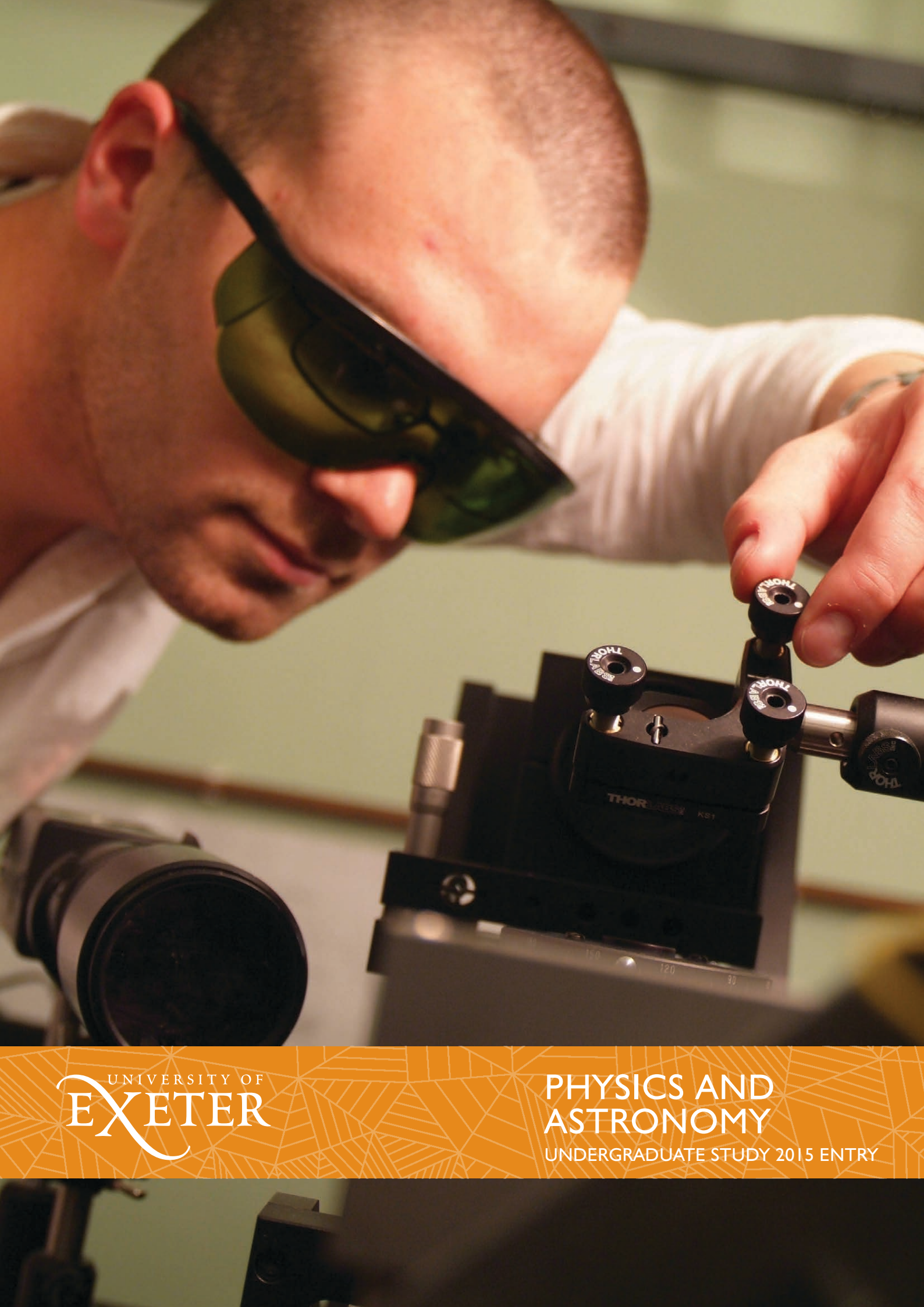


UNIVERSITY OF EXETER

PHYSICS AND ASTRONOMY

UNDERGRADUATE STUDY 2015 ENTRY

KEY INFORMATION AND ENTRY REQUIREMENTS

	UCAS CODE	TYPICAL OFFER
MPhys Single Honours		
Physics	F303	AAA-ABB; IB: 36-32
Physics with Astrophysics	F3FM	AAA-ABB; IB: 36-32
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	AAA-ABB; IB: 36-32
Physics with Astrophysics	F3F5	AAA-ABB; IB: 36-32
BSc Combined Honours		
Mathematics and Physics	FG31	A*AA-AAB; IB: 38-34

Please note: 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.

Normally students can transfer between any of the programmes above during the first year, however capacity limitations may restrict transfer on to the Professional Experience and Study Abroad options.

For further details on all our entry requirements, please see our Physics and Astronomy pages at **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 interview with a member of academic 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 popular Pre-University Physics Course. This course is intended for Year 12 students who are, or have been, studying Physics or Physical Sciences at pre-university level and who are considering applying to study Physics or related subjects at university. The course provides a taste of university life in all its diversity. During the three-day programme students attend lectures, visit the research and teaching laboratories of the department of Physics, live in University student accommodation and make use of our recreational, sporting and social facilities. Contact **pupc@exeter.ac.uk** for more details.

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

PHYSICS

8th in the UK for world-leading and internationally excellent research[1]

92% in professional-level employment or further study within six months of graduating[2]

A £3 million renovation of facilities in our building, including teaching laboratories and study environments

Weekly, small group tutorials with academics

Opportunities for studying abroad, and for undertaking a salaried year-long research-project in industry

An experimental or theoretical research project of at least one year on the MPhys programmes

Opportunity to continue into PhD study as part of Exeter's new centres of doctoral training

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.

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 quantum optics, exoplanets, and methods of theoretical physics. 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 option modules reflect our research interests. You can obtain first-hand experience of what it is like to conduct research yourself by undertaking extended experiments in BSc programmes, or a project in one of our research groups as part of the MPhys programmes.

We firmly believe in individual attention, which begins from the day you visit us for an interview. You will meet the professors and lecturers in tutorials, in problem-solving classes, in the laboratories and when you undertake project and research work, 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.

The Physics building has recently undergone a multi-million pound refurbishment programme that has included significant investment in our teaching laboratories (including the computer suite), new student study areas and teaching laboratories, and a new student services area in the foyer. Advanced research facilities include: clean-rooms for photo and nanolithography; 3D printing equipment; a helium liquefier for low temperature experiments; a research-grade telescope on the roof; a water tank for SONAR; amplified ultra-fast laser systems for the study of ultra-high speed phenomena; and a suite of instruments for imaging biological materials. State-of-the-art supercomputers are used in our astrophysics and theoretical research.

[1] *Research Assessment Exercise 2008 based on percentage of research categorised as 3* or 4**
[2] *Destination of Leavers from Higher Education Survey 2011/12*

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 career opportunities. The four-year MPhys degrees take you further and give you a great opportunity to specialise in a research theme in which we excel, spanning 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, however capacity limitations may restrict transfer on to the Professional Experience and Study Abroad options. All our programmes can lead naturally on to PhD-level research or towards a more specialised qualification such as an MSc, and single honours degrees 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 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. In addition, the use of mathematics gives these principles a precise form and provides physics with the ability to make detailed quantitative predictions. This year focuses on the three main cornerstones of physics: quantum mechanics, electromagnetism and statistical physics. These provide the core of most of physics and of our understanding of the evolution of our universe. The other modules in subsequent years draw in part on your knowledge of this core.

Year 3 and Year 4 (MPhys only) of the programme allow you apply the core principles in a number of important broad areas like nuclear and high-energy particle physics and condensed matter physics, and there are numerous options in theoretical physics for you to choose (e.g. *quantum many-body theory*, *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 modules that illustrate how the principles learnt previously can be applied in greater depth to get close to the frontier of the subject (e.g. *Galaxies and High Energy Astrophysics*, *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. For the MPhys programme, you are 'adopted' into one of our research groups (see page 4), working in a small group (typically 3), to undertake a project for at least one year. Each year, the academics in the department write short research proposals, from which students select their preferences. The projects are original and open-ended, i.e. they each represent a previously unstudied piece of Physics, and you will meet with your supervisor (professor or lecturer) once a week to discuss progress and future work. As a member of the research group 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. If you opt for the BSc programme, you will work on two term-long projects in your third year. If you choose the 'Applying Physics' project, one of these can be team-based work tackling a real-world problem proposed by local business or industry. It is not uncommon for some of the most academically gifted students to produce project work that is published in major scientific journals.

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 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 undergraduate 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. 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, plus academics from Exeter. You will return to Exeter to present your findings, and also to take the examinations in the two modules you will study via distance learning. Companies that have recently participated in this programme include HP Labs, QinetiQ, the Met Office, Rutherford Appleton Laboratories and the Royal Devon and Exeter Hospital. You will return to Exeter to study in your final year which will include 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 include additional options in astronomy (with access to, for example, 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, University of Kansas, and 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 to study in your final year which will include 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 is 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 maths and physics, and you will learn to understand the ways in which they co-exist and complement each other. You will benefit from the flexibility and freedom to choose 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**

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 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 option modules 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 programmes. Exeter astronomers are observing on the largest facilities in the world including the Hubble Space Telescope (HST), the 10.4m GranTeCan in Spain and the 8m Gemini telescopes (Hawaii and Chile) providing, in particular, information about the atmospheric properties of extra-solar planets.

The Astrophysics group is also developing a new field of research, namely extra-solar planet climatology. We have built strong links with the Met Office in Exeter, taking advantage of meteorologist 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.

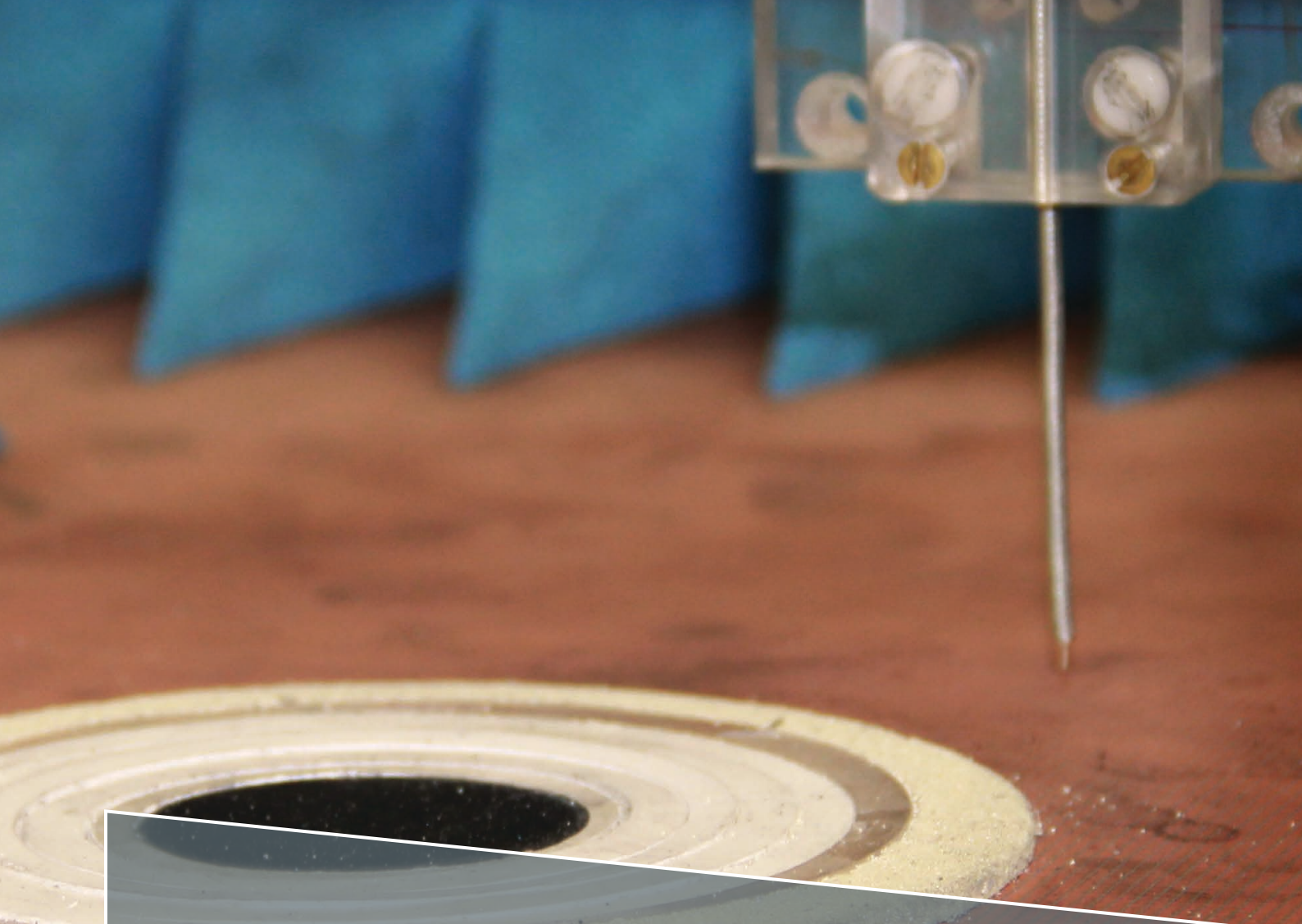
In your first term at Exeter you will take the *Introduction to Astrophysics* class as a core module (except BSc Mathematics and Physics students). Not only will it introduce you to the theories of quantum mechanics and special relativity, it will demonstrate how they are applied to a wide variety of 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* takes the fundamental concepts of gravitation, quantum mechanics, and thermodynamics to derive the properties of stars, their formation and death; *Relativity and Cosmology* which includes an introduction to the special and general theories of relativity and the evolution of the Universe; *Galaxies and High Energy Astrophysics* 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 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 integrative studies on touch perception. 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 £50 million Living Systems Institute. This new building is currently under construction 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 (e.g. 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 microwave, ultrafast laser and synchrotron sources, which are combined with numerical and analytic theory in quantum optics and quantum information science.

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. This goes far beyond what can be accomplished with traditional materials in the form of lenses and mirrors, and can lead to exciting concepts such as invisibility cloaking, perfectlensing and other novel forms of wave manipulation including those associated with wireless communication and energy transfer.

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 to develop new designs of RF-ID technology, anti-counterfeiting measures and sound proofing in collaboration with industry. In addition to this, the study of highly evolved biological systems that strongly manipulate light and colour, such as those found in insects and plants, continue to offer exciting opportunities to inspire transformational developments in technological and industrial devices and processes. Another area, currently of much national interest, concerns quantum technologies both from a fundamental perspective and also with regards to device development.

OUR RESEARCH CONTINUED

Electromagnetic and Acoustic Materials

(incorporating the Centre for Doctoral Training in Metamaterials)

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* (which take you from electrostatics, vector fields and Maxwell's equations in Year 2, to the interaction of electromagnetic radiation and metamaterials in Year 3), 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 light may be controlled and guided, and how quantum physics may be harnessed in the future to offer new and exciting opportunities in manipulating light, 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 science of systems that are comprised of just one- or a few-hundred atoms differs significantly from that of macroscopic devices as it thrives primarily on the fundamental laws of quantum mechanics. This is leading to the discovery of a new realm of 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 constitute the focus of the research in Quantum Systems and Nanomaterials.

Graphene, a single atomic-layer carbon honeycomb structure that was first isolated in 2004, has unique electronic, thermal and mechanical properties which is enabling the development of electronic applications with novel functionalities such as flexible and transparent displays and energy harvesting devices. We are studying the fundamental physics of graphene and developing new methods for fabricating graphene on a large scale, with the aim of exploiting its unique properties in device and sensor applications. To this end, Exeter physicists discovered a new graphene-based material in 2012, dubbed '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 also supported by a world-leading team of theoretical scientists developing analytical and numerical models to unveil the physics of nano-scale systems. The unique synergy between theoretical and experimental work conducted in 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 in particular to prepare you for research-led courses associated with the Quantum Systems and Nanomaterials group. The core modules direct an education that includes the Schrodinger Equation, perturbation theory, nanomaterials, semiconductors and magnetism. Research-led options, lectured by our world-leading researchers include *Principles of Theoretical Physics* which reviews concepts such as the action, symmetries, and conservation laws, and shows how they help physicists to think about seemingly disconnected topics, 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; and *Quantum Many-Body Theory*, which starts with the second-quantisation formalism, and uses methods such as Green functions, Feynman diagrams, and relativistic and non-relativistic quantum field-theories to analyse phenomena including superfluidity and the BCS theory of superconductivity.

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

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 as low as 0.01 Celsius and in magnetic fields as high as 19 Tesla.

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. Being able to make reliable measurements and interpret them are cornerstones of an experimental physicist's abilities. By the time our students reach their final year, they have received all the preparation to undertake the extended project work with confidence and these are tackled with great enthusiasm and energy.

You will have a personal tutor who is available for advice and support, both academic and pastoral, throughout your studies. You will meet with a professor or lecturer with four or five of your colleagues every week during term time throughout your degree, and these meetings provide an opportunity for you to gain help with your lecture courses and project work, as well as for assignments to be set, marked and discussed. We wish to encourage active discourse in physics as this is a good way of understanding the more subtle concepts. You will also have the opportunity to practice your oral presentation skills, and gain support with your professional development.

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 maths 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.

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 most valuable aspect of my programme is that it is applied. It focuses on problem solving in all areas of physics as well as providing a substantial amount of lab work. This gives substance to what could otherwise be considered a purely theoretical subject. It is taught by leading scientists (e.g. Professor Sambles has recently been elected President of Institute of Physics) who are always available if you have questions or need help in anything, and the weekly tutorials and 'extra problems' classes allow for excellent support."

Daphne Perquel, MPhys Physics with Australian Study, 3rd Year

CAREERS

The flexibility and adaptability of a well-trained physicist is appreciated by employers and our graduates have excellent employment prospects. Employability skills are an integral part of the physics curriculum. Physics students at Exeter benefit from:

- ☐ 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 is 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/physics/postgraduate/phd** for details, including our Centre of 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 (e.g. 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:

Occupations

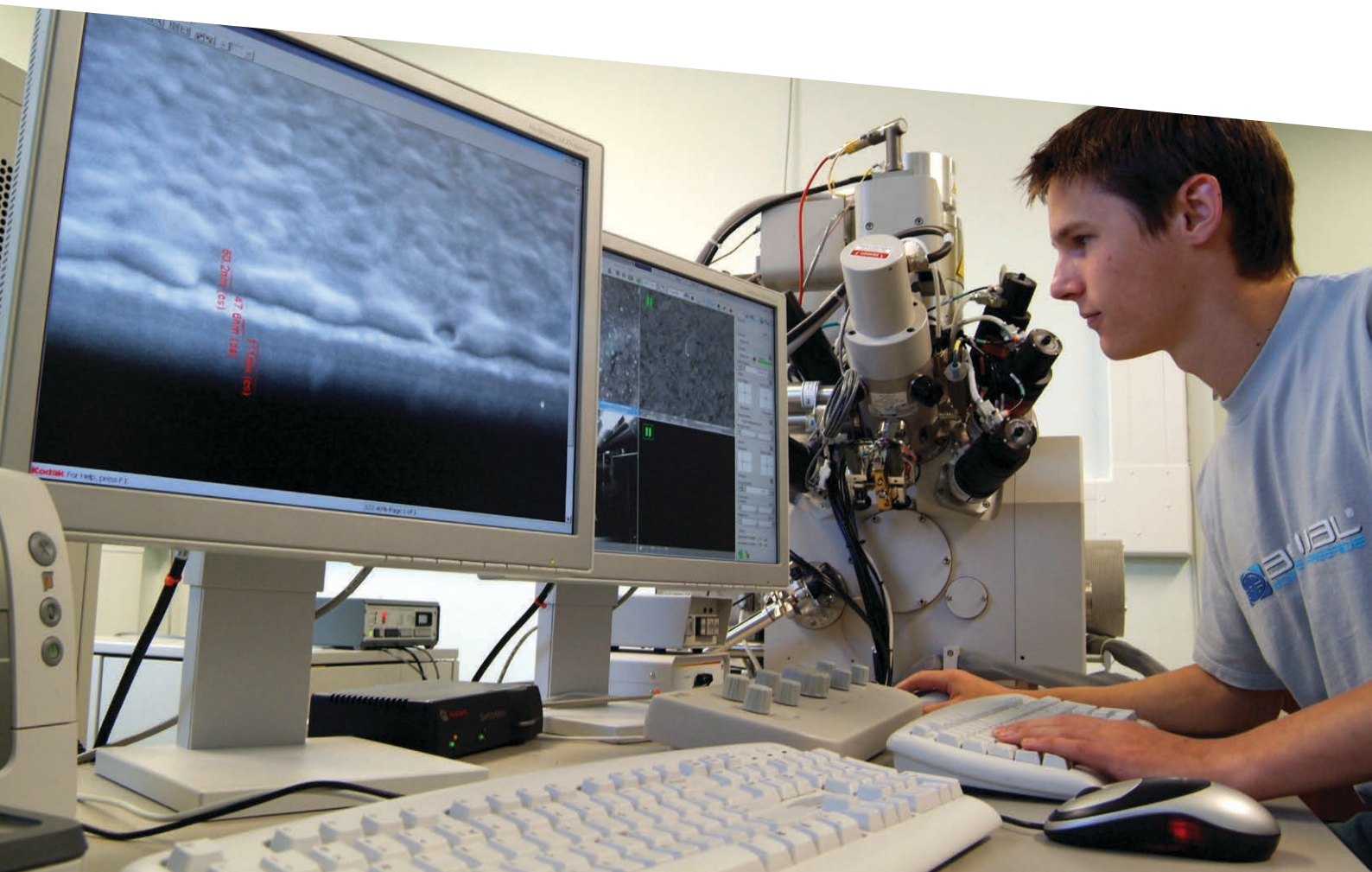
Graduate Engineer // Complex Energy Products Analyst // Technical Advisor // Non-Production Support Engineer // Higher Research Scientist // Software Developer // Financial Modeller/Analyst

Employers

A N Technology // Base 3 Systems // DSTL // MBDA Systems Ltd // Symantec Hosted Services // National Instruments // NHS // PPS Publications // QinetiQ // Robinson Reed Layton // Royal Navy // Science and Technology Facilities Council // Virtus

Examples of further study followed by our graduates:

- ☐ PhD Astrophysics
- ☐ MSc Fusion Energy
- ☐ MSc Machine Learning
- ☐ PGCE Secondary Physics Teaching
- ☐ PhD Physics
- ☐ PhD Buildings Science
- ☐ MSc Machine Learning, Computer Science and Mathematics



MODULES

KEY C = Core
O = 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 Overseas	BSc Mathematics and Physics†
Introduction to Astrophysics	C	C	C	C	
IT and Electronics/Astrophysics Skills	C	C	C	C	
Mathematics	C	C	C	C	C
Numbers, Symmetries and Groups					C
Practical Physics	C	C	C	C	C
Probability and Discrete Mathematics					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 Overseas	BSc Mathematics and Physics†
Analytical and Chaotic Mechanics	O	O	O	O	
Condensed Matter I	C	C	C	C	O
Elective(s)*	O		O	O	
Electromagnetism I	C	C	C	C	C
Lasers, Materials and Nanoscale Probes for Quantum Applications	O		O	O	
Mathematics with Physical Applications	C	C	C	C	
Observing the Universe	O	C	O	O	
Practical Physics II	C	C	C	C	C
Quantum Mechanics I	C	C	C	C	C
Scientific Programming in C	O	C	O	O	
The Physics of Living Systems	O		O	O	
Thermal Physics	C	C	C	C	C

Years 3 and 4 Modules

Module Name	MPhys/BSc Physics	MPhys/BSc Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Overseas	BSc Mathematics and Physics▲
Applying Physics (BSc Group Project)	O	O			
Computational Physics and Modelling	O	O	O	O	
Condensed Matter II	C	C	C	C	
Elective (MPhys Physics only)*	O				
Electromagnetism II	C	C	C	C	C
Energy and the Environment	O	O			O
Galaxies and High Energy Astrophysics	O	C			O
General Problems	C	C			
Independent Study	O	O	O	O	
Methods of Theoretical Physics	O	O			O
Nanostructures and Graphene Science	O	O			O
Nuclear and High Energy Particle Physics	C	C	C	C	C
Physical Methods in Biology and Medicine	O	O	O	O	
Principles of Theoretical Physics	O	O		O	O
Professional Experience			C		
Project(s)	C	C	C	C	C
Quantum Many-Body Theory	O	O	O	O	
Quantum Mechanics II	C	C	C	C	
Quantum Optics and Photonics	O	O			O
Relativity and Cosmology	C	C	O	O	
Scientific Programming in C	O				
Solar and Extra-Solar Planets and their Atmospheres	O	C	O	O	
Stars	O	C			O
Statistical Physics (MPhys only)	C	C	C	C	
The Biophysics of Cells and Tissues	O	O			O
Ultrafast Physics	O	O	O	O	
Year Abroad				C	

* *an 'elective' is an unspecified module that allows the student to broaden their education by taking a module from another discipline e.g. philosophy, or a foreign language*
† *BSc Mathematics and Physics students have core modules in* Differential Equations *and* Vector Calculus and Applications, *and options in* Analysis, Numerics and Optimisation, Algebraic Structures and Systems, *and* Series and Transforms *in addition to those listed above*
▲ *in addition to the above, BSc Mathematics and Physics students also have 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. *A full description of the programme is available at www.exeter.ac.uk/ug/physics*

MODULES CONTINUED

Year 1 modules

Introduction to Astrophysics	The theories of quantum mechanics and special relativity, 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.
Numbers, Symmetries and Groups	You will gain an understanding of the theory of groups, up to Lagrange's Theorem.
Practical Physics	Experimental physics in the teaching laboratories.
Probability and Discrete Mathematics	You will be concerned with counting rather than measuring, for example, learning how to enumerate permutations and combinations of objects satisfying specified conditions.
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, e.g. 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, e.g. 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, debuggable 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	This module introduces classical thermodynamics and shows how 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	Students taking this module will develop both their programming skills and their knowledge of a range of computer algorithms of relevance to the simulation and modelling of physical systems.
Condensed Matter II	The module will apply much of the core physics covered in previous modules to novel systems and engage 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	The module aims to develop students' understanding of Maxwell's equations and their applications. Specifically, students will get to the point where they can handle the fundamentals of fields due to moving charges and also to begin to explore 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. Students will work individually and in groups in order 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	This module develops 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 cellular and molecular level, and the particular challenges arising in their application to living systems and medicine.
Principles of Theoretical Physics	This module reviews 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	The module covers a range of advanced topics leading to the discussion of quantum transitions and non-relativistic scattering. Much of physics concerns manifestations of the electromagnetic interaction which is susceptible to perturbation techniques.
Quantum Optics and Photonics	You will develop a detailed understanding of the physics that underpins photonics and a familiarity with 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	You will learn how to understand and interpret 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	This module takes fundamental physical concepts and uses 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 and Cells and Tissues	This module 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.

ABOUT THE UNIVERSITY OF EXETER

We are in the top 1% of universities in the world

We rank 8th in *The Times and The Sunday Times University Guide 2014* and 10th in *The Complete University Guide 2014*

We have ranked in the top 10 of the National Student Survey every year since it launched

Our teaching is inspired by our research, nearly 90% of which was ranked as internationally recognised in the 2008 Research Assessment Exercise

84% of our students graduate with either a First or 2:1 degree

VISIT US TO FIND OUT MORE

Open Days

Tuesday 10 June 2014
Saturday 6 September 2014

Campus Tours

We run campus tours at the Streatham Campus each weekday during term time. You'll be shown round by a current student, who'll give you a first-hand account of what it's like to live and study at the University of Exeter.

For full details and to book your place, contact us on:
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Phone: +44 (0)1392 724043
Email: visitus@exeter.ac.uk

We also invite potential applicants to visit the Physics department 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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