PHYSICS AT OXFORD

UNDERGRADUATE DEGREE COURSES AT THE UNIVERSITY OF OXFORD

UNIVERSITY OF OXFORD






PHYSICS AT OXFORD

Physics is about unravelling the complexity of the universe to discover how and why it works. Discoveries in physics form the foundation of countless technological advances and play an important role in many scientific areas. The contributions of physics to solving global problems such as energy production, environmental protection, global warming and public health are essential and have an enormous impact on our society. It is an exciting and challenging field to study, requiring an adventurous and inquiring mind, and good mathematical abilities. The rewards include a deeper understanding of the world around us and the development of skills that are highly sought after by many employers.

THE COURSE

There are two undergraduate physics degrees, a three year BA and a four year MPhys. All applicants apply for the four year MPhys in the first instance. We also offer a four year joint degree in Physics and Philosophy.

BA PHYSICS

The three year course provides a general education in the basic principles of physics and includes a group industrial project.

MPHYS

Most students study the four year course, in which they pursue two fields up to the research frontier and complete a longer project. The MPhys should be of interest to those who seek a possible career in research.

MPHYSPHIL

Physics and philosophy are studied in parallel for the first three years and then students may specialise in one subject or continue with both.

TEACHING

Oxford has a unique approach to undergraduate physics teaching, drawing on the breadth and quality of the Department's research programme and a wealth of expertise. Teaching involves both the Physics Department and the Colleges. The Physics Department determines subject matter, arranges lectures and practicals, and sets and marks examinations. The Colleges organise tutorials, where work is submitted and discussed, and also provide pastoral support and advice.

LECTURES

Lectures normally happen in the department and will be the primary source of information. Lectures will be for the entire year, approximately 180 students.

TUTORIALS

Tutorials give students direct and regular access to physicists actively involved in research and provide an opportunity to explore scientific ideas face-to-face with experts in the field. Tutors take a personal interest in the academic progress of their students and offer help and advice. Students normally have two tutorials or classes a week.

Classes are typically with their College year group (approximately six students), while tutorials are with one or two other students.

PRACTICAL WORK

Experimental work forms an important part of any physics degree, providing training in transferable skills such as communication, teamwork and problem solving, in addition to learning about measurements and instrumentation. Practical work is compulsory for the first three years; students spend on average one day a week in the laboratories. Some useful skills (computing and electronics) are taught almost entirely through practical work. The first year of the practical course provides basic training in experimental physics and computing. In the second and third year there is a choice of practicals including electronics, thermal physics, computing, optics, biophysics, astrophysics, atmospheric physics, nuclear physics and condensed matter physics. Students can also do extra practicals in place of a written short option in the second year. A student's final year project often involves experimental work in the teaching laboratories or in a research group.

1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR
Current courses	**Current courses**	**Current courses**	**Research**
• Classical mechanics and special relativity • Electromagnetism, circuit theory and optics • Mathematical methods • Differential equations and waves **Practical work** • 17 days spread over the year, experiments can include optics, electronics and computing **Short options, eg:** • Astronomy • Complex analysis • Quantum ideas	• Thermal physics • Electromagnetism and optics • Quantum physics • Mathematical methods **Practical work** • 12 days spread over the year, experiments can include thermal physics, computing and optics **Short options, eg:** • Classical mechanics • Climate physics • Introduction to biological physics	• Fluids • Symmetry and relativity • Atomic and laser physics • Nuclear and particle physics • General relativity • Condensed matter physics • Computational and experimental projects **Practical work** • 6 days plus a mini project **Short options, eg:** • Advanced quantum mechanics • Classical mechanics • Plasma physics	**Research Project and two option courses:** • MPhys project – projects give students valuable experience of open-ended work and solving real problems, and are the equivalent of about one full term's work **Current major options** • Astrophysics • Laser science and quantum information processing • Condensed matter • Particle physics • Atmospheres and oceans • Theoretical physics • Biological physics
Assessment	**Assessment**	**Assessment**	**Assessment**
First University examinations: Four written papers; short option paper; satisfactory laboratory work	Final University examinations, Part A (BA and MPhys): Three written papers; short option paper; laboratory work; individual presentation	Final University examinations, Part A: MPhys: up to 5 written papers, short option paper, mini project, laboratory work BA: up to 4 written papers, short option paper, mini project, laboratory work, project report, optional industrial project	Final University examinations, Part C (MPhys): Project report; two major option papers

MMATHPHYS 4TH YEAR

The Physics and Mathematics Departments jointly offer an integrated master's level course in Mathematical and Theoretical Physics. Physics students are able to apply for transfer to a fourth year studying entirely mathematical and theoretical physics, completing their degree with an MMathPhys. The course offers research-level training in: Particle physics, Condensed matter physics, Astrophysics, Plasma physics and Continuous media. With a great number of options offered from both the Mathematics and Physics departments this course may be of particular interest to those intending graduate study in theoretical topics. For full details see **mmathphys.physics.ox.ac.uk**.

The course descriptions provided are correct at time of publication, but details are subject to change.

WHY STUDY PHYSICS AT OXFORD?

Studying Physics at Oxford is brilliant: not only does it equip you with the tools to understand and pick apart this fascinating subject, but it trains your brain to attack all manner of problems in an efficient and intelligent way.

4TH YEAR OPTIONS

MPhys students spend their fourth year working on two major options and a substantial project. The options reflect specialisms within the department: Astrophysics, Biological Physics, Condensed Matter Physics, Laser Science and Quantum Information Processing, Particle Physics, Physics of Atmospheres and Oceans and Theoretical Physics. These options are taught in lectures and classes.

FINAL YEAR PROJECTS

In the final year (3rd year for BA, 4th year for MPhys), students will have the option to choose from a wide range of projects in fundamental physics. In addition, BA students can choose to study a real-life industrial physics problem with an external company. The goal of these projects is to give all students valuable experience of exploring what research can look like and what they can contribute to solving real problems, independent of whether they will continue in academia, industry or elsewhere. These projects are the equivalent to about one full term's work.

OPTIONAL UNITS

The physics undergraduate degrees at Oxford offer students a significant amount of choice through short option courses, laboratory experiments and two major options in the fourth year of the MPhys. Short option courses allow students to experiment with new material. All students have the opportunity to either acquire expertise in a more specialised area of physics or to broaden their education by studying subjects outside the mainstream course, offered by another department or faculty. A sample of short optional courses are listed below:

Course Title

- Astrophysics: from Planets to the Cosmos
- Introduction to Biological Physics
- Classical Mechanics
- Climate Physics
- Energy Studies
- Exploring Solar Systems
- Functions of a Complex Variable
- Exoplanets
- Plasma Physics
- Quantum Ideas
- Advanced Quantum Mechanics
- Stars and Galaxies

From other departments or faculties

- History of Science
- Language Option (French, Spanish or German)
- Philosophy of Quantum Mechanics
- Philosophy of Science
- Philosophy of Space-Time
- Teaching and Learning Physics in Schools

> Tutorials were initially scary, because you are sat across from someone who is an expert in their field. But once you realise that they don't mind if you get things wrong, the environment is incredible. A tutor will never hesitate to ask difficult questions, and will push you to fully understand. I've walked away from tutorials feeling so pleased that I'm here because it is the best teaching I've ever had.

ARE TUTORIALS TERRIFYING?

PHYSICS AND PHILOSOPHY

Oxford also offers a joint Physics and Philosophy Masters degree (MPhysPhil), which aims to bridge the arts/science divide. Physics and philosophy complement each other as they both seek to reach a fundamental understanding of the nature of reality.

In this degree students will learn how to write, reason and argue with precision, as well as how to use physical principles and mathematical equations to solve problems. Graduates are equipped with the ability to think in abstract and general terms as well as to evaluate scientific claims that arise in areas such as social sciences, policy making, media and business. In addition, depending on students' choices in the fourth year, the course provides an ideal springboard to graduate work in either physics or philosophy. Graduates regularly go on to the very best research programmes worldwide in physics, and likewise in philosophy. The course covers topics in physics, philosophy and the philosophy of physics.

PHYSICS AND PHILOSOPHY

Physics and philosophy are studied in parallel for the first three years. Philosophy covers topics such as the theory of knowledge, metaphysics, philosophy of science and logic. There is flexibility in the fourth year to specialise in either physics or philosophy, or to continue with both.

PHILOSOPHY OF PHYSICS

Linking physics and philosophy throughout the course is the subject area of Philosophy of Physics. Topics covered include classical space-time concepts, foundations of special relativity, conceptual problems in quantum mechanics, concepts of symmetry and foundations of general relativity and statistical mechanics. This course is amongst the most demanding at Oxford. Students are expected to become as fluent in mathematics as their single honours peers in physics, and as skilled in writing essays as those taking other joint degrees involving philosophy.

COLLEGE CHOICE

Not all colleges accept applications for Physics and Philosophy. Some colleges will take Physics and Philosophy students only occasionally (typically one in every year or two years); others have a policy of attempting to take at least two students per year in the course if possible. These Colleges have such a policy: Balliol, Brasenose, Merton, Oriel, Pembroke, St Edmund Hall, St Hilda's, Somerville, University.

CAREERS

A degree in physics is a valued qualification and provides a pathway into a wide variety of rewarding careers. This is reflected in the diversity of employers, such as energy companies, research laboratories, banks, government agencies and engineering firms, who actively target trained physicists.

A CAREER IN RESEARCH

Careers in research are rewarding, with opportunities to travel and collaborate with other researchers across the globe. A large proportion (40%) of graduates at Oxford take higher scientific degrees such as DPhil/PhD qualifications; the first steps in an academic career in research. Fundamental research in physics can help us understand the nature of our universe. Physicists specialise in topics ranging from galaxies to quarks, and clouds to crystals. Physics also plays an important role in the development of technology. At Oxford, for example, quantum computing is an exciting area of research, as is work in medicine to develop techniques such as proton therapy. Physics research can also help to solve global problems, such as improving the efficiency of solar cells to meet the increasing demand for energy in developing countries.

USING YOUR KNOWLEDGE

Physics graduates often use their knowledge and skills in areas other than academic research. For example, many physics graduates also work in industry; working for companies that specialise in areas such as energy, instrumentation, audio and visual technology, defence and telecommunications. They also go on to work as engineers, medical physicists, teachers, TV science advisors, environmental scientists, science journalists, writers, editors for scientific journals and in many other fields, e.g. specialising in law involving intellectual property and patents.

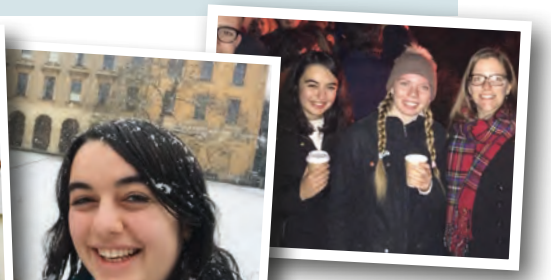
USING YOUR SKILLS

You may decide you don't want to work in a physics-related job; however the broad skills acquired by physics students are in high demand, especially in professions requiring analytical, IT and numerate problem solving abilities such as computing, finance and technical consultancy. Physicists have an ability to grasp concepts quickly, along with a determination to find coherent answers. Their ability to understand and model complex systems, for example, lends itself to a variety of different careers such as computer games design and financial forecasting. Studying physics is not only very enjoyable but is an excellent preparation for the world of work.

STUDENT PROFILE

A day in the life of Maria, 3rd year MPhys

8:00	Wake up and go for a run round Addison's Walk (a path around the deer park!) in my college, Magdalen. Then make a bowl of porridge in the upstairs kitchen
9:00	Work on a fluid dynamics problem sheet in the college library
9:40	Walk through Oxford to lectures (the Physics Department is 15 minutes from my college). Attend three lectures on atomic physics, special relativity and chaos theory
13:00	Have lunch with college friends in the OKB (Old Kitchen Bar)
14:00	Tutorial in college on atomic physics. We discuss the Rabi Oscillations in atoms (where an atom oscillates between an excited and ground state, then collapses into one state when observed)
15:00	Go to the library to review what I learnt in the tutorial and continue working on my fluid dynamics sheet for tomorrow's tutorial
16:00	Give a college tour to Year 10 students as a Magdalen student ambassador and finish the problem sheet for tomorrow's tutorial
18:00	Go to Magdalen's Medieval Hall for dinner with friends
19:00	I may go to a Physics Society talk; play casual college badminton or partake in the college philosophy discussion group (discussing anything from art, to God and time travel, over wine)
21:00	Sort out emails and plan the next day or catch up on work in the library if I have a deadline
22:00	Meet my friends for tea in someone's room



WHY DID YOU CHOOSE OXFORD?

The main reason I chose Oxford was the tutorial system. I also thought the college structure would suit me; a campus within the city gives a ready-made pool of people from all subjects to make friends with.

WHAT HAVE YOU ENJOYED?

I've really enjoyed the breadth and depth of third year labs. One week I'm cooling a semiconductor to 0.6K with liquid helium, observing quantum physics at the forefront of current research. Another I'm essentially blindly recreating a classic experiment in the optics dark room with goggles, gloves and an apron, developing a film that shows the absorption spectrum of sodium.

ADMISSIONS

We seek to recruit highly-motivated students who have exceptional ability in physics and mathematics. Successful applicants need to be able to analyse and solve problems using a logical approach and see how one part of a physical system connects with another. They also need to have an ability to give precise explanations both orally and numerically.

ENTRANCE REQUIREMENTS

Candidates are expected to have Physics and Mathematics to A-level, Advanced Higher, IB Higher Level or other equivalent. The standard offer is A*AA at A-level or the equivalent, specific details can be found at **www.ox.ac.uk/admissions/undergraduate_courses**

An A-level or an AS-level in Further Mathematics may be helpful for students taking this course, however it is not an admissions requirement

OPEN DAYS

Potential applicants are invited to join us at an Open Day in June or July, or a smaller Information Day in September. Booking for Physics Open Days is not required. Many Colleges also hold events on these days and you should contact the Colleges to confirm booking requirements. For more information see **www.ox.ac.uk/admissions**

HOW TO APPLY

For a five-step process on how to apply see **www.ox.ac.uk/admissions/undergraduate_courses/applying_to_oxford**

For more information about the course and how to apply, visit **www.physics.ox.ac.uk/study-here**

STUDENT FINANCE

The cost of studying is an increasingly important consideration when applying to university. The funding arrangements for students entering higher education are available on the University website: **www.ox.ac.uk/fundingupdate**

This page also includes information about the University's generous support package for students from lower income households in the form of tuition fee waivers and bursaries

APPLICATION CALENDAR

Early September

Applications are made through UCAS **www.ucas.com**

15 October

Final deadline for registering for the Physics Aptitude Test. Your school will need to have submitted your details via the Cambridge Assessment Admissions Testing's secure Entries Extranet. More information can be found here: **www.admissionstestingservice.org/pat**

Closing date for all UCAS applications

October/November

All applicants must sit the Physics Aptitude Test

December

Interviews take place in Oxford, more information is available on the Physics website: **www.physics.ox.ac.uk/study-here/undergraduates/applications/interviews**

By mid January of the following year

You will be notified of the outcome of your application

August

If you have been made a conditional offer and you meet the conditions of the offer, your College will confirm your place after the publication of examination results

Web links are correct at time of publication, but these are subject to change, please see www.ox.ac.uk/admissions

Cover images top row, bottom right and inset top right, and large image p5: © John Cairns Photography; other images © Hannah Glanville, © Media Services Unit, Dept. of Physics and © Sian Tedaldi

Design: www.catherinecharnock.co.uk

Issued by Department of Physics 05/19

FSC www.fsc.org MIX Paper from responsible sources FSC® C013002

www.physics.ox.ac.uk

Department of Physics, Clarendon Laboratory, Parks Road, Oxford, OX1 3PU