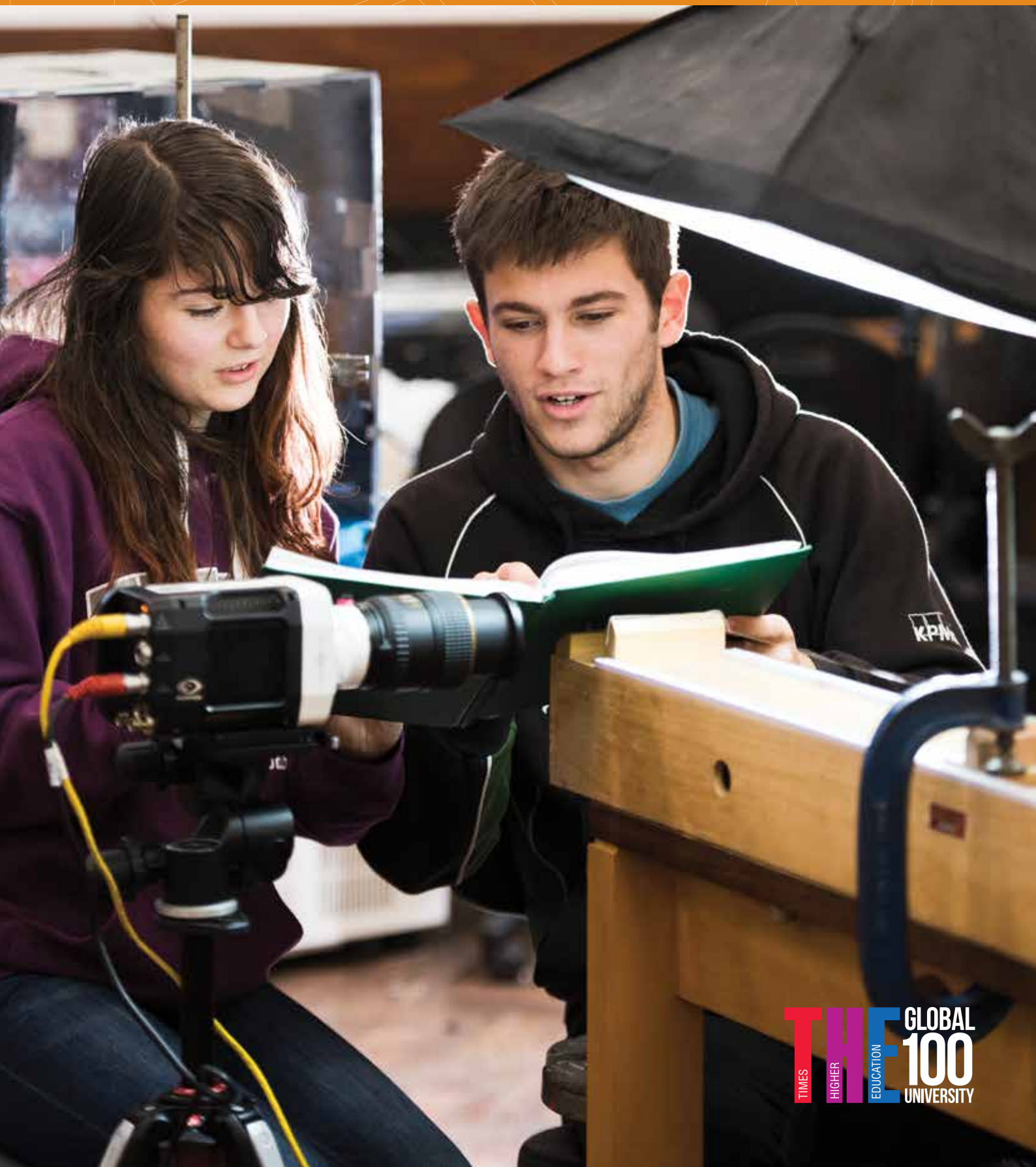
UNIVERSITY OF EXETER

PHYSICS AND ASTRONOMY

UNDERGRADUATE SUBJECT BROCHURE 2017



TIMES HIGHER EDUCATION THE GLOBAL 100 UNIVERSITY

KEY INFORMATION AND ENTRY REQUIREMENTS

	UCAS CODE	TYPICAL OFFER
MPhys Single Honours		
Physics	F303	A*AA-AAB; IB: 38-34
Physics with Astrophysics	F3FM	A*AA-AAB; IB: 38-34
Physics with Professional Experience	F304	A*AA-AAB; IB: 38-34
Physics with Australian Study	F3TV	A*AA-AAB; IB: 38-34
Physics with North American Study	F3T7	A*AA-AAB; IB: 38-34
Physics with Study in New Zealand	F308	A*AA-AAB; IB: 38-34
BSc Single Honours		
Physics	F300	A*AA-AAB; IB: 38-34
Physics with Astrophysics	F3F5	A*AA-AAB; IB: 38-34
BSc Combined Honours		
Mathematics and Physics	FG31	A*AA-AAB; IB: 38-34

Please note: Places are not normally offered to applicants who do not take part in an interview (see below).

At least one grade A and a grade B in GCE AL Maths and Physics or at least one HL6 and one HL5 in IB Maths and Physics are required for all of the above programmes. GCE AL Maths, Pure Maths or Further Maths are all acceptable Maths subjects, and applicants may offer Physics, Maths and Further Maths towards their offer. Applicants offering non-standard qualifications (for example the Access to Higher Education Diploma or Open University credits) may need to pass an AL-style mathematics test to demonstrate ability. This test will be undertaken as part of an interview.

Normally students can transfer between any of the programmes above during the first year. However, when applying to transfer on to programmes with limited capacity (ie, Professional Experience and Study Abroad), your transfer may be made dependent on academic performance.

For further details on all our entry requirements, please see **www.exeter.ac.uk/ug/physics**

You may also be interested in:

BSc/MSci Natural Sciences
Please see **www.exeter.ac.uk/ug/natural-sciences**

Physics and Astronomy Interview Days

Those applicants who meet our minimum entry requirements will be invited to visit the department between November and March. The visit will include tours and presentations relating to our research activity and a short academic interview with a member of staff, during which details of programmes can be explained and any queries answered. All applications are considered on an individual basis and offers will be made shortly after an interview has taken place.

Places are not normally offered to applicants who do not attend an interview. However, if visiting the campus is difficult for you please contact us when you receive your invitation letter to discuss alternative arrangements.

Pre-University Physics Course

Each summer we run our very popular Pre-University Physics Course. This course is for Year 12 students who are studying Physics or Physical Sciences at pre-university (AS) level and who are considering applying to study Physics or related subjects at university. During the three-day programme students will attend lectures spanning our research interests in Physics and Astronomy and visit our research and teaching laboratories where you will have the opportunity to carry out a group research project of your choosing, benefiting from some of the recent £400,000 investment in undergraduate teaching provision. Beyond the academic content, the course provides a taste of university life in all its diversity, with students living in University student accommodation and making use of our recreational, sporting and social facilities. Contact pupc@exeter.ac.uk for more details.

Athena SWAN Bronze Award

IOP Institute of Physics Juno Practitioner

The Athena SWAN Charter recognises and celebrates good employment practice for women working in Science, Technology, Engineering, Mathematics and Medicine (STEMM) in higher education and research, while Project Juno is a scheme run by the Institute of Physics which recognises good practice in relation to gender equality. The University is proud to have held a Bronze institutional Athena SWAN award since 2011, and we were awarded a Bronze award at departmental level in 2015. Physics at Exeter has held Juno Practitioner status since 2013. Find out more at **www.exeter.ac.uk/physics-astronomy/about**

STREATHAM CAMPUS, EXETER
Website: **www.exeter.ac.uk/ug/physics**
Email: **ug-ad-phys@exeter.ac.uk**
Phone: **+44 (0)1392 725349**
Twitter: **www.twitter.com/uoe_physics**

PHYSICS AND ASTRONOMY

2nd in the Russell Group for graduate progression[1]

9th in the UK in *The Complete University Guide 2016*

Weekly, small-group tutorials with academic staff

Multimillion-pound renovation of the Physics building, including teaching laboratories and study environments

90% of research classified as world-leading or internationally excellent[2]

Specialise in Astrophysics: our world-leading group focuses on star formation and exoplanets

Home to the EPSRC Centre for Doctoral Training in Metamaterials, The Centre for Graphene Science and The Living Systems Institute; each with pioneering research in material, quantum and biomedical physics

A long experimental or theoretical project during the final two years of the MPhys degrees

Spend your third year studying in a university abroad, or undertaking a research project as part of a salaried placement

Studying physics is a challenging, stimulating, thought-provoking and ultimately rewarding experience. We are one of the foremost centres of research in the UK, staffed by academics dedicated to their research and teaching. Our building is set in a beautiful location with views of the coastline and Dartmoor, providing an inspiring environment for you to address the intellectual challenges that arise as part of your scientific training.

The Physics Building has recently undergone a multimillion-pound investment programme, filling our teaching laboratories and computer suites with new equipment, creating new student study areas and relocating the Student Services area to an accessible location in the Foyer. We have advanced research facilities that include clean rooms for photo and nanolithography, a helium liquefier for low-temperature experiments, a water tank for acoustic experiments (SONAR), amplified ultra-fast laser systems for the study of ultra-high speed phenomena and a suite of instruments for imaging biological materials.

Our degree programmes include a wide range of options, both applied and theoretical, allowing you to develop your own particular interests. The options range from cosmology and biophysics to many-body theory, exoplanets and programming. You can also take options in other subjects such as a modern language, philosophy or mathematics. Lectures are illustrated with in-depth descriptions of recent discoveries and many of our optional modules reflect our research interests.

Ultimately we are training you to be a practitioner of physics, ie, a researcher in your own right, and that means you need to obtain first-hand experience of what it is like to conduct research work yourself. You will gain this experience either in our third-year teaching laboratory or embedded in our research groups. Indeed, we rely on undergraduates to contribute towards Exeter's research effort in the years to come via this project work, as potential PhD students or by playing a role in promoting our department if you find employment in industry. Therefore we firmly believe in individual attention, from the day you visit us for an interview. During your programme, you will meet the professors and lecturers in tutorials, in problem-solving classes and in the laboratories, and we have an 'open-door' policy to encourage academic discussion between students and staff. You will feel part of a department that is enthusiastic about physics and wants you to succeed.

[1] *Destination of Leavers from Higher Education Survey (DHLE) of 2013/14 graduates.*
[2] *Research Excellence Framework 2014 based on percentage of research categorised 4* and 3*.*

DEGREE PROGRAMMES

For up-to-date details of all our programmes and modules, please check **www.exeter.ac.uk/ug/physics**

Single Honours

Our BSc degrees are three-year programmes that give you a sound education in physics and lead on to a wide variety of careers. The four-year MPhys degrees take you further and give you a great opportunity to specialise in a research theme in which we excel, from astrophysics and quantum physics, through to electromagnetic and acoustic materials and biomedical physics. Normally students can transfer between any of the programmes during the first year. All our programmes can lead naturally on to PhD-level research or towards a more specialised qualification such as an MSc, and all are accredited by the Institute of Physics.

Year 1 You will develop your understanding of physics and become familiar with a variety of basic mathematical tools. The concepts and phenomena you'll meet are many and varied, but are united by the underlying principles of physics. In a typical week you will spend 15 hours in a formal teaching environment, and you will be expected to spend a further 20 hours in independent study. You'll have four hours of lectures in physics, two in mathematics, one tutorial, six hours in the teaching laboratories and two hours in problem-solving classes.

Year 2 Your second year provides a firm foundation of physics, and the principles that constitute the framework of the subject. The use of mathematics gives these principles a precise form and provides physicists with the ability to make detailed quantitative predictions. This year focuses on four main cornerstones of physics: condensed matter, quantum mechanics, electromagnetism and thermodynamics. These provide the core of most of physics and of our understanding of the evolution of our universe. The other modules in your second and subsequent years draw in part on your knowledge of this core.

Year 3 and Year 4 (MPhys only) of the programme allow you to apply the core principles in a broad range of important areas, such as *Nuclear and High-Energy Particle Physics* and *Statistical Physics*, plus advanced electromagnetism, quantum physics and condensed matter physics. There are numerous options in theoretical physics for you to choose such as *Quantum Many-Body Theory*, and *Relativity and Cosmology*. You can also choose to study technologically important areas such as *Quantum Optics and Photonics*, and *Physical Methods in Biology and Medicine*, and active research areas such as *Galaxies and High Energy Astrophysics*, and *Nanostructures and Graphene Science*. (Options are dependent on the programme of study: see modules on page 11).

The final year(s) of the programme also involve substantial project work. On the BSc programmes you will undertake extended experiments utilising a suite of equipment that includes an atomic force microscope, an infra-red spectrometer and our own observatory and radio telescope. You also have the opportunity to undertake team-based work tackling a real-world problem proposed by local business or industry. On the MPhys programme, you will be 'adopted' into one of our research groups (see page 4), working in a small group (typically three or four, but with individual roles), to undertake a project for at least one academic year. You will select your preferred project from a list of short research proposals freshly written by the academics each year. The projects are original and open-ended, ie, they each focus on a previously unstudied piece of physics. You will meet with your supervisor (a professor or lecturer) once a week to discuss progress and future work. You are also encouraged to attend research seminars from visiting speakers, attend the weekly group meetings and integrate and socialise with the PhD students and researchers.

MPhys/BSc Physics

Our MPhys/BSc Physics programmes give you an excellent understanding of mainstream physics and develop your scientific intuition. While the first year is common for all students, in later years you have the widest variety of options to choose from (detailed on page 11) and modules in other subjects, such as engineering or languages (termed 'electives'), are also available to you. MPhys Physics students can apply to undertake their research project in any of our research groups (see page 4).

MPhys/BSc Physics with Astrophysics

Our Physics with Astrophysics programmes focus on the core of mainstream physics, but also provide a balanced understanding of modern observational and theoretical astrophysics, from planets and stars to galaxies and cosmology. You will apply the fundamental laws of physics to some of the most remarkable environments in the universe. Observational astrophysics is taught using our recently upgraded teaching observatory. BSc projects, and the extended MPhys research projects, are normally based on data from world-class ground and space-based facilities and state-of-the-art computational codes for theoretical astrophysics.

MPhys Physics with Professional Experience

This degree programme allows you to spend your third year in a research environment in a professional laboratory away from the department. We'll help you to find a host, and you will be paid a salary for this year, but you will remain registered as an undergraduate student at Exeter. The research project you undertake will be assessed by your local supervisor along with academics from Exeter. You will return to Exeter to present your findings, and also to take examinations in the two modules you will study via distance learning. Companies that have recently participated in this programme include Renishaw, the Home Office and the Rutherford Appleton Laboratories. Your final year will be back in Exeter, and will include further modules and a research project in one of our research groups.

MPhys Physics with Study in North America, Australia or New Zealand

In these programmes you will broaden your experience by studying physics in a new cultural environment in your third year. The core programme is essentially identical to the physics programmes offered entirely in Exeter, but includes alternative options in, for example astronomy (with access to, for instance, the University of New Mexico's telescope sited in the desert), space physics and the physics of weather. We have agreements with Iowa State University, the University of Kansas, and the University of New Mexico in the USA; the University of Sydney and the University of Wollongong in Australia; and Massey University and the University of Auckland in New Zealand. You will return to Exeter in your final year, to take further modules and carry out a research project in one of our research groups.

Combined Honours

BSc Mathematics and Physics

Physics and Astronomy may be studied in Exeter together with Mathematics in a degree programme recognised by the Institute of Physics. Your work will be divided evenly between the two subjects, and the programme is designed so that there are no differences in the workload in comparison to the Single Honours degrees.

The Combined Honours degree programme allows you to explore the interplay between the two disciplines of mathematics and physics, learning to understand the ways in which they co-exist and complement each other. You will benefit from the flexibility and freedom to choose from a wide range of optional modules, enabling you to specialise if desired. Options include many of the physics modules available to Single Honours students, but also mathematics courses with great relevance to physicists, such as pure mathematics: *Combinatorics*, *Galois Theory* and *Number Theory*, and applied options like: *Mathematics of Climate Change*, *Cryptography*, and *Mathematical Biology and Ecology*. Just like in physics, all academic staff teaching you mathematics are active, internationally recognised researchers across a wide range of applied, pure and theoretical topics.

Full details of the options available to you on the Combined Honours Mathematics and Physics programme are available in the Mathematics brochure, or via **www.exeter.ac.uk/ug/physics**

When I came to Exeter for my interview and had the chance to meet some of the staff in the department, I found out how friendly and welcoming everyone was; it was obvious that the lecturers really want you to learn and are happy to help you any time.

Hannah Osborne, MPhys Physics with Astrophysics

OUR RESEARCH

Physics is an exciting and dynamic subject that is continually evolving, and our reputation for high-quality research is a testament to the research pedigree of our staff, many of whom are world leaders in their field. We collaborate with internationally leading scholars, academic centres and external organisations to ensure we are at the very heart of the most innovative research. This has enormous benefits for you as a student. Working to extend the frontiers of knowledge generates an innovative, lively atmosphere and the research undertaken gives physics at the University its own distinctive flavour. Lectures are illustrated with in-depth descriptions of recent discoveries and many of our optional modules are based on our research interests. Students on the MPhys degrees can obtain first-hand experience of what it is like to conduct research by undertaking a project in one of our research groups during your third and fourth years. All students can apply to undertake a placement with our researchers during the summer vacation.

Astrophysics

Our Astrophysics group is one of the largest in the UK studying star formation and extra-solar planets. Our research spans various themes devoted to the general understanding of stars and planets, from their birth to their death. The strength of these activities relies on the remarkable synergy between Exeter's complementary expertise in theory, applied mathematics, climate science, numerical simulations and observations.

Our researchers study star and planet formation based on state-of-the-art numerical simulations and produce theoretical models describing the life of stars and planets that provide the theoretical foundation to analyse the outcome of observational programs. Exeter astronomers observe using the largest facilities in the world, including the Hubble Space Telescope (HST), the Very Large Telescope (VLT) and the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile, a facility that is particularly powerful for the detection and characterisation of discs around newly formed stars within which planetary systems are forming.

The Astrophysics group is also developing a new field of research in extra-solar planet climatology. We have built strong links with the Met Office in Exeter, taking advantage of meteorologists' expertise to apply the sophisticated tools they have developed for Earth-weather predictions and climate studies to the atmospheres of extra-solar planets. The application of these methods to the study of distant new worlds, which could harbour new life forms, is a fascinating problem in modern astrophysics.

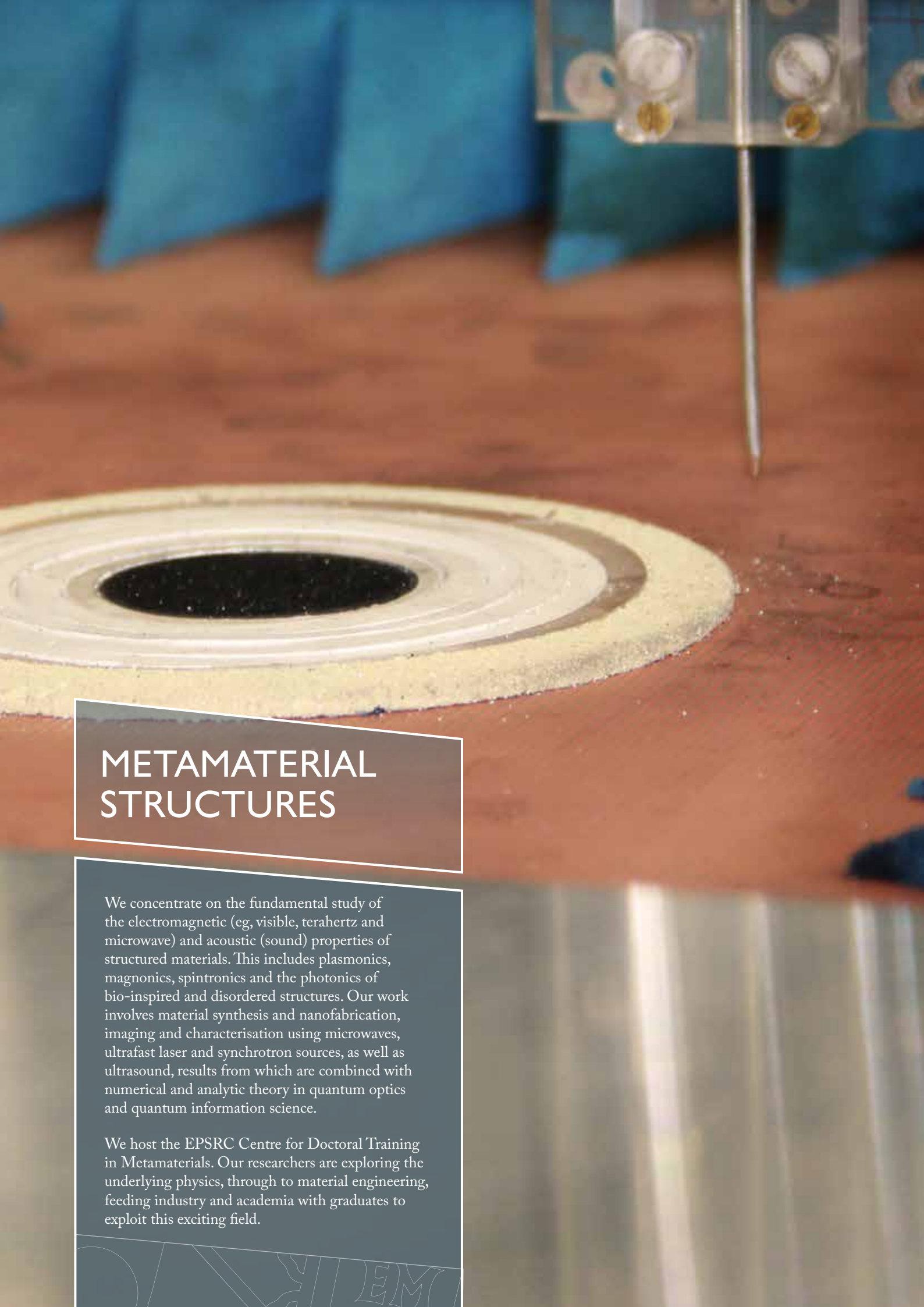
In your first term at Exeter you will take the *Introduction to Astrophysics* class as a core module (except BSc Mathematics and Physics students). Not only will this introduce you to the theories of quantum mechanics, it will demonstrate how they are applied to a wide variety of astrophysical phenomena. You will develop a broad knowledge and understanding of the key ideas and language used by modern astronomers to describe and explain the observed Universe. Modules in later years (compulsory for Astrophysics programmes) include: *Observing the Universe*, which will give you a basic understanding of the universe and its contents, and astrophysical measurement techniques; *Stars*, which takes the fundamental concepts of gravitation, quantum mechanics and thermodynamics to derive the properties of stars, their formation, evolution and death; *Relativity and Cosmology*, which includes an introduction to the general theory of relativity and the evolution of the Universe; *Galaxies and High Energy Astrophysics*, which delivers an overview of astronomical observations and theoretical modelling, in order to understand galaxies in the Universe, including the Milky Way, and their physical processes; and *Solar and Extra-Solar Planets and Their Atmospheres*, which is based on a major research theme at Exeter, and will show how theory and observations underpin our rapidly developing knowledge of planetary objects both inside and outside the solar system.

Biomedical Physics

For decades physics has played a crucial role in the development of new techniques for medicine and is increasingly important in understanding the behaviour of biological systems. With many years' experience of magnetic resonance imaging, we are now developing complementary expertise in the development and application of optical imaging and vibrational spectroscopy. We have recently established a multiphoton microscopy laboratory. Multiphoton techniques are attracting a great deal of interest as they offer increased depth penetration and molecular contrast without the use of dyes. We are also collaborating with major pharmaceutical companies to develop novel optical approaches to drug discovery.

Our work also considers a wide range of fundamental questions in modern biology and physiology. Current activities range from studies of the cell membrane, through investigations of the ways in which cells sense and respond to physical signals, to assessment of the mechanical behavior of tissues. This work helps us to understand processes that may be involved in diseases ranging from diabetes to cancer, and so develop novel therapeutic approaches. Many of our researchers in biomedical physics are working closely with the development of the University's new £50million Living Systems Institute, situated alongside the Physics Building. From late 2016 it will bring together leading mathematicians, physicists, cell and molecular biologists, biomedical scientists and engineers to apply investigative techniques to make biology a predictive as well as observational science.

Modules associated with our Biomedical Physics research build on the core modules in the first two years. These classes are lectured by academics undertaking active research in this field, and include: *The Physics of Living Systems*, which adapts a synthetic approach: molecules-cells-tissue, emphasising the contributions of physics and the outstanding challenges; *The Biophysics of Cells and Tissues*, which describes the physical properties of tissues and their constituent cells, and their role in normal growth and the development of diseases; and *Physical Methods in Biology and Medicine*, which discusses the principles and current techniques used for the understanding of biology at cellular and molecular level, highlighting some of the contributions these approaches can make to medicine and the life sciences.



METAMATERIAL STRUCTURES

We concentrate on the fundamental study of the electromagnetic (eg, visible, terahertz and microwave) and acoustic (sound) properties of structured materials. This includes plasmonics, magnonics, spintronics and the photonics of bio-inspired and disordered structures. Our work involves material synthesis and nanofabrication, imaging and characterisation using microwaves, ultrafast laser and synchrotron sources, as well as ultrasound, results from which are combined with numerical and analytic theory in quantum optics and quantum information science.

We host the EPSRC Centre for Doctoral Training in Metamaterials. Our researchers are exploring the underlying physics, through to material engineering, feeding industry and academia with graduates to exploit this exciting field.

OUR RESEARCH CONTINUED

Electromagnetic and Acoustic Materials

Substantial effort is devoted to exploring the consequences of the merger of two recent developments: spatial transformations and metamaterials. The idea of spatial transformations is to provide entirely new methods to manipulate the emission, propagation and absorption of waves and can lead to exciting concepts, such as invisibility cloaking. We are developing new ways to generate and control THz radiation, and recent innovative studies into the manner in which molecules are influenced by their optical surroundings are opening up a new area of nanotechnology. Several patents have been filed and we are working closely with industry. The study of highly evolved biological systems that strongly manipulate light and colour, such as those found in insects and plants, continues to offer exciting opportunities to inspire transformational developments in technological devices. Another area, currently of much national interest, concerns quantum technologies both from a fundamental perspective and also with regards to device development.

We use optical and electrical measurement techniques as well as neutron and synchrotron radiation sources around the world to study nanostructured magnetic materials that we both fabricate in Exeter and obtain from collaborators in academia and the magnetic recording industry. We are particularly interested in magnetic processes that occur on sub-nanosecond timescales, and which may lead to the reduction of read and write times in data storage systems, and enable the operation of 'spintronic' devices that exploit the electron spin. We have particular expertise in the use of ultra-fast lasers to obtain snapshots of the magnetic state of thin film-materials after they have been stimulated by either optical or magnetic field pulses.

There are many modules directly associated with this field of research. *The Waves and Optics* module in Year 1, and the two core courses in *Electromagnetism*, together with modules in *Quantum Mechanics* and *Condensed Matter*, prepare you for the research-led options. These include: *Lasers, Materials and Nanoscale Probes for Quantum Applications* which will develop your understanding of light and matter and how they may be used to provide assorted optoelectronic devices; *Quantum Optics and Photonics*, which explores how quantum physics may be harnessed to offer new and exciting opportunities, with topics including optical fibres, nonlinear optics, entangled states, cavity QED and negative index materials; and *Ultrafast Physics*, which covers areas of physics that emerged as a result of application of the state-of-the-art ultrafast measurement techniques in the study of spintronics, magnonics, plasmonics and metamaterials.

Quantum Systems and Nanomaterials

(incorporating the Centre for Graphene Science)

The properties of systems that consist of up to few-hundred atoms can differ remarkably from those of macroscopic devices because the effects of the fundamental laws of quantum mechanics dominate the behaviour of such small systems. This paves the way to the discovery of new physical properties and exciting phenomena. The emerging class of atomically thin materials offers easy access to a new realm of optical, electrical and thermal properties which are the focus of research in the Quantum Systems and Nanomaterials group.

Graphene is a single atomic-layer carbon honeycomb structure that was first isolated in 2004. It has unique electronic, thermal and mechanical properties that are enabling the development of novel electronic devices such as flexible and transparent displays and energy-harvesting devices. Exeter physicists discovered a new graphene-based material in 2012, named 'GraphExeter', which is the most highly conductive transparent material known, and has potential applications in flexible transparent electronics (for instance, electronic paper).

Our experimental work is supported by a world-leading team of theoretical scientists developing analytical and numerical models to unveil the physics of nanoscale systems. The close links between theoretical and experimental work within our group has opened new research areas of strategic interest for fundamental and applied science. We are also currently exploiting the potential of our discoveries such as GraphExeter to develop novel functional electronic devices in partnership with a wide range of industrial partners, such as Nokia.

There are four condensed matter and quantum mechanics modules to prepare you for research-led courses associated with the Quantum Systems and Nanomaterials group. The core modules direct an education that includes the concepts and methods of quantum physics, nanomaterials, semiconductors and magnetism. Research-led options, lectured by our world-leading researchers, include: *Principles of Theoretical Physics*, which reviews the most fundamental theoretical ideas such as action, symmetries and path integrals, and explores the links between various fields of physics ranging from mechanics to quantum field theory; *Nanostructures and Graphene Science*, which explains the operation of quantum devices and demonstrates the application of this physics to technology; *Quantum Many-Body Theory* uses methods such as Green functions, Feynman diagrams and quantum field-theories to analyse phenomena including superfluidity and superconductivity.

For further details of physics research at Exeter, visit **www.exeter.ac.uk/physics/research**

"I think the most valuable aspect of my degree programme so far would be that I've been taught some really interesting and important physics by people who are at the forefront of research in these fields themselves."

Sam England, MPhys Physics with Australian Study

NANOFABRICATION SUITE

We are able to create nanostructured materials and devices using our recently built state-of-the-art clean room facility equipped with focused ion beam and electron beam systems, and we use optical, electrical transport and thermodynamic techniques to study these structures at temperatures barely 0.01 degrees above absolute zero and in high magnetic fields.

LEARNING, TEACHING AND ASSESSMENT

We believe that every student benefits from being part of a culture that is inspired by research and being taught by experts. Not only do we teach you about our pioneering research, we teach you how to undertake the research yourself. Experimental skills are acquired in the laboratories and astronomical observatory, and here you are introduced to a wide range of apparatus and techniques. Training in theoretical techniques are provided by our methods and computational modules. By the time you reach the start of their extended project work, you will have received the necessary preparation to undertake it with confidence in either experimental or theoretical topics, and these projects are tackled with great enthusiasm and energy.

We will fully support you as a student in a friendly environment: you will receive individual attention and feedback throughout your programme. Weekly tutorials form the core of our academic support, complementing all the modules and project work that you are taking. You will meet with your tutor (a professor or lecturer) in a small group with four or five others for one hour during every teaching week of your programme. These sessions are your opportunity to discuss any element of your academic studies. Assignments will also be set, discussed and marked – sometimes these will be on unfamiliar topics: we wish to encourage active discourse in physics as this is a good way of understanding the more subtle concepts and gaining confidence in your intuition. You will also have the opportunity to practice your oral presentation skills, and gain support with your professional development. In the final year of the MPhys programmes, your research-project supervisor is your tutor. Throughout your time in Exeter, your tutor will also be your first point of call for pastoral support and will advise about the availability of University services including wellbeing, disability and financial help.

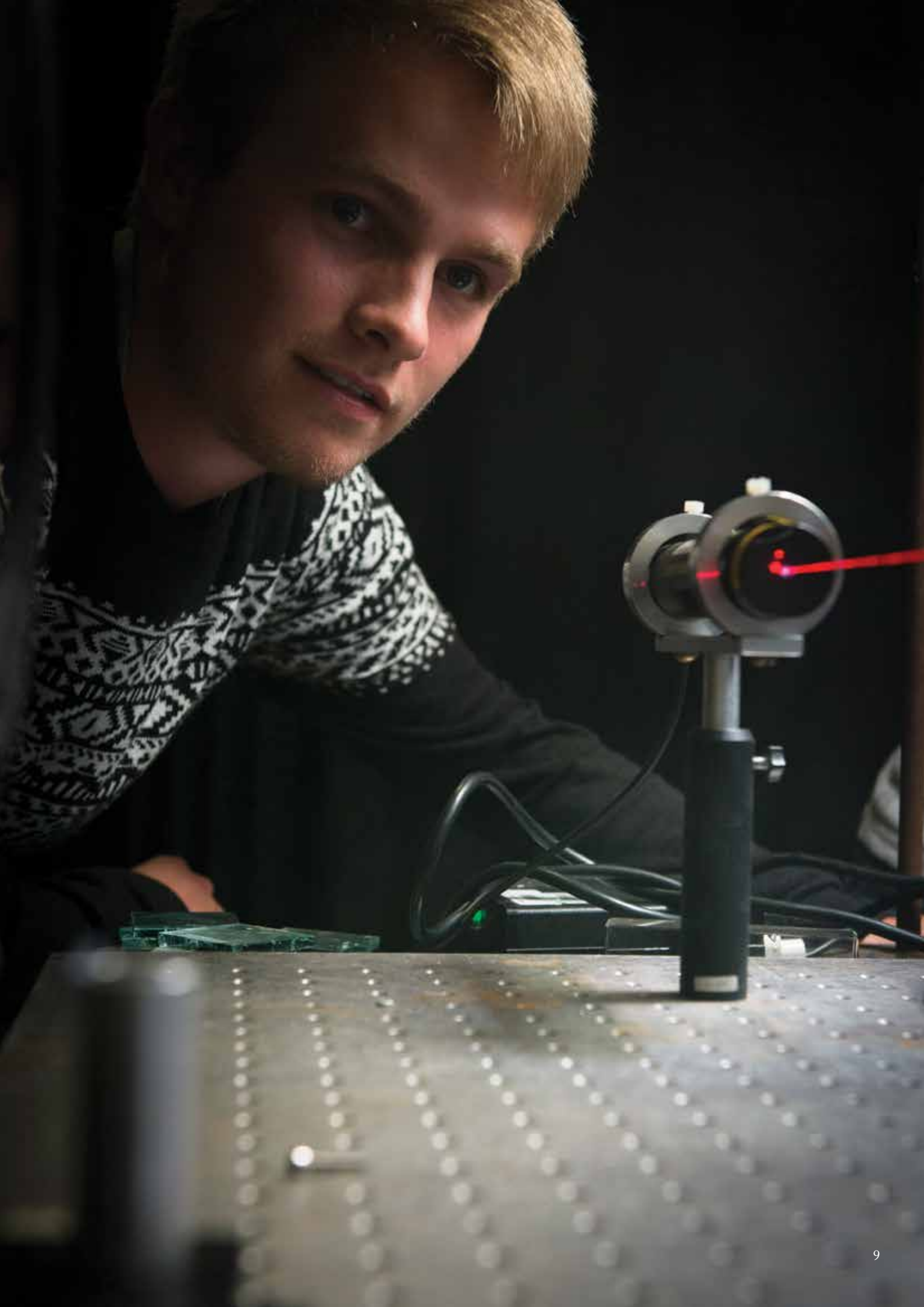
Teaching is undertaken in a variety of ways, with lecturing the primary method. There are also weekly problem-solving classes in the first two years for both mathematics and physics modules. Physics at the University of Exeter is also actively engaged in introducing new methods of learning and teaching, including increasing use of interactive computer-based approaches to learning through our virtual learning environment where the details of all modules are stored in an easily navigable website. Students can access detailed information about modules and learning outcomes, as well as sets of lecture slides/notes, example and problem-sheets, videos, and interact through activities such as the discussion forums. Video recordings of lectures are normally made available whenever possible to aid your revision.

There are also a number of services on campus where you can get advice and information, including the Students' Guild Advice Unit. You can find further information about all the services in the University's undergraduate prospectus or online at **www.exeter.ac.uk/undergraduate**

Assessment in the first two years is a combination of continuous assessment and exams. About 65 per cent of the assessment in each of these years is by written examinations and short mid-term tests; the rest involves work for projects, laboratories, problems classes and more. You must obtain a pass mark for your first year in order to proceed but your performance at this stage does not count towards your final degree classification.

"The weekly tutorials offered throughout my degree have been one of the most useful aspects of the teaching at Exeter. These provide a point of contact should you have any problems or concerns with any of the modules or if you are ever confused about a particular subject."

Katie Mason, BSc Physics



CAREERS

Employability skills are an integral part of the physics curriculum. The flexibility and adaptability of a well-trained physicist is appreciated by employers: they acknowledge the benefits of excellent problem-solving skills, an educated scientific intuition and the confidence to be able to grasp new concepts quickly. With over 89 per cent of our graduates from Physics entering into professional occupations or graduate-level further study within six months (2013/14 DLHE), you will have excellent employment prospects.

- ☐ A two-day employability and graduate development workshop in year one
- ☐ A two-day communication skills course in year one
- ☐ Annual personal development planning exercises
- ☐ Training in the formulation and solution of problems
- ☐ Substantial amounts of practical and project work, the results of which must be presented and defended in various formats (written reports, posters, oral presentations)
- ☐ Working with others in projects and problem-solving classes
- ☐ IT skills training
- ☐ Mathematical skills training
- ☐ An opportunity to take a commercial and industrial experience module

In addition, the purpose of the extended project work in both the BSc and MPhys programmes is for you to develop research skills. You will learn to present and scientifically defend your work and ideas in a variety of ways. The experience and skills developed not only form a valuable basis for a research career, but are also known to be highly valued by employers.

The most academically able graduates are normally strongly encouraged to apply for a fully funded PhD studentship in physics or astrophysics. Visit **www.exeter.ac.uk/postgraduate/research-degrees/physics** for details, including of our Centre for Doctoral Training in Metamaterials.

The largest proportion of our graduates enter science-based industries in positions involving research and development, production and management. Other careers include scientific work in government establishments (eg, QinetiQ or Harwell Laboratories), hospital physics in the NHS and technical management in broadcasting and the communications sector. Some work in high-tech start-up companies.

For further information about what the careers service at Exeter offers, please see **www.exeter.ac.uk/ug/careers**

Examples of the destinations of our recent graduates:

Employers

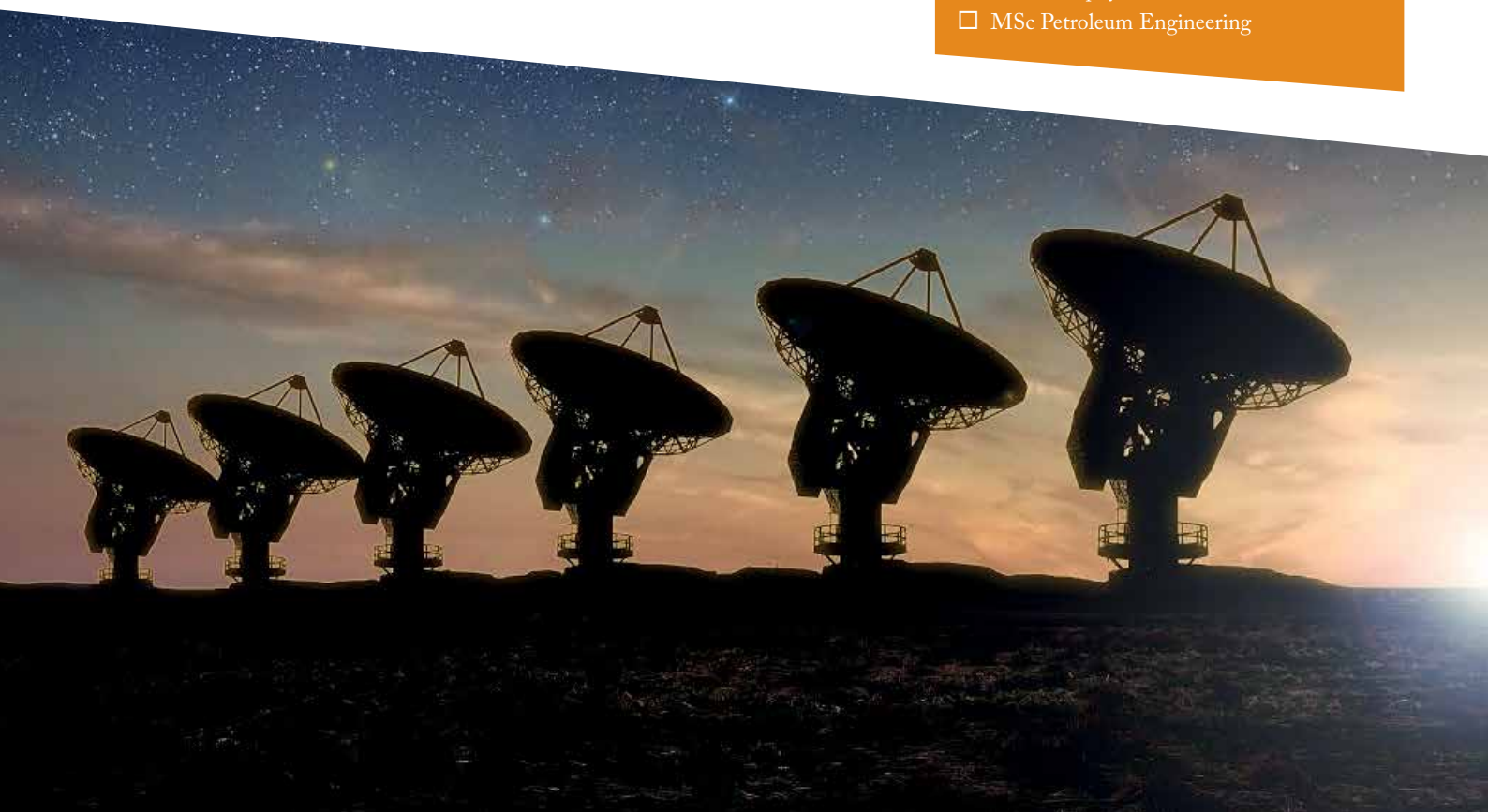
Met Office // NHS // British Gas // Novia Financial PLC // DSTL // Randall & Payne LLP // Reddie & Grose LLP // Rolls Royce // BMI // Frazer-Nash Consultancy IMS Research // Morgan Stanley // Science and Technology Facilities Research Council // Renshaw Plc // AWE // Thales // IBM // KPMG // First Great Western // QinetiQ

Occupations

Geophysicist // Medical Physicist // Air Quality Scientist // IT Security Officer // Field Support Engineer // Financial Modeller/ Analyst // Technical Consultant // Commercial Analyst // Complex Energy Products Analyst // IT Consultant // Trainee Chartered Accountant // Data Analyst // Trainee Patent Attorney // Software Developer

Examples of further study followed by our graduates:

- ☐ PhD Physics
- ☐ PhD Biophysics Analysis
- ☐ PGCE Secondary Science
- ☐ MA Terrorism, Security and Society
- ☐ MSc Water and Environmental Management
- ☐ MSc Materials for Nuclear Fusion
- ☐ MA Marine Engineering
- ☐ MSc Machine Learning
- ☐ MSc Theoretical Physics
- ☐ MA Astrophysics
- ☐ MSc Petroleum Engineering



MODULES

KEY C = Core
● = Optional

We continually review and update our modules and have included a selection across all years below.
For the latest details, please check **www.exeter.ac.uk/ug/physics**

Year 1 Modules

Module Name	MPhys/BSc Physics	MPhys/BSc Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Abroad	BSc Mathematics and Physics†
Introduction to Astrophysics	C	C	C	C	
IT and Astrophysics Skills		C	●	●	
IT and Electronics Skills	C		●	●	
Mathematics (two modules)	C	C	C	C	C
Modules from Mathematics					C†
Practical Physics and IT Skills					C
Practical Physics	C	C	C	C	
Properties of Matter	C	C	C	C	C
Vector Mechanics	C	C	C	C	C
Waves and Optics	C	C	C	C	C

Year 2 Modules

Module Name	MPhys/BSc Physics	MPhys/BSc Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Abroad	BSc Mathematics and Physics†
Analytical and Chaotic Mechanics	●		●	●	●
Condensed Matter I	C	C	C	C	●
Elective(s)*	●		●	●	
Electromagnetism I	C	C	C	C	C
Lasers, Materials and Nanoscale Probes for Quantum Applications	●		●	●	●
Mathematics with Physical Applications	C	C	C	C	●
Modules from Mathematics					C/●†
Observing the Universe	●	C	●	●	●
Practical Physics II	C	C	C	C	●
Quantum Mechanics I	C	C	C	C	C
Scientific Programming in C	●	C	●	●	
The Physics of Living Systems	●		●	●	●
Thermal Physics	C	C	C	C	●

* *An 'elective' is an unspecified module that allows the student to broaden their education by taking a module from another discipline, eg, philosophy, or a foreign language.*
† *BSc Mathematics and Physics students take Numbers, Symmetries and Groups and Probability and Discrete Mathematics in Year 1, and Linear Algebra in Year 2 as compulsory modules. In Years 2 and 3 there are a large number of options to choose from in Mathematics, ranging from Mathematical Theory of Economics, to Mathematics: History and Culture, to Mathematics of Climate Change. See www.exeter.ac.uk/ug/maths for more information.*

Year 3 Modules

Module Name	MPhys/BSc Physics	MPhys/BSc Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Abroad	BSc Mathematics and Physics†
Applying Physics (BSc Group Project)	●	●			
Elective (MPhys Physics only)*	●				
Electromagnetism II	C	C	C		C
Energy and the Environment	●	●			●
Galaxies and High Energy Astrophysics	●	C			●
General Problems	C	C			
Methods of Theoretical Physics	●	●			●
Modules at Year Abroad Host				C	
Modules from Mathematics					C/●†
Nanostructures and Graphene Science	●	●			●
Nuclear and High Energy Particle Physics	C	C			C
Principles of Theoretical Physics	●	●			●
Professional Experience			C		
Project(s)	C	C	C	C	C
Quantum Mechanics II (MPhys only)	C	C	C		
Stars	●	C			●
The Biophysics of Cells and Tissues	●	●			●
Ultrafast Physics	●	●			

Year 4 Modules

Module Name	MPhys/BSc Physics	MPhys/BSc Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Abroad
An option from the Year 3 list	●	●		
Computational Physics and Modelling	●	●	●	●
Condensed Matter II	C	C	C	C
Independent Study	●	●	●	●
Nuclear and High Energy Particle Physics			C	C
Physical Methods in Biology and Medicine	●	●	●	●
Project(s)	C	C	C	C
Quantum Many-Body Theory	●	●	●	●
Quantum Mechanics II				C
Quantum Optics and Photonics	●	●	●	●
Relativity and Cosmology	●	C	●	●
Solar and Extra-Solar Planets and Their Atmospheres	●	C	●	●
Statistical Physics	C	C	C	C

MODULES CONTINUED

Year 1 modules

Introduction to Astrophysics	The theories of quantum mechanics, and how they are applied to astrophysical phenomena.
IT and Electronics/ Astrophysics Skills	This module will teach you how to use LaTeX to write technical reports, and will introduce numerical mathematical software as a tool employed by physicists to analyse data and solve problems. The final part of the module focusses on digital electronics, while Astrophysics students substitute this for an introduction to computer-aided manipulation and analysis of modern astrophysical data.
Mathematics	There are two maths modules that have wide applicability throughout physics, including differential calculus, complex numbers, Fourier Series and matrices. There is great emphasis on problem-solving, with examples taken from the physical sciences.
Practical Physics	Experimental physics in the teaching laboratories.
Properties of Matter	Topics such as elastic properties and hydrostatic properties are explained using experimental observations and macroscopic (large-scale) theories. Surface tension in liquids is explained using a molecular-level theory. This is followed by a microscopic treatment of interatomic interactions, the ground-state electronic structure of atoms and rotational and vibrational energy levels in molecules.
Vector Mechanics	Our interest in mechanics is rooted in its general applicability to a vast number of familiar phenomena. This module provides meaningful and easily visualised problems that allow development of the skills of problem-solving, required in all the fields of physics. It provides the necessary background to later modules that extend the principles of mechanics to the solution of more complex problems.
Waves and Optics	The concepts of oscillation and wave propagation permeates the whole of physics. This module first considers the characteristic parameters of a forced, damped harmonic oscillator. Later stages discuss the propagation of waves on a string, in solids, in gases, and in periodic structures, and is followed by an introduction to geometrical optics.

Year 2 module examples

Analytical and Chaotic Mechanics	An introduction to some fundamental concepts in analytical dynamics, covering: the calculus of variations; Lagrangian and Hamiltonian formulations of dynamics; Poisson brackets; canonical transformations; and Hamilton-Jacobi equations.
Condensed Matter I	Focusing on how electrons, phonons and other waves propagate within crystalline materials. The behaviour of electrons in metals and semiconductors is discussed, and the role of phonons in insulators is described.
Electromagnetism I	The phenomena associated with electrostatics (charges at rest) and magnetostatics (the magnetic effects associated with steady currents), electric and magnetics fields and classical induction.
Lasers, Materials and Nanoscale Probes for Quantum Applications	This module emphasises how our understanding of light and matter may be used to provide assorted optoelectronic technique devices, eg, lasers and electron microscopy.
Observing the Universe	You will gain a basic knowledge of the hierarchy of objects in the universe, including their structural and evolutionary relationship to each other, an understanding of the underlying principles of key instrumentation used for observational astrophysics and an understanding of how we can obtain structural information and physical parameters from distant, often unresolved, objects.
Quantum Mechanics I	This module introduces the mathematical expression of the basic principles of quantum mechanics and methods for finding solutions of problems that permit straightforward mathematical analysis, eg, the quantum harmonic oscillator and the hydrogen atom.
Scientific Programming in C	Practical sessions in the computer suite, designed to give students the ability to write clearly structured, de-buggable and maintainable computer programs.
The Physics of Living Systems	Covering the basic physical concepts and principles required to understand and study living systems. It starts at the molecular level and works up the scale of size and complexity to cover several major systems found in complex organisms.
Thermal Physics	An introduction to classical thermodynamics, demonstrating that its laws arise naturally from the statistical properties of an ensemble. Real-world examples of the key ideas are presented and their application is emphasised.

Years 3 and 4 module examples

Computational Physics and Modelling	Development of both programming skills and knowledge of a range of computer algorithms of relevance to the simulation and modelling of physical systems.
Condensed Matter II	The application of the core physics covered in previous modules to novel systems, and the engagement with fundamental electric, magnetic and optical phenomena in metals and dielectrics. The module illustrates and draws on research undertaken in the department: studies of the metal-to-insulator transition; oscillatory effects in strong magnetic fields; optical and magnetic phenomena.
Electromagnetism II	A development of the understanding of Maxwell's equations and their applications. Specifically, the fundamentals of fields due to moving charges and also the exploration of the interaction of electromagnetic radiation with matter.
Energy and the Environment	An introduction to the broad range of issues concerned in the relationship between energy use and environmental change. Individual and group work to engage with the associated technical, economic and social issues.
Galaxies and High Energy Astrophysics	An understanding of the physics of galaxies, their constituents and their evolution over cosmological time will be developed. The fascination that these objects hold is due in part to the challenge of extracting information from objects so faint and distant, and in part to the exotic physics of dark matter, black holes, non-Newtonian gravity, quasars and the expansion of the universe.
Methods of Theoretical Physics	The development of a deeper understanding of, and greater competence in using, some important mathematical methods and techniques of theoretical physics, including complex variables, conformal mapping and group theory.
Nanostructures and Graphene Science	Drawing on research undertaken at Exeter, this module will explore the fascinating material world of the small. In addition to their potential applications, quantum phenomena continue to provide new ways of probing our understanding of the world and allow us to explore new physics.
Nuclear and High Energy Particle Physics	Investigations of the atomic nucleus and of the fundamental forces that determine nuclear structure offer fascinating insights into the nature of the physical world. The tools for probing these systems are high-energy particle accelerators and, more recently, colliding-beam systems.
Physical Methods in Biology and Medicine	You will develop an understanding of the principles and current techniques used for the understanding of biology at the cellular and molecular level, and the particular challenges arising in their application to living systems and medicine.
Principles of Theoretical Physics	A review of the most important concepts of theoretical physics, in particular: the action, symmetries and conservation laws. It shows how they help physicists to think about seemingly disconnected topics, ranging from mechanics to quantum field theory.
Quantum Many-Body Theory	An introduction to the foundations of the theory, from both the technical and physical points of view. Although many of the examples are drawn from condensed matter physics, the analogies between these and the theories of high-energy physics will also be emphasised and illustrated.
Quantum Mechanics II	Covering a range of advanced topics leading to the discussion of quantum transitions and nonrelativistic scattering. Much of physics concerns manifestations of the electromagnetic interaction that is susceptible to perturbation techniques.
Quantum Optics and Photonics	The physics that underpins photonics and topics at the forefront of current optics research, such as the production and manipulation of light in special states.
Relativity and Cosmology	You will develop an understanding of Einstein's Special Theory of Relativity. The General Theory will also be introduced and applied to the standard cosmological model and to the three historical tests of the theory: the precession of the perihelion of mercury, the bending of light passing close to the sun and the gravitational red shift.
Solar and Extra-Solar Planets and Their Atmospheres	The understanding and interpretation of a wide range of phenomena associated with planetary objects both inside and outside the solar system, an area of physics that has been developing rapidly since the first observation of an extra-solar planet in 1995 and a major research theme at Exeter.
Stars	Taking fundamental physical concepts and using them to derive the properties of stars. The basic internal structure of stars is described in the first sections, while later sections deal with the ageing and death of both high- and low-mass objects. The final sections describe how stars form.
Statistical Physics	An understanding of how the time-symmetric laws of quantum mechanics obeyed by all systems can be linked, through a chain of statistical and thermodynamic reasoning, to the (apparently time-asymmetric) natural processes occurring in macroscopic systems.
The Biophysics of Cells and Tissues	Describes the fundamental physical properties of biomolecules, cells and tissues and introduces some of the biophysical and biomechanical challenges in understanding the behaviour of normal tissues and their failures in disease.
Ultrafast Physics	This topic is revolutionising our understanding of matter and offering many new exciting opportunities, for example some speculate that table-top particle accelerators might become possible.

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Saturday 4 June 2016
Saturday 1 October 2016

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We also invite potential applicants to visit the Physics building at any time. Please contact us in advance of your planned trip so that we can organise a member of staff or student to meet you.

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