The Abdus Salam International Centre for Theoretical Physics
Physics Without Frontiers

United Nations Educational, Scientific and Cultural Organization

IAEA International Atomic Energy Agency

Introduction to Careers and Opportunities in Academia and industry

Dr Kate Shaw

The International Centre for Theoretical Physics (ICTP)

Timetable today

Wednesday, 11 September 2024

11:30 - 12:00 Introduction: Introduction: A reminder to check top right for TimeZone. This timetable is 2:00 pm - 7:30 pm DST (Kabul Time) / 11:30am - 5:00pm CEST (Italian Time)

Convener: Kate Shaw (Ictp)

- 11:30 **Introduction to careers and opportunities in academia and industry** *15'*
  Speaker: Kate Shaw (Ictp)
- 11:45 **The Educational Journey** *15'*
  Speaker: Farsila Payandi

12:00 - 13:00 Careers in Industry

- 12:00 **From Physics to Industry** *20'*
  Speaker: Shakardokht Jafary
- 12:30 **Applications of Physics in the Medical Industry** *20'*
  Speaker: Mohammed Abujami
  Material: Slides
- 12:50 **Skills and Data Science in Industry** *10'*
  Speaker: Kate Shaw (Ictp)

13:00 - 13:30 Study Paths

- 13:00 **My Path to Higher Education in the UK** *15'*
  Speaker: Samiullah Osman
- 13:15 **Studying in the US** *15'*
  Speaker: Śhahir Ahmad Tahiri
  Material: Slides

13:30 - 14:00 Break

13:30 - 14:00 Break

14:00 - 14:25 Student Presentation

- 14:00 **Quantum Machine Learning for Quantum Many-Body Systems** *12'*
  Speaker: Shahzaib Abbas
- 14:12 **Acousto-Optics and its Application in Quantum Circuits** *13'*
  Speaker: Hazrat Shah Rasouli

14:25 - 15:30 Academic Careers and further study

Convener: Sharif Hussainyar

- 14:35 **Navigating Future Pathways** *10'*
  Speaker: Fawad Hassan
- 14:45 **CV and Interview techniques** *15'*
  Speaker: Zainab Nazari (Ictp)
- 15:00 **CERN Summer School Experience** *5'*
  Speaker: Humaira Yaqoti
- 15:05 **Programmes at the Perimeter Institute** *20'*
  Speaker: Dan Wohns
- 15:25 **Close and Certificates** *5'*
  Material: Evaluation Form

What skills do physics students have?

What training and skills, and professional development should you develop?

What opportunities can you look for

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IOP Career Guide

Career development

16 key skills and attributes for a successful career in physics

Carol Davenport explains why soft skills are as essential as technical knowhow when it comes to a successful career in physics

iStock/Wakar Sokerver

Applying for a job, a placement or an internship can be a challenging and stressful task. Even if you're successful, you'll still have to face an interview, where a potential employer will hope to quickly appraise your talents and abilities. Of course, your technical prowess is indispensable, but you'll need much more than scientific knowledge to secure the position.

That's because today's employers are looking for a host of additional skills to determine how you will fit into their workplace. From being able to manage your time and sort out conflict to knowing how to communicate, these so-called "soft skills" are as important as your subject-specific knowledge that you developed during your degree.

The "hard" skills you gained while studying – whether it's knowing how to solve a differential equation or line up mirrors on an optics bench – are easy to provide evidence for, from the modules you took or the lab work you did. But the other more nuanced and practical skills – such as presenting in front of your peers, writing reports or keeping to deadlines – are just as crucial. After all, they show how you work with others, how you communicate and how you organize yourself.

Developing and understanding how your practical experiences have already led you to build these skills is an important step in your career planning and job hunting. Despite being categorized as "hard" or "soft", both of these skill sets are invaluable when it comes to your employability. If you've worked part-time in the hospitality industry, for example, and had to communicate effectively with an irate customer, you'll know that it definitely isn't easy to use soft skills.

And just in case you don't believe that soft skills are really that important for a career in physics, just look at a recent job advert for an applied laser physicist at the UK defence company AWE that I spotted on *Physics World Jobs*. The company said it was looking for candidates to have the following attributes, where the first three are hard skills and the last two are soft skills:

- A degree in physics
- Some experience of working with lasers or optics in an undergraduate laboratory setting would be advantageous
- Experience conducting empirical scientific research and drawing sound conclusions
- Ability to plan and manage the delivery of own work
- Ability to work as part of a team with a range of stakeholders

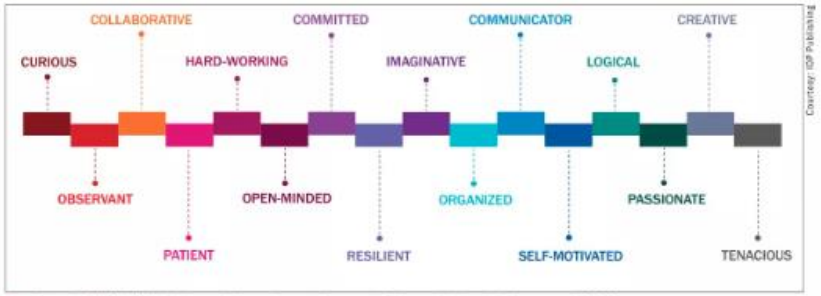
As a former physics teacher and now director of NUSTEM, an outreach and research group at Northumbria University in the UK, I regularly help schools showcase careers in science, technology, engineering and mathematics (STEM) subjects to young people. We often talk about soft skills that people who work in STEM require. And as a recent student or graduate, you should think about which of these skills you may already have developed. You might surprise yourself. At Northumbria, for example, we feature a "STEM Person of the Week" – a short profile that showcases three attributes that are important to that person's success in their job. These profiles, we hope, will help students to identify where they might have demonstrated such qualities themselves.

To further support our work at NUSTEM, we recently undertook a research project to look into the skills and attributes that people who work in STEM have. We already had a list of 16 skills (see graphic, top right), that we developed using previous research into employability skills and in collaboration with teachers and the Institute of Physics, but we wanted to find out what qualities STEM professionals would think were important, and if they matched the ones we used.

Using an online survey, we asked more than 200 STEM professionals from across the UK – including physicists, engineers, data scientists and technicians – to note six key attributes that they felt were essential to being successful in their job. We then looked at all of the terms and grouped them into broader categories. The table below shows the attributes given by at least 30% of the STEM professionals.

Looking at these nine attributes, there are just two that could actually be categorized as hard skills: logical and domain-specific knowledge. All of the rest are soft skills. When looking more broadly, our analysis identified 19 attributes in total: 13 are soft skills, four are hard skills and two are a combination of both.

These attributes are ones that STEM professionals think help make them successful in their jobs, which brings us back to job applications. Imagine you've applied for the laser physicist role mentioned earlier and got an interview. You may be asked something like "Can you give me an example of a project or situation where you've had to work as part of a team, and how did you contribute to the effectiveness of the team?" Well, if you've collaborated on a group project then that shows teamwork, and if you've already reflected on those attributes, you'll be able to answer the question more easily and in detail.



Courtesy IOP Publishing

The chosen 16 NUSTEM picked these skills as the most important for those looking to build a career in STEM.

Nine attributes

Attribute	Examples of terms used by STEM professionals for this attribute	% of STEM professionals with this attribute
open-minded	adaptable, embrace change, healthy level of scepticism	48
communicator	diplomatic, good writer, deliver clear presentations	46
logical	critical thinker, analytical, can improve processes	37
domain-specific knowledge	numerate, safety conscious, know the subject	35
curious	ask questions, interest in learning, try new things	33
creative	innovative, inventive, resourceful	33
good colleague	fair, friendly, get on with people	32
resilient	learn from mistakes, don't give up, problem solver	32
collaborative	team player, learn from and with others, supportive	30

Adapted from Davenport *et al.* (2022) FIE 2022 (accepted for publication)

Case studies

Recently, I asked two physics students to look at the original 16 NUSTEM attributes and consider which three they thought they had developed most during their degrees so far.

Bethany Willis – who has completed a BSc (Hons) in physics at Northumbria University and is now doing a PhD in product-integrated photovoltaics – chose:

- *Committed* A degree is a long-term commitment and parts of it are long, hard, boring or difficult. You need to be motivated and try your hardest to get the best out of your education and you sometimes end up enjoying the things you didn't previously like.
- *Tenacious* Physics can be complicated at first and being tenacious means you are able to overcome any challenges that come your way. This could be problem-solving or even working on a longer project.
- *Communicator* In physics it is important to share your ideas and inspire others. This is why being a good communicator is important – particularly for tutoring other students or doing outreach and motivational presentations in public.

Rosie Wainwright – a 3rd year BSc (Hons) student in physics with astrophysics at Northumbria University – chose different attributes:

- *Passionate* I would say that my passion

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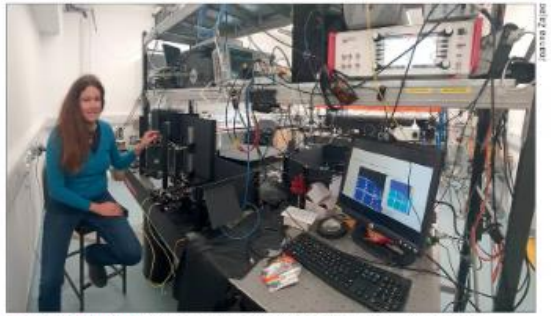
IOP Career Guide

Industry or academia? How to choose your path

After doing a PhD and postdoc in quantum technology in the UK, **Joanna Zajac** spent three years in industry before returning to fundamental research. She now works as a quantum scientist at Brookhaven National Laboratory in the US. So how do academia and industry differ and which one is right for you?



Academic endeavours While at the University of Oxford, Joanna Zajac developed a low-temperature confocal imaging system.

The fundamental conundrum for junior scientists after graduating is whether to move into industry or continue in academia. I have worked on both sides of this divide. After completing my Master's degree in physics at Southampton University, I went to Cardiff University to do a PhD on novel types of vertical-cavity surface-emitting lasers. I then did a postdoc at Heriot-Watt University in Edinburgh, and at the University of St Andrews, where I worked on single-photon laser diodes and how they can be applied to quantum information technologies.

In 2017 I switched to industry and became a quantitative analyst at Moody's Analytics, a financial-services and risk-assessment company that does research and creates tools for corporate clients. While there, I used my strong mathematical and programming skills to do research in applied finance. After working in industry for three years, I then went back to fundamental science, becoming a senior researcher in quantum computing at the University of Oxford. Last year I moved to Brookhaven National Laboratory in the US, where I currently work as a quantum scientist.

So what are the main differences between academia and industry? In my experience they centre on four major aspects of working life: preferred working style, management, balance between work and family life, and the actual tasks involved in a job. Any career decision is ultimately your own, but I hope my perspective helps you to make a well-informed choice for your career.

Individual or teamwork?

If you are more team-oriented, industry might be a better choice for you. It depends on the company culture, but in industry you are likely to be part of a team collaborating on a project. If you are involved in interdisciplinary projects, as I was, you will be working with colleagues who have expertise in a broad range of areas.

During my time in finance, it was a bare-minimum requirement to have an economist, a physicist and programmers on a team when tackling complex problems in modelling financial markets. A huge benefit for me was that I learned from all these professionals with different backgrounds, who each brought unique skills to the table. For instance, I learned how to do risk modelling while working in teams like this.

In academia, in contrast, group dynamics vary depending on the principal investigator, but in physics and maths there is usually a strong emphasis on individual work. This means you are driving your own research, hopefully given the space and resources you need to grow. I did my PhD and postdoc very much independently and my achievements reflect my determination and hard work. However, this emphasis on individual work creates a highly competitive environment, which I do not think is beneficial for the development of young researchers.

I feel that close collaborations and interactions with colleagues are hugely beneficial, especially during the early stages of your career. That's when it's important to learn not only practical knowledge but also soft skills like communication and management. Consequently, the higher level of guidance and feedback that you get in industry makes it easier for you to learn and improve on the job.

The main differences between academia and industry include preferred working style, management, balance between work and family, and the actual tasks involved in the job

Management

Another feature of industry is that there is more structure and risk mitigation, with product managers ensuring that solutions are delivered to clients on schedule. In my case, I was responsible for developing and implementing financial modelling tools, among other tasks. My projects had specific resources assigned to them and concrete deadlines that needed to be met. Although the work was clearly structured, it was not always easy, and there were times when extended team efforts were required.

Working in academia tends to be much more *ad-hoc*, with flexibility to choose what you work on and when. This arrangement can be great, especially for people with strong focus and time-management skills, and it suits me. However, it might not be ideal for everyone, and it takes time to adapt. You might find yourself overwhelmed by passing time with scarce results.

Although some risks are considered and mitigation measures taken in academic research, this is not done as rigorously as in industry. The chances of bottlenecks, especially for collaborative projects, are therefore higher in academia.

Balance of work and family life

One big benefit of industry is that the working environment is more accommodating for employees with families than it is in academia. With companies offering generous benefits to attract top talent, it is easier to find the stability and resources required to support family life. There also tends to be more social interaction with colleagues from various backgrounds who often happily share their own experiences and advice. More generally, there is usually much more going on outside of work too, such as charity events or after-work get-togethers, all of which contribute to a healthy work environment.

Academia lags behind when it comes to supporting employees with families. There are various initiatives aiming to address this. Athena Swan, for example, is a charter and accreditation scheme that makes recommendations on how academic departments can improve gender equality and gives awards to recognize and encourage efforts in this area.

I was a member of the Athena Swan committee at both Heriot-Watt and Oxford, and our efforts were aimed at introducing more benefits for working parents, such as adopting shared parental leave. However, in my opinion, these initiatives do not reach far enough and are slow to keep up with evolving needs.

This is especially visible in science, technology, engineering and maths (STEM) departments where it is very rare to hear of a colleague taking maternity leave. I believe that the limited support available for parents and the prevalence of short-term contracts in academia contribute to the low retention rate of female academics in STEM fields.

Tasks involved

The final major point to consider when deciding whether to move into industry or stay in academia is the actual work you will be doing. Industry is product-oriented, so you will see your idea develop from the whiteboard through to implementation, and even receive feedback from users. While working at Moody's Analytics, for example, I was involved in projects developing client-oriented software solutions for use by financial institutions. My colleagues and I did write reports and papers about our research, just as we would in academia, but these documents were for internal purposes only to protect the company's intellectual property.

This product-development cycle is rarely present in academia, where the projects are usually on prototype-stage ideas or even completely blue-skies research. The focus on very detailed tasks can certainly be intellectually stimulating, but it can also leave you longing to work on something more applied and immediately useful. Having said that, current graduates have much broader career options compared with what was available to me and my peers when I graduated almost 15 years ago. This is because quantum research has become much more mature and product-driven in recent years.

In the end, the choice of which path to take depends on what type of work and professional environment you will personally find satisfying. What is most important is that you make yourself aware of these differences, so you can find a job and workplace that is right for you.

Joanna Zajac is a quantum scientist at Brookhaven National Laboratory, US

Today

This is an interactive day!

- Please we want to hear your voice
- We want to get your ideas and feedback