

Careers for Physics Graduates

Physicists underpin many areas of growth in the UK economy. However, they may not call themselves physicists - even though they have a university degree in the subject - they can be found working in areas as diverse as business, finance, marketing or engineering.

There are two options open to physics graduates when they complete their degree: continue studying or find a job. After completing their degree, one third of students opt to continue their studies either with a Master's degree or a PhD. The remainder go on into employment in a variety of different areas.

The potential earnings of physics graduates reflect the contribution they can make: according to a report by PriceWaterhouseCoopers, physics graduates earn around £187,000 more during their career than non-graduates. When compared with other disciplines, for example, history, this figure is £30,000. This difference in earnings reflects the particular skills and abilities physics graduates have. Their approach to problem solving alongside their mathematical skills make them valuable employees.

Space Industry

With organisations such as NASA withdrawing funding for human spaceflight, governments are increasingly looking to the private sector to drive innovation. Virgin Galactic – an extension of Virgin Atlantic run by Sir Richard Branson – aims to fly tourists into space for short trips. Currently costing \$200,000, flights will become cheaper as advances are made in technology and flying into space could be as commonplace as taking a budget flight from London to Glasgow. Graduates are required to design and build these space craft and the field will also require qualified pilots and technical maintenance staff.

Aeronautical Engineer

Typical starting salary: £20,000 - £25,000
Senior salary range: £28,000 - £65,000

Medical Physics

Each hospital has a medical physics department. The people who work there are responsible for the design, maintenance and use of different pieces of equipment and they are a technical

source of information to doctors, nurses and clinicians. This can apply to an ultrasound scan for an expectant mother, an X-ray for a teenager who has broken their arm or an MRI scan for someone with a suspected tumour. Medical physicists are also found working side by side with doctors in deciding on cancer treatment, for example. In order to work in this field, graduates normally need to complete a Master's degree in Medical Physics before joining a training programme with the NHS.

Typical starting salary: £25,472 - £34,189
Senior salary range: £38,851 - £80,810

Engineering

There are many different areas of engineering that Physics graduates can access: from structural and mechanical, to civil and environmental. Engineering is the application of mathematics and physics to a variety of problems. Physics graduates have the necessary knowledge and skills to work in these fields. One particular example involves construction and the role is that of a Building Services Engineer. When designing and building a new project, such as a school or theatre, a lot of thought is put into the design of the lighting, heating and general environmental conditions in the building. This is where physics knowledge is applied and has an effect on the designs. This could result in a natural lighting system instead of having many expensive electric lights.

Typical starting salary: £20,000 - £24,000
Senior salary range: £45,000 - £85,000

Games Industry

Computer programming skills are vital in this industry, but so is creativity. This industry is continuing to grow as new consoles and ways of playing games (e.g. in 3D) are developed. Companies are in need of graduates with technical skills and physics knowledge in order to make worlds come alive. Graduates can design how the computer game world will work and will have the opportunity to use their own ideas and manipulate the laws of physics in a virtual world – not something that is generally open to us. Typical day-to-day activities include solving technical problems with the games, dealing with clients and writing computer code. The higher-salaried positions in this industry tend to be those which deal with the most



technical aspects of the games, something that physics graduates are well placed to approach.

Typical starting salary: £25,000
Senior salary range: £35,000 - £70,000+

Business and Finance

There are a number of different roles and functions within a business suitable for a physics graduate, but one example is the role of a Management Consultant. This role requires excellent problem solving and communication skills. It involves working with a variety of clients on issues within their business or operation. One week they could be carrying out a review of the way in which a department runs in order to make recommendations on how to make it more efficient, the next they could be recommending changes to the NHS in order to save money. It is a very project-based role which means that each week can be different to the one before.

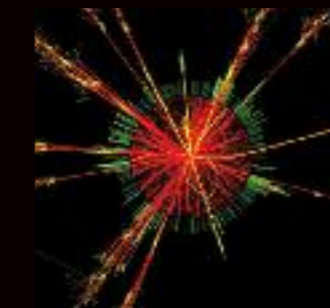
Typical starting salary: £25,000 - £35,000+
Senior salary range: £50,000 - £120,000

Actuaries can be found working in many different areas, including banking, insurance and pensions. This is an important role, as they advise on how to minimise risk based on an analysis of data using statistics and probability. Initial positions are as trainees, meaning that as well as working, exams need to be completed. Day to day, actuaries will be advising on investment decisions, carrying out calculations and monitoring risk – amongst others.

Typical starting salary: £25,000 - £35,000
Senior salary range: £60,000 - £100,000+



School of Physics and Astronomy Parents' Guide to Studying Physics



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Why study physics at university?

Like many people, I didn't find physics particularly easy or exciting at school. If I met my high school teacher today, they would probably go into shock at the fact that I completed an astrophysics degree. My main memories of physics in the classroom are of the black and red circuits we built which never seemed to work, whilst chemistry classes were more exciting affairs where we made gases and caused explosions of material. So, if physics wasn't my favourite subject at school, why did I go onto study it and why do thousands choose the subject each year at university?

I have always been curious about the world around me. I grew up in a small town but with a big view: the sky at night. Growing up, whenever I saw the moon I waved to the astronauts who were there (it was only when I was a teenager that I learned the last astronaut had left the Moon before I was born) and daydreamed about becoming an astronaut, even to the point of researching the different ways to reach my goal (Fighter pilot or research scientist – the stumbling block was that I'd need to be a US citizen). I was fascinated by the stars and enjoyed power cuts more than I should have as they provided a beautiful view of our galaxy, the Milky Way, above my back garden.

At school I was always capable at mathematics and considered studying the subject at university, but I had lots of unanswered questions. How are stars formed? What is a black hole? What happened at the start of the universe?

I first came across the degree of astrophysics whilst looking through a university prospectus. I followed this up with a couple of visits to universities to find out more. In the meantime, I discussed my options with my parents. When I told my Dad that I wanted to study astrophysics, his response was "What kind of job can you get with an astrophysics degree?" At that stage (aged 17) a job seemed a long way off and I was more concerned with finding answers to my questions, but I was able to give a generic reply along the lines of "I can go on and do pretty much anything" and that seemed to work (and turned out to be true!) In the end, my

parents could see my interest and passion for the subject and they knew that would be the key to success at university.

Physics at school turned out to be a necessary foundation. Without this knowledge as a basis, I would not have been able to go on and enjoy my university degree. Just as building a foundation for a house can seem unexciting, the resulting structure on top can be full of colour, interest and clever design. In progressing through my degree I discovered how creative physics is and how in using physics to solve problems, you begin to think in a particular way and I began to discover the answers to my questions (short answers can be found at the end of this article!).

It is several years since I graduated but I still look at the world around me with curiosity and am always finding more questions to be answered, but now have the skills and knowledge to do my best to answer them. Ultimately, physics is useful to all of us and it helps me understand how a lot of things work: from the liquid crystal display (LCD) screen I'm using to write this article to the DVD player I use to watch films. Being able to understand these things, and many others, makes me feel happy with my choice in studying physics – even though I don't necessarily use it week in week out for my job.

In the following articles you'll find out more about what physics is like at university in terms of lectures, labs and exams along with examples of careers for physics graduates. But for now, on the right are the answers to the first questions I had. If you'd like to find out more about physics, there are happily now many ways for you to explore the subject. Whether through television programmes, magazines or websites there are lots of sources available. If you'd like to read more about the subject there are some fantastic physics authors, including Marcus Chown (a Queen Mary graduate!), Richard Feynman, John Gribbin and Carl Sagan. You may also find that your local university hosts public lectures, for example we have the Richard Garriott lecture series covering a variety of different topics of interest.

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How are stars formed?

Stars are formed when a cloud of gas and dust collapses. As it collapses, the gas gets hotter and once a certain temperature is reached, nuclear processes can start and the star begins to shine.

What is a black hole?

A black hole is what is left when a massive star dies. It is black because it takes in the surrounding light and this is due to the strength of gravity. The star needs to be around 20 times larger than our own Sun for a black hole to be produced.

What happened at the start of the universe?

The universe began 13.7 billion years ago. At that time particles were very hot and closely packed together. The universe expanded outwards and after 150 million years, the first stars began to form. Over time more and more objects were formed and the universe expanded to what we see today.

Studying for a Physics Degree

In completing a university degree in physics there are two main aspects students need to master: theoretical and practical skills. The theoretical side will require students to learn more about mathematics and apply it to physics problems, whilst they will then be able to take their theory and test it via an experiment, therefore developing their practical skills. The subjects they will take at university will cover each of these aspects along with the mathematical grounding and problem solving techniques required to advance in them.

Lectures, Labs and Tutorials

In each year students will take a number of different subjects (usually called modules). In first year the modules are almost all chosen for them. For example, our BSc Physics course has one module choice for the student to make and the remaining seven are compulsory for the student (one quarter of the modules taken in first year cover the mathematical techniques required for physics). This is for various reasons, but mainly to ensure that they are given a good foundation of the breadth of physics to work from in future years. If the student is taking a course such as BSc Astrophysics, for example, there is an additional requirement for them to take an Astronomy module in the first year so they have no options. As the years progress, students will have the opportunity to make more decisions on what to study.

These decisions are not taken alone: each student will have an academic adviser for the duration of their university degree. They meet with their adviser at the beginning of the year to finalise module choices and discuss questions they may have.

Students attend between nine and twelve lectures per week covering three or four different topics. This means they will have three or four lectures for each module or will spend time in the laboratory (explained below). The academic year is split into two semesters with the total of eight modules split between the two. Lectures will differ in style as lecturers teach in a variety of ways. Typically, students will take notes on what is written on the board and said by the lecturer. In some cases notes will be provided and for

all modules there will be information on the department's website containing lecture notes and questions to be answered by the student. There are copies of recommended textbooks available in the library but students may be expected to purchase some textbooks of their own and they will be advised on this by their lecturer. The size of the audience in lectures will vary and this will depend on the university department. However, first year modules tend to be the largest as everyone takes the same subjects, whilst final year modules tend to be the smallest as there are more options available and people make different choices. So you could find that the student is one of five students taking a final year module, even though they were one of one hundred in first year.

Lectures are not the only timetabled classes students will attend: they have tutorials for each of the modules they are taking. This is an opportunity to work through questions relating to material covered in the lecture. These sessions are run by the lecturer and postgraduate students in the department. Whereas students may not be comfortable asking questions in a packed lecture theatre, at Queen Mary tutorials are typically attended by 15-20 students and are a great opportunity to get some one-to-one advice on a problem.

The final timetabled session which will take up their week covers the experimental aspect: undergraduate laboratory. Students will spend three to six hours per week working on experiments. They complete the work in pairs but individual lab reports are maintained by each student.

In total, physics undergraduates will be spending more than 20 hours in timetabled teaching in a mixture of lectures, tutorials and laboratory sessions.



Exams, Coursework and Projects

Assessment varies across the modules as it is changed to fit the nature of the course. In the majority of cases, students will sit an end of year exam (lasting 1.5-2 hours) accounting for the majority of their mark for the course. A small amount of the mark for the subject, 10-20%, will come from weekly coursework. Questions will be set by lecturers each week. They are marked, along with feedback, and returned to the student. This is a good opportunity for the student to see how they are progressing through the year and if they are not performing as they hoped, they can take steps to ask for some support from the department. For those courses based in the laboratory, lab reports are assessed and awarded marks.

In the final year of study, each student is expected to carry out a research project. Academic staff in the department will advertise the projects they have available and students make a selection. However, staff are always keen to hear ideas and encourage students to come up with their own investigations. The project will involve working under the direction of an academic member of staff to achieve a particular goal. This could be writing a computer programme which analyses data or investigating mathematics used to describe the universe around us.



Student finance explained for 2012 entry

Yes, fees are rising, but students will have access to an excellent financial support package – and they will only repay their student loans in manageable amounts after graduation.

With the new finance arrangements for going to university from 2012 splashed all over the media it is understandable that there may be some confusion. In fact, students will be able to borrow the cost of tuition fees and money to cover living expenses – and repay them after graduation, in manageable amounts related to your income. So don't let these concerns put you off university. Additionally, there will be lots of 'free' money available if you are a low or even middle income household.

Tuition fees: how much – and how do I pay?

From 2012, universities will be able to charge between £6,000 and £9,000 per year, as long as they meet strict criteria to ensure that all students can access their courses, regardless of family income. The majority of universities have announced that they will charge £9,000, but check their websites for full details. The good news is that fees do not need to be paid upfront. Instead, the student can take out a Tuition Fee Loan from Student Finance England, who pay the fees direct to the university. The loan is available to all eligible home students, on part- and full-time degree programmes, irrespective of their family's income.

Living costs: how will I survive?

Obviously money is needed for accommodation, food, books, socialising, communications (smartphone, plus apps), and so on. Where will this money come from? Your lottery-win dreams are unlikely to come true, so for most this will mean taking out a Student Loan for Maintenance, again from Student Finance England, to cover living costs. Eligible students are entitled to at least 65 per cent of the maximum amounts available; the other 35 per cent depends on household income.

The maximum loan available will vary depending on where the student lives and studies. If living away from home to study in London, the maximum will be £7,675.

For a student living away from home outside London it will be £5,500, and for students living at home it will be £4,375. The loan will be paid into their bank account in instalments each term to help them budget: so that means they won't spend it all in freshers' week on clothes/socialising/a car!

How will I repay the loans?

Fee and maintenance loans will be combined and students will start paying them back through the tax system from the April after they graduate, BUT, only if they are earning over £21,000 (gross). However, interest will begin to accrue from the time they receive their loan. The most important point is that the monthly repayments will be linked to how much they earn, not the amount they actually owe: they'll repay at a rate of 9 per cent of their income above £21,000 (gross). For example, if they are earning £25,000 they will pay back approximately £30 a month. If for any reason their income drops below £21,000, their repayments will stop. Any debt left after 30 years will be written off. The interest rate is linked to the Retail Price Index (RPI), plus extra depending on their graduate income. The maximum interest rate, which will apply once you are earning over £41,000 a year, will be RPI plus 3 per cent.

Maintenance Grant

If your family's household income is £25,000 or less, the student will be entitled to a non-repayable Maintenance Grant of up to £3,250; students from households with incomes of up to £42,600 will be entitled to a partial Maintenance Grant. Your family income will be assessed before they go to university. Like the maintenance loan, any grant awarded will be paid termly. (However, the maintenance loan will be reduced by 50p for every £1 of grant you receive.)

Bursaries

A bursary is provided by the university and is not something that is repaid. From 2012 onwards, universities charging between £6,000 and £9,000 have to agree to provide financial support to help students from low income backgrounds. You need to check universities' websites

to find out what they are offering; but, as an illustration, Queen Mary plans to offer a generous bursary package: £1,500 a year for students in receipt of the full Maintenance Grant and £1,200 for students who get a partial Maintenance Grant.

Scholarships

Scholarships are awarded by universities and are non-repayable. The criteria for awarding them can be based on academic achievement, for example, excellent results in year 13 exams, or, once at university, first year exam results. Many universities offer scholarships, although information on these can be hard to find. To find out more, contact university finance advisers, usually located in welfare or student support offices. They can advise on all aspects of financial support to study, including how to actually obtain what students are entitled to.

National Scholarship Programme

The Government has announced a £150m National Scholarships Programme for students from lower income families. Again, check with individual universities to see how they will administer this. For example, Queen Mary plans to offer 266 students from low income families a £3,000 benefit in their first year: a £1,500 fee reduction plus £1,500 made up of a cash bursary and 'in-kind' support. In their second and third years, they'll receive the Queen Mary Bursary.

Important note 1: these arrangements refer to students living in England and studying for an eligible course at an English university, and who qualify as home students.

Important note 2: some of this information might change before you start university so keep up to date at: www.direct.gov.uk/studentfinance and/or www.bis.gov/studentfinance

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