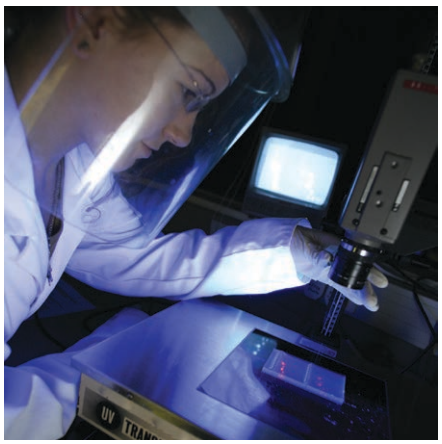
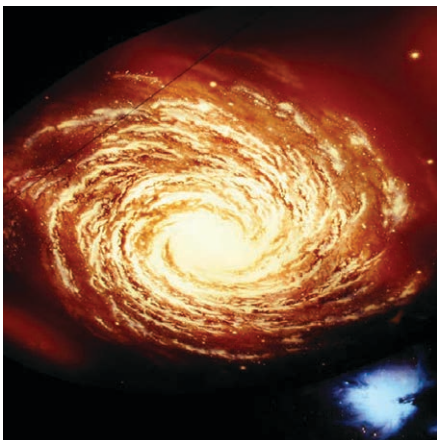
UNIVERSITY OF EXETER

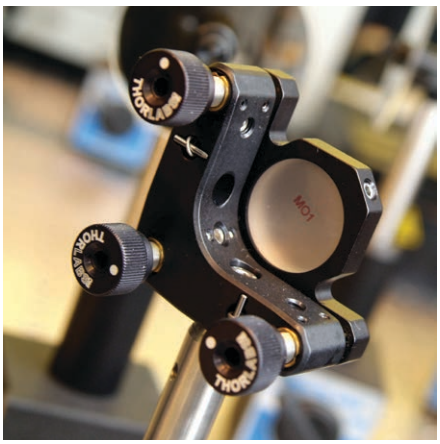
THE SUNDAY TIMES UNIVERSITY OF THE YEAR 2012-13 UNIVERSITY OF EXETER

PHYSICS AND ASTRONOMY

UNDERGRADUATE STUDY 2014 ENTRY








Key information

	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

For further details on all our entry requirements, please see our Physics and Astronomy pages at **www.exeter.ac.uk/undergraduate/degrees/physics**

You may also be interested in BSc/MSci Natural Sciences.
Please see **www.exeter.ac.uk/naturalsciences**

STREATHAM CAMPUS, EXETER
Website: www.exeter.ac.uk/physics
Email: physug@exeter.ac.uk
Phone: +44 (0)1392 725349

“A Physics degree will get you anywhere. Employers love problem solving, analytical skills and people that are good with numbers and computers. During the degree you’ll develop strong time management, report writing, presentation making and organisational skills, and you’ll get plenty of team work experience. These skills will give you a huge range of opportunities; a good physics degree from a good university is a fantastic investment for your future and your career.”

ALEXANDRA PATERSON, RECENT BSC PHYSICS GRADUATE

Why study Physics at Exeter?

The study of physics is both stimulating and thought provoking and requires commitment. At the University of Exeter you will discover a very well-equipped department, staffed by academics dedicated to their research and teaching. Set in a beautiful location, our building provides an inspiring environment for you to address the intellectual challenges that arise as part of your scientific training.

Our research is highly rated and this has enormous benefits for you as a student. Lectures are illustrated with in-depth descriptions of recent discoveries and many of our option modules reflect our experimental and theoretical research interests. You can obtain first-hand experience of what it is like to conduct PhD-style research by undertaking an experimental or theoretical project on the MPhys programmes. These projects, which may be experimental, theoretical, computation, or a combination of these, are led by our academics, in one our research groups: Electromagnetic and Acoustic Materials, Astrophysics, Quantum Systems and Nanomaterials (including Graphene Science) or Biomedical Physics. Several recent MPhys projects have resulted in papers that have been published in leading professional journals. Students on the BSc programmes work on extended 'open-ended' experiments in the third year and can also undertake a group project to solve a problem posed by one of our industrial partners.

The department provides a variety of modern apparatus in the undergraduate laboratories and extensive IT facilities for you to use. Advanced suites of equipment include nanofabrication in clean-rooms, rapid prototyping machinery, a mechanical workshop, a helium liquefier facilitating low-temperature experiments, and a research-grade telescope. Our research laboratories include amplified ultra fast laser systems for the study of high-speed phenomena and terahertz experiments, microwave labs for the study of antennas and metamaterials, acoustic and SONAR apparatus for studying the propagation of sound, and a suite of instruments for imaging biological materials. State-of-the-art supercomputers are used in our astrophysics and theoretical research.

We firmly believe in individual attention, and you will work with the academic staff in tutorials, in the laboratories and when you undertake project and research work. There is an active and effective Student-Staff Liaison Committee where suggestions and ideas can be discussed and introduced. You will feel part of a department that is passionate about physics and astronomy and that really wants you to succeed.

Our physics degrees are well-understood and respected in industry and commerce, and will give you a sound basis for a satisfying and fruitful career as a professional scientist. Our Single Honours programmes are accredited by the Institute of Physics and holders of the MPhys degrees are eligible to follow a route to corporate membership of the Institute and to the CPhys professional qualification.

8th in the UK for world leading and internationally excellent research▲

5th in the UK for Physical Science in *The Sunday Times University Guide 2013*♦

91% for Overall Satisfaction in the National Student Survey (2012)❖

£3 million renovation of the Physics building, including teaching laboratories and study environments

Weekly, small group tutorials with academic staff

Up to two-year experimental or theoretical project on the MPhys degrees

Multi-million pound investment in electromagnetism, biomedical and astronomy research facilities, plus a new Centre for Graphene Science

Opportunities to study abroad or take a salaried work experience year

▲*Research Assessment Exercise 2008 based on percentage of research categorised as 4* and 3**
♦*the classification of 'Physical Science' at Exeter refers to Physics and Geology*
❖*percentage of Physics students who agreed they were satisfied*

Degree programmes

We offer a choice of four-year MPhys programmes and three-year BSc programmes. The three-year BSc provides a strong foundation in physics, which is invaluable in many areas of industry and commerce. A four-year MPhys programme gives you a greater opportunity to specialise in areas that reflect our experimental and theoretical research interests and also to undertake a project of up to two-academic-years duration within one of our research groups. These masters-level programmes provide an education comparable to that of second-cycle degrees in the European Higher Education Area and are ideal for those aiming for a career that directly uses physics. All our degree programmes involve project work, which provides a link with the world of research and are important in providing evidence to employers of your achievement.

How your degree is structured

The first year of the three-year BSc and four-year MPhys programmes at Exeter are common, so there is flexibility to switch between them during the first year. You will be expected to show that you have the ability to cope with the greater depth of the third and fourth year before proceeding to the final two years of the MPhys programmes.

The programmes are divided into core and optional modules, to provide the flexibility to structure your study to match your particular interests and aptitudes. Most individual modules are worth 15 or 30 credits each and full-time undergraduates need to take 120 credits in each year.

Year 1 During year one of your degree programme you will develop your comprehension 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.

Year 2 The second year provides you with 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 is important not only in providing verifiable tests of the principles but also in developing new technologies.

The core of our current knowledge is centred on three important areas: quantum mechanics, electromagnetism and thermal physics. These three cornerstones are intellectually demanding, but they provide the foundation of most of physics and of our understanding of the evolution of our universe. The other modules in the second and subsequent years draw, in part, on your knowledge of this basis.

Years 3 and 4 The third and fourth years of the programme allow you to apply the core principles in a number of important broad areas, such as nuclear and high-energy particle physics, condensed matter physics and the technologically important communications and devices areas, together with modules that reflect our experimental and theoretical research interests. Other modules illustrate how the principles can be applied in greater depth in a particular area, getting closer to the cutting edge of the subject.

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

Single Honours

MPhys/BSc Physics

These programmes will give you an excellent understanding of mainstream physics and develop your scientific intuition. You will study topics such as quantum mechanics, electromagnetism, optics, relativity, high-energy and nuclear physics, quantum excitations in condensed matter, thermodynamics and cosmology. There are a variety of applied and theoretical options to choose from and, after the first year, it is possible to take 'elective' modules in other departments. An indicative list of optional modules is given in the tables towards the back of this brochure.

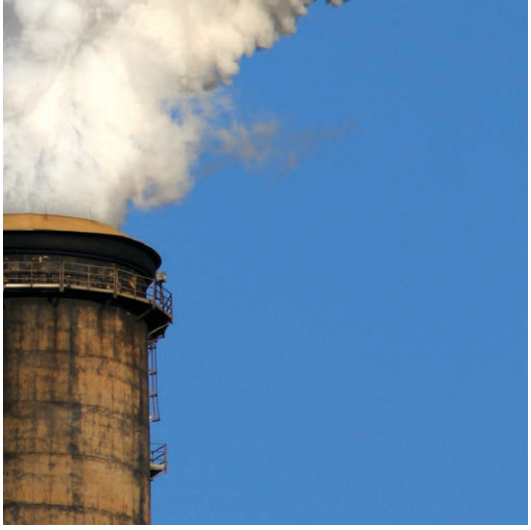
In the third and fourth years the programmes involve substantial project work. For the MPhys programmes this takes place within our research groups. Throughout your project you will meet once a week with your project supervisor to discuss progress and plan future work. If you opt for a BSc programme, you will work on two shorter projects in your third year. One of these can be team-based work tackling a real-world problem proposed by a local industrial company. As well as developing your research skills, you'll learn to present and defend your work and ideas in a variety of ways. The experience and skills developed during this project work not only forms a valuable basis for a research career, but is also highly-valued by employers. Some project work has been of such a high standard that it has been published in major scientific journals. Final year MPhys modules are linked closely to our research interests, allowing you to understand and explore the latest ideas and results in topics such as metamaterials, graphene science, photonics, astrophysics and biomedical physics.

MPhys/BSc Physics with Astrophysics

In these programmes you will learn the core of mainstream physics, but also gain 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 extreme environments in the universe. Observational astrophysics is taught using our undergraduate teaching observatory. BSc projects, and the two-year MPhys research projects, are normally based on data from world-class ground and space-based facilities and/or 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 work environment at one of a wide range of high-level and well-respected commercial laboratories. You will be paid a salary during this year. In addition to your work within the laboratory, you will undertake distance learning with the University as well as completing a project at the organisation in which you are placed. Companies who have recently participated in this programme include Sharp Laboratories, HP Labs, Renishaw, Rutherford Appleton Laboratories, QinetiQ, the Royal Devon and Exeter Hospital, BAE Systems and the Met Office.


Our research

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. The core curriculum is essentially the same as the physics programmes offered entirely in Exeter, but include options such as astronomy (with access to, for example, the University of New Mexico's telescope which is sited in the desert where clear skies are typical), 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; with the University of Sydney and the University of Wollongong in Australia; and Massey University and the University of Auckland in New Zealand.

Combined Honours

BSc Mathematics and Physics

Because of the interplay between mathematics and physics, in which they co-exist and complement each other, this Combined Honours degree is a fulfilling way to study the subject area. The physics component of this degree is a coherent, self-contained programme in degree-level physics. The core and optional modules available in each year are shown in the tables towards the back of this brochure. Further information on each of the mathematics modules is available at **www.exeter.ac.uk/mathematics**

Our research is built around five themes: Astrophysics, Biomedical Physics, Electromagnetic and Acoustic Materials, Quantum Systems and Nanomaterials (incorporating the Centre for Graphene Science) and the Centre for Energy and the Environment.

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.

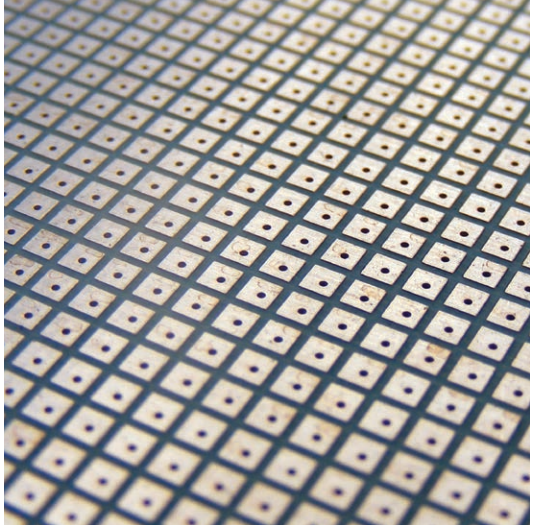
Our researchers study star and planet formation based on state-of-the-art numerical simulations and produce theoretical models describing the life of stars and planets that provide the theoretical foundation to analyse the outcome of observational programs. Exeter astronomers are observing on the largest 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.

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.


Electromagnetic and Acoustic Materials

We concentrate on the fundamental study of how both electromagnetic (eg, visible, terahertz and microwave) and acoustic (sound) waves interact with synthetic and biological systems that incorporate structures from the nanometre to centimetre scale. For example, we have a strong background in plasmonics, spintronics and the photonics of bio-inspired structures.

A theme which is of great interest to several of our team is the merger of two recent developments: spatial transformations and the design and fabrication of metamaterials. These are at the heart of exciting ideas such as invisibility cloaking, perfect lensing and other novel forms of wave manipulation including those associated with wireless communication and energy transfer.

Our research has led to new types of highly sensitive optical transducers, absorbers and filters, and even commercial paper and cosmetics products, whilst unravelling the detailed optical behaviour of liquid-crystal layers used in displays and offering biological insight for the evolved colour processes in many animals and plants. 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 offer exciting opportunities to inspire transformational developments in technological and industrial devices and processes.

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. In particular we investigate the properties of electrons, phonons and photons in these nano-scale systems.

Recently our investigations have focused on graphene, a single atomic-layer carbon honeycomb structure that was first isolated in 2004. Graphene has extraordinary electronic, thermal and mechanical properties that are 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).

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 only 0.01 degrees above absolute zero and in magnetic fields as high as 19 Tesla.

Energy and the Environment

The Centre for Energy and the Environment in an interdisciplinary team of scientists that carries out research into energy policy, low carbon building design and transport. The team specialise in the thermal and acoustic performance of buildings and have particular expertise in climate change adaptation of the built environment. In addition to these areas the Centre has completed a number of studies of district heating schemes and has extensive experience in monitoring the performance of low and zero carbon buildings.

Recent research projects include modelling the impact on buildings of future climate change and the design and monitoring of a zero carbon school. The Centre has worked with organisations on the development of more efficient biomass supply chains.

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

Learning and teaching

We believe that every student benefits from being part of a culture that is inspired by research and being taught by experts. Physics is an exciting and dynamic subject that is continually evolving and all our academic staff are actively involved in research across a wide range of topics. Working to extend the frontiers of knowledge generates a lively atmosphere and the research undertaken gives physics at the University its own distinctive flavour. Physics students need a range of skills and we endeavour to develop your analytical, communication and presentational abilities, among others. Teaching is undertaken in a variety of ways, with lecturing the primary method. There are also problem-solving classes and tutorials. We wish to encourage active discourse in physics as this is a good way of understanding the more subtle concepts. Discussions with members of academic staff occur in tutorials, problem-solving classes, at the end of lectures and in our teaching and research laboratories.

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. Another very popular activity is the research projects, which are tackled with great enthusiasm and energy. These can be experimental or theoretical and develop your judgement and self-reliance.

In a typical week in the first year you will spend 15 hours in a formal teaching environment, 10 hours working on set work and will be expected to spend a further 12 hours in independent study. You'll have four physics lectures, two lectures in mathematics, one skills class, one tutorial and spend a day in the teaching laboratory. Every week there are separate problem-solving classes for physics and maths that last for up to two hours. Time in private study is spent developing the lecture material, tackling assigned problems, doing tutorial work and writing up reports on experiments.

We're 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, and interact through activities such as the discussion forums.

Academic support

All students have a personal tutor who is available for advice and support, both academic and pastoral, throughout your studies. Groups of about four students meet every week during term-time and these meetings provide an opportunity for two-way communication as well as for assignments to be set, marked and discussed. Weekly problem classes for both mathematics and physics modules provide further opportunities for academic support.

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

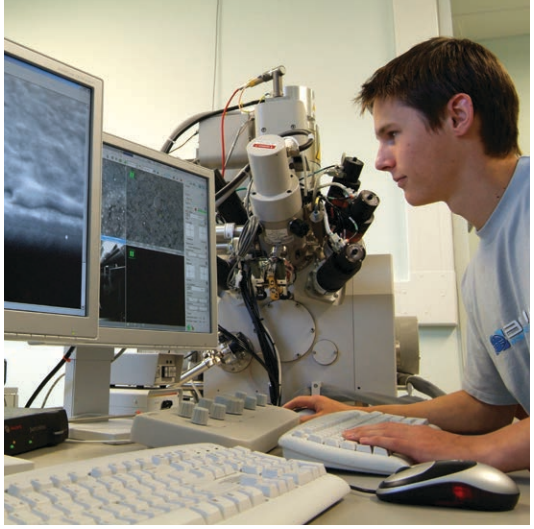
Assessment in the first two years is a combination of continuous assessment and exams. About 65 per cent of the assessment in each of these years is by written examinations and short mid-term tests; the rest involves work for projects, laboratories, problems classes, etc. You must obtain a pass mark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

Scholarships

We offer a number of academic scholarships and we are committed to ensuring that high achieving students will be able to study for an undergraduate degree irrespective of their financial background. For example, The Lawrence Scholarship is available to top performing students undertaking a four-year undergraduate degree programme in the College of Engineering, Mathematics and Physical Sciences. An up-to-date list of all bursaries and scholarships for Physics applicants is available at **www.exeter.ac.uk/physics/undergraduate/scholarships**

"The professional experience option is one of the best things about the degrees that the University offers; it allows you to add a lot of value to your degree and distinguish yourself from other graduates. The department also offers summer placements with some of the research groups in the department, giving you plenty of opportunity to gain real experience to go with your degree. One of the main reasons I'm enjoying Exeter is the balance between the University and the city itself. As Exeter is a campus university, you have the support of being in a community of students with all the facilities that you need. However the fact that the Streatham Campus is then only ten to fifteen minutes walk from the centre of the city means you're not confined to the campus and can go out to experience the city."

EDWARD LOFTS, MPHYS PHYSICS WITH PROFESSIONAL EXPERIENCE


Module details

KEY C = Core O = Optional

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

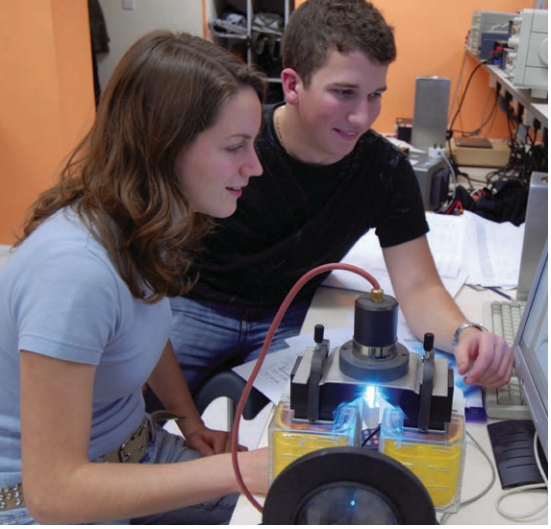
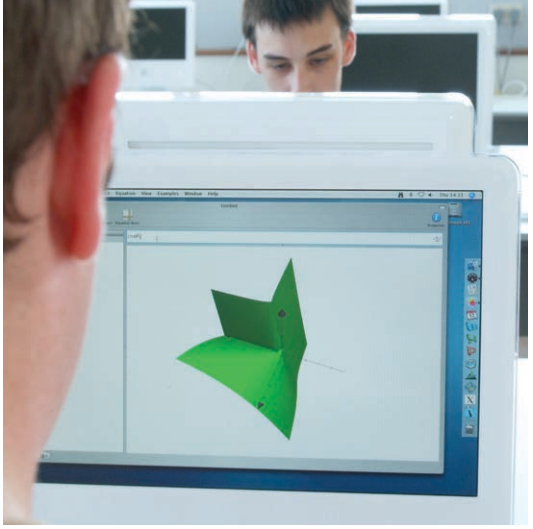
Please note that modules are subject to change and timetabling constraints and that not all modules are available every year. Some programmes include 'elective' options, which are not shown here. Elective options are modules in non-physics subjects, delivered by other departments.

Year 1

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	C
IT and Astrophysics Skills		C			
IT and Electronic Skills	C		C	C	
Mathematics for Physicists	C	C	C	C	
Mathematics Skills	C	C	C	C	
Practical Physics I	C	C	C	C	
Practical Physics and IT Skills					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

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 Electronics	O		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


Year 3/4

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			
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			
Methods of Theoretical Physics	O	O			O
Nanostructures and Graphene Science	O	O			O
Nuclear and High-Energy Particle Physics	C	C	C (yr4)	C	C
Principles of Theoretical Physics	O	O		O	O
Professional Experience			C (yr3)		
Project(s)	C	C	C	C	C
Quantum Optics and Photonics	O	O			O
Scientific Programming in C	O				
Stars	O	C			O
Statistical Physics (MPhys only)	C	C	C	C	
The Biophysics of Cells and Tissues	O	O			O
Year Abroad				C (yr3)	

Year 4 only

Module Name	MPhys Physics	MPhys Physics with Astrophysics	MPhys Physics with Professional Experience	MPhys Physics with Study Overseas
Condensed Matter II	C	C	C	C
Quantum Mechanics II	C	C	C	C
Independent Study	O	O	O	O
Physical Methods in Biology and Medicine	O	O	O	O
Solar and Extra-Solar Planets and Their Atmospheres	O	C	O	O
Plasmonics, Spintronics and Electromagnetic Metamaterials	O	O	O	O
Quantum Many-Body Theory	O	O	O	O
Relativity and Cosmology	C	C	O	O
Ultrafast Physics	O	O	O	O
Project	C	C	C	C
Option from Year 3 list	O	O		O

Physics and Astronomy modules

Please note that availability of all modules is subject to timetabling constraints and that not all modules are available every year. For up-to-date details of all our programmes and modules, please check the undergraduate section of our website at **www.exeter.ac.uk/physics**

Year 1

Introduction to Astrophysics	This module will introduce you to the theories of quantum mechanics and special relativity and show 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.
Mathematics for Physicists	This module will consolidate your skills in foundation topics in mathematics and introduce some of the mathematical techniques that are most frequently used in physics, and will give you experience in their use and application. Emphasis is placed on the use of mathematical techniques rather than their rigorous proof.
Mathematics Skills	This module covers areas such as differential calculus, complex numbers and matrices that have wide applicability throughout physics. It provides a firm foundation for study in years two and three and emphasises problem solving with examples taken from physical sciences.
Practical Physics	Experimental observations form the basis for new hypotheses, and also test scientific theories. It is therefore essential that all physicists understand the experimental method and develop the ability to make reliable measurements. This module provides a broad foundation in experimental physics, which experimental work for years two, three and four build upon.
Properties of Matter	Understanding properties of condensed matter is both a basic aspect of physics and very important in view of its increasing technological importance. The coverage of condensed matter within the degree programmes is spread over a number of modules, this being the first.
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 concept of wave propagation permeates the whole of physics with many examples arising from many different physical phenomena. There are common underlying principles that make it possible to understand many apparently unrelated systems. The primary aim of the module is to identify and make use of these concepts at an elementary level and also to introduce a wide range of physical phenomena as examples.
Astrophysics Skills	This module-component introduces computer-aided manipulation and analysis of modern astrophysical data. You will gain an understanding of the basic properties of digital imaging and spectroscopy data and an appreciation of the computer tools and algorithms used to analyse astrophysical data. The module also illustrates the interesting differences of approach needed for 'observational physics' as opposed to 'experimental physics'.
IT Skills	This module-component develops the IT Skills essential to all physicists. These include the use of LaTeX to write technical reports that include technical drawings and equations, to analyse experimental data and to use computers for problem solving. Physicists in the workplace need to be able to use modelling packages, to access and manipulate the information available in databases and also to make full use of the internet.
Electronics Skills	This module-component introduces the basic areas of digital electronics, as they might be encountered in physics instrumentation, etc, and provides the necessary theoretical background to carry out experimental investigations. A small amount of analogue electronics is also covered, for the benefit of those students who opt to do no further electronics modules.

Year 2

Analytical and Chaotic Mechanics	This module is aimed at students wishing to study theoretical physics. Analytical dynamics provides the basis for many advanced theoretical methods, which prove elegant and versatile in solving dynamical problems. This module introduces some fundamental concepts in analytical dynamics, and illustrates their applications. It covers the calculus of variations, Lagrangian and Hamiltonian formulations of dynamics, Poisson brackets, canonical transformations, Hamilton-Jacobi equations, non-linear systems and chaos theory.
Condensed Matter I	This module will develop your understanding of how electrons, and other waves, propagate within crystalline materials. The first section involves learning about the crystal structures common in nature. The second section covers the vibrational excitations of the crystal lattice. The last section considers the transport of electrons in the free-electron and nearly-free-electron approximations, which give a good description of the behaviour of electrons in metals and semiconductors.
Elective(s)	Electives are optional modules taken in any of the other departments at Exeter. You can use your elective quota to broaden your education by a studying almost any of the wide range subjects offered at Exeter. In recent year, these have included: Archaeology, Economics, Psychology, Spanish and Theology.

Electromagnetism I	The electromagnetic force holds atoms, molecules and materials together and plays a vital role in our understanding of almost all existing and potential technological developments. This module uses vector analysis to develop Maxwell's equations and investigate their application to quasi-static systems, including those involving matter. It builds a firm foundation for the study of advanced material in subsequent modules.
Lasers, Materials and Nanoscale Probes for Quantum Applications	We are now entering the age of quantum optoelectronics: optical-signal processing, high-power laser sources, optical amplifiers, single-photon manipulation, quantum confined-electron devices, and so on. This module emphasises how our understanding of light and matter may be used to provide assorted optoelectronic devices, and also how they in turn may enhance our understanding of light and matter.
Mathematics with Physical Applications	This module will give you a deeper understanding of and greater competence in some central mathematical ideas and techniques used throughout physics with the emphasis on practical skills rather than formal proof. You will acquire skills in some key techniques that relate directly to the advanced modules in the third and fourth years but also have wide applicability across the mathematical sciences.
Observing the Universe	This module will give you a basic understanding of the universe and its contents, and a good understanding of astrophysical measurement. When combined with the detailed understanding of stars, galaxies and cosmology gained in the modules *Stars* and *Relativity and Cosmology* it provides a well-balanced grounding in astrophysics.
Practical Electronics	This module introduces the basic areas of analogue electronics, as they might be encountered in physics instrumentation and so on. Professional electronics design involves three stages: design, simulate and build; represented in this module by worksheet, simulation exercises and laboratory elements.
Practical Physics II	Laboratory work is an important part of the process of learning physics. It allows you to deepen your understanding and improve your problem solving techniques, and enables you to take an active part in the enquiry into the natural world. The module builds upon the first-year work, introducing more advanced techniques and equipment, with more detailed and often open-ended experiments.
Quantum Mechanics I	This module introduces the basic principles of quantum mechanics and then applies these principles to atomic systems. The purpose of the applications chosen is to highlight the facets of atomic systems and their quantum properties. They provide a view of the basic features of atomic spectrosopy (and related magnetic effects) and atomic structure as evidenced by the features of the periodic table.
Scientific Programming in C	Knowledge of a computing language and how to write programs to solve physics related problems is a valuable transferable skill. There is currently a high demand in many industries to recruit employees who have a working knowledge of the C programming language. This module will allow you to write simple computer programs and understand those written by others. It teaches methods for writing effective, debuggable and maintainable computer programs and applies these principles to physics problems.
The Physics of Living Systems	Research at the interface between physics and biological science is developing rapidly. This module introduces the field through discussion of the physical properties of biomolecules, such as proteins and DNA that are key to their biological functions, and the remarkable physical processes that underlie cellular function. Finally it provides a physicist's introduction to the functions of organs and tissues, reviewing, for example, the mechanics of bones and joints, the fluid mechanics of the circulation and the optics and acoustics of sensory perception.
Thermal Physics	This module builds on the year one module *Properties of Matter,* and develops the discussion of thermal properties into classical thermodynamics. The module demonstrates how the laws of thermodynamics arise naturally from the statistical properties of an ensemble. Real-world examples of the key ideas are presented and then built upon in later modules.

Years 3 and 4

Applying Physics (Group Project BSc Only)	If you take this module you'll work in teams of six-eight students and will start with a project briefing, a budget and access to laboratory/ computing resources. The end-point is a report and presentation attended by company representatives who will contribute to the assessment process. The skills that can be developed and/or demonstrated in the process are of great interest employers of graduates.
Electromagnetism II	This module develops a firm basic knowledge of time-dependent electromagnetism, involving advanced applications and their relevance to physical phenomena.
Energy and the Environment	This module introduces the broad range of issues in the relationship between energy-use and environmental change. You will become acquainted with the technical, economic and social issues in sufficient depth to allow you to make informed and quantitative judgements on proposals to ameliorate environmental damage by policy and other changes. You will also have the opportunity to exercise these skills in examining a 'real world' issue in the course of researching a project report.
Galaxies and High-Energy Astrophysics	This module covers the physics of large-scale objects in the universe from star clusters, galaxies and quasars to the structure of the universe itself. The fascination that these objects hold is due in part to the enormous range of physical processes that play a role in their formation and evolution. The module is intended to complement *Stars*, which covers the small-scale universe (eg, stellar astrophysics).
General Problems	Good physicists are able to solve many problems by the appropriate application of basic physical laws and by doing so demonstrate their knowledge of the relevant laws and deepen their understanding of the physical world. The ability to solve problems is also an essential life-skill, and most physics graduates earn a living not from their detailed knowledge of physics, but from their ability to solve their employers' problems.
Methods of Theoretical Physics	During this module you will develop a deeper understanding of, and greater competence in using, some of the important mathematical methods and techniques of theoretical physics not covered in earlier modules. You will acquire skills in techniques that relate directly to the advanced modules in years three and four, and which also have wide applicability across the mathematical sciences.
Nanostructures and Graphene Science	Drawing on research undertaken at Exeter, this module explores the fascinating world of systems that have one of more nanometre-scale dimensions. Such nanostructures are dominated by quantum mechanical effects and exhibit astonishing physical properties, which are forming the basis for many novel devices and applications.
Nuclear and High-Energy Particle Physics	Nuclear physics is an important area of application of the ideas of quantum physics, with applications that have significant impact globally. High-energy particle physics discovers and tests the laws of physics at the extreme limits accessible to human experiments. This module provides a sound understanding of the physical principles underlying these areas.
Principles of Theoretical Physics	*Least action* is a unifying principle that underpins modern theoretical physics. This module treats it in detail along with its many interesting applications and consequences. The topics explored will include: action and the Euler-Lagrange equations of motion, symmetries, Noether's theorem, conservation laws, field theories (scalar, vector and tensor), gauge invariance, Feynman's formulation of quantum mechanics, path integrals and interactions mediated by virtual particles.
Professional Experience	This year-long module gives you direct experience of undertaking a research project in a non-university professional environment, normally an industrial or government laboratory. The project topic will usually be physics-based but in some cases may involve the application of physics-related skills (eg, mathematical modelling) to another field. You will experience at firsthand the various pressures, including financial and managerial, and practices of the commercial environment, and apply physics and physics-related skills to real practical problems.
Project	The project work provides a unique opportunity for you to carry out original work and detailed investigation into a specific area of experimental or theoretical physics. You will undertake this project with the support of your supervisor and the wider research group. It develops your analytical and problem-solving skills in a context where you won't be told the 'right' answer but must discover and validate it yourself. Your work may involve designing experiments or analysing data, building experimental apparatus or writing computer codes, devising explanations or discovering solutions. Discussion of ideas with other group members will be paramount to success and you will also learn to use the scientific literature, and present your own work, in both written and oral form.
Quantum Optics and Photonics	This module 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. Topics include: waveguides and optical fibre; lasers; amplifiers; nonlinear optics; polarization, optical activity and birefringence; orbital angular momentum; entangled states; cavity QED; novel light sources; photonic crystals; and negative index materials.
Stars	The study of stellar systems encompasses a wide range of physics, including gravitation, quantum mechanics, and thermodynamics. This module takes these fundamental physical concepts, learned in the core modules, and uses them to derive the properties of stars. The basic internal structure of stars is described in the first lectures, while later lectures deal with the ageing and death of both high- and low-mass objects. The final lectures describe how stars and planetary systems form.

Statistical Physics	The module builds upon the *Thermal Physics* module and examines 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. This module furnishes the theoretical background in statistical mechanics for a number of other modules and develops links between microscopic and macroscopic systems in order to describe the energy and thermal properties of collections of atoms in terms of the microscopic properties of their constituents.
The Biophysics of Cells and Tissues	This module introduces the remarkable physical properties of the cell membrane and the cytoskeleton and explains how these structures are involved in many essential cellular functions. It also describes how a complex network or proteins forming the extracellular matrix provides tissues such as cartilage and blood vessels with the unique physical properties that are essential to their function. It also introduces cutting edge research linking dysfunctions of these systems to diseases ranging from cancer to atherosclerosis.
Year Abroad Study Electives	Electives modules within the Study Abroad programmes are intended to enable you to develop your understanding of the educational system and culture of the host country and institution.

Year 4 only

Condensed Matter II	This module will develop your understanding of the effects that played a key role in the development of the modern solid state physics and provides a general description of its current trends. You'll be required to apply much of the core physics covered in earlier modules to novel systems and engage with fundamental electric, magnetic and optical phenomena in metals and dielectrics. The theme linking the different topics covered is the idea that electrons in solids can be treated as quasi-particles interacting with other quasi-particles: electrons, phonons, photons. The module illustrates and draws on several research activities at Exeter: studies of the metal-to-insulator transition, oscillatory effects in strong magnetic fields, optical and magnetic phenomena.
Quantum Mechanics II	This module provides a sound grasp of modern quantum principles and techniques and their application to atomic and molecular systems, with an appreciation of the resulting quantum properties.
Independent Study	This module enables you to pursue a completely self-defined programme of study. You'll identify a piece of work that can be satisfactorily completed in the given time; plan how to accomplish the task and communicate progress via short reports to a staff member acting as a mentor. The final assessment can take one of a number of forms but you must show evidence of critical self-appraisal through the submission of a self-assessment of the accomplished work and hence show that you are able to understand a new subject entirely through self-study.
Physical Methods in Biology and Medicine	From Robert Hooke's construction of the light microscope to the development of clinical MRI imaging the provision by physicists of new tools has provided a major stimulus for advances in biology and medicine. This module provides an introduction to many areas of physics such as nonlinear optics and nanophotonics that are being harnessed in biosensing and bioimaging to provide new windows on biological function and new approaches to disease detection.
Solar and Extra-Solar Planets and Their Atmospheres	This module shows how physics helps us observe interpret and understand a wide range of phenomena characteristic of planetary objects inside and outside the solar system. Topics covered will include: the physics of planetary and interplanetary fluids, plasmas, radiative transfer and thermodynamics.
Plasmonics, Spintronics and Electromagnetic Metamaterials	Exciting new fields have emerged in recent years that exploit physics at the nanoscale, plasmonics and spintronics. In plasmonics the electrons in metals are used to control light deep into the sub-wavelength regime with possible applications ranging from the generation of X-rays to high-resolution imaging. In spintronics the spin rather than the charge of electrons is exploited to carry information, with potential applications in low power electronics and quantum computers. Amazing properties such as cloaking are possible from materials that do not occur in nature, but which may be made by synthesising them from simple building blocks – metamaterials. In this advanced module these exciting developments will be discussed and explored.
Quantum Many-Body Theory	This module explores the applications of quantum many-body theories, with emphasis on the analogies between the theories of high-energy physics and condensed matter physics. Topics include: second-quantisation, spontaneous symmetry-breaking, Green functions, Feynman diagrams, and quantum field-theories (relativistic and non-relativistic).
Relativity and Cosmology	This module introduces the special and general theories of relativity. Application of the general theory to the standard cosmological model is also included. Although the module avoids the use of advanced mathematical topics and emphasises the concepts behind the theory, you will require a good level of mathematical fluency and intuition in order to engage with the material.
Ultrafast Physics	Ultrafast physics is revolutionising our understanding of matter and offering many new exciting opportunities, for example some speculate that table-top particle accelerators might be possible. Ultrafast physics is primarily explored using short pulse lasers. Topics explored in this module include: ultrafast lasers; pulses; time resolved experiments and imaging; ultrafast magnetisation reversal; excitation of non-Fermi electron distributions; coherent phonons; magnons; ultrafast demagnetisation; nonlinear electro- and magneto-optical effects (including electromagnetic radiation); and ultrafast X-ray sources.

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 communications skills course at the end of 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

The department also has a dedicated Careers Consultant who provides specific services tailored to careers in physics such as careers workshops in matters such as applications and job interview skills. The Employability and Graduate Development team runs four careers fairs throughout the year. The fairs are particularly successful in putting major UK employers in touch with Exeter students.

The department employs an Employability Officer who regularly invites relevant employers and alumni in interesting careers to speak to students directly. We have excellent links with employers and there are opportunities for students to do work placements as a part of their degree.

Many students from the department take part in the Exeter Award and the Exeter Leaders Award. These schemes encourage you to participate in employability related workshops, skills events, volunteering and employment which will contribute to your career decision making skills and success in the employment market.

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 those wishing to specialise in research, a period of further training for an MPhil or PhD qualification is important. Some Physics graduates wish to teach and a PGCE is the starting point into a profession where physicists are in great demand. A number of graduates decide to use their analytical and logical skills in careers in finance, banking or commercial management.

For further information about what the Employability Service offers at Exeter visit **www.exeter.ac.uk/undergraduate/employability**

Examples of the destinations of our recent graduates:

Occupations

Graduate Engineer // Market Research Analyst // Technical Advisor // Higher Research Scientist // Software Developer // Financial Modeller/Analyst

Employers

Aon Hewitt // DSTL // HSBC // e2v technologies // Frazer-Nash Consultancy // National Physics Laboratory

Many of our Physics graduates choose to go on to further study either here at Exeter or at a variety of other universities. A range of subjects are studied from Masters level and PhDs in Physics and associated topics through to professional qualifications such as teaching and accountancy.

Entry requirements and applying

You can find a summary of our typical entry requirements on the inside front cover of this brochure.

The full and most up-to-date information about Physics is on the undergraduate website at **www.exeter.ac.uk/undergraduate/degrees/physics** and we strongly advise that you check this before attending an open day or making your application. Some programmes at the University require prior study of specific subjects and may also have minimum grade requirements at GCSE or equivalent, particularly in English Language and Mathematics.

We make every effort to ensure that the entry requirements are as up-to-date as possible in our printed literature. However, since this is printed well in advance of the start of the admissions cycle, in some cases our entry requirements and offers will change.

If you are an international student you should consult our general and subject-specific entry requirements information for A levels and the International Baccalaureate, but the University also recognises a wide range of international qualifications. You can find further information about academic and English language entry requirements at **www.exeter.ac.uk/undergraduate/international**

For information on the application, decision, offer and confirmation process, please visit **www.exeter.ac.uk/undergraduate/applications**



Academic excellence

- The University of Exeter has been named as *The Sunday Times* University of the Year and is also ranked 7th in the UK in its University Guide 2013
- We are also in the top one per cent of universities in the world, and a regular fixture in the top 10 league tables in *The Guardian* and *The Times*
- University of Exeter students are among the most satisfied in the UK: we are ranked 6th in the UK in the National Student Survey 2012 amongst traditional universities and 3rd for the quality of our teaching
- Our teaching is inspired by our research, nearly 90 per cent of which was ranked as internationally recognised by the 2008 Research Assessment Exercise
- We attract the best qualified students in the country; we're in the top 10 for the number of students graduating with a first or 2:1 and for entry standards (students achieving AAB at A level and above)

A vibrant community

- Our students are the most engaged in the country, smashing participation records in student elections for the last two years running
- The Students' Guild offers an unrivalled selection of societies, from sport to culture to community volunteering groups – 8,000 students take part in 165 societies
- We are a top 10 UK university for sport and provide excellent facilities and support whether you want to compete at the highest level or just for fun
- We work with our students to continually improve the education on offer, via initiatives which put students at the heart of our decision making process
- We're a truly international community, with students from over 130 countries and staff of 50 different nationalities

Ambition for the future

- We equip you with the skills employers need via business placements, study abroad schemes, volunteering opportunities, careers advice from successful alumni and much more
- Despite tough economic times, we've improved our employment record year-on-year: more than 90 per cent of students get a job or further study place within six months of graduating
- We've invested over £350 million in our three campuses, from new accommodation and research labs to state-of-the-art lecture theatres and library spaces

Explore the possibilities

Open Days

Come and visit our beautiful campuses. We hold Open Days twice a year in June and September.

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 Exeter.

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

Offers/Interviews

All shortlisted applicants be invited to visit the department between November and February. The visit will include tours and presentations relating to our research activity and a short period for discussion with a member of staff when 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 a visit 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.

You are also welcome to visit the department before completing your UCAS form. If you wish to do so, please contact the Undergraduate Admissions Tutors on **physug@exeter.ac.uk**

Pre-University Physics Course

We run a three-day Pre-University Physics Course early in the Summer each year that is intended for A level (or equivalent) Physics students who have completed their first year. It provides a unique opportunity to get a feel for the subject at this level and for university life, before you make your choices on the UCAS form.

UNIVERSITY OF EXETER

www.exeter.ac.uk/physics

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