

WHITE ROSE INDUSTRIAL PHYSICS ACADEMY (WRIPA)

Cross institutional collaboration supporting physics
graduates into technical careers



DR ANDREW MIZUMORI HIRST
White Rose Industrial Physics Academy



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CONTRIBUTORS

**ANDREW
MIZUMORI HIRST**

andrew.hirst@york.ac.uk

THOMAS KRAUSS

thomas.krauss@york.ac.uk

BETH MEDLEY

beth.medley@york.ac.uk

SOPHIE PACKMAN

sophie.packman@york.ac.uk

DAVID MOWBRAY

d.mowbray@sheffield.ac.uk

ALASTAIR BUCKLEY

alastair.buckley@sheffield.ac.uk

ANNE BOOTH

anne.booth@sheffield.ac.uk

SAMANTHA PUGH

S.L.Pugh@leeds.ac.uk

ALISON VOICE

A.M.Voice@leeds.ac.uk

SIDDEEQUAH AZMI

S.M.Azmi@leeds.ac.uk

RICHARD CAMPION

Richard.Campion@nottingham.ac.uk

SERGEI ZARKOV

S.Zharkov@hull.ac.uk

EMANUELE VERRELLI

E.Verrelli@hull.ac.uk

OLGA FERNHOLZ

Olga.Fernholz@nottingham.ac.uk



SUMMARY

The White Rose Industrial Physics Academy (WRIPA) is a joint collaboration between HEI Physics departments in the North of England and businesses. It was created to provide physics students with the opportunity to gain graduate attributes and work experience that better prepare them for graduate-level technical employment. The primary objective is to increase the number of physics graduates that pursue technical careers. This objective is realised by incorporating real-life learning within the curriculum that emphasises both factual knowledge and the application of that knowledge. The Academy developed a diverse range of interventions to embed work-based learning, professional skills development, and employer delivery into the curriculum. In total, from Sept 2019 – Dec 2022, the project engaged with 956 businesses and supported 238 students to participate in some form of work experience, with emerging graduate destinations data showing that WRIPA interventions have successfully supported students into graduate-level technical work.

WRIPA also increases the profile of technical industries through employer events and offers (digital) careers support to students. Analysis of the digital career support showed that it was well used across the WRIPA universities (62% student engagement) and was positively evaluated by students. In addition, website analysis has shown that students from non-WRIPA universities are use the digital career support provided by WRIPA.

CONTEXT

Within the Yorkshire, Humberside and East Midlands (YH+EM) economic region sits the White Rose Industrial Physics Academy (WRIPA). Inaugurated in 2014 and supported by HEFCE Catalyst funding, WRIPA is a 10-year collaboration between business and the university physics departments of Hull, Leeds, Nottingham, Sheffield, and York. WRIPA's aim is to provide physics students with the opportunity to gain skills, knowledge and work experience that will better prepare them for graduate-level technical employment, irrespective of where they choose to work. The outcome will be an increased and more relevantly trained flow of graduates into technical careers. This ambition is delivered through physics-contextualised activities based on curriculum development, improved undergraduate laboratories, careers support and the organisation of employer recruitment events. More recently, WRIPA has been awarded funding from the Office for Students' Challenge Competition to improve links between physics departments and regional employers, develop inclusive modes of work-based learning and support physics students to be more work mobile.

RATONALE

Physics-based technical industries contribute significantly to wealth creation in the UK and Ireland. It is estimated that physics-based businesses directly contribute 8.5% of the UK's economic output, more than £77bn per year¹. Including indirect spending, the total impact of physics-based businesses on the UK economy is more than £220bn. A recent report concluded there were 1.85 million jobs in physics-demanding occupations across UK and Ireland in 2020, with the number growing over the past decade². Despite such impressive statistics, employers find it difficult to recruit sufficient numbers of suitably qualified physics graduates and in parallel, students are often not aware of the range of physics employment opportunities available, or they lack the essential skills for entering these technical careers³. At the same time, undergraduate students are becoming much more aware of employability issues and seek exposure to industry as part of their degrees. However, there remain several significant challenges in connecting physics students to highly skilled (regional) employment opportunities, including:

- physics students connect poorly with central careers services
- physics students tend not to look broadly outside of academia when looking for a career
- physics students are often unaware of the regional employment opportunities that are available
- physics students disproportionately engage with large companies via institutional recruitment fairs and are not aware of the opportunities offered by SMEs where a high proportion of high value and technical (regional) employment exist

METHODOLOGY AND IMPLEMENTATION

To address these issues, WRIPA has developed a range of interventions that embed work-based learning, professional skills development and employer delivery into the physics curriculum. WRIPA also delivers extra-curricular support through careers support, the organisation of recruitment events and site visits, and digital career planning tools. Examples of WRIPA interventions are outlined below:

1. Curricular

1.1 Industrial projects that use technical businesses as clients: All 'WRIPA university physics departments' now run final year industrial projects for their students. The research project is provided by the industry partner in collaboration with an academic with relevant expertise. Participating students or groups of students then have the opportunity to apply their academic knowledge to address a technical business problem set by the employer.

1.2 Year in industry placements: All 'WRIPA physics departments' now offer year in industry programmes. Nottingham, Sheffield and York have direct UCAS entry to the year in industry variants of the degree programme. Leeds and Hull physicists internally transfer onto the year in industry programme once they commence their studies.

1.3 Work placement modules: The School of Physics & Astronomy, University of Leeds is now running a level 2 “Professional Experience” teaching and learning module, entitled: Physics into Work. As part of this 15-credit module undergraduate physics students complete 25-30 hours of work with a regional employer. Assessment is by poster presentation, reflective log, and employer evaluation.

1.4. Embedded technical employer input and development of graduate skills:

1.4.1 School of Physics, Engineering and Technology, University of York has embedded alumni businesses into three credited modules (Experimental Techniques, Medical Physics and Professional Skills). For the academic year 2022/23 four modules will have embedded delivery by alumni businesses. The additional credited module will be High Performance Computing. Alumni give presentations on how their current role and organisation relates to the specific module.

1.4.2 School of Physics & Astronomy, University of Nottingham has updated an existing physics communication skills (i.e., scientific writing and oral presentations) module and redesigned how communication skills are taught and assessed. For example, students are: (a) assessed on how well students communicate scientific ideas to a general audience, not the quality of the scientific material per se and (b) taught particular stylistic and rhetorical devices to construct an argument or discussion points.

1.4.3 School of Physics & Astronomy, University of Leeds have embedded a careers component into three year 2 and year 3 credited modules (Experimental Physics, Communicating Physics and Professional Skills). The embedded careers-related component enables students to create an employability action plan aimed at developing skills, work experience and knowledge based on SMART objectives.

1.4.4 School of Physics & Astronomy, University of Sheffield have embedded reflective practice and careers sessions alongside the taught curriculum. For example, a level two core 70 credits module (Classical and Quantum Physics PHY21005/6) has an employer/student networking event in Semester 1 along with employer talks. A novel aspect of this new module is a portfolio, which students must complete to pass the module. The portfolio has four components:

1. Physics and Maths Knowledge – students must complete and pass a minimum of 7 out of 9 pieces of homework. A failed piece of homework can be converted to a pass via a suitable reflection in their portfolio, hence students must act on the feedback received.
2. Scientific Investigation – students produce a poster or a project report. They also must describe one ethical consideration relevant to their lab work.
3. Personal and Employability Skills – students must evidence how they have engaged with various university resources related to employability and personal skills development. This component incentivises students to engage with extracurricular employability events, such as the annual WRIPA Physics careers’ fair.
4. Final Reflections, Group Working and Actions on Feedback – students must evidence their contribution to group work, discuss what feedback they have provided to their peers and how they have acted on feedback.

1.4.5 School of Natural Sciences, University of Hull have integrated skills training into Experimental Physics and Mathematics II & III (labs) modules. This enables students to reflect on the technical skills they have learnt and how these skills 'fit' into the graduate labour market. In addition, local employer delivery has been embedded into a level four Data Science Year 4 module.

2. Extracurricular

2.1 WRIPA website and embedded digital careers planning tools: Students are increasingly interested to hear about businesses beyond their corporate messages (eg the organisations ethics, work/life balance). WRIPA has developed a series of digital tools and resources to enable physics students to make better-informed career choices and connect with (regional) employers. These digital career resources are embedded within the WRIPA website and are also used in employability workshops, credited professional skills modules and 1-to-1 careers meetings with students. Two interactive digital tools are highlighted below:

1. The Physics Careers Discovery Tool: This tool is aimed at students with 'low career readiness'. Often students with 'low career readiness' need a 'foundational' starting point to understand how the physics degree fits into graduate labour markets. By answering three simple questions (e.g What's your ideal work environment?) the users are presented with job role 'matches' (eg geophysicists), which give information on what the role is about, skills valued by employers and links to job vacancies and professional institutes.
2. The Physics Case Studies Tool: Based on student and physics alumni interviews, the tool enables users to access 76 cases studies based on search terms including 'experience type', 'region of work', as well as connecting with (regional) alumni businesses via LinkedIn.

2.2 WRIPA Physics Industry and Placement Fair: Since 2014, the WRIPA fair has been a huge opportunity for businesses to engage with a larger and more diverse talent pool of regional physicists drawn from eleven university physics departments from across the Midlands and the North. Typically, there are organised coaches from the 'non-WRIPA' university physics departments: (a) Loughborough; (b) Newcastle; (c) Keele and (d) Lancaster. The 2022 fair has evolved to become a hybrid event consisting of 'face-to-face' (e.g. employer exhibitor stands) and virtual (e.g. sector-specific panel discussions) elements. The fair also utilised 'Career Fair Plus' – an App to facilitate more meaningful and equitable student-employer engagement. The App helps students' confidence by providing pre-event information, including employer profiles, interactive floor plans and a schedule of presentations and panel discussions. A hybrid event enables us to address the various business needs with "strong brand" technical employers keen to retain digital engagement whilst less well-known and often local employers prefer face-to-face interaction with students. The 2022 fair was attended by 43 employers and 1100 UG/PG students. Of the 43 employers, at the 2022 event, 28 were based in the North of England giving the event a regional focus.

2.3 Site Visits: WRIPA has organised site visits to a wide variety of employers, including: (a) EDF Energy, Hartlepool; (b) Rolls Royce, Derby; (c) Castle Hill NHS Hospital, Hull; and (d) MBDA Systems, Stevenage.



ANALYSIS AND EVALUATION

1. Quantitative analysis

Tables 1-4 below show the level of engagement of both students and employers in the WRIPA initiatives. Table 3 additionally illustrates the subsequent graduate employment levels of students. Table 4 shows the extent of digital engagement with the WRIPA website

Table 1: Numbers of students and employers involved in project activities (Sept 2019 – Dec 2022)

STUDENTS		EMPLOYERS	
How many (individual) students were involved in the various curricular activities which were run as a result of this funding?	~1503	How many (individual) employers were involved in the design and delivery of curricular activities run as a result of this funding?	100 (28) – parenthesis indicates regional employers
How many (individual) students were involved in the various extra-curricular activities which were run as a result of this funding?	~9172 (this includes 6.4K users to the WRIPA website)	How many (individual) employers were involved in the various extra-curricular activities run as a result of this funding?	202 (79) – parenthesis indicates regional employers

Table 2: Students’ engagement with local employment opportunities, and employers’ engagement with WRIPA

Student Engagement	
How many students are now undertaking placements, years in industry, or internships during their degree?	238. Additionally at least 26 students participated in (virtual) Bright Network internships during the summer of 2020 (From 2014-2019, ~250 students gained work experience)
How many students are now intending to seek local graduate vacancies or opportunities after their degree?	Student survey: 28% indicated they intend to look for a graduate opportunity in Yorkshire, Humberside and East Midlands. This figure increases to 38% of respondents when the data is aggregated to The North/Midlands.
How many local graduates are progressing into graduate level employment with local SMEs and employers?	Across the academic years 2020/21 and 2021/22, 147 students have progressed into regional employment
Employer engagement	
How many (regional) graduate vacancies/ internships/ placement opportunities are currently being advertised through WRIPA+	Across an academic year WRIPA advertises ~300-400 physics-related work opportunities
Total number of employers engaged with WRIPA	WRIPA engaged with 956 local businesses. 2014-2019, WRIPA engaged with 50-60 local businesses.
How many employers are consistently engaging with WRIPA to advertise graduate vacancies/	103
How many employers are consistently engaging with WRIPA to undertake curriculum development activities?	77

Table 3: Number of Physics graduates employed regionally (i.e. undertaking graduate level work with either their placement host or a different but related regional employer)

(The analysis relates to graduating years 2021 & 2022. Information based on known destinations of graduates).

Leeds Physics:	
WRIPA Student Engagement	NON-WRIPA Student Engagement
22 students completed either a 'Physics into Work' (PiW) placement and/or a Year in Industry (Yil) placement. All 22 students are in further study (6/27%) or graduate level technical work (16 / 73%) Of the 16 students that are in graduate-level technical work all work for a different but related local/national employer 3/16 students are in regional graduate level technical work	97 students did not complete either a PiW or Yil placement. 31 (32%) students in further education 13 (13%) students in non-stem jobs/non-graduate jobs 54 (56%) students in graduate level technical work 19/54 students in grad-level regional employment (35%)
York Physics	
WRIPA Student Engagement	NON-WRIPA Student Engagement
80 students engaged with WRIPA+ interventions (eg Yil, summer internships, 1-to-1 careers coaching / disability support) 52 (65%) students are in graduate level technical employment 18 (22%) students are in further study 10 (13%) students are in non-grad and/or non-stem roles 21 (40%) students of those in graduate-level employment are regionally	44 students did not engage with WRIPA+ interventions 14 (32%) students are in grad level technical employment 19 (43%) students are in further study 11 (25%) students are in non-grad and/or non-stem job 1 student in graduate-level employment are working regionally

In summary, Table 3 shows that:

University of Leeds:

- Students that complete PiW or Yil more likely to be in a grad-level tech role
- Data suggests students that complete PiW or Yil doesn't influence them to remain in the region

University of York:

- Students that engage with WRIPA are more likely to be in graduate-level technical work
- Students that engage with WRIPA are more likely to be in regional graduate-level technical work

Table 4: Digital Engagement of physics students with the WRIPA website (academic year 2021/22)

WRIPA University	No. of Unique Users / Sessions	Percentage of UG students that have engaged with the WRIPA website
Hull	Unique Users: 115 Sessions: 208	78% (total number of students = 147)
Leeds	Unique Users: 193 Sessions: 284	35% (Note: Leeds have 550 UG physics students but specifically directed their BSc finalists to the website of which there are approx. 100)
Nottingham	Unique Users: 199 Sessions: 376	33% (total number of students = 600)
Sheffield	Unique Users: 207 Sessions: 293	91% (total number of students = 227)
York	Unique Users: 290 Sessions: 548	54% (total number of students = 540)

In summary, Table 4 shows that across the academic year 2021/22, 1004 physics students engaged with the WRIPA website with 1,709 sessions (lots of returning users). Hull, Sheffield and York has the highest fraction of digital engagement with 78%, 91% and 54% of students respectively using the website. Leeds specifically direct only their BSc finalists to the website and so the fraction of digital engagement will be considerably higher than reported in Table 2. Nottingham had the lowest fraction of students (33%) engage with the website although this fraction represents nearly 200 undergraduate students. Overall, across the WRIPA consortium ~62% of UG physicists engaged with the WRIPA website (figure based on Leeds BSc students only).

It is also worthy to note that from 1st Sept 2021 – 4th Dec 2022 the redesigned website has garnered 47,927 page views with ~6.4K individual users and ~10K sessions (total of individual users and returning users).

Digital engagement from non-WRIPA Universities: Website data analytics suggests that students from non-WRIPA universities are utilising the WRIPA website. There is strong digital engagement from locations, including Edinburgh, Birmingham, Newcastle and Manchester. In the latter two cases, WRIPA has disseminated its digital careers tools and resources to these institutions to help support their respective physics students. For example:

- **Use of the Physics Careers Case Studies Tool:** From 1st Sept 2021 – 4th Dec 2022 this digital tool has been used by 1.9K individual users with 2.6K sessions (i.e. lots of returning users). As of December 14th 2022 there are 70 case studies. 22 case studies (31%) promote job roles and employers in Yorkshire, Humberside and East Midlands. The number of case studies increases to 36 (51%) if the geographic location is increased to The North / Midlands. This highlights the importance of this digital tool to promote regional physics-related roles and technical employers.
- **Use of the Physics Discovery Careers Tool:** From 1st Sept 2021 – 4th Dec 2022 it's been used by 774 individual users with 1.1K sessions (i.e. lots of returning users).

2. Qualitative Analysis

The evidence below explores the positive student and employer feedback to WRIPA interventions.

1. School of Physics, Engineering and Technology, University of York – Student feedback from embedding alumni businesses into 2021/22 physics modules:

1.1 Experimental Techniques (38% response rate)

The majority of students (67%) were aware that the module was relevant to graduate roles. A majority (83%) of respondents now feel they have a better understanding of how the module fits into graduate roles and industry. The majority of students (67%) said they are more likely to apply for a technical role with 33% saying no or unsure. General comments – “glad it’s part of a module so it doesn’t clash with other things but would be good to hear it earlier rather than at the end of the module”. “The presentations were really helpful with learning about how different sectors use things from the experimental techniques module”. “It was very insightful to hear about student’s first hand experiences and helped me gain an idea of what technical industry roles entailed

1.2 Medical Physics (57% response rate)

The majority of students (68%) were aware that the module was relevant to the NHS Scientific Training Programme (STP). 100% of respondents now feel they have a better understanding of how the module fits into roles/industry. The majority (88%) of respondents said they were likely to apply to the STP with 12% saying no or unsure. General comments – “it would be helpful to have these talks before module choices to encourage others to choose Medical Physics and also to understand the STP”. “Found the talks really useful, and it was good to see a practical application of the teaching”. “I had heard of the STP before the module but hearing from alumni really made me consider applying”. “It was very useful and informative. It definitely helped fuel my passion for medical physics”.

2. School of Physics, Engineering and Technology, University of York - Student focus group feedback on how the digital Physics Careers Case Studies tool influences students’ attitudes to graduate employment and career aspirations.

Statement	Average (Mode) Score (Scale 1-5)
I understand better how my skills and interests match to a variety of job roles.	4 (agree)
I have a clearer understanding of the types of roles I would like to do, either as an undergraduate (internship/placement) or graduate.	3 (neutral)
I am more likely to consider a technical career in industry.	2 (disagree)
I am surprised by the broad range of roles that a physicist can do.	5 (strongly agree)
I am more likely to consider applying to employers within the “Yorkshire, Humber and East Midlands” region for roles.	4 (agree)
I can relate to the students in the case studies and can envisage myself being in their shoes in the future.	5 (strongly agree)

Student feedback:

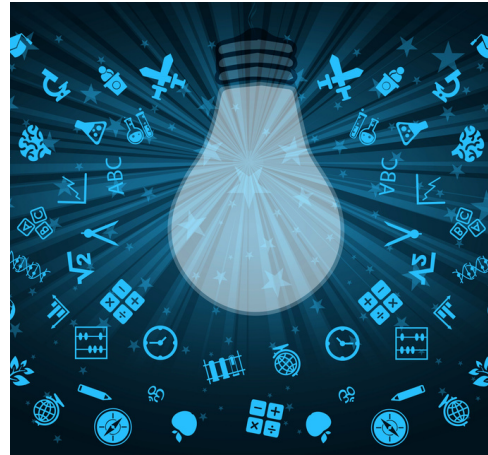
“Before enrolling in University, I was quite sure that I wanted to do a bachelor’s, a master’s, and a PhD. However, I used the WRIPA Physics Careers Discovery Tool to help narrow down my choices. Technical Author immediately jumped out at me. I looked into the field extensively and deemed that it was a perfect combination of writing (which I love) and employing technical skills on a daily basis, while constantly learning. WRIPA quite literally changed my life.”



3. Employer engagement and impact feedback

To explore the impact of WRIPA and our students on our industry partners and employers we have a range of employer case studies. These can be viewed on our [WRIPA companies webpages](#). To find out more about the impact of student internships on our employers and on their own skill levels and career awareness see our range of [student case studies](#).

In addition, we have collected a range of employer testimonies in line with the examples below:

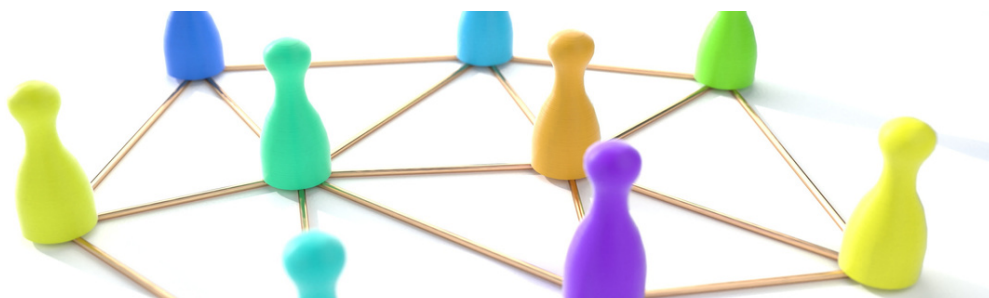


3.1 Laser Optical Engineering feedback on their University of Nottingham physics placements students:

“Laser Optical Engineering Ltd (LOE) is a company based upon the industrial estate at East Midlands Airport and prides itself in delivering advanced laser engineering concepts through to real-world customer applications. LOE was fortunate in being able to host three students from the Physics Department. [...]. All three students were exceptional and have made significant contributions to the various research programs currently underway at LOE. [...] At the end of one of the internships we were successful in recruiting one of the students to now become a full-time employee, one student is set to return to undertake his PhD, the third is still ongoing with the internship. This has been a highly satisfying experience for both the students and the company. I look forward to further involvement in your program as more students become available.”

3.2 Bluesmith Information Systems on the value of their relationship with Leeds Physics

“The relationship that Bluesmith has with the School of Physics and Astronomy has been invaluable, and we regularly take on fantastic graduate talent as a result. I really enjoy meeting with students to discuss the broader opportunities that their degree presents in the world of work, which can seem scary at times. Not everyone studying Physics is looking for a career in CERN, NASA, research or teaching! Bluesmith is a small 65 person data analytics specialist, and the attitude, attention to detail and analytical skills we find in physics graduates is exactly what we are looking for. [...]”



CONCLUSION

The WRIPA project, from Sept 2019 – Dec 2022, has engaged with 956 businesses and supported 238 students to participate in some form of work experience. 'WRIPA staff' have worked with a diverse range of departmental learning and teaching staff to integrate employability into the curriculum. For example, Leeds Physics created the 'Physics into Work' module and Sheffield Physics embedded employability, work-based learning and skills training at a programme-level. Other examples include York Physics embedding employer delivery into three teaching and learning modules and both Nottingham Physics and Leeds Physics revising existing modules (Communication for Physicists and Professional Skills respectively) to embed graduate attributes into course content. Emerging graduate destinations data suggests that WRIPA interventions do support students into graduate-level technical work. Because of the pandemic the project placed a stronger emphasis on digitally supporting students to make better-informed career decisions, connect with employers and to offer information on physics-adjacent careers. From 1st Sept 2021 – 4th Dec 2022 the redesigned website has garnered 47,927 page views with ~6.4K individual users and ~10K sessions (total of individual users and returning users). Google analytics suggests that across the WRIPA universities ~62% of UG physicists engaged with the WRIPA website. Website data analytics also suggests that students from non-WRIPA universities are utilising the WRIPA website. Student feedback about the WRIPA website and digital tools was positive and highlights the role digital career resources can play in supporting students to make better informed career decisions. These digital resources complement curricular work-based learning opportunities, embedded delivery by employers and recruitment and networking events.

REFLECTIONS AND NEXT STEPS

The evaluation and feedback outlined above show that the activities of the WRIPA have been successful and much has been learned. Curricular interventions support an equitable approach to careers and employability and this approach will continue. Students need near-peer and early career alumni role models to support them to apply for roles and connect with employers. Smaller (regional) employers are less visible to students than larger organisations. This imbalance will be challenged by the continued embedding of employers into the curriculum (eg presentations, final year projects and placements) and by promoting their organisations and vacancies on the WRIPA website. In the latter case, work is in progress to embed a jobs board into the WRIPA website. University-Alumni business relationships will be grown and sustained to support students into (regional) employment and to raise the visibility of physics-relevant technical sectors. Physics students will be encouraged to be more "digitally engaged" – utilising digital career resources and tools to make better-informed career decisions, and connect with and market themselves effectively to future employers.

REFERENCES AND HYPERLINKS

<https://www.ncub.co.uk/insight/the-unemployability-of-physics-graduates-in-technical-careers/>

1. "The importance of Physics to the UK Economy", Institute of Physics (Deloitte), October 2012
2. "Unlocking the potential of physics skills in the UK and Ireland", Institute of Physics, (Emsi Burning Glass) January 2022
3. "The (un)employability of physics graduates in technical careers", (Andrew Hirst) National Centre for Universities and Business", October 2018

All 'WRIPA articles' can be accessed here: <https://wripa.ac.uk/research-events/>

WRIPA fair videos:

<https://www.youtube.com/watch?v=vG0pFunRU9s>

<https://www.youtube.com/watch?v=hD5SceL9IxM>

