UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

# Physics

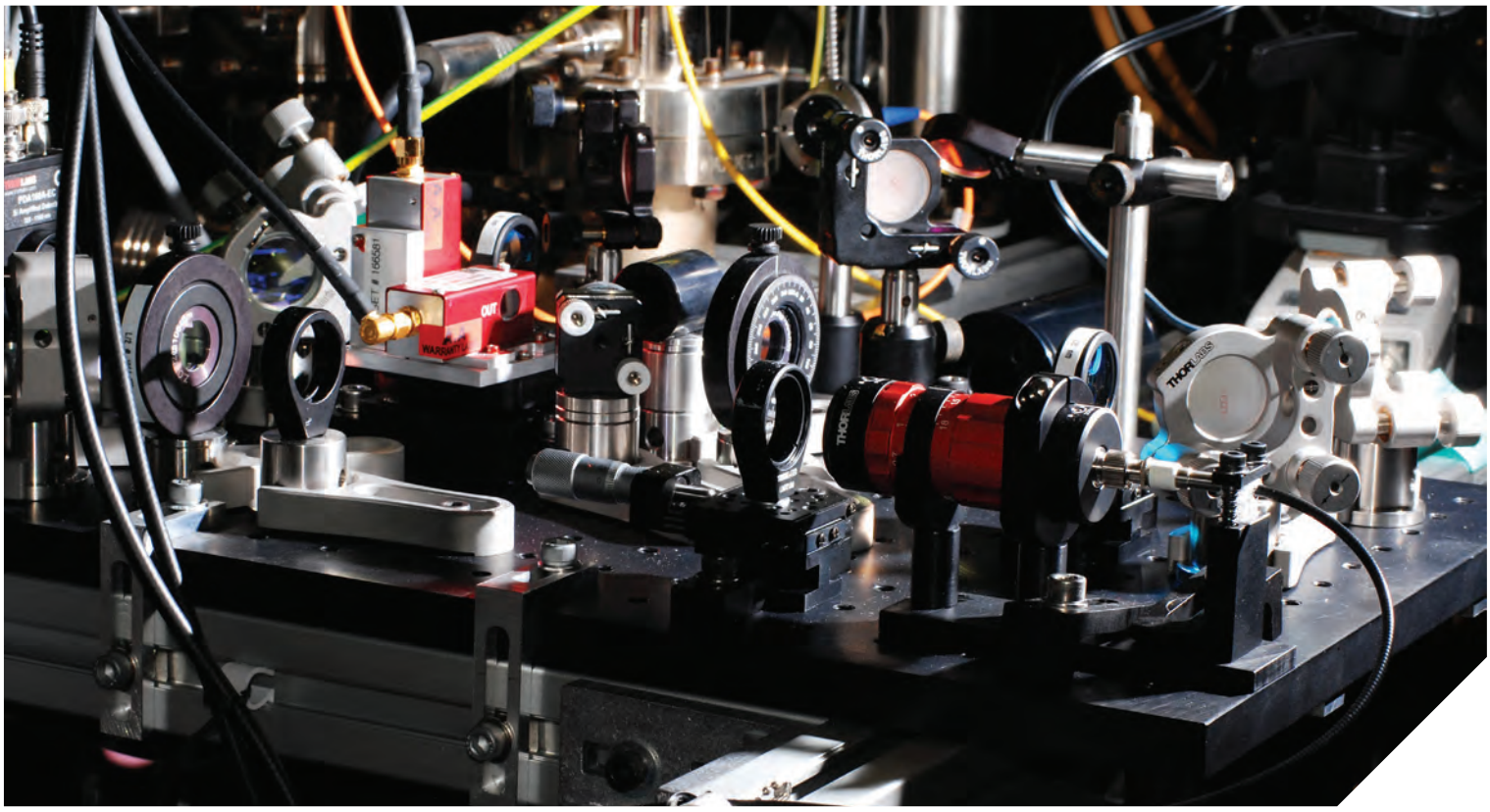
## How the world works

"The skills I learned at Otago, like analytical thinking and communicating ideas, are all hugely useful in what I'm doing now. And the breadth of research areas covered by the Department of Physics at Otago means that you do get exposed to all sorts of ideas. That wide range of topics is standing me in good stead too."

Adam Norrie – PhD Physics

Physics is a search for and an application of rules that can predict the evolution of the world around us. This includes planetary motion, quantum jumps in atoms and the propagation of light. Through central concepts such as energy, force, particles and waves, Physics attempts to answer fundamental questions about Nature, while at the same time providing solutions to technological problems.

0800 80 80 98 | otago.ac.nz | txt 866 | university@otago.ac.nz



## Why Study Physics?

Learning how the physical world works is fascinating. It is also useful. Physics will hone your thinking ability, and help you to develop high level analytical and problem solving skills.

In Otago's Physics department you will get to study with some of the country's top physicists. Our research informed teaching draws from a broad spectrum of expertise areas including geophysics, optics, energy science, atomic physics, electronics, and quantum theory.

## Background required

We recommend that students enrolling for a Physics degree have a background in NCEA level 3 Physics and/or Mathematics. We are always very happy to answer any questions you may have about what studying physics involves, where it might take you, and how to get off on the best possible start for your degree.

## Careers

An Otago degree in Physics will give you multiple future options. You could work in high-tech areas such as electronics, laser technology, smart materials, healthcare, analytics, or telecommunications. You might find yourself working for a company developing new products or services, relying on your know-how to come to grips with the complex physical problems of the real world.

By combining your study of Physics with another subject you could move into any number of specialist fields. For example, a Physics degree with particular emphasis in acoustics, combined with a music degree, might lead you to becoming an acoustics expert for a construction or architectural company. You might move into medical physics, working on such techniques as radiotherapy and solar phototherapy. You could work at a hospital, becoming involved in important health initiatives, such as improving or evaluating a public health screening programme.

If you choose to continue in Physics and physics research, you might move into areas such as atomic and laser research or energy management. You may find yourself at sea off Antarctica, studying the effect of waves on the break up of sea ice. Such pursuits could see you working for a university, a research institute or a company specialising in a particular area of physics and its application. Once established in a particular field, you might find yourself suitably experienced to be a high-tech management consultant. Large international organisations depend on consultants for much of their contracted work. Such positions offer great variety and, in many cases, fantastic opportunities for travel.

Physics teachers are in hot demand, both here and overseas. There is an ongoing shortage of secondary school physics teachers, particularly at the higher levels. Being able to teach physics will make you a much sought after employee.

## How might Physics help me in other careers?

You might choose to use your Physics degree as a launching pad for a career in a different area. The numerical and logical skills you learn are in high demand in many fields including the financially-lucrative areas of corporate banking and software engineering.

## Studying Physics at Otago

**100-level**

In your first year as a Physics student, you learn to approach, solve, and understand a wide variety of physics problems on both qualitative and quantitative levels. With an emphasis on conceptual understanding, we cover the development of physical law from Newton to Einstein, and the physics of the real world including applications of physical principles to a technological society. You will also be equipped with the mathematical tools needed to advance into second year Physics.

A major in Physics requires you to take papers

PHSI 131 Physical Law and its Applications

PHSI 132 Fundamentals of Modern Physics

*and both*

MATH 160 Mathematics 1

MATH 170 Mathematics 2

**Note:** It is possible to take the paper PHSI 191 Biological Physics instead of PHSI 131 to fulfill the major requirements. If for some reason you are inclined to do so you are encouraged to contact the Physics Department for course advice. PHSI 131 and 132 assume an understanding of Yr 13 Physics and Mathematics.

Details of first-year papers are in the *Prospectus*, and in the *Guide to Enrolment* (which also has information about papers at higher level) published with enrolment material.

**200 level and beyond**

From second year onwards papers become more specialised.

Core papers on electromagnetism, quantum mechanics and thermodynamics lay a solid foundation for studying atoms, solid state systems (conductors, semi-conductors, insulators) and the propagation of light and its interaction with matter. You can also pursue papers within the realm of geophysics concerned with our environment, climate, and the upper atmosphere. The Otago Physics Department has some of the best experimental and computational research facilities in the country which rubs off in the labs you are offered in 3rd year and the projects we offer to our postgraduate students.

## Teaching style

All courses involve a mixture of lectures and practical laboratories, so you will have plenty of opportunities to gain hands-on experience in problem solving. Several of our courses, in particular our first year courses PHSI 131 and 132, make use of "Classroom Response Systems", where the lecturer poses a multiple-choice questions and each student submits an answer using a handheld transmitter. The submitted answers then forms the basis of engaging in-class discussions centered on pivotal concepts of Physics.

## Scholarships

Top Physics students may receive an annual Beverly Bursary in the second to fourth years of their degree.

## PROFILE Thomas McKellar MSc Physics

Thomas McKellar's strongest subjects were always maths, physics, and chemistry, and although he studied all three in his first year at university, he was always going to major in Physics.

"The more mathematically strict and rigorous side of it appealed – as did the fact my father and grandfather both studied Physics at Otago – that may had something to do with it too" he jokes.

Thomas now works at Syft Technologies in Christchurch as a Development Scientist. Syft Technologies is a company that started about fifteen years ago with a relatively new mass spectrometry technique called *Selected Ion Flow Tube Mass Spectrometry,* or *SIFT-MS* – a gas analysis technique targeted at detecting, identifying, and quantitating gaseous chemicals in air samples.

"My role over the last two years has been in the hardware development team, working to improve, redesign, and upgrade the various components inside the instrument to achieve better differentiation between compounds, better sensitivity, wider range of compound detection, and so on."

A degree in Physics necessitates a major component of Mathematics, and Thomas says they've both played a major role for him.

"Working in technical hardware development, you need to think at the fundamental level of the hardware you're dealing with – the physics level."

Undergraduate studies in physics lay the theoretical foundations of the physical world we deal with, which enable questioning, then querying, then manipulation of the systems you're dealing with.

"That ability to be critical is honed in the research environment you work in during a Masters or PhD."

Thomas says the mathematics component of his studies – from both maths and physics papers – has been invaluable.

"Almost everything I deal with in my current role is rooted in mathematics, and it's great to be able to work with these systems with the confidence that you get from that exposure. Most of the practical mathematics I learnt at University – differential equations, linear algebra, combinatorics, statistical analysis – have come up at some time or another."


For questions about Physics

otago.ac.nz/physics

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