Physics opens doors
– where will your degree take you?

IOP Institute of Physics

Queen Mary
University of London

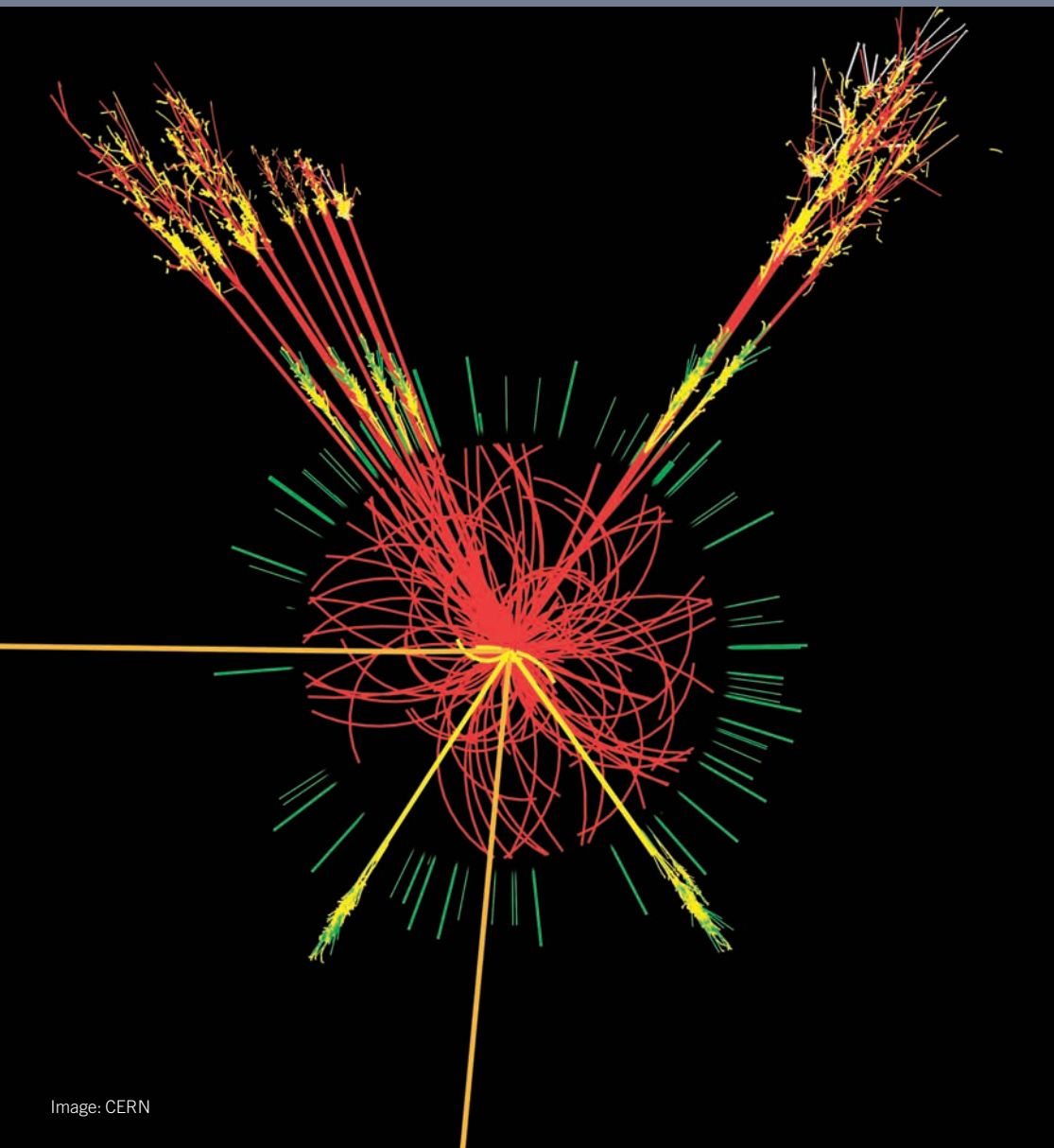

Image: CERN

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Introduction from the Head of School

A Physics degree opens up a range of exciting career options that is wider than you might think.

As a Physics graduate you'll naturally feel well-suited to a career in industry or scientific research, but the intellectual rigour, logical thinking and analytical skills that Physics students develop are much sought after by employers in a whole range of sectors, from green energy to computer games, investment banking to the Civil Service.

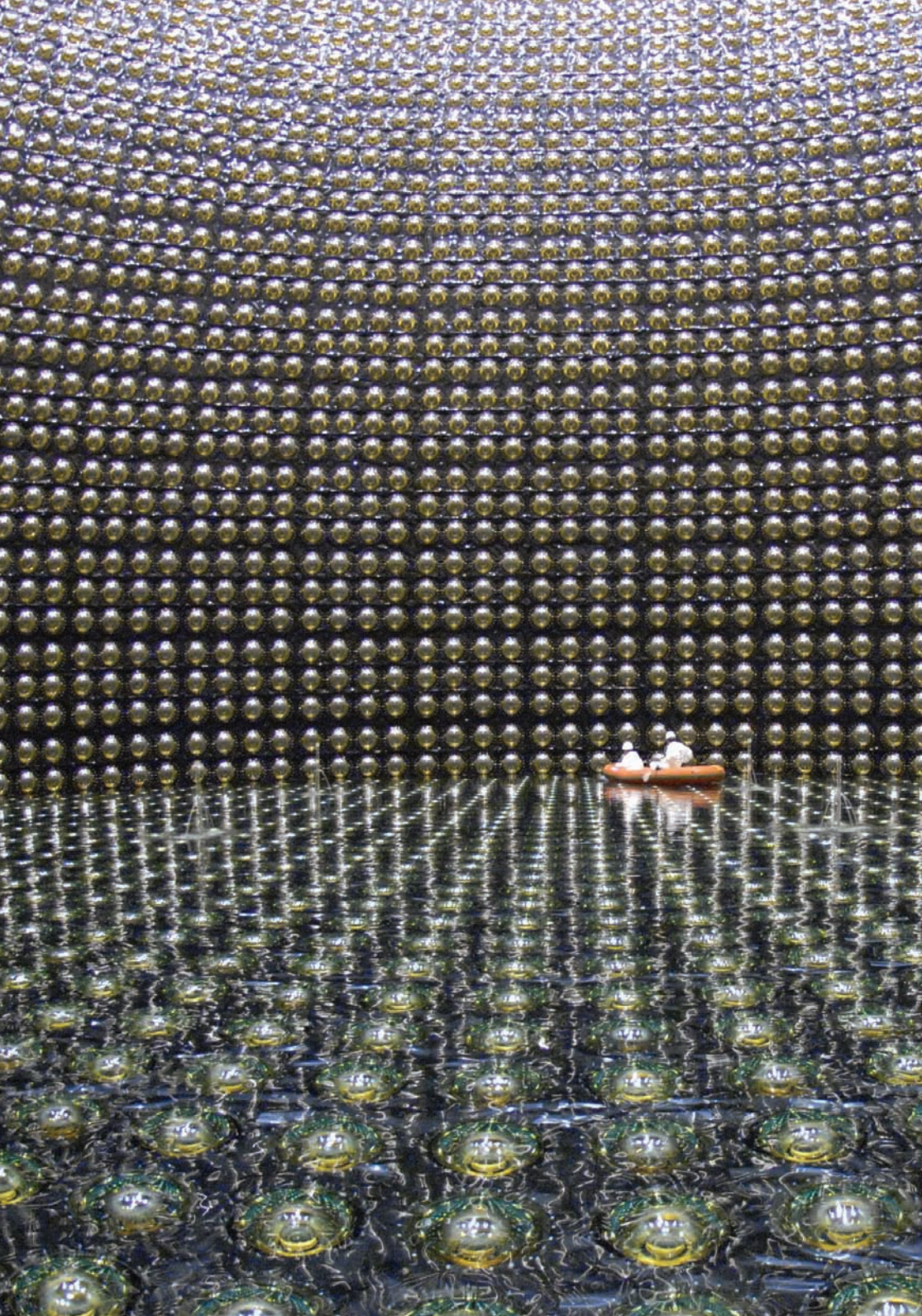
We hope that this guide will give you an idea of what it might be like to work in some of those fields. It includes guidance on qualifications needed, information on entry routes and career progression, and advice on how to make the most of your skills to get that job and climb the ladder.

We have included case studies of Queen Mary graduates working in academia, banking, management consultancy and science writing to give you a more personal perspective on how your career might evolve.

The graduate jobs market is certainly tougher now than it has been in many years, but a Physics degree is a respected qualification by employers and will put you at an immediate advantage.

I hope this guide will prove a useful starting point and I wish every Queen Mary graduate the very best of luck in their search for a challenging and fulfilling career.

Professor Bill Spence
Head of School of Physics and Astronomy
Queen Mary, University of London



Academia and Scientific Research

If you're really passionate about your subject and love the atmosphere of a university or research institution, then life as an academic may be for you.

However, it's no easy option. A PhD is now a minimum requirement for entry into most academic careers. And be warned that there are now far more doctoral graduates than there are jobs, so competition is tough.

As well as academic qualifications, you will need strong communication skills to deliver lectures and tutorials. You will also be expected to raise research funds and help oversee the administration of your department. And to pursue your career, you'll need to be willing to re-locate if necessary to find a post.

Pathways into academia and research

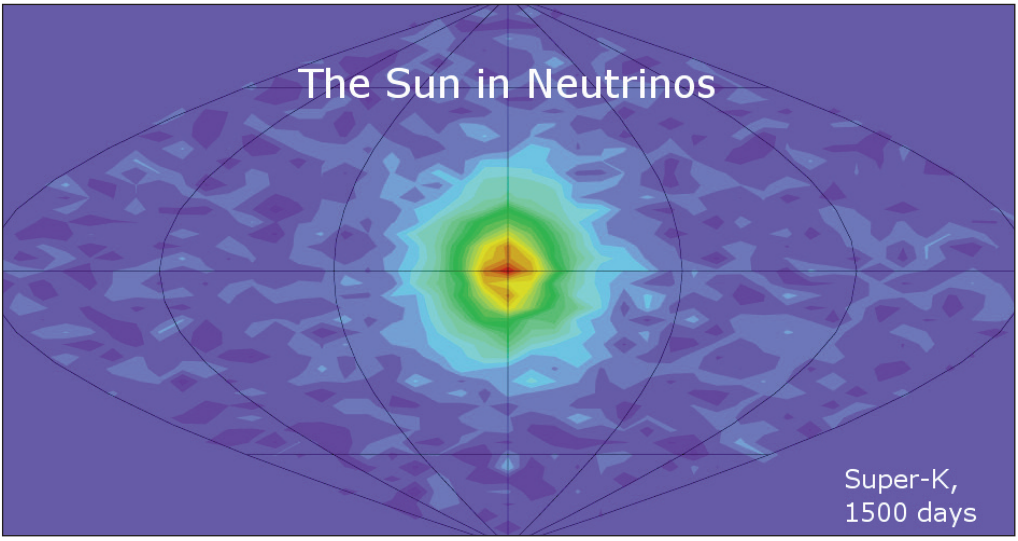
It is still possible in the UK to go straight from an undergraduate degree to a PhD in Physics, but a Masters qualification is becoming a more common stepping stone.

Once you've completed your Masters, you may be able to obtain a PhD studentship or to find work as a research assistant at a University which might allow you to register for a PhD alongside your normal work.

After your PhD, you may move on to fixed-term (2-4 years) Postdoctoral research contracts, normally working with academics on advanced research projects. These posts are normally funded by research grants won by the academics.

Research fellowships

Research fellowships are an alternative to postdoctoral research posts. These are awarded to outstanding individuals. Long-term (5+ year) fellowships often lead to a permanent academic job. Others buy you research time during which you'll be able to either apply for further research funding or seek a permanent academic job. Either way, they are competitive. Before applying for a fellowship, it's wise to have built up a track record of successful research.



Permanent research-focused positions that do not include teaching are much less common than traditional lectureships which are a mix of research and teaching. If you are university based but not teaching it is very likely that you will have other responsibilities outside of research such as general administrative duties. Long term research-focused posts generally rely on you continuing to bring in sufficient research funding from external sources to cover the costs involved.

Next steps

Jobs in academia and research are advertised in the following websites:

- **www.academicjobseu.com**
- **www.jobs.guardian.co.uk**
- **www.jobs.ac.uk**
- **www.thes.co.uk**
- **www.brightrecruits.com**

Vitae is a national organisation championing the development of research staff in higher education institutions and research institutes. Their website is at **www.vitae.ac.uk**

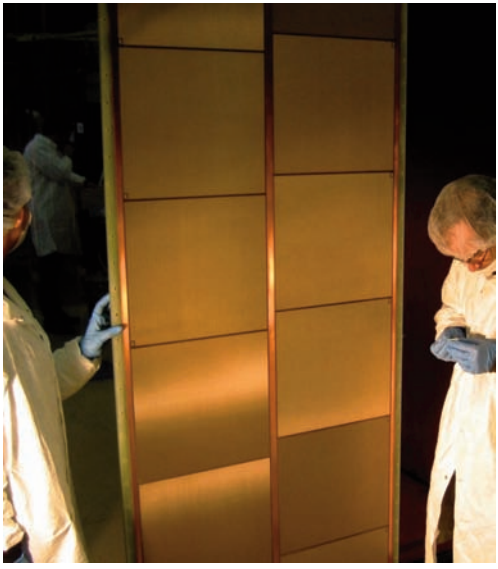
Academia and Scientific Research

Scientific research outside academia

A university is not the only possible workplace if you're looking for a career in research.

Many private companies and corporations employ researchers. Commercial objectives usually mean that your field of enquiry will be more constrained than in an academic setting. However, you may be allowed a limited amount of time to do your own research. If you impress your employers sufficiently, you may find they are willing to fund or part-fund your PhD.

Many scientific research jobs outside universities are advertised at **www.jobs.ac.uk** and brightrecruits. **www.brightrecruits.com**



Case Study: Sarah-Jane Lock

Age: 34

Job: Post-Doctoral Research Assistant

Employer: School of Earth and Environment, University of Leeds

Qualifications, MSci Theoretical Physics, Queen Mary, University of London; PhD University of Leeds, "Numerical model development in atmospheric dynamics."

I work in academic research at the School of Earth and Environment at the University of Leeds. I explore and use numerical methods to write computer models of atmospheric dynamics.

This involves reviewing previous research publications for methods appropriate to our problem of increasing the efficiency of atmospheric model forecasts. Next, I consider how to implement those methods in our model computer code. Then I write and test the code and I perform modeling studies to identify whether the model can produce sufficiently accurate and speedy solutions.

My current project is a collaboration between individuals at six UK universities, the UK Met Office and the Science and Technology Facilities Centre. Given the size of the collaboration, it is rare that we all get together, so day-to-day, I work most closely with my boss, the principal investigator, for the Leeds University contribution to the project.

I split my working week between days in my office with other post-doctoral and PhD researchers – all working on different aspects of atmospheric science – and days working from home.

Time out

After graduating I spent some time as an analyst in the civil service and some time travelling. That's not typical, but both experiences helped me identify the career I do want to pursue – research in numerical methods in a physics and environmental-based science. I found a PhD advertised at Leeds University that offered, what for me was, a perfect combination of mathematics, physics and computing, applied to an environmental science.

I enjoy the mental challenge of the work – striving to perform precise, well-justified implementations and analyses of new methods. I loved the intellectual challenge of mathematics, physics and computing from my first degree, but wanted to apply that knowledge and those skills in a science area that is clearly visible in our day-to-day, natural world.

Studying the oceans and the atmosphere seemed to be the right application field for me. I also felt confident I would enjoy the challenges of academic research – the freedom to explore exciting new ideas without the same pressure for fast results, often at the expense of quality, that can be felt in other sectors.

Learning to prioritise

The main challenges of my job are staying abreast of new developments and learning from the wealth of existing research. It's also difficult to manage my time effectively. There is not enough time for me to do all the work I would like to do. So, it's important that I prioritise, build collaborations, talk to other researchers to learn from them, and keep the goals of my work clearly in mind.

I hope to make the step to being an independent researcher – perhaps a research fellowship – before applying for lectureship positions and starting a career as a member of permanent academic staff.

Words of wisdom

- Find a research question that you really care about – there are a lot of frustrations and obstacles along the way.
- Typically, it is important to be committed to finding an answer as this dedication will get you through tough times. Unlike many jobs, it is rare that there's anyone sitting over you demanding some output, though there is usually a wealth of encouragement from peers if you look for it.

"I loved the intellectual challenge of mathematics, physics and computing from my first degree, but wanted to apply that knowledge and those skills in a science area that is clearly visible in our day-to-day, natural world."

Banking and finance

The banking industry in the UK can roughly be divided into three parts: retail, private and investment.

Retail banking

Retail banking covers the activities of the so-called "high street" banks such as Lloyds and NatWest, providing accounts, mortgages, loans and other services to personal customers and small businesses. Working in retail banking will involve taking responsibility for staff, advising customers about their finances, and building links with the local community. The work is target-driven and marketing skills are important. Back office roles that might appeal to physics graduates include financial modelling work, actuarial work, and IT project management.

Private banking

Private banks provide services tailored to the needs of wealthy individuals (eg portfolio management and estate planning). Private banks are sometimes independent, but more often a division of a larger investment or high street bank. Typical roles include working as a financial adviser, a portfolio manager, or a relationship manager (maintaining communication with the client). Clients will expect you to have high levels of professional skill and knowledge in a range of investment-related areas. You will need to have excellent communication skills, an interest in financial products and markets, and the ability to explain complex information clearly. Physics graduates will be well placed to demonstrate the strong mathematical, IT and analytical skills required.

Investment banking

Investment banking involves the delivery of much more specialised financial services to far bigger clients, including corporations and national governments. These services require the application of skills specific to physicists such as utilising an understanding of numbers and analytic skills to carry out financial modelling, leading to the development of appropriate financial solutions for the client. Areas of work for investment bankers include mergers and acquisitions, loan facilities for governments and corporations, foreign exchange dealings, export guarantee credits and investment management. The main employers are big international investment banks, UK clearing banks and smaller "boutique" operators. Though very well paid, investment banking is stressful and the hours are long. You'll need an excellent academic record, resilience, ambition and plenty of business acumen.

IT in banking

IT plays an increasingly important role in the financial sector, with complex computer programmes needed to support retail banking and inform traders in investment banks. Physicists are particularly in demand for the development of these programmes.

Entry routes

A number of banks run work experience programmes and summer internships for students. You can also apply for graduate schemes during your final year. Your chances will be greatly improved if you've taken part in a prior internship.

Case Study: Paul Dembina

Age: 51

Job: Senior software developer

Employer: Merrill Lynch

Qualifications: BSc Theoretical Physics at Queen Mary College

My current position is concerned with commodity trading, which is a new area for me. The job involves supporting the commodity traders' risk platform and provides a daily view of the risk for all open commodity trades. This means making changes as requested by the application users and providing ongoing support.

However, my work doesn't just involve software development. There's a high level of interaction with our users, to clarify requirements, discuss testing and provide support after release of a new version.

Teamwork and problem solving

I work in a very small team: just my manager and four developers. We are based in an office in the City of London. I enjoy getting my head around a problem and solving it. Developing software solutions can be very creative and finding new ways to solve problems and using your experience to diagnose problems are very satisfying.

A growing interest

When I was at Queen Mary (between 1978 and 1981 as an undergraduate) I wasn't particularly interested in IT and at that time it wasn't an obvious career choice. However, for my PhD work I was involved with developing a computer simulation of some solid state models. The simulation used what was then a state-of-the-art computer: the ICL Distributed Array Processor. I became more and more interested in this aspect of the work until I decided that I wanted to have a career in I.T.

I didn't initially go into finance and banking. My first job was at a software house (Logica) where I worked on space and defence projects. What attracted me to investment banking was the challenge of a high pressure environment and the initial excitement of working on a trading floor. There's also the allure of the remuneration, which is pretty good compared to equivalent jobs in other industry sectors.

As I now have two young children one of the biggest challenges is making sure I have a good work/life balance. There's a big tendency in investment banking for people to work very long hours.

People skills

Apart from the work-life balance issue I suppose the hardest thing can be having to deal with awkward people in the workplace. This is less of an issue where I work now but sometimes you get users making demands that seem unreasonable and it's learning how to address those issues and deal with them that can be challenging.

I'm cautious about future prospects in financial software. Obviously we have the rise of the Asian economies and we're already seeing a lot of the lower level IT jobs being farmed offshore to places like India. However if your job requires you to be in close and constant contact with your stakeholders then that is very hard to be outsourced in this way.

Words of wisdom

- Don't think you can go into a job and spend it coding all day long. That sort of job can easily be done more cheaply offshore. My job involves liaising with my users and other IT teams as well as to my management and other teams.
- Be flexible about what your job entails, the job market is constantly in flux and who knows what the IT worker in the Twenty-first Century will be required to do.

Computer Games

The computer gaming industry is bigger than you might think.

There are about 30,000 people employed in the UK games industry overall, including developers, publisher and retailers. The number of British games development studios alone stands at 250 – the biggest games development community in Europe and the largest after the USA. Liverpool, Manchester, Dundee and Guildford are hubs of the British industry.

With gaming technology advancing constantly, entrants need to be quick learners, and a genuine passion for gaming is a must. You will also need to be a good team player, as games are designed by groups of programmers.

A changing industry

The industry is currently male-dominated. However this may change as the demand for physics based programming increases. The use of physics to energise the environment of games has produced stunning visual results; it is possible that in the future there may be skills shortages in areas such as storytelling and cinematography. In the future, it's likely there will be skills shortages in areas such as storytelling and cinematography.

Working hours in the gaming industry can be long, especially towards deadlines. Salaries start at around £25,000 for skilled artists, animators and programmers and can rise to £45,000 for project managers, producers and lead developers.

Entry Routes

Working as a games tester could be a good (though not lucrative) starting point. No qualifications are needed; you simply need to be happy to spend your days playing computer games, finding bugs and noting the problems systematically for the developers.

The industry is competitive and you will need to be passionate about gaming to make your mark. Here are some tips to help you find your way:

- Send speculative letters to gaming companies asking for an internship
- Build up a portfolio of your own work so you can show off your skills
- Consider taking an MSc in Games Programming and Computer Animation. More and more British universities now offer this option
- Check out websites like **www.dperry.com** or **www.gamesindustry.biz** to keep yourself updated with developments in the industry.


“The industry is competitive and you will need to be passionate about gaming to make your mark.”

Defence

A career in defence can offer a fantastic range of challenges, and an exceptionally varied workload.

The UK boasts a strong defence sector, and the Government's Ministry of Defence will be the first port of call for physicists interested in working in it.

The MOD actively recruits the top flight of graduates through its Fast Stream development programme. There are two Fast Stream programmes in the MOD: one for high-level administrative jobs, the other (run by the Defence Engineering and Science Group) is for engineers and scientists.

Around 100 individuals are currently employed in the MOD Fast Stream, working in a very broad range of areas to gain experience of how the ministry works on every level.

A varied workload

Fast Streamers focused on administration need to develop strong management and interpersonal skills and can expect to work alongside Army, Navy and Air Force personnel. Typical areas they get involved in include:

- Overseas defence policy
- Supporting a minister or senior official
- Defence procurement policy
- Media planning
- Policy on public-private partnership investment issues
- Financial planning of the Army equipment programme

Fast Streamers are initially likely to spend a large proportion of their careers in London or Bristol but many posts will eventually involve travel to Europe and beyond.

Further information on the Home Civil Service Fast Stream can be found on the Home Civil Service Fast Stream website http://faststream.civilservice.gov.uk

Defence Engineering and Science Group

Of particular interest to physicists will be the Defence Engineering and Science Group (DESG): a community of 9,000 professional civilian engineers and scientists working within MOD Civil Service to equip and support the Armed Forces with cutting-edge technology.

The DESG Graduate Scheme is a direct route after the final year of your degree and consists of up to two years' structured training, leading to a professional post. Further information can be found on the DESG website

www.mod.uk/DefenceInternet/AboutDefence/WhatWeDo/ScienceandTechnology/DESG

Defence Science Technology Laboratory (Dstl)

Dstl is the science and technology arm of the MOD, working to develop cutting-edge technologies applicable to defence. They run a two-year graduate development programme and there are currently 60 to 70 young people on the scheme.

You can find out more at their website **www.dstl.gov.uk/pages/45**

Case Study: Jane Weir

Age: 35

Job: Senior Scientist, Biophysics Group

Employer: Defence Science Technology Laboratory

Qualifications: MSc Physics, Sheffield University

I work for the Defence Science Technology Laboratory (DSTL), based at their headquarters in Salisbury, Wiltshire. DSTL has about 3,500 employees, about 70 percent of whom are scientists and engineers.

There is no such thing as an average day but the work is challenging, interesting and rewarding. I manage my own schedule and am free to organise the activities that I need. This means that my work is quite varied and the focus can change from week to week, depending on priorities. The activities I am involved with include practical work such as building and running trials, fixing and maintaining kit in the workshop or ballistic range.

A variety of responsibilities

There's also desk work such as bidding for funding, project planning, report writing, data analysis; and meetings on and off-site with customers, user groups and research partners. I am also senior mentor for the Institute of Physics on the DSTL chartership scheme, so I spend some of my time providing guidance to mentors and candidates to enable them to achieve their professional development goals.

I am part of a team that works on personal protective systems and closely linked with other teams that develop models to represent the human body, analyse casualty trends and assess weapons. The technical team that I work with varies depending on the nature of the project that I'm doing, so I get to work with a lot of people in very different technical fields to this.

Balancing requirements

I came to DSTL after a spell of travel abroad following graduation and a couple of temporary jobs in unrelated fields. I worked on aerosol science for a few years before moving into ballistics, body armour and personal protection. I never pictured myself working in defence, but when I was looking for jobs after university I saw an advert in New Scientist and came for an interview. It looked like somewhere you could get stuck in, so I thought I'd give it a go.

There are a lot of stakeholders for my work – the ones who use the kit, the ones who're buying it, and the ones who fund me – and they all have different priorities. Balancing all their requirements is a real art! I enjoy the variability, the randomness, technical challenges and making a difference. A lot of what we do in our team makes it into the papers, and more importantly, to the frontline to save lives.

Words of wisdom

Don't be put off – defence has a bad name in some circles but defence research isn't all about developing the next big weapon. A lot of the work being carried out is directly aimed at saving lives and improving quality of life.

> "A lot of what we do in our team makes it into the papers, and more importantly, to the frontline to save lives."

The Energy Sector

Green energy

With ever-mounting concern over climate change, long-term growth in the green energy sector cannot fail to be impressive.

The UK is obliged under EU law to generate 15% of its energy from renewable sources by 2020. The biggest single source of green energy will be wind, and it's estimated that the wind energy industry will go from employing around 5,000 to 60,000 people over the current decade.

Employers within the wind sector range from small wind energy specialists to large international power companies developing their own wind energy products. Advancing technology means wind energy turbines are increasing in size, and that in turn is driving the development of bigger and bigger wind farms.

Marine energy is the second largest component of the UK green energy sector. In all, there are around 500 British companies involved in the combined marine and wind energy business.

Physicists might well find themselves working in research and development, software, data analysis, planning and project management. Working conditions will vary depending on the area you specialise in, and you could work in a lab, an office or on a site.

For more information, go to **www.greenenergyjobs.com, www.greenjobs.co.uk** or **www.bwea.com**

Oil and Gas

The green energy sector has seen substantial growth in recent years, but as demand for energy worldwide continues to rise, the oil and gas sector is growing too.

Skills in science, technology, engineering, mathematics and business disciplines are in great demand and physicists could expect to get involved in exploration, production, refining and engineering.

Go to **www.oilandgas4u.com** for more details.

Nuclear energy

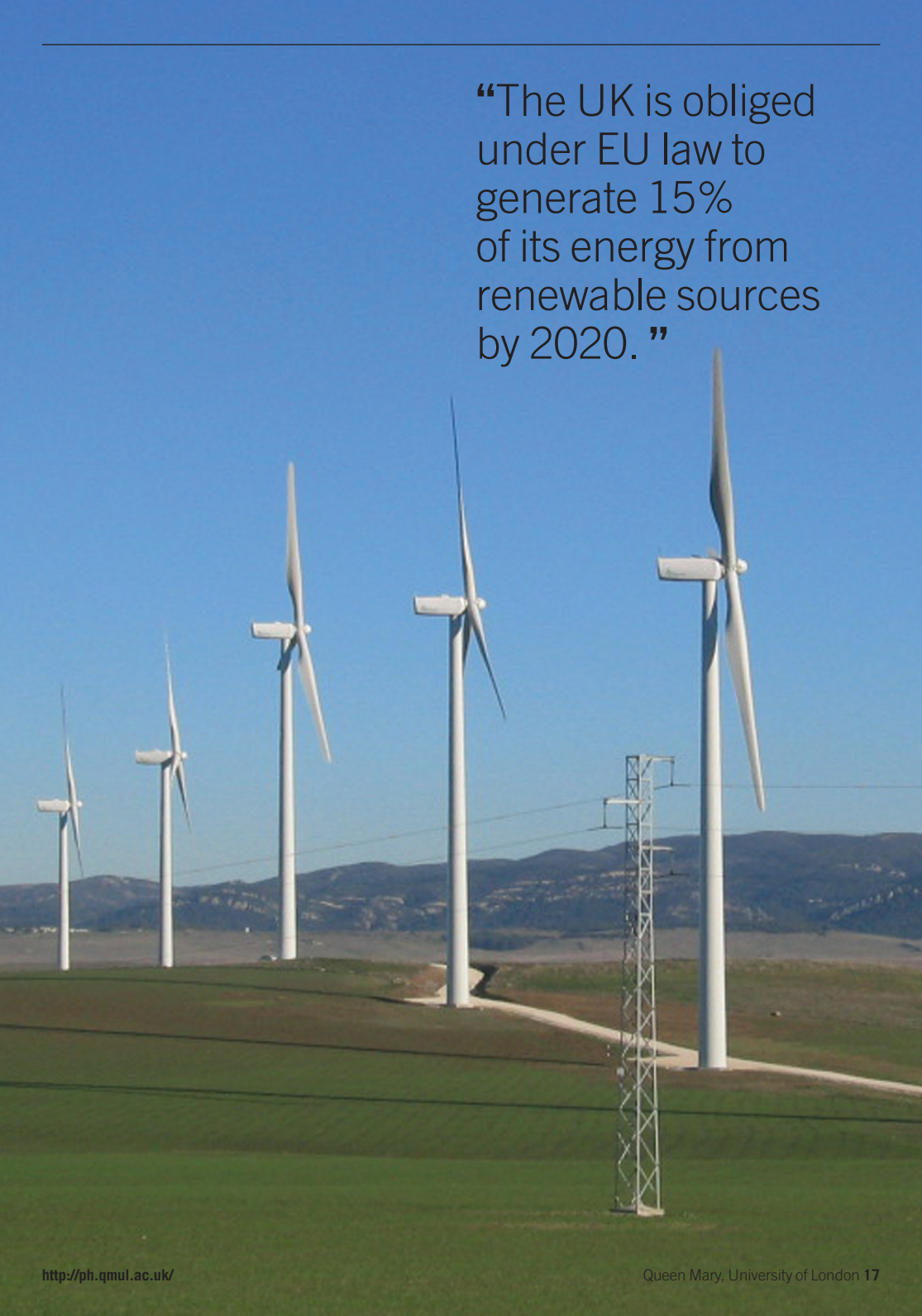
The core skills of physicists are also in demand in the nuclear industry. A new wave of nuclear power stations means the sector looks to be a growth industry in coming years in the UK.

Physicists could typically get involved in:

- Power generation.
- Reprocessing of nuclear waste.
- New build of the next generation of power stations.
- Decommissioning of power stations and waste management.

The work is highly skilled and highly technical. Major players within the industry include Amec, Sellafield UK and consultancies such as Areva and Hyder Consulting.

The Nuclear Graduates Scheme **www.nucleargraduates.com** could be a useful first step.


“The UK is obliged under EU law to generate 15% of its energy from renewable sources by 2020. ”

Management Consultancy

If you like working with people and enjoy the challenge of analysing a complex situation and suggesting solutions, management consultancy could offer you a varied and rewarding career.

Put simply, management consultants advise companies on how to achieve their goals. They may typically give advice on reorganising a company's structure, outsourcing, IT systems, human resources management and long-term strategy, but the type of work can vary enormously.

There is a broad range of employers in the sector. Management consultancy companies vary in size and scope, from large "generalist" consulting firms that offer a wide range of services to specialist niche providers.

Physics graduates wishing to pursue a career in consultancy will need the following:

- A strong academic record.
- An analytical, solution-focused approach.
- The ability to master a great deal of information quickly.
- A clear, comprehensible speaking and writing style.
- Soft skills such as empathy, integrity and awareness of the views of others.

Entry routes

The majority of management consultancy clients are private companies, and the industry has been adversely affected by the recession. However, the long term outlook remains positive.

Although there is no fixed recruitment period, organisations generally have vacancies in the summer after exams. The first term of your final undergraduate year will be the right time to apply.

Salaries and conditions are attractive. A newly recruited graduate or those with up to two years' postgraduate work experience can expect a starting salary of £28,000 per year. Promotion can be rapid and salaries can rise to as much as £180,000 for a director or partner.

For more information go the Institute of Consulting website **www.iconsulting.org.uk** or the Management Consultancy Association site **www.mca.org.uk**

Case Study: Akira Shibata

Age: 30 years old

Job: Associate at the Strategy Institute

Employer: Boston Consulting Group

Qualifications: PhD in Experimental Particle Physics, Queen Mary, University of London

In a nutshell, what we do is sell ideas to help corporate management make strategic decisions. I work within in a team in a New York based office. I also work with support teams, external people including clients, people from other offices and scholars from academia.

Strategy and analysis

My typical week revolves around discussions with my team leaders and team members. We spend our time analysing large datasets to extract insights useful for the firm activities (using computer programming and Microsoft Excel). Then we'll develop our findings into stories that would appeal to people in charge of strategic management (this involves writing PowerPoint presentations). Finally, we'll facilitate collaboration with academic scholars via e-mails and face-to-face meetings.

Personal contacts

My way into consultancy was that I had a few friends who worked in the consulting industry. I found there were strong connections between my skills and way of thinking and theirs.

Originally I had the desire to start my own business, but I knew nothing about doing business. A consulting firm is a place where you can get experience of working closely with people in a number of industries in a very short period of time.

My main work challenge is staying focused and being very sharp logically while also enabling multiple levels of communications. It's not just about doing analysis and making hypotheses, but also putting findings in context and selling your ideas.

Words of wisdom

- Stay focused but don't stay in a shell.
- Physics is a very well established discipline and therefore is well respected and very rich in both theory and experiment. The drawback to it is that people can believe they know about the world because they know how the universe works!

"It's not just about doing analysis and making hypotheses, but also putting findings in context and selling your ideas."

Medical physics

Physics has made some profound contributions to modern medicine, from the x-ray to ultrasound scanning.

Scientists who work in medical physics and engineering use their skills to provide equipment for patient care. Although their roles are overwhelmingly technical, at the same time they will be intimately involved in assessing and treating illness and disability.

They collaborate closely with doctors to provide the best treatment possible to the patient. Sometimes they will see patients treated with equipment they themselves have designed – something that can be a major source of job satisfaction. Good communication skills are important, especially when explaining complex treatments to patients.

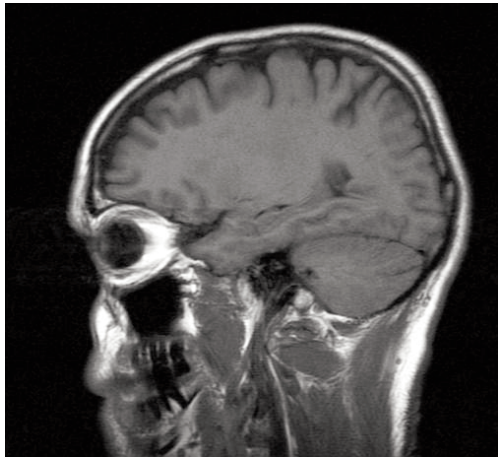
Physicists may work in many different medical fields. Many are focused on the design and safe operation of nuclear medicine, radiotherapy, radiology and various aspects of physiological monitoring and investigation. Others contribute to specialisms such as anaesthetics to urology.

Entry routes

For Physics graduates, the NHS Scientist Training Programme will be the most likely first port of call to pursue a career in medical physics. The STP is a three-year period of on-the-job training that will result in an accredited Master's degree. It's very competitive and job numbers are limited.

A 2:1 BSc in a relevant science is the minimum requirement for this programme. There is an annual recruitment cycle for the STP and applications are usually made through the NHS Jobs website **www.jobs.nhs.uk.**

The Institution of Physics and Engineering in Medicine is an excellent source of further information about the sector. Go to their website: **www.ipem.ac.uk** and keep an eye out for the new e-zine IPEM Aspire.



"My immediate team is a group of dosimetrists, fellow physicists and technicians. We all work together to ensure the patients get the best treatment possible.."

Case Study: Debbie Holmes

Age: 27

Job: Clinical Scientist (Radiotherapy)

Employer: Northampton General Hospital Trust

Qualifications: MSc Medical and Radiation Physics at University of Birmingham

My work as a medical physicist is very varied. It includes testing the equipment used to deliver radiotherapy treatments, planning radiotherapy treatments, administering radioactive nuclides, doing patient case studies and looking at special requirements.

This variety means every day is different depending on what's going on around the department. There are ongoing projects that I'm working on that sometimes get put on the back burner when more urgent things come through the office door. These can be anything from machine breakdowns, patients' plans that need reviewing or phone calls from the police after finding what they think is a radioactive substance on the side of the motorway!

Teamwork and communication

I work as part of a multi-disciplinary team, which makes communication a really important skill. I have to discuss complex situations with consultants but not overwhelm patients with "the science". My immediate team is a group of dosimetrists, fellow physicists and technicians. We all work together to ensure the patients get the best treatment possible.

I found out about medical engineering and medical physics on an Insight course run by the National Training Organisation for Engineering Manufacture. Medical physics became a way for me to do the subjects I'm good at with a biological slant, which I really enjoy.

I learnt about medical physics whilst still at school and found it really interesting. It influenced my degree choices and I studied Physics with Biomedical Physics. It was during the biomedical physics modules of my degree that I learnt more about the subject and decided that it sounded like something I could really get into.

Every day's a challenge

I love my job and the fact that every day's different makes it all the more interesting. Being faced with a patient or situation that's not routine is one of the main challenges, as is listening to what a consultant wants and trying to turn it into reality. Those kinds of situations really make you think, but seeing a job well done and knowing the input you had is definitely rewarding.

My job will progress up the career ladder and working in different centres with different equipment is something I'm looking forward to. New technologies will always keep us on our toes making things better for patients and improving outcomes.

Words of wisdom

Contact your local hospital and ask about the possibility of doing some work shadowing. Most hospitals will happily accommodate a few days of work experience and it'll give you a real taste if it's something you could be interested in.

Teaching

If you're passionate about your subject and enjoy working with young people, teaching could prove an exciting and rewarding career.

However, teaching is a challenging profession. You'll need to be able to:

- communicate the key principles of physics
- pass on knowledge effectively
- show patience and compassion, even with challenging students
- create a positive, supportive learning environment

Physics is currently considered a priority subject and due to the shortage of suitably qualified staff there is great demand for physics teachers in most schools in the UK.

What's more, the financial rewards are better than you might expect. Starting salaries range from £21,000 to £27,000, but as a fully qualified classroom teacher you could earn £35,000 and up. And if you enter training as a physics teacher you may be eligible for a tax-free training bursary of £9,000.

Many who enter the teaching profession are happy to remain as classroom teachers. However, there is a clear path for career progression if you choose to take it, and promotion to Head of Department, Head of Year or Headteacher is possible. As the Headteacher of a secondary school, you could earn up to £140,000.

Entry Routes

A Post-Graduate Certificate of Education (PGCE) is the most common route into becoming a fully-qualified classroom teacher. The course generally takes one year full time or two years part time.

If you have a 2.1 degree or above you may be eligible for Teach First, a "fast track" into teaching. Teach First candidates undergo a much shorter, more intense period of training but must then commit to spending at least two years as a classroom teacher.

You may be able to apply for the Graduate Teacher Programme, enabling you to get qualified teacher status (QTS) while working in a paid teaching role.

For more information on the options, go to **www.tda.gov.uk**

Case Study: Stephanie Taylor

Age: 25

Job title: Physics Teacher and Year 7 Science Co-ordinator

Employer: Highgate School, London

Qualifications: BA in Physics at Merton College, Oxford.

My job title is Physics Teacher, but teaching is only one part of the job. However, it is both the most fun and the most exhausting part!

I am also a form tutor, which involves sorting out pupils issues pastorally and liaising with parents. I mark work, plan lessons, write reports, supervise break times, attend (and occasionally deliver) assemblies. I also attend parents evenings, write lessons for a scheme of work, mentor a new teacher, observe lessons of those teaching the course for which I am responsible. Plus I run a science club and two astronomy societies, one for parents and one for older students. It's a busy job!

I work mostly with the students themselves, but I'm also part of a wider team of science teachers and year-group tutors. I work in an office in the evenings and during free periods, but otherwise I am on my feet somewhere around the school site.

Autonomy and unpredictability

I enjoy helping students understand new things, and the challenge of engaging them in a subject I am passionate about. I love the fact that you never know how a day or a particular lesson will go, and you never know what the students will say and ask! I also like having a lot of control over what I do and how exactly I teach particular topics. There is quite significant responsibility and autonomy from an early stage in your career.

I got into teaching at university. I didn't enjoy labs and there was an option to replace some of these with a teaching course, so I leapt at the opportunity. I ended up really enjoying the course so I applied for a PGCE. I really enjoyed that, so I carried on.

After my PGCE I spent two years in my first school and am now in my second year at my second school.

A steep learning curve

The nature of the job means it is very busy, with long hours during term time. It can also be emotionally draining too. It can be hard to know where to draw the line with work because there is always more you could do, but there are good holidays to make up for this.

All of the aspects that make it difficult are particularly acute in the first few years. Perhaps that's partly why there is a high drop-out rate for newly qualified teachers.

However, there is a career path, and most teachers progress with subject teaching, by becoming a Head of Department and perhaps ultimately a Director of Studies. Others progress pastorally, by becoming a Head of Year, then perhaps a deputy head.

Words of wisdom

- Don't underestimate what hard work it will be, particularly at first!
- I enjoy being around young people and that is the most important thing if you are considering teaching.

> "I love the fact that you never know how a day or a particular lesson will go, and you never know what the students will say and ask!"

Science Writing

Science writers have a unique job. Not only must they understand science, but they also need to have a flair for the written word.

They have to balance a responsibility to report an issue truthfully and accurately with the need to capture and maintain the interest of the public. What's more, as journalists they'll often be called on to produce articles and features at very short notice.

As a science writer, you'll need a good grasp of public affairs, and a love of finding out and discussing what's in the news. You'll also need to be sociable and to enjoy talking to all sorts of people. It's important to be comfortable promoting yourself and your work to build your professional profile.

Flexible working

The sector offers a good deal of flexibility. Many writers are freelance and work largely from home. Writers will typically work for 40 hours a week, although the need to meet deadlines will require some weekend and evening work. Photography skills could enhance your employability, as will an understanding of new media approaches like blogging and podcasting.

You may want to specialise in newspapers, magazines website, TV or radio journalism. That said, may writers move from one medium to another without too much effort, or find they "fall into" working in a certain area.

As a journalist, you will be able to progress to become an editor where you are responsible for planning, commissioning and checking the work of other writers.

Entry routes

No particular qualifications are necessary for a career as a writer, but a BSc and a postgraduate qualification such as an MA in journalism or the NCTJ Diploma in Journalism will prove helpful.

Competition is fierce and starting salaries are not high. You could expect to start with a salary of £20,000 to £25,000 writing on a national newspaper or working for a prominent broadcaster.

"Some students have told me they only studied physics because they read my book. So as a writer you can really make a difference. That feels very rewarding."

Case Study: Marcus Chown

Age: 52

Job: Freelance writer

Qualifications: BSc Physics, Queen Mary, University of London

I'd describe myself as a writer and journalist first and foremost. I basically write about space and physics but I'm also the cosmology consultant on the *New Scientist* magazine.

One of the nice things about being a freelancer is you can do what you want. Every single day is different. I get to talk to the most interesting people in the world and ask them really stupid questions!

I work from home, which suits me very well. I live in central London and I can walk round Hyde Park any time I like.

Self-promotion

Quite a lot of my work is publicising things. For example, I have a new book coming out called *Tweeting the Universe*. I've contacted the *Sunday Times* and the *Independent* to get them interested. Getting yourself about is a big part of what I do. Mostly I enjoy it, but sometimes I find it can be quite uncomfortable. There's a fine line between promoting yourself and bigging yourself up.

When I was at school, I really liked both English and Science. Unfortunately in the English educational system you can't ultimately do both. So after university I did a masters degree at the California Institute of Technology in Pasadena, then decided academic research wasn't really what I wanted to do. I thought a non-risky step would be to write about science.

A foot in the door

At the time there were no real career paths for science journalists. How I got into it was to write to newspapers and magazines asking for a job. They all told me to get lost – you need to be really persistent! Then finally I got a job on *Nature* magazine. That really helped, because editors always ask if you have an experience. Nowadays it's easier perhaps, because you can write a blog or use Twitter to get your words and ideas out there.

When I left *Nature*, I thought I'd burned my boats because I couldn't go back and do a PhD, but pretty soon after I was asked to write articles for the *New Scientist*. Eventually a job became vacant there and I got that.

There's a lot of job satisfaction in my work. I really enjoy writing and the physics element is also really important. I think I'm reasonably good at communicating complicated things. Some students have told me they only studied physics because they read my book. So as a writer you can really make a difference. That feels very rewarding.

Highs and lows

I have some real high-points in my job. I was sent to the 2009 Sydney Writers Festival by my publisher, for example. I have also spoken at the Cheltenham, Oxford and Bath Literature Festivals and the Edinburgh Science Festival.

I think the biggest challenge comes from being freelance. I have to have a lot of irons in the fire. Sometimes things dry up and you have to keep thinking, what am I going to do to replace that?

Words of wisdom:

- Persistence is the key. You'll get lots and lots and lots of rejections. The ability to deal with rejection is the most important thing.

- You have to be very imaginative. You've got to make yourself appear different from everybody else. I once sent a publisher a fancy postcard with a packet of chocolate stars asking her to read my manuscript; if you just send someone a standard email, they won't be very impressed.

The Space Sector

The UK may not have much of a reputation for space exploration, but the space sector is a vigorous and growing component of the UK economy, comprising more than 200 companies and directly employing around 24,900 staff.

The sector can be broken down into space science, which includes astronomy, astrophysics and cosmology, space engineering, which involves the design and management of spacecraft and satellites, and space-based applications, which play a huge and growing role in modern life.

Space science aims to broaden our knowledge of the universe. For the most part, it's university-based and highly competitive. It includes pure research into astronomy and astrophysics, space weather science and other disciplines.

Space engineering involves the design, building and operation of vehicles for space exploration, including manned space flight. It's very challenging, high-risk work requiring extreme attention to detail. The major employers are government agencies and big international corporations.

Space-based applications include earth observation and environmental monitoring, which are vital to our understanding of global warming. Satellite navigation and telecommunications applications such as mobile phones, TV and radio are also space-based. The commercial possibilities of space-based applications are enormous and look set to grow substantially in the future.

Entry routes

The space sector is highly international and you should be prepared to work overseas. Language skills are a definite plus.

Starting salaries are around £25,000 to £30,000 for a graduate involved in space engineering but can rise to £80,000 or more. A lot of the work in space engineering is based on short-term contracts, so flexibility is important.

Several major employers run their own graduate programmes, including the European Space Agency and Astrium. Go to **www.esa.int/esaMI/Careers_at_ESA** and **www.astrium.eads.net/en/gdp** for more details.

The UK Space Agency is a good source of further information about the industry. Their website is: **www.bis.gov.uk/ukspaceagency**

"For me space was a childhood passion that ensured that I challenged myself continuously. "

Case Study: Jose Pizarro

Age: 37

Job: Systems Engineer

Employer: European Space Agency

Qualifications: BSc Physics with Astrophysics at Newcastle University; MSc Space System Engineerings, Technical University of Delft

The area that I work in comes under the generic title of System Engineer in the ESA Technical Directorate. I use my physics knowledge to support programmes in manned space flight and robotics, navigation and consultancy.

The job varies a lot. For example, it involves the installation and training of astronaut instructors on simulator equipment, brainstorming with industry, technical reviews of new projects and feasibility studies.

I'm based at ESA's technology Centre ESTEC in the Netherlands. Some weeks I can be in my office reviewing documents or working in the labs. Others I can be out at industry sites working closely with them. But one of the best times is when you get to go to a launch site to see something you've worked on be launched.

I started in the space business writing instrument simulators for the European Southern Observatory. From there I worked in Darmstadt, Germany on a satellite visualisation tool, then to ESTEC in the simulations section.

Soft skills

The way I found my first foothold in the industry was by having a range of other skills that complemented my physics background such as software, languages and people skills. This combination allowed employers to see that I would not be just a one-trick pony.

Even though I did not graduate with the highest of marks it was my adaptability and life skills coupled with my knowledge of physics and optics that ensured that I already had a position and was working at the European Southern Observatory before even graduating.

What held me in good stead was a commitment to continuous professional development, which meant that I was able to achieve Chartered Physicist status after four years' practical industrial experience. Later in my career I was able to complete a Masters at the Technical University of Delft.

For me space was a childhood passion that ensured that I challenged myself continuously. This allowed me to set high goals that at the time did not seem achievable but enabled me to push myself.

Everyday impact

The space industry is a manufacturing and research industry that day-to-day the public does not realise is there. It makes an impact every day on all our lives, from TVs to mobile phones; from the weather forecast to the maps in your car's satnav system.

The next 10 years will see a rapid commercialisation of space, allowing today's graduates to be come the entrepreneurs of tomorrow.

Words of Wisdom:

- Remain adaptable. In the same way that Physics is multifaceted, you should be too.
- For the interesting projects you have to be adaptable and willing to go where the work is.
- Having another language helps even if it only to say thanks for the coffee. It shows your people and team skills in an international environment.

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