

# PHYSICS AND ASTRONOMY

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# DISCOVER PHYSICS AND ASTRONOMY AT MONASH

Have you ever wondered if absolute zero temperature can be reached, how a black hole forms, or what the Universe is made of?

Have you ever had a CT, an ultrasound or an MRI scan?

Do you use a smart phone, the internet or the computer?

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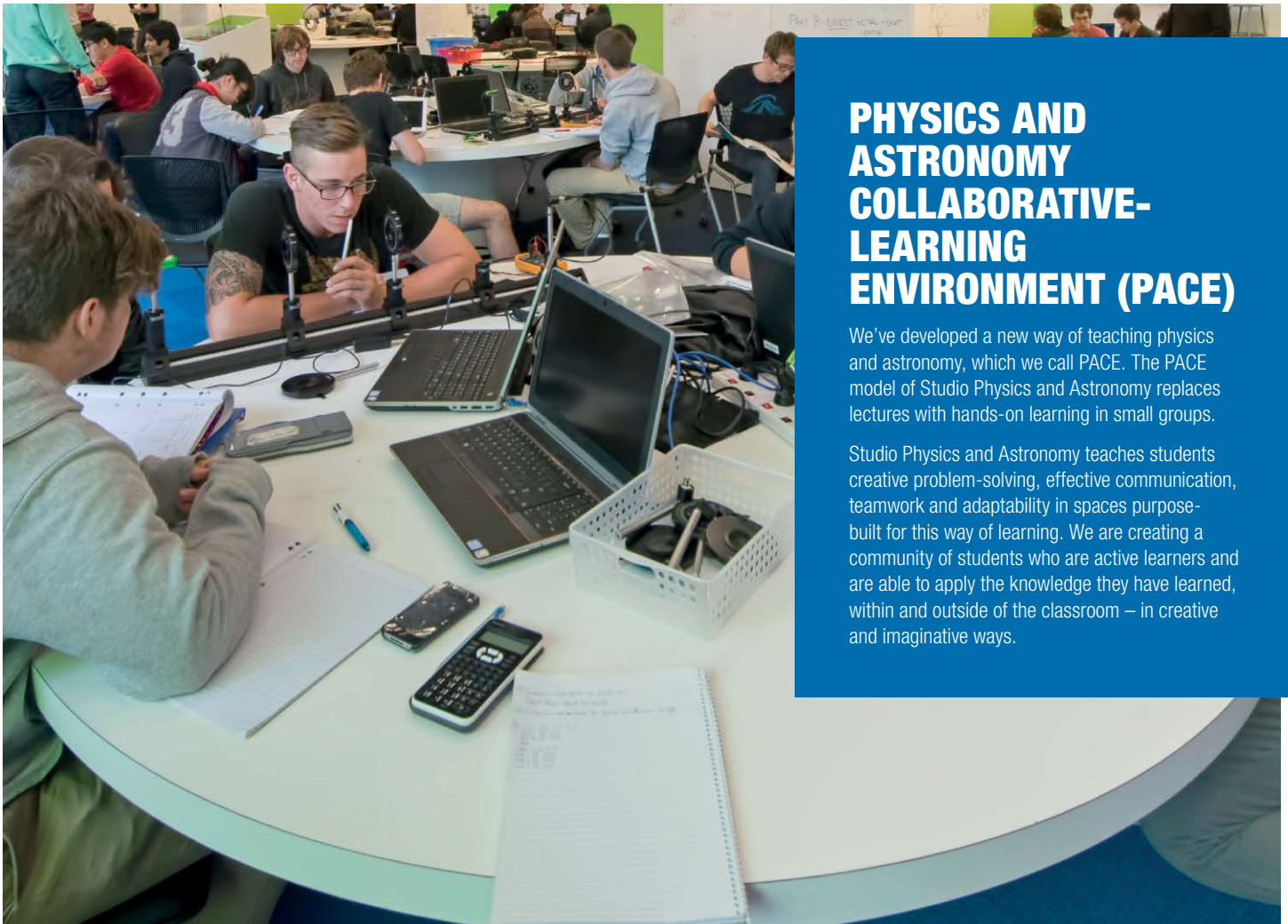
Almost everything that makes your life more comfortable, or allows you to work more efficiently, is due to engineered solutions based on fundamental physical principles. Physicists and astrophysicists explore the Universe at all scales of length, time, and energy – from sub-atomic particles to the large-scale structure of the Universe; from ultra cold gases to the origins of the Universe in the Big Bang.

The skills you gain through studying physics and astrophysics can be used in many areas, such as developing medical instrumentation, radiotherapy treatment of cancer, modeling climate and weather, analysing big data and financial systems, developing innovative ways to address sustainability, exploring emergent behaviour in complex biological systems, and understanding the function of the brain.

All of our teaching is underpinned by world-class research and education facilities.

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## PHYSICS AND ASTRONOMY COLLABORATIVE-LEARNING ENVIRONMENT (PACE)

We've developed a new way of teaching physics and astronomy, which we call PACE. The PACE model of Studio Physics and Astronomy replaces lectures with hands-on learning in small groups.

Studio Physics and Astronomy teaches students creative problem-solving, effective communication, teamwork and adaptability in spaces purpose-built for this way of learning. We are creating a community of students who are active learners and are able to apply the knowledge they have learned, within and outside of the classroom – in creative and imaginative ways.



## NEW HORIZONS RESEARCH CENTRE

The New Horizons Research Centre is a \$175M research and training complex that houses the research laboratories of the School of Physics and Astronomy. The New Horizons Research Centre brings together world-class researchers from Monash and CSIRO, with diverse backgrounds in physics, astrophysics, engineering, IT and biosciences. The scope of the New Horizons Research Centre is beyond anything else that exists in Australia – drawing on an incredible array of talent, state of the art equipment and specialised infrastructure to generate and develop innovative ideas across disciplines. It houses the Monash Centre for Atomically Thin Materials where researchers are pushing the boundaries of the new quantum revolution.

## PHYSICS AND ASTRONOMY

# WHAT TO EXPECT IN FIRST YEAR

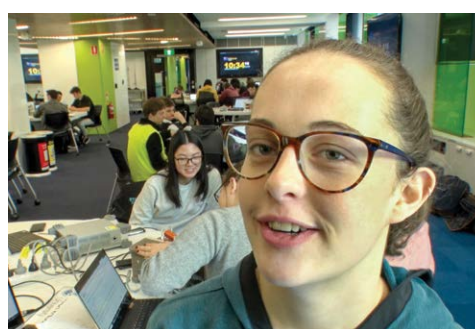
### SEMESTER ONE

Course unit	Unit information	What you will study
<b>Classical physics and relativity</b> PHS1011	<ul style="list-style-type: none"> <li>If you have sufficient high school physics and/or mathematics (see handbook for specifics) and wish to study physics or astrophysics, you need to take this unit.</li> <li>MTH1020 (or equivalent) is recommended alongside PHS1011 as this is the level of mathematics required for the subsequent second-semester unit PHS1022.</li> </ul>	Classical mechanics, thermal physics and relativity.
<b>Foundation physics</b> PHS1001	<ul style="list-style-type: none"> <li>This unit is for students who do not meet the requirements for PHS1011</li> <li>No specific prerequisites.</li> <li>No calculus is used – however, if you study physics beyond this unit you will need calculus.</li> <li>MTH1020 (or equivalent) is recommended alongside PHS1001.</li> </ul>	Classical mechanics, electromagnetism, waves and modern physics.
<b>Physics for the living world</b> PHS1031	<ul style="list-style-type: none"> <li>Suitable for students with a broad interest in science – of particular relevance to students interested in biology, physiology, and biomedicine.</li> <li>No specific prerequisites; a general science and mathematics background is sufficient.</li> <li>No calculus is used.</li> </ul>	Biophysical processes involving energy, fluids, sound, light, and electricity. Technologies such as radiation therapy and medical imaging systems.
<b>Earth to cosmos – introductory astronomy</b> ASP1010	<ul style="list-style-type: none"> <li>Suitable for students with a broad interest in science, or to complement other studies in physics.</li> <li>There are no specific prerequisites.</li> <li>No calculus is used.</li> <li>Note: to continue with astrophysics at second year, you will need PHS1022 or PHS1002 and the relevant mathematics units.</li> </ul>	Introduction to astronomy, including planets, the Solar System, stars, galaxies, cosmology, and extreme events in the Universe.

For more information scan the to Physics and Astronomy handbook QR code on the back page.



Scan to view a PACE 360° virtual tour  
[monash.edu/science/pace-360-virtual-tour](https://monash.edu/science/pace-360-virtual-tour)



Workshop teaching is really good, it's challenging and it's fascinating. ”

\*Further information about a specific unit can be found by searching the web for "Monash Handbook" and entering the relevant unit code (e.g. PHS1022).



## SEMESTER TWO

Course unit	Unit information	What you will study
<b>Fields and quantum physics</b> PHS1022	<ul style="list-style-type: none"> <li>This unit continues from PHS1011; it requires PHS1011 and MTH1020 (or equivalent), and provides a route to second-year physics and astrophysics units.</li> <li>MTH1030 (or equivalent) is recommended alongside PHS1022 as this is the level of mathematics required for second year physics and astrophysics units.</li> </ul>	Gravity, electromagnetism and quantum physics.
<b>Physics for engineering</b> PHS1002	<ul style="list-style-type: none"> <li>This unit continues from PHS1001; it requires PHS1001 (or equivalent) and an understanding of calculus. It provides a route to second year units.</li> <li>MTH1030 (or equivalent) is recommended alongside PHS1022 as this is the level of mathematics required for second year physics and astrophysics units.</li> <li>PHS1002 can be taken as a stand-alone elective by Engineering students with sufficient high school physics and/or mathematics (see handbook).</li> </ul>	Rotational mechanics, gravity, electromagnetism, and quantum physics.
<b>Life in the universe – astrobiology</b> ASP1022	<ul style="list-style-type: none"> <li>Suitable for students with a broad interest in science, or to complement other studies in physics.</li> <li>There are no specific prerequisites.</li> <li>No calculus is used.</li> <li>Note: to continue with astrophysics at second year, you will need PHS1022 or PHS1002 and the relevant mathematics units.</li> </ul>	Characteristics of life, how we first appeared on Earth, conditions for life to appear elsewhere in the cosmos.



Why study Physics at Monash?



\*Further information about a specific unit can be found by searching the web for "Monash Handbook" and entering the relevant unit code (e.g. PHS1022).



Best part of Physics is we do workshops not lectures, so there is a lot more interaction with the teacher and your friends, you get to learn a lot more than just sitting in a lecture. ”

# WHERE PHYSICS OR ASTROPHYSICS CAN TAKE YOU

## OUR GRADUATES HAVE VARIED AND DIVERSE CAREER OPTIONS

Studying physics or astrophysics at Monash can take you to places we are yet to imagine. Graduates with physics or astrophysics majors are highly skilled in empirical reasoning, computational and theoretical modelling, data analysis and visualisation. At Monash we will help develop and hone these skills and, of equal importance, we will provide you with an environment in which you can work as part of a team, communicate your ideas, think creatively and solve problems. These are essential skills for the workplace, and key to any career.

Some career options include:

- Accelerator physicist
- Acoustician
- AI/machine learning
- Astrophysicist
- Atmospheric physicist
- Big data analyst
- Biophysicist
- Climate modeller
- Electron microscopist
- Energy consultant
- Environmental physicist
- Financial analyst
- Forensic physicist
- Geophysicist
- Industrial physicist
- Information security analyst
- Instrumentation physicist
- Materials scientist
- Metallurgist
- Medical physicist
- Nuclear physicist
- Optical physicist
- Observational astronomer
- Particle physicist
- Patent attorney
- Physics teacher
- Radiation oncology physicist
- Radiation protection practitioner
- Renewable energy manager
- Solar energy physicist
- Synchrotron scientist
- Science journalist
- Telecommunications consultant
- University lecturer

## HONOURS AND MASTER'S DEGREES



### Honours programs

A one-year program at the completion of an undergraduate BSc. The year provides you with the skills to conduct original research and a sound scientific background for our complex and increasingly technologically oriented world.



### Master's degrees

Two year expert master's courses that prepare you for professional employment or doctoral research. These advanced programs are for science graduates with an undergraduate BSc degree in physics, astrophysics, or a cognate discipline.



### DR LINDA CROTON

Linda studied astronomy in the United States and Germany, and worked as a spacecraft controller for two NASA science missions at the University of California, Berkeley's Space Sciences Laboratory.

After several years away from science to start a family and move to Australia, she decided to pursue a PhD. Monash offered the best opportunity for Linda to combine her experience in image analysis with an interest in medical imaging. She is developing new techniques for imaging the brain to enable the visualisation of soft tissue structures at a higher resolution than was previously possible.



### CHRIS WHITTLE

Studying science at Monash gave Chris flexibility in choosing his subjects, allowing him to build his degree around his passions. Collaboration with physics researchers has been a highlight of his studies, and Chris is a member of the LIGO Scientific Collaboration, which announced the detection of gravitational waves in 2016, one hundred years after their prediction by Einstein.

During his honours year, Chris spent three months in the United States working on the commissioning of Advanced LIGO to improve the sensitivity of the interferometer to gravitational waves. Chris continued his studies with a PhD at the Massachusetts Institute of Technology, which he completed in 2023.

# SOME OF OUR PEOPLE



## PROFESSOR MEERA PARISH

Meera is a leading theoretical physicist working in ultracold atomic gases and superconductivity. Since obtaining her PhD in 2005, Meera has made significant contributions to our understanding of new states of quantum matter and the collective behaviour of fermionic condensates, superconductivity, and magnetotransport.

Her outstanding contributions to these fields led to the award of the Institute of Physics Maxwell Medal and Prize in 2012 (previous winners include Stephen Hawking and Nobel Laureates).



## PROFESSOR DANIEL PRICE

Daniel started his career with a science degree at Monash, which led to a PhD at the University of Cambridge and two international postdoctoral fellowships before returning to Monash.

Daniel develops advanced simulation techniques for astrophysics (using the world's most powerful supercomputers) to model the birth of stars, the formation of planets from discs around newborn stars and the flow of gas around black holes. Techniques and computer codes developed at Monash are used around the world for modelling all kinds of exotic astrophysical phenomena.



## ASSOCIATE PROFESSOR KAYE MORGAN

Kaye is an ARC Future Fellow, former VESKI Fellow, and Monash graduate who works in the field of phase contrast x-ray imaging (PCXI) using synchrotron radiation. The techniques developed by Kaye have been applied to sensitively image soft tissue at high resolution.

Her work on imaging the airways has led to improved treatment of cystic fibrosis. Kaye spent two years at the Institute for Advanced Study at the Technical University of Munich, where she developed new generation x-ray sources capable of capturing not only structural information, but also high-speed dynamics in "x-ray movies".



## DR ANNA PHILLIPS

Anna studies the teaching and learning of physics. She integrates qualitative and quantitative methods of education research with history and philosophy of physics to understand how professional physicists and students alike engage in the practice of physics. Her work in understanding how problems are defined and constructed by classroom and professional communities has shaped research into how to teach science from primary school science through university physics, chemistry, and engineering. She is presently conducting a longitudinal, mixed-methods study into retention in the physics major and how best to support students from marginalised groups. She also studies students' engagement in computational physics practices and how those practices are integrated with hands-on activities.



## PROFESSOR ILYA MANDEL

Ilya is an ARC Future Fellow and theoretical astrophysicist who uses basic physical models and complex data-analysis to understand a variety of phenomena in high-energy astrophysics. His research uses cutting-edge computational techniques including machine-learning to interpret and model a range of astrophysical observations, from cosmic explosions to dynamics of stars being shredded by the gravity of massive black holes.

Ilya is a world leader in the nascent field of gravitational-wave astronomy, where he uses signals from the mergers of compact remnants of massive stars – neutron stars and black holes – to explore the evolution of these stars billions of years ago.



## PROFESSOR MICHAEL FUHRER

Michael is a former ARC Laureate Fellow and Director of the Monash-led ARC Centre of Excellence in Future Low Energy Electronics Technologies (FLEET), which aims to re-invent the transistor based on new developments in condensed matter physics, such as topological insulators. Michael has also set up the Monash Centre for Atomically Thin Materials, to explore the forefront of two-dimensional (2D) materials, such as graphene.

His research team is investigating many novel 2D layered materials, with applications in spintronics, nanoscale electronics, optoelectronics, and photovoltaics. These new materials have the potential to revolutionise electronics and computing by developing an alternative to silicon-based chips.

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## FURTHER INFORMATION

**MONASH UNIVERSITY**  
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T Australia freecall: 1800 MONASH (666 274)  
T +61 3 9903 4788 (outside Australia)  
E [study@monash.edu](mailto:study@monash.edu)

## MONASH SCIENCE ONLINE

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## AFFILIATIONS



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Faculty of Science



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