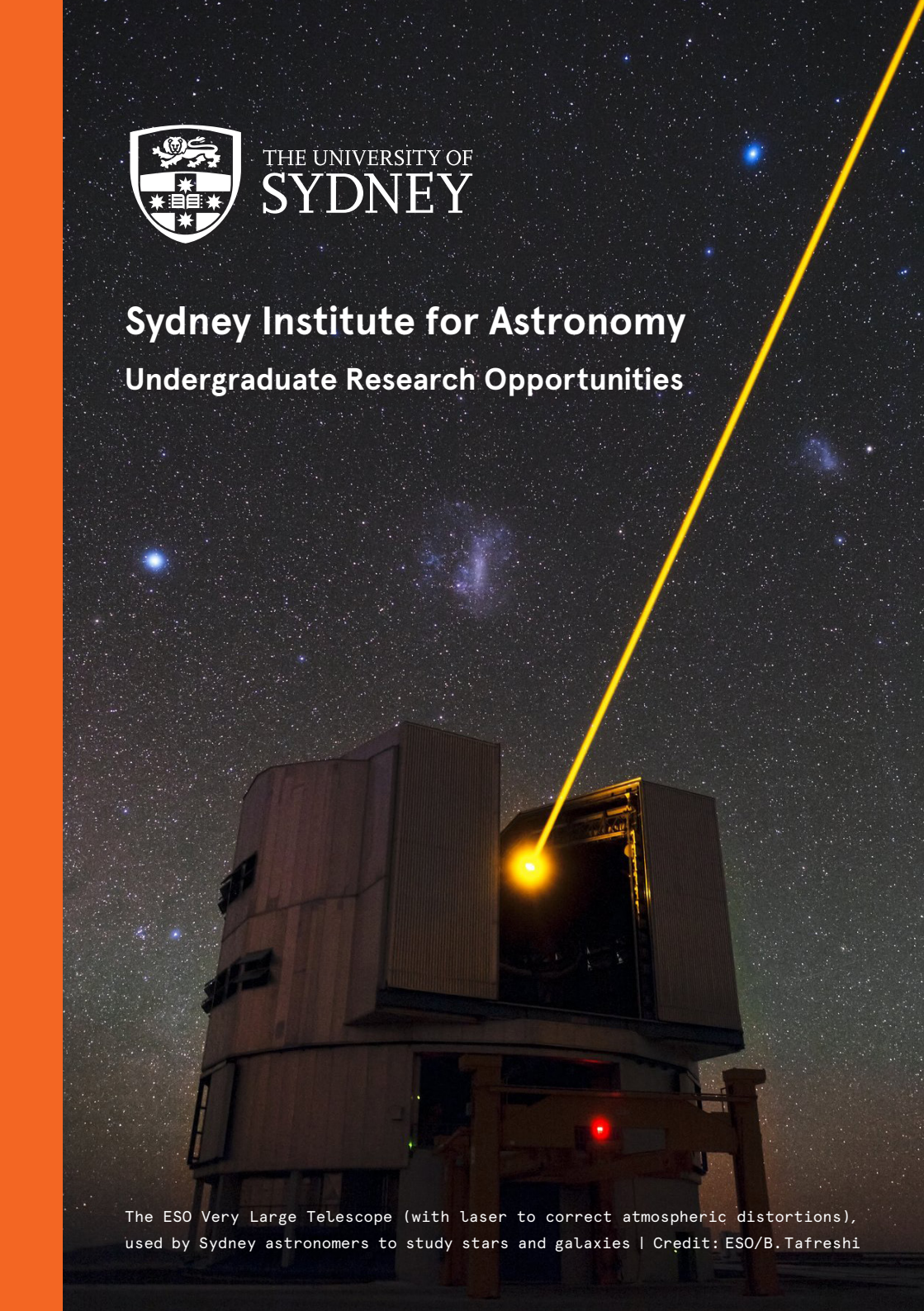
THE UNIVERSITY OF SYDNEY

Sydney Institute for Astronomy

Undergraduate Research Opportunities



The ESO Very Large Telescope (with laser to correct atmospheric distortions), used by Sydney astronomers to study stars and galaxies | Credit: ESO/B.Tafreshi

"I find the scope and creativity of research in astronomy unparalleled. It's amazing to consider the wealth of information deep space photons can reveal to us humans living on a tiny planet millions of light years away."

Yinuo Han
Summer vacation scholarship student

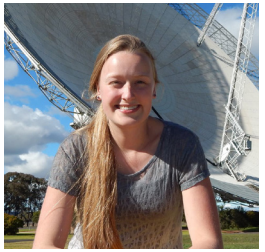
WHAT IS ASTRONOMY RESEARCH?

Astronomers ask really big questions: where did the Universe come from? how do galaxies form? is there life beyond the Solar System? To answer these questions, we observe the sky with telescopes; run supercomputer simulations; perform complex calculations; build and test astronomical instruments, and bring all of this together in research publications. In the Sydney Institute for Astronomy we study the Sun, exoplanets and stars, galaxies, black holes and the early Universe.

In your research project, you'll get to work in a team of astrophysicists solving real problems at the forefront of science.

Nicholas Barbara
Third year project student

"My project has not only opened up room for future research into stellar classification, but also into searches for rare stars in large data sets, and how data-driven methods can be used to tackle challenging problems in astronomy from a different perspective."



Charlotte Ward
Physics honours student

"My project was exciting because Fast Radio Bursts are very rare and there are many unconfirmed theories about what they could be. A great thing about astronomy is that I get to collaborate with people from all over the world...it's a fantastic community to be a part of."

HOW CAN YOU DO ASTRONOMY RESEARCH IN YOUR DEGREE?

Astronomy is part of Physics, and everyone can do astronomy research within a Physics Major in their senior year. If you are a Dalyell Scholar or in the Special Studies Program you have opportunities earlier in your degree. Contact the Unit of Study coordinator to find out more about project requirements.

First Year Physics

PHYS1904 Physics 1B (SSP)

You will work on an astrophysics research project with a small group of students. This replaces the group project in the experimental lab, and takes about three hours of work per week.

SCDL1991 Science Dalyell showcase

You will investigate a scientific question led by a senior undergraduate mentor, and supported by an academic expert. This involves a few hours of weekly meetings and a final presentation to share your discoveries.

Second Year Physics

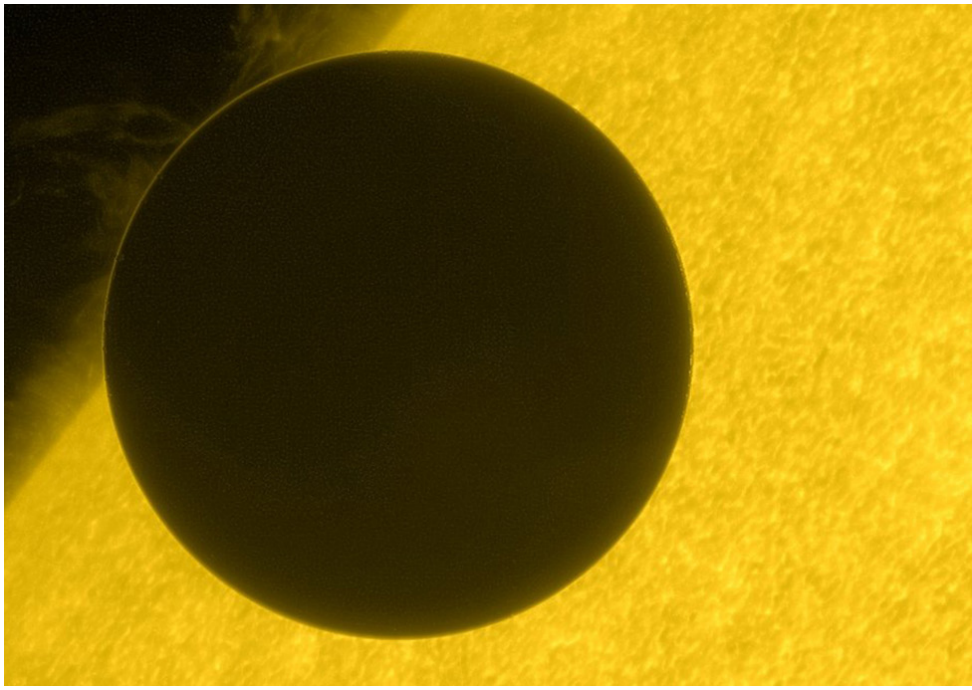
PHYS2921 Physics 2A (SSP)

PHYS2922 Physics 2B (SSP)

You will work on an individual research project, mentored by one or more of the academic research staff. This replaces work in the laboratory, and the time commitment is 3 hours per week across the semester. At the end of the project you will give a presentation and write a report on your research.

PHYS2923 Astrophysics and Relativity (SSP)

You will work on an individual research project, mentored by one or more of the academic research staff. This replaces work in the laboratory, and the time commitment is 3 hours per week across the semester. At the end of the project you will give a presentation and write a report on your research.



Sydney Astronomers use data from Hinode and other satellites to model the Sun's dynamic atmosphere | Credit: JAXA/NASA/Hinode.

Third Year Physics

PHYS3888 Physics Interdisciplinary Project

In this project you will work in groups to tackle an interdisciplinary problem. For example, using machine learning or data science to explore an astronomy dataset. This consists of 4 hours per week project work and at the end you will give a presentation and report describing your results.

SCDL3991 Science Dalyell Individual Research Project

In this unit you will get a first-hand experience of cutting-edge research. Working in an astrophysics research group you will contribute to answering a novel research question. This could involve making theoretical predictions, exploring new astronomy data, or modelling an astrophysics phenomenon. At the end you will present your results in a scientific seminar and report.

Honours

Physics honours is your chance to tackle a substantial year-long astrophysics research project. For many people this is the first step towards a research career, and for others it provides advanced training in problem solving and data analysis skills that they take into industry.

Honours research tackles unsolved problems in astrophysics, and many students end up publishing one or more scientific papers based on their honours thesis work.

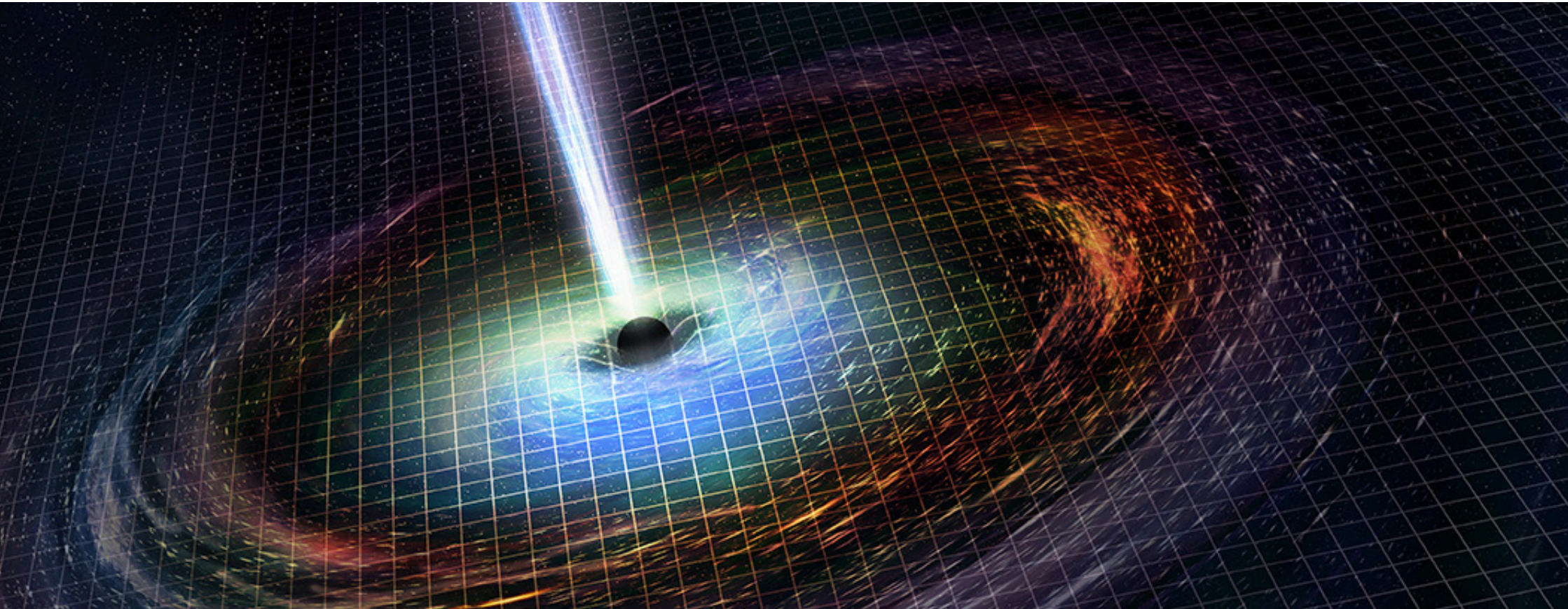
To enter honours you usually need a credit (65) average across Senior Physics, as well as a SciWAM of at least 65 or above. However you should contact the honours coordinator to discuss alternative paths.

Summer Vacation Scholarships

There is also the opportunity to get research experience over the summer break with a summer vacation scholarship aimed at high performing students. You will work for 6 weeks (full time) within SIfA over the December to February break.

For astrophysics projects there is the opportunity to extend this to a 12 week project with a Hunstead Scholarship in Astronomy.

Sydney Astronomers follow-up gravitational wave events from neutron star mergers | Credit: NASA/CXC/M.Weiss



WHAT PROJECTS ARE AVAILABLE?

You can do research in the wide range of areas listed below. Contact these SIfA astrophysicists for information on specific projects.

Tim Bedding studies oscillations in stars ("starquakes") to reveal details about their interiors. He uses data from NASA's Kepler and TESS spacecraft to measure the ages of stars and understand their internal structure, including those with exoplanets.

tim.bedding@sydney.edu.au

Joss Bland-Hawthorn builds models of the Milky Way with the goal of understanding how it formed and evolved over billions of years. He is an expert in Galactic archaeology, a field that concentrates on the oldest stars.

joss.bland-hawthorn@sydney.edu.au

Céline Boehm is an astroparticle physicist working at the interface of particle physics, astrophysics and cosmology. She is trying to discover what dark matter is made of.

celine.boehm@sydney.edu.au

J**ulia Bryant** examines how gas gets into galaxies. She leads a team that is building the Hector instrument for the Anglo-Australian Telescope, which uses robotic positioning of optical fibre bundles so that many galaxies can be imaged in 3-D at once.

julia.bryant@sydney.edu.au

Scott Croom explores galaxy evolution and cosmology. He leads the SAMI Galaxy Survey, using an instrument developed by SIfA with the Australian Astronomical Observatory. He is an expert in black holes and quasars, and their role in galaxy formation.

scott.croom@sydney.edu.au

Anne Green is engaged in radio astronomy surveys of star-forming complexes and astrophysical masers as well as searching for cosmic sparklers. She is an expert in radio supernova remnants - the shocks that live on after massive stars die.

anne.green@sydney.edu.au

Dick Hunstead is engaged in surveys of active galaxies and high-redshift radio sources. He also studies galaxy clusters, the largest and most massive concentrations of galaxies in the Universe.

richard.hunstead@sydney.edu.au

Helen Johnston conducts research into stellar remnants like neutron stars and black holes, particularly those in binary star systems. She also studies the supermassive black holes at the centres of galaxies.

h.johnston@sydney.edu.au

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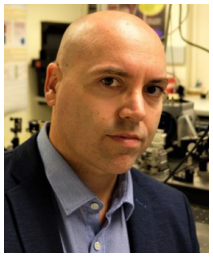


Sergio Leon-Saval develops optical and photonic instruments for cubesats, for astronomical telescopes and for commercial applications. He is Director of the SAIL labs, the experimental arm of SIfA.

sergio.leon-saval@sydney.edu.au

Geraint Lewis explores the influence of dark energy and dark matter on the evolution and ultimate fate of the Universe. He also uses gravitational lensing to probe the structure of dark matter in galaxies.

geraint.lewis@sydney.edu.au

Don Melrose is a theoretical physicist who builds complex models of energetic processes in the Universe. He studies phenomena such as solar outbursts, pulsar activity and relativistic plasmas in astrophysical jets.

donald.melrose@sydney.edu.au

Tara Murphy studies some of the most energetic sources in the sky including gamma-ray bursts and supernovae using new radio telescopes like ASKAP and the MWA. She leads the radio follow-up of gravitational wave events that occur when neutron stars merge.

tara.murphy@sydney.edu.au

John O'Byrne has been engaged in high resolution imaging, interferometry and photonic developments, but also has interests in astronomy education.

john.obyrne@sydney.edu.au

Elaine Sadler studies the coevolution of massive galaxies and their central black holes. She also searches for neutral hydrogen gas around distant galaxies to learn about the fueling process of star formation.

elaine.sadler@sydney.edu.au

Peter Tuthill develops novel technologies to image the theatres of stellar birth and death, revealing the cradles of solar system formation. He also leads a space telescope project to find exoplanets around stars in our immediate galactic neighborhood.

peter.tuthill@sydney.edu.au

Mike Wheatland builds complex models of solar flares and solar activity, and examines the plasma interaction between the Earth and the Sun. He also constructs computational models of mechanical devices.

michael.wheatland@sydney.edu.au

Other Opportunities to Study Astronomy

You can also study astronomy in the following Units of Study:

OLET1618 Data Science in Astronomy: Algorithms

OLET1620 Data Science in Astronomy: Analysis

OLET1636 Astronomy: from Earth to Exoplanets

OLET1638 Astronomy: from Stars to Black Holes

OLET1640 Astronomy: from Big Bang to Darkness

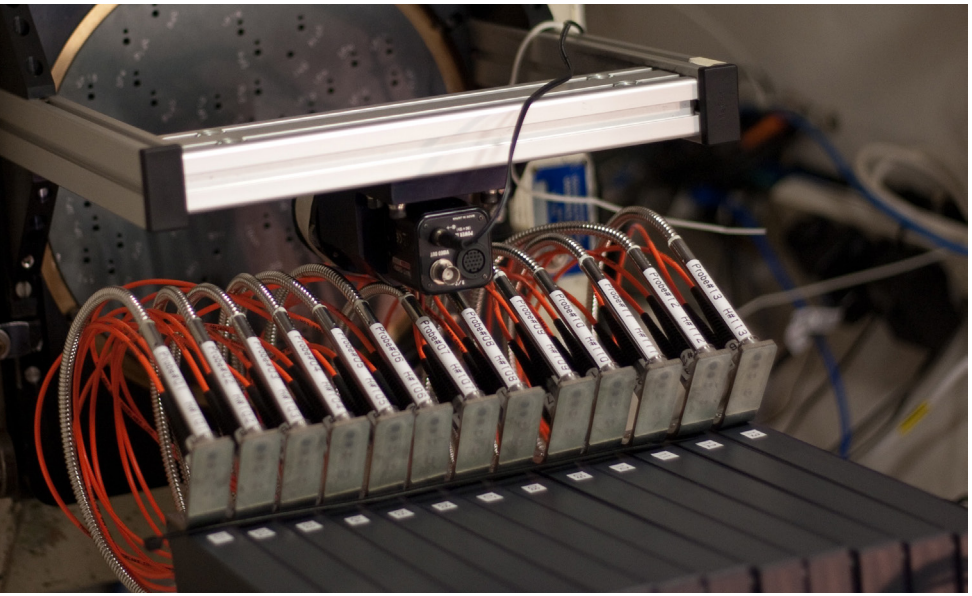
PHYS2x13 Astrophysics and Relativity

PHYS3x37 Astrophysics and Plasma Physics

PHYS4122 Astrophysics and Space Science

PHYS4123 General Relativity and Cosmology

Sydney astronomers build instruments like the Sydney-AAO Multi-object Integral-field unit. | Credit: Sydney Astrophotonic Instrumentation Labs



Where to next?

By doing an astronomy research project you will not only get to explore some incredible science, you will improve your skills in data science, computing and quantitative analysis. These skills will be useful in all kinds of careers, from finance to IT and all STEM disciplines.

An ESO VLT image of a triple star system discovered by SIfA astronomers Credit: ESO

The CSIRO’s ASKAP telescope used by SIfA astronomers to explore the distant Universe | Credit: Alex Cherney/CSIRO