

https://zfourge.tamu.edu

ZFIRE: High-z MOSFIRE Survey

- Keck/MOSFIRE spectroscopic survey of star-forming galaxies in rich environments at $1.5 < z < 2.5$, building directly on ZFOURGE
- $\sim$400 sources across $1.57 < z < 2.66$ from emission lines (Hα, Hβ, [N II], [O II], [O III]) with resolving power $R = 3500$
- Key results include confirmation of galaxy protoclusters at $z \sim 2$ and constraints on star formation, metallicity, and gas fractions in dense environments



https://zfire.swinburne.edu.au

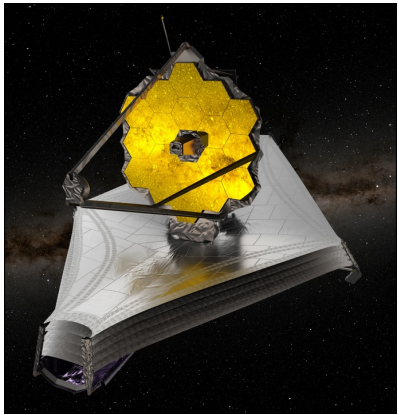
DESI: Dark Energy Spectroscopic Instrument

- Spectroscopic survey on 4m Mayall Telescope at Kitt Peak, targeting $\sim$40 million galaxies and quasars across 1/3rd of sky
- Constructs largest 3D map of the Universe spanning 11 billion light years, with DR1 already comprising 18.7 million redshifts
- Primary goal is to constrain dark energy via baryon acoustic oscillations and redshift-space distortions, while also enabling galaxy evolution and AGN science

https://www.desi.lbl.gov

MINERVA: Medium-band Imaging with JWST

- JWST Cycle 4 treasury program obtaining 8-filter NIRCam medium-band and 2-filter MIRI imaging across four legacy fields (UDS, COSMOS, AEGIS, GOODS-N)
- Delivers photometric catalogues with up to 35 filters per galaxy, extending the medium-band imaging of ZFOURGE into the JWST era with far greater depth and sensitivity
- Enables precise redshifts, stellar masses, and ID of rare populations including little red dots.



https://minerva.colorado.edu

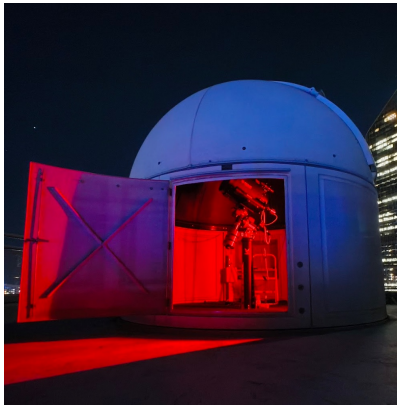
ASKAP-EMU: Evolutionary Map of the Universe

- Wide-field radio continuum survey of the Southern Sky at 943 MHz using CSIRO's ASKAP telescope
- Expected to catalogue $\sim$20 million extragalactic radio sources, spanning star-forming galaxies, AGN, galaxy clusters, and large-scale structure
- An international collaboration of over 400 scientists across 24 countries; our group contributes to galaxy evolution and AGN science working groups

https://emu-survey.org

Observational Astronomy at QUT

- Hands-on observational program using QUT's dome telescope and a fleet of digital smart telescopes
- Student-led research into the impacts of light pollution on astronomical imaging, combining urban and dark-sky observations with digital image analysis pipelines
- Projects span photometry, image stacking, signal-to-noise analysis, and comparison with major sky survey datasets



Aboriginal Astronomy in South East Queensland

- Documenting and preserving Aboriginal astronomical knowledge in South East Queensland, home to $\sim$120 known bora sites with documented astronomical orientations
- Research led by Carmen Martinez Harris (MPhil), developing ethical community engagement frameworks in collaboration with CSIRO and the University of Melbourne
- Framework paper in preparation for the *Journal of Astronomical History and Heritage*

Place of Knowledge, 2014 by Uncle Chris Thorne

Dr Michael Cowley, Senior Lecturer

Galaxy Evolution & Supermassive Black Holes

ASKAP-EMU · ZFOURGE · ZFIRE · MINERVA

Established the QUT Astrophysics Research Group in 2019, which has grown to two academics, six HDRs, and over 90 undergraduate research projects supervised to date. His research focuses on co-evolution of galaxies and AGN using multiwavelength survey data. Coordinates astrophysics minor and lectures across all years, serves as Academic Lead of L&T in School of Chemistry & Physics and is QLD Chair of AIP.

Dr Rossana Ruggeri, Lecturer

Dark Energy & Large-Scale Structure

DESI · LSST · Dark Energy Survey

Cosmologist mapping millions of galaxies to investigate dark energy and the large-scale structure of the Universe. She is co-leader of the DESI Lensing working group and contributes to the Vera Rubin Observatory. At QUT, Rossana lectures across the physics curriculum and is a strong advocate for diversity in STEM through science communication and outreach.

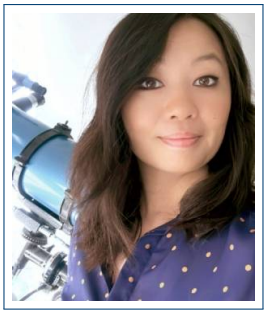
Lily Gustafson, PhD Candidate

Multi-tracer Star Formation Rate Calibration

ASKAP-EMU Survey

Lily's PhD investigates how different observational tracers of star formation relate to one another across a sample of $\sim$6,000 galaxies. By comparing radio continuum (probing $\sim$100 Myr timescales), Hα emission ($\sim$10 Myr), and full star-formation histories from ProSpect SED fitting, her work establishes a robust multi-tracer calibration and quantifies the scatter introduced by AGN contamination and dust attenuation.

Vanessa Porchet, PhD Candidate

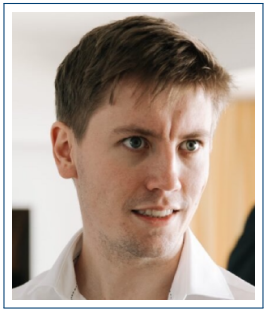


Revealing the Growth of Supermassive Black Holes in Radio Galaxies

ASKAP-EMU Survey

Vanessa's PhD investigates the role of supermassive black holes in shaping their host galaxies over the past nine billion years. Using SED fitting tools such as CIGALE and ProSpect, she disentangles the energy contributions from star formation, dust, and black hole accretion in radio-detected galaxies at $z < 1.5$, building a robust framework for identifying active black holes in next-generation radio surveys.

David Whebell, MPhil Candidate



The Star Formation History of the Universe from EMU

ASKAP-EMU Survey

David's MPhil addresses one of the key challenges in radio survey science: incompleteness. By developing probabilistic methods to statistically correct for undetected sources, his work aims to recover a more complete picture of the cosmic star formation history from EMU's vast catalogue of radio-detected galaxies.

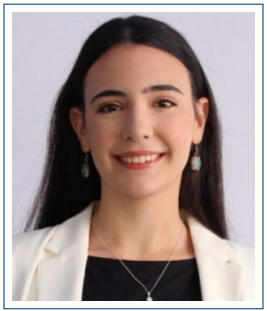
Jessica Stewart, MPhil Candidate

AGN Demographics Across Cosmic Time

ZFOURGE Survey

Jessica's MPhil investigates how the population of active galactic nuclei has evolved across cosmic history. Using the rich multiwavelength photometry of the ZFOURGE legacy fields, she characterises AGN demographics out to high redshift, shedding light on the role of black hole activity in shaping galaxy evolution over billions of years.

Carmen Martinez Harris, MPhil Candidate



Discovering Bent-Tailed Radio Galaxies with Machine Learning

ASKAP-EMU Survey

Carmen's MPhil applies machine learning to bent-tailed radio galaxies, whose curved morphologies betray their motion through dense cluster environments. Using EMU's vast imaging dataset, she is developing automated detection pipelines to discover and catalogue these objects at an unprecedented scale.

Honours Research Projects 2026

Student	Project
Abin Binu	Mapping Dark Energy with Supernovae and Bayesian Inference
Craig Bonnington	Galaxy Classification and Property Prediction with Machine Learning
Stephanie Clark	Measuring Cosmic Homogeneity with DESI
Jamie Guthrie	Hunting Black Holes with Machine Learning
Kelsey Hargraves	Unmasking Black Holes in the MINERVA Survey
Samantha McIvor	How Spectral Index Assumptions Shape AGN Selection in EMU
Emma White	Quantifying Light Pollution in Astronomical Imaging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