UNIVERSITY OF LIVERPOOL

Physics

THE ORIGINAL RED BRICK

Contents

Why choose Physics at Liverpool?

We are one of the UK's leading physics departments, with a history of discovery that goes back over 130 years. We are internationally renowned for our work in particle physics, nuclear physics, condensed matter physics and accelerator physics and, as a student, you will be immersed in our research environment from the start.

Create a degree to suit you

Explore and apply fundamental principles that underpin modern physics, from electrodynamics and semiconductors to the startling conclusions of relativity and quantum mechanics. Our flexible programmes allow students to transfer up to the end of Year Two between any of the physics programmes.

Be part of a supportive community working together to do great science

Our open-door approach enables us to offer you a friendly and supportive learning environment.

Prepare for your professional career

All of our BSc and MPhys programmes are accredited by the Institute of Physics, and our specialist programmes such as Physics with Nuclear Science and Physics with Medical Applications provide skill sets necessary for these growing sectors.

Be at the forefront of modern physics

There are opportunities to work alongside our internationally renowned academics at projects at the LHC at CERN and in many international and national research centres in the USA, Canada, Japan, Korea and many European countries.

Learn in our award-winning facilities

Teaching takes place in our £23 million Central Teaching Laboratories, which have transformed the way in which physical sciences are taught at the University.

How you learn

Our research-led teaching ensures you are taught the latest advances in cutting-edge physics research. Lectures introduce and provide the details of the various areas of physics and related subjects. You will be working in tutorials and problem-solving workshops, which are another crucial element in the learning process, where you put your knowledge into practice. They help you to develop a working knowledge and understanding of physics. All of the lecturers also perform world class research and use this to enhance their teaching.

Most work takes place in small groups with a tutor or in a larger class where staff provide help as needed. Practical work is an integral part of the programmes, and ranges from training in basic laboratory skills in the first two years to a research project in the third or fourth year. You will undertake an extended project on a research topic with a member of staff who will mentor you. By the end of the degree you will be well prepared to tackle problems in any area and present yourself and your work both in writing and in person. In the first two years students take maths modules which provide the support all students need to understand the physics topics.

Study Abroad

Studying abroad has huge personal and academic benefits, as well as giving you a head start in the graduate job market. Students on the four-year programmes can currently apply to one of our many worldwide partners including universities in Canada, America, Hong Kong, Australia or New Zealand. For more information visit **liverpool.ac.uk/goabroad** where all of our partner institutions are listed.

Year in China

The Year in China is the University of Liverpool's exciting flagship programme enabling undergraduate students from a huge range of departments, including Physics, the opportunity to spend one year at our sister university Xi'an Jiaotong-Liverpool University (XJTLU), following XJTLU's BA China Studies degree classes. See **liverpool.ac.uk/yearinchina** for more information.

Good to know

125
first year students (2018).

93%
are employed or in further study within six months of graduating (DLHE 2016/17).

5th
in the Guardian University League Tables (2019).

We offer study abroad opportunities.

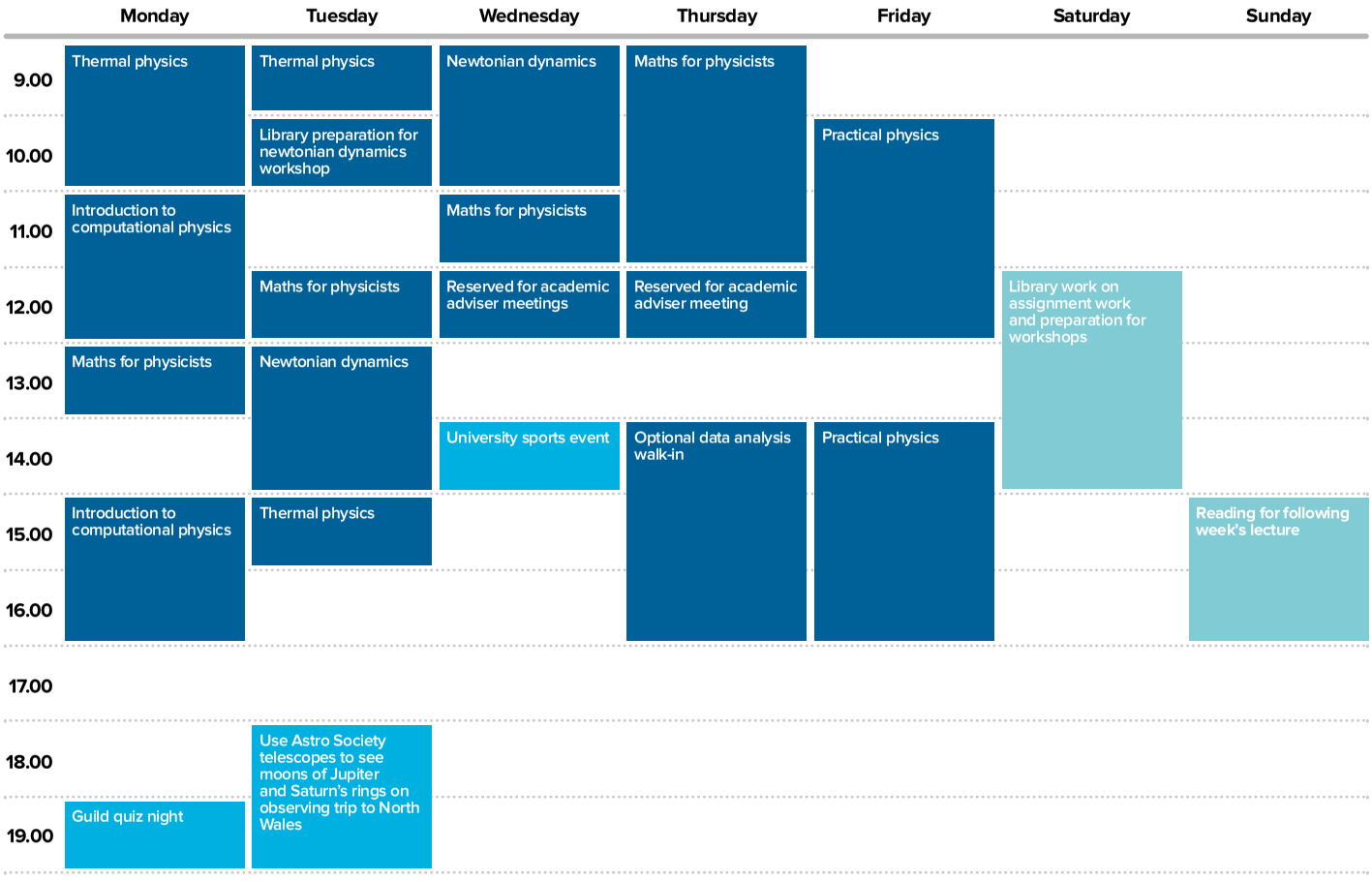
We offer a Year in China.

We offer accredited programmes.

IOP
Institute of Physics

Timetable

Semester One Typical week



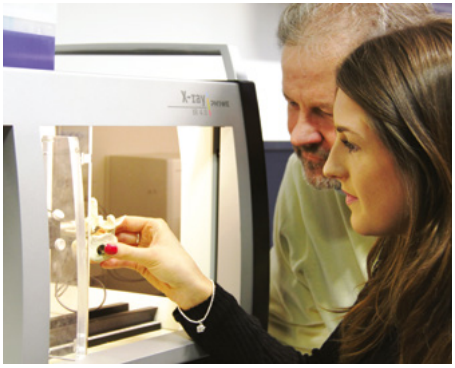
Invest in your future

Physicists are trained to solve a wide range of problems. That's why graduates have gone on to explore careers in such diverse areas such as telecommunications; microelectronics; nuclear power and instrumentation; cryogenics; astronomy; geophysics medical physics; materials science; computing; teaching; business; finance and management. Physics graduates are currently among those earning the highest starting salaries in the UK, according to latest figures, and our graduates enjoy excellent opportunities for careers in research, industry, computing, teaching, business and finance.

Work experience opportunities

For those who are studying Physics on our master's programme (**F303**) there will be opportunities to carry out summer work at an international research laboratory. This typically takes place during the summer break between your third and fourth year.

The results obtained during your summer project will be brought back to Liverpool for a project report with a member of staff as your adviser and may form the basis for a more detailed project in your fourth year. Laboratories with which we have a close research relationship include TRIUMF in Vancouver, CERN in Geneva, the European Synchrotron Radiation Facility in Grenoble and the Cockcroft Institute at the Daresbury Laboratory, Warrington.



Postgraduate opportunities

The knowledge, skills and experience that our graduates develop during their degree are in high demand by employers and researchers. This means our graduates benefit from superb postgraduate study opportunities particularly in the fields of condensed matter physics, nuclear physics, particle physics, nanoscience and energy. The Department has significant achievements in research and attracts considerable research income. As a consequence, there are excellent opportunities for our undergraduates to study for research degrees and there are exceptional facilities at their disposal.

Qualifying you for life

The skills you will develop are highly valued by employers, such as a practical approach to problem solving, strong powers of analysis, numeracy, good IT skills and the ability to communicate well. At the University of Liverpool, we ensure our students graduate with the skills employers need. Our stakeholders group, formed of strong industry leaders, advises on all relevant aspects and entrepreneurship is introduced as a key skill through project work.

Degrees

Programmes at-a-glance

See **liverpool.ac.uk/study/undergraduate/courses** for current entry requirements.

You get to find out answers to how the world works that most people would probably never know. What's surprised me most about my programme is how wide-ranging it is, we've covered all sorts of areas of physics from relativity on the very large scale, to quantum mechanics on the very small.

Amelia Ross
Physics BSc (Hons)

Physics BSc (Hons)
UCAS code: F300
Programme length: 3 years

Physics is the most fundamental of the sciences. New concepts, such as quantum mechanics and relativity, are introduced at degree level in order to understand nature at the deepest level. These theories have profound philosophical implications because they challenge our view of the everyday world. At the same time they have a huge impact on society since they underpin the technological revolution.

While studying one of the most intellectually satisfying disciplines, you will acquire transferable skills including numeracy, problem solving and an ability to reason clearly and communicate well.

Physics degrees are highly prized in the flexible labour market of today and our graduates have excellent career opportunities in academic research, industrial research and development, teaching, computing, business and finance.

Key modules
Year One
The first year starts with a one-week project to familiarise you with the staff and other students. There will be two maths modules in each of the first two years; these are designed to provide the mathematical skills required by physics students.

See “Modules at a glance” page 12.

Year Two
In Year Two you will broaden your understanding of physics, with modules designed to ensure you have mastered the full range of physics concepts.

See “Modules at a glance” page 14.

Year Three
The third year comprises a mix of core modules and many optional modules in physics. You will undertake a research project with a member of staff usually based around their research area.

See “Modules at a glance” page 16.

Physics MPhys
UCAS code: F303
Programme length: 4 years

This programme is intended for those considering a career as a professional physicist in fundamental research or industrial research and development.

It covers a wider range of topics than the Physics BSc and provides more research experience. The Department has an excellent track record of securing PhD studentships and, as a consequence, our graduates have a good opportunity to study higher degrees spanning the whole of physics. The research-led teaching will provide a core of experience that will make you an excellent researcher and also prepare you to excel in many other professions.

Programme in detail
In addition to core physics modules, you will also take mathematics, computing and experimental physics modules. There is an advanced computer modelling project in the third year. There may be opportunities to carry out a major project at an international laboratory such as TRIUMF in Vancouver, CERN in Geneva or the Diamond Light Source in Oxfordshire during the summer vacation between the third and fourth years for three months. These projects are fully paid and can form the basis of a more substantial final-year project at the cutting-edge of research.

Key modules
Year One and Two
The first two years follow the same programme as **F300**.

See “Modules at a glance” page 12-14.

Year Three
With the core physics modules completed in the first two years there is now considerable scope to choose amongst the optional modules available, mostly based around the research interests of the departmental staff.

See “Modules at a glance” page 16.

Year Four
In the final year of the course you will have considerable flexibility to choose between the many optional modules based around various physics research areas. You will also undertake an extended project with a member of staff, normally in their research area.

See “Modules at a glance” page 20.

Physics with Astronomy BSc (Hons)
UCAS code: F3F5
Programme length: 3 years

The BSc (Hons) Physics with Astronomy is taught jointly by world-leading academics from the University of Liverpool and Liverpool John Moores University. The three-year Physics and Astronomy degree gives students a wide appreciation of the varied astronomical phenomena in the physical Universe.

Programme in detail
From the formation, evolution and deaths of stars (involving planetary systems, nucleosynthesis and supernovae) through structure of galaxies to the evolution of the Universe itself, the degree structure introduces the physics involved in the cosmos. At the end of Year Two, the week-long field trip to the Teide Observatory in Tenerife introduces students to professional observatories. The three-year Physics and Astronomy degree will equip students with skills relevant for jobs in a wide range of careers, from education, research, finance and the city to industry.

The two-metre aperture Liverpool Telescope located in the Canaries, which is the largest robotically controlled telescope in the world, will provide you with unique access to observations from a major research facility when you undertake a research project in your final year.

Key modules
Year One
The first year starts with a one-week project to familiarise you with the staff and other students. There will be two maths modules in each of the first two years; these are designed to provide the mathematical skills required by physics students.

See “Modules at a glance” page 12.

Year Two
In Year Two you will broaden your understanding of physics and astronomy, with modules designed to ensure you have mastered the full range of physics concepts.

See “Modules at a glance” page 14.

Year Three
The third year comprises a mix of core modules and many optional modules in physics. You will undertake a research project with a member of staff.

See “Modules at a glance” page 16.

Astrophysics MPhys
UCAS code: F521
Programme length: 4 years

The MPhys Astrophysics is delivered collaboratively by acclaimed experts from the University of Liverpool and Liverpool John Moores University. An Astrophysics degree has the unique potential to provide students with an understanding of the most up-to-date discoveries in the Universe.

Programme in detail
During the programme, students will be introduced to all aspects of physics and astronomy from quantum mechanics to cosmology. In Year Two, there is a week-long field trip to the Teide Observatory in Tenerife, where students make astronomical measurements at a professional observatory. The two-metre aperture Liverpool Telescope sited on La Palma in the Canaries, which is the largest robotically controlled telescope in the world, will provide you with unique access to observations from a major research facility when you undertake a research project in your final year.

Continued over...

This four-year Astrophysics degree will equip students with skills relevant for further study of the universe at postgraduate research level as well as for jobs in a wide range of careers.

Key modules

Year One

The first year starts with a one-week project to familiarise you with the staff and other students. There will be two maths modules in each of the first two years, these are designed to provide the mathematical skills required by physics students.

See “Modules at a glance” page 12.

Year Two

In Year Two you will broaden your understanding of physics, with modules designed to ensure you have mastered the full range of physics concepts.

See “Modules at a glance” page 14.

Year Three

With the core physics modules completed in the first two years there is now considerable scope to choose amongst the optional modules available, mostly based around the research interests of the departmental staff.

See “Modules at a glance” page 16.

Year Four

In the final year of the course you will have considerable flexibility to choose between the many optional modules based around various astrophysics and physics research areas. You will also undertake an extended project with a member of staff, normally in their research area in astrophysics.

See “Modules at a glance” page 20.

Physics with Medical Applications BSc (Hons)

UCAS code: F350

Programme length: 3 years

Physics research is helping us to live longer, healthier lives. It is helping us to develop new cures for disease and new ways to quickly diagnose health problems. For example, particle beams and detectors used in physics research have led to the development of proton cancer therapies and new diagnostic imaging technologies.

Combining the study of physics and selected topics in medical applications, this programme provides skills such as numeracy, problem solving, reasoning and communication that are attractive to the general employer, and it is an excellent preparation for a career in medical physics.

Programme in detail

In addition to core physics modules you will also take mathematics, computing and experimental physics modules in support of these studies.

There is a project on a medical physics topic in Year Three with involvement from the local hospitals and medical research centres. Staff from these institutions will also be involved with teaching.

Key modules

Year One

The first year starts with a one-week project to familiarise you with the staff and other students. There will be two maths modules in each of the first two years; these are designed to provide the mathematical skills required by physics students.

See “Modules at a glance” page 12.

Year Two

In Year Two you will broaden your understanding of physics, with modules designed to ensure you have mastered the full range of physics concepts.

See “Modules at a glance” page 14.

Year Three
Comprises a mix of core modules and optional modules in physics, including a project on medical physics with a member of the academic staff and staff from the NHS.

See “Modules at a glance” page 16.

Physics with Nuclear Science BSc (Hons)
UCAS code: F390
Programme length: 3 years

This programme offers the study of physics and selected topics in nuclear science and provides an excellent preparation for a career in nuclear related industries.

There are links with many parts of the nuclear industry including those involved with decommissioning and homeland security. Staff from these institutions will be involved in the project work. The programme comprises modules in common with the physics programme (including mathematics support).

Programme in detail
In addition to core physics modules, you will also take mathematics, computing and experimental physics modules in support of these studies. There is a project on a nuclear science topic in Year Three with involvement from industry. Other modules from the Physics **F300** programme may also be taken.

Key modules
Year One
The first year starts with a one-week project to familiarise you with the staff and other students.

There will be two maths modules in the first year and one in the second year, these are designed to provide the mathematical skills required by physics students.

See “Modules at a glance” page 12.

Year Two
In Year Two you will broaden your understanding of physics, with modules designed to ensure you have mastered the full range of physics concepts.

See “Modules at a glance” page 14.

Year Three
The third year comprises a mix of core modules and many optional modules in physics. You will undertake a research project with a member of staff and one of our partner companies on an aspect of nuclear physics.

See “Modules at a glance” page 16.

Physical Sciences entry route leading to BSc (Hons) (4-year route including a Foundation Year at Carmel College)
UCAS code: F308
Programme length: 4 (1+3) years

This programme offers a four-year route to the BSc (Hons) degree programmes offered by the Department of Physics.

You follow the Foundation Year at Carmel College, St Helens, about nine miles away from the main University campus. It offers small class sizes and high academic standards. You then opt to follow any of the physics programmes.

Programme in detail
At Carmel College, you will take three foundation modules chosen from physics, mathematics, chemistry, biology or geography, depending on which degree route you want to follow. In your second year, you will attend the University of Liverpool and take the same modules as other students on your chosen programme. Please contact Carmen Nuñez for full details **E: degree@carmel.ac.uk** or **T: +44 (0)1744 452 213**

Degrees offered with other departments

Geophysics (Physics) BSc (Hons)
UCAS code: F656
Programme length: 3 years

This programme provides training in the principles and practice of geophysics with an emphasis on pure and practical physics.

High-level training is given in geophysics with supporting physics, providing classical physics training to second year university level, and including university training in geology and mathematics. The programme is particularly strong for careers in geophysical data analysis, and research areas related to global geophysics and planetary science. Transfer to a Physics degree is possible up to the end of Year One. This degree is recognised by the Institute of Physics.

For more information, download the Earth, Ocean and Ecological Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Geology and Geophysics MESci (Hons)
UCAS code: F641
Programme length: 4 years

This four-year degree delivers advanced and rigorous training in both geophysics and geology, including a high proportion of field-based work, and fundamental training in physics and mathematics.

Graduates benefit from a wide range of careers in geosciences, allowing flexible career paths between geology and geophysics in a large company. Transfer to a geology degree is possible up to the end of Year One. This degree is accredited by the Geological Society of London, satisfying the requirements of Fellowship and Chartered Geologist status.

For more information, download the Earth, Ocean and Ecological Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Geophysics (Geology) BSc (Hons)
UCAS code: F640
Programme length: 3 years

This degree provides high-level training in geophysics with supporting geology, and including fundamental university training in physics and mathematics.

This programme is particularly strong for careers in interpretation and processing of geophysical data, and research areas related to geological applications. Transfer to a Geology degree is possible up to the end of Year One. This degree is accredited by the Geological Society of London, satisfying the requirements of Fellowship and Chartered Geologist status.

For more information, download the Earth, Ocean and Ecological Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Geophysics (North America) MESci (Hons)
UCAS code: F660
Programme length: 4 years

The first two years of this four-year degree are shared with the F640 programme whilst the final two years provide more advanced training.

Year Three will be spent at a sister department in North America or Australia, where you will have the opportunity to experience a different culture and learning environment, along with access to diverse subject areas. Current links include the University of Georgia; the University of Illinois at Urbana-Champaign; McGill University, Montreal, Canada; Toronto University in Canada and Monash University in Melbourne, Australia. The number of places available on this degree programme is limited. If you apply, but don't achieve the required grades, you will be offered a place on either **F641** or **F640**, provided you obtain the required grades for those programmes.

This degree is accredited by the Geological Society of London, satisfying the requirements of Fellowship and Chartered Geologist status.

For more information, download the Earth, Ocean and Ecological Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Mathematical Physics MMath
UCAS code: FGH1
Programme length: 4 years

Physics and Mathematics BSc (Joint Hons)
UCAS code: FG31
Programme length: 3 years

Theoretical Physics MPhys
UCAS code: F344
Programme length: 4 years

Physics and Mathematics degrees are highly prized and our graduates have excellent career opportunities in industrial research and development, computing, business, finance and teaching.

We offer one three-year BSc degree and two four-year degrees, MMath or MPhys, combining these two intimately related disciplines. These programmes provide a strong mathematical training, and mathematical techniques help you to deal with new ideas that often seem counterintuitive, such as string theory, black holes, superconductors and chaos theory.

For more information, download the Mathematical Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Ocean Sciences BSc (Hons)
UCAS code: F700
Programme length: 3 years

Ocean Sciences MOSci (Hons)
UCAS code: F710
Programme length: 4 years

Programme in detail
The ocean plays a central role in the earth's climate system by regulating the transfer of heat and carbon over the globe.

The effect of the ocean can only be fully understood by addressing the fundamental physical and chemical processes operating in our environment. This degree route offers three distinct pathways in oceanography, physics or chemistry, combined with an understanding of the ocean and climate system.

Each pathway has its own mix of modules from the School of Environmental Sciences and School of Physical Sciences. Scientists from the National Oceanography Centre in Liverpool provide guest lectures and supervision of projects.

The four-year master's programme, **F710**, will provide you with the high-level skills and knowledge required to work in a research environment and address the challenges in ocean science. There is a strong emphasis on numerical skills hands-on laboratory and fieldwork at sea and independent study.

You will have the opportunity to work with scientists from the National Oceanography Centre (Liverpool), who are international leaders in sea level science and shelf sea physics.

For more information, download the Earth, Ocean and Ecological Sciences brochure from **liverpool.ac.uk/study/undergraduate/courses/publications**

Modules at a glance

Core and selected optional modules overview Year One

Module title	F300	F303	F3F5	F521	F350	F390
Foundations of modern physics PHYS104	C	C	C	C	C	C
Introduction to astrophysics PHYS155	O	O	C	C		
Introduction to computational physics PHYS105	C	C	C	C		
Introduction to medical physics PHYS115	O	O			C	
Introduction to nuclear science PHYS135	O	O				C
Introduction to physics for education PHYS165	O	O				
Mathematics for physicists I PHYS107	C	C	C	C	C	C
Mathematics for physicists II PHYS108	C	C	C	C	C	C
Newtonian dynamics PHYS101	C	C	C	C	C	C
Practical physics I PHYS106	C	C	C	C	C	C
Thermal physics PHYS102	C	C	C	C	C	C
Wave phenomena PHYS103	C	C	C	C	C	C

Please note: modules are illustrative only and subject to change.

Key: C: Core **O**: Selected optional modules

Semester	Credit	Module description
2	15	This module will introduce the theory of special relativity and its experimental proofs. It will also introduce the concepts and the experimental foundations of quantum theory.
2	7.5	Provides the students with a broad introduction to astrophysics.
1	7.5	Students will develop their ability to break down physical problems into steps amenable to solution using algorithms.
2	7.5	Provides students with a broad introduction to medical physics and enables them to develop skills in mathematical calculations directly related to Medical Physics.
2	7.5	Provides the students with a broad introduction to nuclear science.
2	7.5	Provides the students with a broad introduction to physics for education.
1	15	Provides a foundation for the mathematics required by physical scientists.
2	15	Consolidates and extends the understanding of mathematics required for the physical sciences.
1	15	This module covers the fundamental concepts and principles of classical mechanics together with an introduction to the study of fluids. The use of elementary vector algebra in the context of mechanics is also introduced.
1 and 2	15	This module introduces experimental work in a physics laboratory through a series of introductory, foundation and core experiments.
1	15	Covers thermal physics and the laws of thermodynamics together with the kinetic theory of gases, the equation of state, Van der Waals equation, and the basis of statistical mechanics.
2	15	An introduction to the fundamental concepts of wave phenomena which will highlight the many diverse areas of physics in which an understanding of waves is crucial. The module will cover reflection, transmission, and superposition of waves leading to the concepts of interference and diffraction. In addition, it will address lenses, optical instruments, and the basic principles of lasers.

Core and selected optional modules overview Year Two

Module title	F300	F303	F3F5	F521	F350	F390
Accelerators and radioisotopes in medicine PHYS246	O	O			C	C
Condensed matter physics PHYS202	C	C	C	C	C	C
Electromagnetism PHYS201	C	C	C	C	C	C
Mathematics for physicists III PHYS207	C	C	C	C	C	C
Mathematics for physicists IV PHYS208	O	O	C	C		
Nuclear and particle physics PHYS204	C	C	C	C	C	C
Practical astrophysics I PHYS216			C	C		
Practical physics II PHYS206	C	C			C	C
Quantum and atomic physics PHYS203	C	C	C	C	C	C
Stellar physics PHYS151	O	O	C	C		
Working with physics II PHYS205	C	C	C		C	C

Please note: modules are illustrative only and subject to change.

Key: **C**: Core **O**: Selected optional modules

Semester	Credit	Module description
2	15	This module provides an introduction to applications of accelerators and radioisotopes in medical imaging and tumour therapy.
1	15	Condensed matter refers to both liquids and solids and all kinds of other forms of matter in between those two extremes. While the module will touch on liquids, the emphasis will be on crystalline solids, including some nanomaterials.
1	15	This module will cover electrostatics, magnetostatics, circuit analysis, electromagnetism and Maxwell's equations. This will lead on to electromagnetic waves and the concepts of field theories in physics using electromagnetism as an example.
1	15	Reinforces students' prior knowledge of mathematical techniques and introduces new mathematical techniques for physics modules.
2	15	Builds on **Mathematics for physicists III**.
2	15	This module covers the basic principles that determine nuclear size, mass and decay modes. It will introduce the basics of Rutherford, electron and neutron scattering as well as giving examples of the applications of nuclear physics.
1 and 2	15	Learn how to take reliable and reproducible data and develop an understanding of various techniques of data gathering and analysis in modern astrophysics.
1 and 2	15	This lab-based module will cover the setting up and calibration of radiation monitoring equipment. This will involve taking reliable and reproducible data, calculating experimental results and their associated errors, and using computer software for simulation and data analysis.
2	15	This module will introduce the concepts of quantum theory. It will cover the Schrodinger equation as applied to particle flux and to bound states, and demonstrate how quantum ideas provide an understanding of atomic structure.
2	15	Provides an understanding of the physical processes which determine all aspects of the structure and evolution stars, from their birth to their death.
1 and 2	15	Students will further develop Python programming skills and their ability to devise new and apply existing algorithms to solve physical problems.

Core and selected optional modules overview Year Three

Module title	F300	F303	F3F5	F521	F350	F390
Advanced condensed matter physics PHYS363	O			O	O	O
Advanced observational astronomy PHYS362				O		
Advanced practical physics (BSc) PHYS378	C					
Chaos and dynamical systems MATH322		O		O		
Communicating science PHYS391	O	O	O	O	C	C
Electromagnetism PHYS370	C	C	C	C	C	C
Group physics project PHYS395	O		O			
Introduction to particle physics PHYS377	O	C	C	C	O	O
Materials physics PHYS387	O	O	O	O	O	O
Medical physics project PHYS386					C	
Nuclear physics PHYS375	O	C	C	C	O	C
Physics of energy sources PHYS388	O	O	O	O	O	C
Physics of galaxies PHYS373		O	C	O		
Physics of life PHYS382	O	O	O	O	O	O
Physics of medical imaging PHYS385				O		
Planetary physics PHYS355	O	O	O	O		
Practical astrophysics II PHYS394			O	O		
Project (BSc) PHYS379	O		O			
Quantum mechanics and atomic physics PHYS361	C	C	C	C	C	C

Please note: modules are illustrative only and subject to change.

Key: **C**: Core **O**: Selected optional modules

Semester	Credit	Module description
2	7.5	Develops concepts introduced in Year One and Year Two modules which relate to solids and introduces the concept of reciprocal space and diffraction.
2	15	Introduces the experimental techniques which enable astrophysicists to use the full range of the electromagnetic spectrum to study the physics of astronomical objects.
1	15	Gives further training in laboratory techniques, in the use of computer packages for modelling and analysis, and in the use of modern instruments.
2	15	Develop expertise in dynamical systems in general and study particular systems in detail.
1	7.5	Improves science students' skills in communicating scientific information in a wide range of contexts.
2	15	Builds on Year One and Two modules on electricity, magnetism and waves.
2	15	Students will work in a group on a research project.
2	7.5	Develop an understanding of the modern view of particles, of their interactions and the Standard Model.
1	7.5	Looks at the properties and methods of preparation of a range of materials of scientific and technological importance.
1 and 2	30	Gives students experience of working independently on an original problem related to medical physics.
1	7.5	Students will develop an understanding of the modern view of nuclei, how they are modelled and of nuclear decay processes.
2	15	Develop an ability which allows educated and well informed opinions to be formed by the next generation of physicists on a wide range of issues in the context of the future energy needs of man.
1	15	Provides a broad overview of these complex yet fundamental systems which interact at one end with the physics of stars and the interstellar medium and at the other with cosmology and the nature of large-scale structures in the Universe.
2	7.5	Introduces students to the physical principles needed to address important problems such as climate change, the loss of biodiversity, the understanding of ecological systems, the growth of resistance to antibiotics, the challenge of sustainable development and the study of disease.
1	15	Aims to give students a knowledge of the history of medical imaging; introduce the physics principles underlying imaging techniques; familiarise students with modern imaging techniques and improve communication skills through a poster presentation.
1	7.5	Provides a background in geophysics and solar system planetary science towards the understanding of exoplanet system research. Introduces methods of exoplanet detection, and current physical understanding of exoplanet systems.
1	15	Provides practice in the planning and execution of a programme of astronomical observations.
2	15	Gives students experience of working independently on an original problem.
1	15	Builds on the second year module on **Quantum and atomic physics**.

Continued over...

Core and selected optional modules overview Year Three (continued)

Module title	F300	F303	F3F5	F521	F350	F390
Radiation physics advanced practical PHYS380					C	C
Radiation therapy applications PHYS384		O		O	C	
Relativity MATH326		O		O		
Relativity and cosmology PHYS374	O	O	C	C	O	O
Semiconductor applications PHYS389	O	O	O	O	O	O
Statistical physics PHYS393	C	C	C	C	C	C
Statistics for physics analysis PHYS392		O		O		C
Stellar atmospheres PHYS352			O	O		
Surface physics PHYS381	O	C	O	O	O	O
Undergraduate ambassadors project PHYS396	O		O			

Please note: modules are illustrative only and subject to change.

Key: C: Core **O**: Selected optional modules

Semester	Credit	Module description
1	7.5	Gives further training in laboratory techniques, in the use of computer packages for modelling and analysis, and in the use of modern instruments. Students will refine their skills in performing radiation physics experiments and researching an aspect of radiation protection complementary to material met in lectures and tutorials.
2	15	This module will cover the basic physics principles of radiation therapy. It will address the interactions of different types of radiations with biological materials, together with beam modelling for radiotherapy treatments, and treatment planning. In addition, it will describe Monte Carlo modelling in radiobiology.
2	15	Looks at the physical principles behind special and general relativity and their main consequences.
2	15	Introduces the ideas of general relativity and demonstrates its relevance to modern astrophysics.
1	7.5	Develops the physics concepts describing semiconductors in sufficient details for the purpose of understanding the construction and operation of common semiconductor devices.
1	15	Builds on material presented in earlier thermal physics and quantum mechanics courses.
1	15	Gives students a theoretical and practical understanding of the statistical principles involved in the analysis and interpretation of data.
2	7.5	Provides an understanding of the properties of stellar spectra, of the effect of expanding atmospheres and of the relevance for supernovae.
2	7.5	Describes the properties of surfaces; conveys an understanding of the physical properties of surfaces and provides knowledge and understanding of a range of surface characterisation techniques.
2	15	Provides students with opportunities to communicate physics at different levels.

Core and selected optional modules overview Year Four

Module title	F303	F521	Semester	Credit
Accelerator physics PHYS481	O	O	2	7.5
Advanced nuclear physics PHYS490	O	O	2	7.5
Advanced particle physics PHYS493	O	O	2	7.5
Advanced quantum physics PHYS480	C	O	1	15
Astrophysics research skills PHYS496		C	1	7.5
Classical mechanics PHYS470	O	O	1	15
Computational astrophysics PHYS494		C	2	15
Elements of stellar dynamics PHYS484	O	O	1	7.5
Magnetic structure and function PHYS497	O	O	1	7.5
Modelling of functional materials and interfaces CHEM454	O		2	7.5
Nanoscale physics and technology PHYS499	O	O	1	7.5
Physics of the radiative universe PHYS485	O	O	2	15
Project (MPhys) PHYS498	C	C	1 and 2	30
Stellar populations PHYS483		O	2	15
The interstellar medium PHYS495		C	1	15

Please note: modules are illustrative only and subject to change.

Key: **C**: Core **O**: Selected optional modules

Module description
Build on modules on electricity, magnetism and waves. Students will study the functional principle of different types of particle accelerators.
Offers an insight into current ideas about the description of atomic nuclei and nuclear matter.
Gives the student a deeper understanding of the standard model of particle physics and the basic extensions.
Provides breadth and depth in the understanding of the commonly used aspects of quantum mechanics.
Develop the ability of the student to communicate results and ideas in astrophysics at a range of technical levels, dealing with the objective criticism of existing articles, videos, papers and lecture/seminar presentations, as well as the creation of new material.
Provides an awareness of the physical principles that can be applied to understand important features of classical (ie non-quantum) mechanical systems.
Provides practical experience of using computational techniques extensively employed by researchers in the physical sciences.
Provides a basic understanding of the dynamics of systems containing millions and billions of point-like gravitating bodies: stars in stellar clusters and galaxies.
Develop an understanding of the phenomena and fundamental mechanisms of magnetism in condensed matter.
Provides an introduction to modern computational chemistry methods and concepts for functional materials and interfaces. These methods will include primarily density functional theory methods for electronic structure but also an orientation towards wave function methods and classical molecular dynamics methods combined with force fields.
Introduces the emerging fields of nanoscale physics and nanotechnology.
This module looks at some of the many ways that matter radiation interact, in relativistic and non-relativistic physical contexts.
Gives students experience of working independently on an original problem.
Develops knowledge of stellar evolution and techniques to investigate the evolution of stellar population in the universe.
Builds upon the student's appreciation of the role which the interstellar medium (ISM) plays in topics such as stellar evolution (star-forming regions to supernova remnants) and galaxy evolution.

Find out more

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