

Where Do Physics Doctoral Graduates Go?

SEPnet PGR Destination and Placement Report

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Where Do Physics Doctoral Graduates Go? – SEPnet PGR Destination and Placement Report 2016

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Background

Academic research is only one of the many options open to physics doctoral graduates. Businesses face increasing STEM skill shortages and physicists have much to offer in terms of technical knowledge and skills which can benefit both research and industry.

Vitae’s most recent report on destinations of PhD graduates ‘What Do Researchers Do’, revealed that 70% of physical sciences and engineering doctoral holders are working outside higher education (HE) three and a half years after graduating. Destinations include health, business, finance, consultancy, engineering, sales & marketing in roles such as actuarial trainee, credit risk analyst, patent examiner, global energy manager, statistician and aerodynamics engineer.

Destination data about alumni can play an important role in raising awareness of potential job roles and relevant organisations by highlighting the career routes of recent doctoral graduates. Alumni role models, with whom PhD students identify, can provide effective case studies and offer tips and valuable careers information.

The South East Physics Network (SEPnet) aims to create a pipeline of physics doctoral graduates with the employability skills and attributes needed to make a valuable contribution to both research and business. SEPnet’s graduate network (GRADnet) offers physics postgraduate researcher students (PGRs) an insight into careers beyond academia through a programme of professional development training designed to reach a diverse group of students with industry-led business challenges, industry placements, mentoring and employer networking events.

Since many PhD graduates are likely to pursue roles outside academia, raising awareness of career opportunities through a range of initiatives is key to ensuring that as many as possible achieve their potential and organisations and the economy benefits from reaching this wider talent pool of STEM graduates.

SEPnet collated destination data

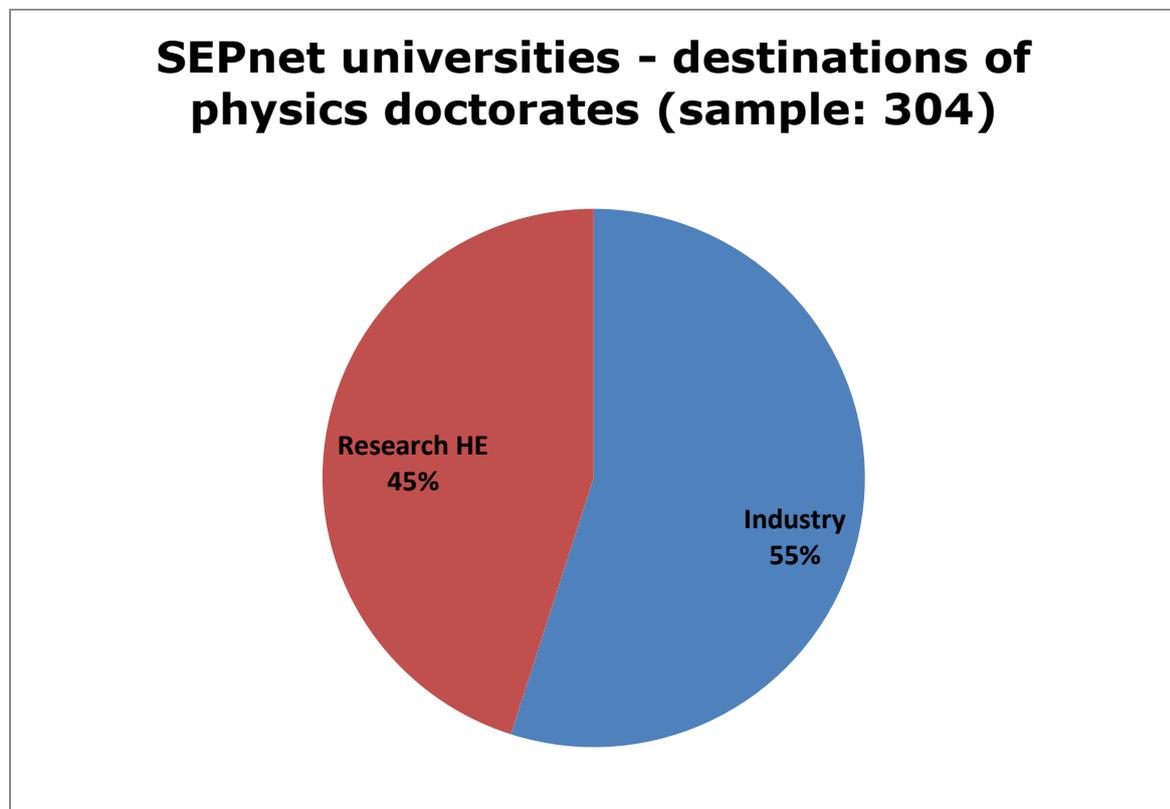
The data for this report was collected from each SEPnet partner for physics PhD students graduating between 2011 and 2015. Collection by universities of

destination data for doctoral graduates is not mandatory so information is often incomplete and inconsistent and this data includes self-declared first destination information provided by departmental supervisors and administrators as well current roles identified via LinkedIn. The data does not include information about the number of doctoral graduates who are unemployed. However, despite these problems, this information, collated for the 9 SEPnet partner universities, can offer a valuable source of career ideas and potential employers for current students.

Destinations for 304 doctorate graduates were identified and divided into two sectors: academic research (within higher education) and non-academic sectors. Non-academic sectors were pre-defined using categories identified mainly based on company website definitions and are inevitably broad with some overlap. They comprise business & technology; defence; education & science communication; energy; engineering & manufacturing, finance, government, law, research organisations and 'other'. Overseas destinations are included (approximately 22) since some companies are global, job roles are similar and a number of PhD graduates are likely to work overseas.

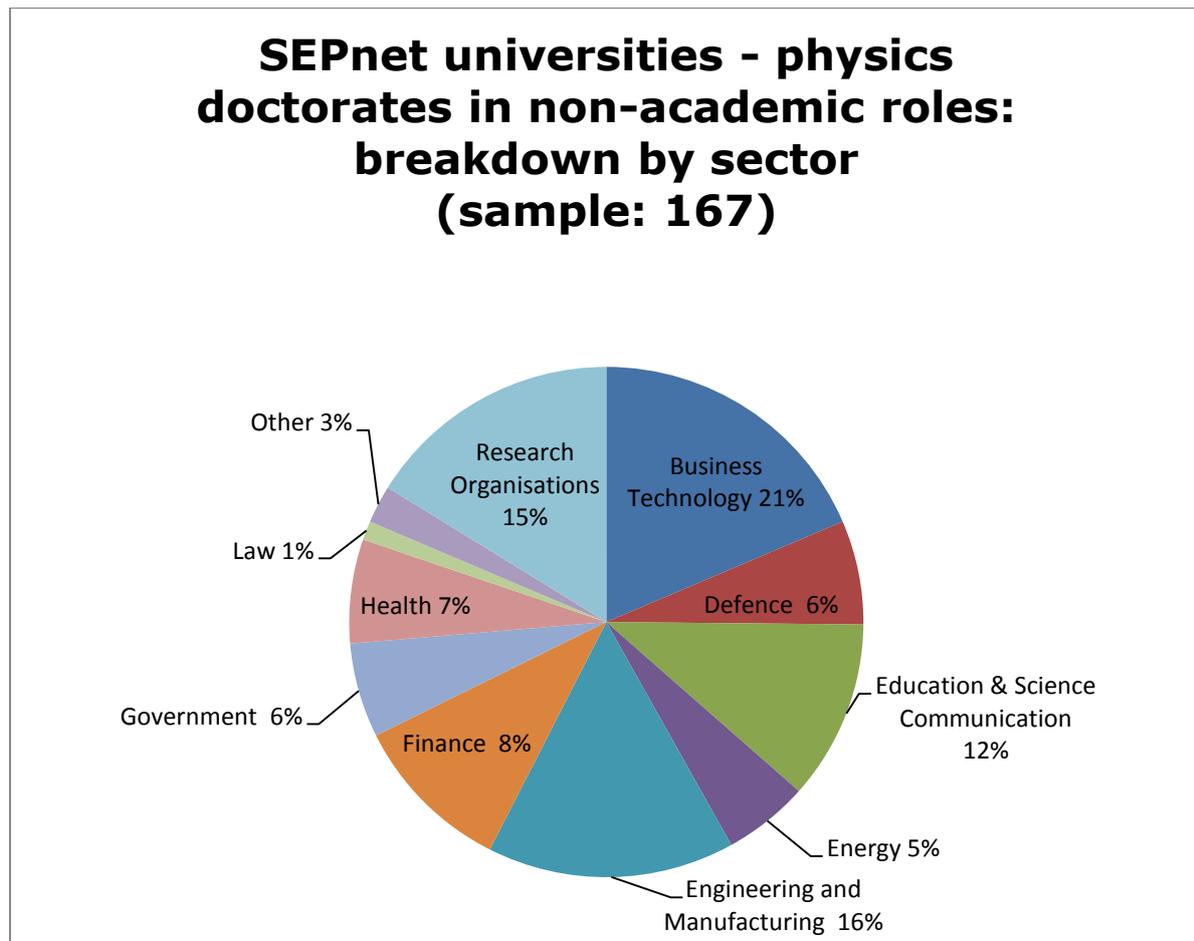
Pie chart 1 below shows the split between those in academic (45%) and non-academic sectors (55%). This data includes PhD graduates' first destinations and already shows a higher percentage in non-academic roles which supports other research findings. Over 60% of those in HE research are described as post-doctoral researchers and are likely to be in short-term roles. Since the data includes first destinations and the majority of roles are short-term, the percentage in HE research is predicted to reduce still further over time.

Pie chart 1



Pie chart 2 (below) shows the breakdown by sector for the 167 PhD graduates in non-academic roles. The largest sector is business & technology (21%). This includes start-ups, technology, IT, gaming companies and consultancies. The roles identified in these companies are principally in data research and analysis (eg Intel, We Predict, SCL Elections) and in software engineering. Less predictable destinations include Paddy Power Betfair, Transport for London and TUI Group.

Pie chart 2



The 2nd largest sector is engineering & manufacturing (16%). This includes food retailers/manufacturing (Sainsbury's, Just Eat, Baxters), advanced manufacturing SMEs (Oxford Lasers, M Squared Lasers, SureFlap) and global engineering companies (Siemens, Rolls Royce). Roles are mainly in research & development engineering. The manufacturing industry struggles to recruit skilled graduates and there are increased opportunities for doctoral graduates to apply their technical knowledge within SMEs in particular.

Research organisations is the 3rd largest category (15%) and includes Rutherford Appleton Laboratory and a number of overseas institutions. The role is predominantly that of research scientist. One might expect the number in this group to be higher. However, the lower percentage could suggest that, by the time doctoral graduates decide to leave academia, many are actively seeking a non-research role or working environment.

12% of the sample are in education & science communication of whom 7 are identified as teachers. Other roles in this sector included outreach officers and tutors. There is a shortage of physics teachers and, while high-profile campaigns with financial incentives aim to attract STEM graduates into the profession, more still needs to be done to attract physicists into teaching.

Finance (banks and accountancy) while not represented by large numbers of doctoral graduates in this sample (8%), does reveal physics PhD graduates working for major players such as Santander, Lloyds and Bank of England. The PhD graduates working in KPMG and Deloitte are analysts or consultants. The main roles identified are data analyst and quantitative researcher. The finance sector, in particular, is keen to attract more physicists and physics PhD students are often not aware that their skills are highly valued in backroom quant roles.

Roles where doctoral graduates are most likely to make direct use of their PhD are within the health sector where 7% are medical physicists or radiotherapists. The defence sector (6%) includes AWE and BAE Systems with PhD graduates working in research scientist or technical consultant roles. Organisations in this sector are keen to attract physics PhD graduates but their strict security clearance regulations limit the opportunities available. 5% of our sample work in the energy sector as energy analysts or research scientists and one would expect to see increased opportunities for physicists within nuclear and renewable energy fields.

Government accounts for 6% of the sample with PhD graduates mainly working as statistical officers. Our 3% in the 'other' category include two photographers, a film maker and a care home manager. Finally, only 1% of the sample are in the legal sector working as intellectual property experts. PhD graduates with technical knowledge are highly sought after for IP consultancy roles and the low number possibly reflects a continued lack of awareness that physicists can apply their scientific knowledge and skills in this field.

While the range of sectors that our PhD graduates work in is diverse, the job roles are less so. It is encouraging to note that 97% of our sample are in technical roles and making direct use of their knowledge and skills.

Organisations and roles

The variety of organisations where doctorates told us they worked is captured in word cloud 1 on the next page. Prominence is given to those mentioned more than once. The 2nd word cloud captures the job roles that were identified with more prominence given to more frequently cited roles.

PhD Subject and Job Role

Previous feedback from current students indicated that they were keen to know the research areas of previous PhD graduates as a way of identifying which roles might be more relevant to them. While some research areas are directly relevant, many are not which illustrates that physicists' skills are generally valued more by employers than their specific knowledge. Examples of different research fields that alumni pursued, their job roles and organisations are listed in the table below.

Table 1

PhD Subject	Job Role	Organisation
Theoretical Nuclear Physics	Licence Audit Analyst	KPMG
Nuclear and Radiation Physics	Senior Scientist and Research Collaborations Manager	Siemens Healthcare
Astronomy	Project Consultant	SunGard (financial software)
Quantum Physics	Technologist - Emerging Technologies & Industries	Innovate UK
Particle Physics	Senior Consultant	Customer Systems PLC (IT consultants)
String Theory	Core Full-Stack Software Engineer	YouView TV Limited
Condensed Matter and Materials Physics	Senior Quant	Royal Bank of Scotland
Cosmology	Data Scientist	Transport For London
Theoretical Physics	Senior Energy Analyst	National Grid
Astrophysics	Change Management Analyst	Santander Bank
Particle Physics	Patent Attorney	Withers and Rogers
Theoretical High Energy Physics	Associate	Bank of England
Condensed Matter and Materials Physics	Photovoltaic Project Manager	Goldwind (renewable energy)
Experimental Physics	Data Analyst	Harwin (electronics manufacturer)
Experimental Physics	R&D Engineer	SureFlap (start-up)

Alumni case studies

Alumni are important as role models and help raise awareness of the routes into different roles. Their own career journeys can be inspiring and offer valuable insights. Read about the careers of two SEPnet alumni below.

Intellectual Property and Contract Governance Rosh Sellaheewa, KPMG

Rosh works for KPMG and is based in London in the Intellectual Property and Contract Governance team. He supplies data storage to technology companies and uses KPMG to piece together sales data and data storage needs to ensure clients are charged correctly for data storage usage.

The role requires problem solving, process mapping and using database applications such as SAP. KPMG values scientists for their objectivity and ability to see data for what it is.

Prior to KPMG, after his PhD in theoretical nuclear physics at Surrey, Rosh worked for 6 months with Actica Consulting, a business and technical consultancy.

'You can still enjoy a job role even if it's not in science! Your first role invariably won't be the last one and employers won't be phased if you move relatively quickly if you know it's not for you.'

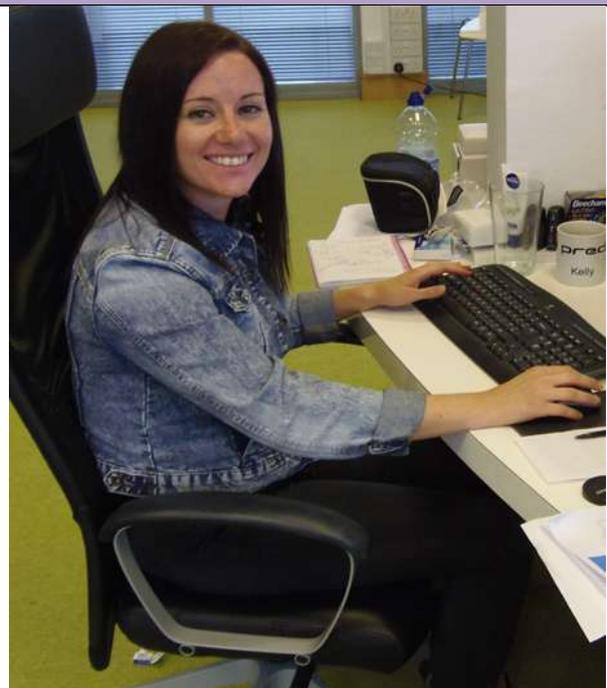


Developing Database Prediction Models Kelly Nock, We Predict

'We Predict' are global leaders in predictive analytics working across sectors including automotive and health, the company provides a predictive analytical service on customers' data sets.

Kelly's research at Portsmouth's ICG involved the examination of data from large scale sky surveys and simulations to developing and optimising galaxy clustering analysis techniques for use in future surveys, such as the Dark Energy Survey. At We Predict Kelly uses the skills developed during her PhD to design and develop descriptive and predictive models using customers' data.

'Working in cosmology developed my innovative thinking and analytical approaches to data. The core skills I developed during my PhD are now directly applicable to my role as a Data Scientist.'



Placements and consultancy

Whether students intend to pursue a career in academia or business, placements and consultancy projects offer opportunities to:

- develop and apply their professional and technical skills and knowledge;
- learn new skills e.g. software programming, business awareness, knowledge exchange;
- improve project management, presentation and communication skills;
- enhance their research through wider commercial experience;
- find out about career opportunities, develop entrepreneurship, networking experience and business contacts.

SEPnet organises short paid placements and consultancy projects for physics PGRs with a range of organisations. These can be taken up at any time during the PhD student's research with their supervisor's permission. However, some students prefer to wait until they have written up their thesis and are looking for a job before applying for a placement.

12 placements or consultancy projects have taken place to date, predominantly with SMEs, and are shown in the table below. All students have benefited from the experience with some placements being extended or leading to offers of job roles. Students' case studies describe their placement role and what they gained from the experience. See extracts of 3 placement case studies over the page.

Company	Type	Description of project
Adaptix	5 month placement	Quantification of imaging power of a novel medical imaging system
Adaptix	3 month placement	Study and characterisation of field-enhancing coatings for field emitters for use in x-ray production and medical imaging
Chomko & Rosier	Group consultancy project	Relative Clocks - Data Creation
Crowd Connected	Job role	Data Scientist
Lumie	3 month placement	LabVIEW optical test platform
Keit Spectrometers	2 month part-time placement	Infra-red emitter characterisation and ageing study
Network Rail	3 month placement	Development of overhead line electrification engineering design tools
National Physical Laboratory	3 month part-time placement	Control Software for Quantum Voltage Digitiser
Snapout	2 month placement	Research and Development
Tranquility Aerospace	3 x 3 month placements	'Devon One' rocket code design and assembly avionics, flow analysis on air braking and fluid systems, pumping systems investigation

THE VALUE OF WORK EXPERIENCE



Student: Zena Patel, University of Surrey

Company: Adaptix

Placement project: Quantification of the imaging power of a novel medical imaging system

'I feel I have gained more knowledge about how a company works in all aspects, and it has made me think about the type of company I want to work for, not just the job.'



Student: Jonathan Keelan, The Open University

Company: Network Rail

Placement project: Development of overhead line electrification engineering design tools

'Coming towards the end of my PhD, there seemed like a large gap in my knowledge of the available options, and an industry placement seemed like the perfect opportunity to help inform any future decisions.'



Student: Yusuf Abubakar, University of Surrey

Company: National Physical Laboratory

Placement project: Control Software for Quantum Voltage Digitiser

'If you are interested in doing a placement, go for it. You cannot be sure which type of working environment will suit you without giving it a try.'

Conclusion

Since academic research is only one option for doctoral graduates, it is important that PhD students are made aware of the range of career roles and job opportunities available to them outside academia. The findings from this report show that of 304 SEPnet physics doctorates completing their PhDs between 2011 and 2015, 167 (55%) are in non-academic roles and this number is likely to increase over time.

Destination data for physics doctoral graduates, and alumni in particular, is a valuable source of information for current PhD students to illustrate where their PhD might lead them. Although the data SEPnet has collated is incomplete, it helps to paint a picture of where physics PhD graduates go. Analysis of the data shows that physics PhD graduates are working across a number of sectors with one fifth working in business & technology. It is encouraging to note that 97% are making use of their physics knowledge and skills working in technical roles as data analysts, research scientists and engineers.

As business and industry face increasing STEM skills shortages, it is important that physics PhD students are made aware of how they can apply their technical knowledge and skills in a range of settings to help address these shortages. PhD students need to be exposed to potential employers through alumni case studies, networking events, employer talks and visits as well as being offered an opportunity to gain work experience and develop employability skills during their research so that they are in a position to make successful, well informed career choices when they complete their PhD.

Visit <http://www.sepnet.ac.uk/sepnet-graduate-network/case-studies/> for more information or contact:

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