The Department of Physics and Astronomy aims to be one of the nation’s leading physical sciences departments. We are committed to embracing and fostering equity and diversity within our workforce and community. We aim to offer distinctive, research-integrated programs and employment-ready undergraduates. Through our graduate research programs, we aim to provide pathways to research independence for academic and industry careers, with international aspects in all research projects. We aim to continue to develop a strong, visible representation in the local and wider communities as an authority in physical sciences, research, outreach and education.

The Department runs an active and rigorous research program of national and global significance; our physics and astronomy researchers enjoy an international reputation as leaders in their fields, with research expertise in three broad areas of astronomy; optics including photonics, lasers and biophotonics; and quantum science. In 2017 the Department hosted major nodes of three ARC Centres of Excellence: the Centre for Engineered Quantum Science (EQuS); the Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS); and the Centre for Nanoscale Biophotonics (CNBP). We also continued to lead the OptoFab node of the Australian National Fabrication Facility (ANFF).

**KEY ACHIEVEMENTS**

**Professor Michael Withford** was named as one of five new Distinguished Professors of the University; a first in the Department. This highly prestigious rank, held for a five year period, recognises world class accomplishments across all areas of scholarship and sees Mick join a cohort of truly eminent scholars.

**Professor Ewa Goldys** was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE). The Fellowship, awarded to people who apply technology in smart, strategic ways for social benefit, recognises Professor Goldys’ pioneering research in non-invasive medical diagnostics, supporting clinicians in making improved diagnosis and health decisions for patients.

**Professor Rich Mildren** was awarded the DST Eureka Prize for Outstanding Science in Safeguarding Australia. The award recognises his work using diamonds to massively extend the power and range of lasers, which might one day help take down drones and missiles.

The Department established and formally adopted a Statement of Workplace Culture: originating in the Department’s Equity and Diversity Committee, the Statement both captures and informs our approach to diversity and inclusion at all levels of our workforce. The Department also officially and publically adopted a position in favour of marriage equality.

**RESEARCH HIGHLIGHTS**

In 2017 researchers in the Department published over 200 articles, with publications in high-impact journals including two papers in *Nature*, one in *Nature Physics*, and two papers in *Nature Communications*.

**KEY DISCOVERIES**

A team from the Macquarie Diamond Nanoscience Laboratory, led by **Associate Professor Thomas Volz**, demonstrated super bright and fast emission at room temperature from diamond nanocrystal colour centres, acting in unison to send out light pulses faster than they could individually – a discovery that may see improvements in biomarkers and quantum sensors.

Macquarie PhD candidate **Maria Kieferova** led a publication that shows the potential for quantum computers to revolutionise machine learning. The work showed how a small quantum computer can learn classical data and quantum states, an approach that enables analysis of complex experimental data.
Researchers in the Centre of Nanoscale Biophotonics (CNBP) led by Dr Yiqing Lu had a breakthrough in optical imaging using upconversion nanoparticles, enabling microscopy at unprecedented low power that achieves optical super resolution down to 30nm. The breakthrough overcomes a problem in current imaging that requires the use of damaging high power lasers and dyes, and opens a new avenue for studying biological process in the body at the nanoscale.

A team of Astronomy researchers lead by Roberto Iaconi and including Professor Orsola De Marco have constructed a model of the notoriously pesky “common envelope” binary star interaction, without which we cannot explain a range of phenomena such as merging stars that emit bursts of light as well as gravitational waves. Macquarie PhD candidate Michael Cowley grabbed the attention of the media after publishing a new study which suggests that supermassive black holes are not responsible for starving their host galaxies of precious star-forming fuel supply. Mr Cowley noted that the work has the potential to re-write our understanding of how the Milky Way and similar galaxies form and evolve over cosmic time.

TEACHING AND ENGAGEMENT HIGHLIGHTS

The new PACE units for the majors in Physics, and Astronomy and Astrophysics were rolled out for the first time in 2017 and saw final year undergraduate students conduct research projects with local industry partners including CSIRO, AAO, Resmed, and international partner Gemini Observatory in Hawaii.

Final year undergraduate students were matched with an academic mentor for the first time in 2017, to support specific discipline interests and career aspirations – whether workforce or further study.

The Department continued to integrate and embed computational work across the curriculum in 2017, standardising the use of Python as our programming language of choice across all levels of the undergraduate majors in Physics and Astronomy.

Masters of Research candidate Wilfred Gee was awarded the University Medal for his thesis Project PANOPTES: a citizen-scientist exoplanet transit survey using commercial digital cameras.

The Department hosted theoretical astrophysicist, Dr Katie Mack, on the local leg of her Australian Institute of Physics Women in Physics tour. Dr Mack’s guest lecture about Dark Matter used her speciality work in cosmology to illustrate new ways of understanding the early universe and fundamental physics through astronomical observations.

Professor Deb Kane and ABC Radio’s Robyn Williams AM were among a number of eminent guest speakers at the Golden Jubilee Symposium in the University’s Mason Theatre. Organised by the Department, the event celebrated 50 years since the first lecture was delivered at Macquarie University on 6 March 1967 by Professor Peter Mason, well-known science communicator and the founder of the Department of Physics at Macquarie. Audience members included a small cohort of the ’67-ers – attendees of the original 1967 lecture.

LOOKING TO 2018

In response to a Federal Government call for a new home for the instrumentation arm of the Australian Astronomical Observatory (AAO) - one of Australia’s two leading optical astronomy instrumentation capabilities - Head of Department, Professor Michael Steel, spearheaded a successful bid to acquire the AAO’s North Ryde laboratories and staff. Looking forward, 2018 brings with it the challenge of achieving a successful transfer of business, and the transition of AAO staff and facilities into the Faculty of Science and Engineering at Macquarie.

For 2018 we are planning further expansion of the successful PACE program and a review of our BPhil program, as well as renewing accreditation of our undergraduate programs with the Australian Institute of Physics.