IOP Institute of Physics

IOP submission to the All-Party Parliamentary Group on Diversity and Inclusion in STEM inquiry on equity in the STEM workforce

January 2021

The All-Party Parliamentary Group (APPG[1]) on Diversity and Inclusion (D&I) in science, technology, engineering and maths (STEM) has recently undertaken an inquiry into equity in STEM education that focused on the education pipeline, culminating in a report[2]. The APPG is continuing its focus on inequities in STEM by initiating an inquiry[3] into equity in the UK STEM workforce.

The APPG states that the 'inquiry will evolve the argument from problems in education and the talent pipeline, to examine the reality of the working world.'

About the IOP

The Institute of Physics[4] (IOP) is the professional body and learned society for physics in the UK and Ireland. The IOP's mission is to support the development of a diverse and inclusive physics community, raise public awareness of physics, and inspire people to develop their knowledge, understanding and enjoyment of physics. As a charity, the IOP seeks to ensure that physics delivers on its exceptional potential to benefit society and reflects the diversity of UK society.

Diversity and inclusion is a core theme running through the IOP's strategy, 'Unlocking the Future'[5]. Our 'Limit Less' campaign[6] seeks to remedy the underrepresentation of certain groups studying physics, or beginning a physics-based apprenticeship, from age 16. Its focus is on ensuring that those who influence the subject choice and career decisions of young people do not perpetuate misconceived ideas about what physics is, and who is suitable to do physics, but instead promote the benefits of physics to all young people. We also have an 'Ecosystem' programme that focuses on the environment of the physical sciences, from nurturing skills for the future and retaining our physicists, to supporting a vibrant physics industry. Our third programme, 'Productivity' focuses on the economic value and potential of the sector and will develop and promote a research and development (R&D) roadmap for physics.

The IOP is a sponsor of the APPG and is making this submission on behalf of its membership. The IOP comprises 23,000 members from across the physics community: in industry, business, academia, the classroom, technician roles, in training programmes and in the public sector. It also works with a range of partners to support and develop policy positions and recommendations, and influence change, aimed at making sure that the benefits of diversity and the value of inclusivity is seen throughout the sector.

[1] https://www.britishscienceassociation.org/appg
[2] https://www.britishscienceassociation.org/Handlers/Download.ashx?IDMF=debdf2fb-5e80-48ce-b8e5-53aa8b09cccc
[3] https://www.britishscienceassociation.org/inquiry-equity-in-the-stem-workforce
[4] https://www.iop.org/
[5] https://www.iop.org/about/strategy
[6] https://www.iop.org/about/strategy/limit-less

Executive summary

The IOP has been driving equality, diversity and inclusion (EDI) in physics as part of the wider STEM community since 2004, and this is a core pillar of the new IOP Strategy, Unlocking the Future. Our focus was primarily to address our members' concerns about equality and progression for female physicists but has since expanded to other under-represented groups. At that time, a Diversity Team was created with staff dedicated to progressing our work. Our work and team have grown and developed to become a well-recognised EDI in STEM programme, covering a range of strands including, but not limited to, gender, LGBT+, disability and ethnicity. From 2012, the team started to actively address how we embed diversity and inclusion as an employer, as well as supporting our membership and the wider physics and STEM community. Through our work over the last decade, we have been able to collect evidence, conduct research, and produce analysis relating to diversity within STEM that have enabled us to provide a plethora of evidence for this consultation.

Data on EDI

Wherever appropriate, the IOP collects diversity data. The IOP stores data on its members' characteristics, which includes age, gender, employer, and the address of members (providing information on region). The IOP also understand member's stage of career, as a result of having a tiered membership system. This data is stored in a member database, which, when broken down by characteristics, provides a good image of the demographics of nearly 14,000 physicists who are employed in physics in the UK.

There are challenges to collecting sensitive and protected data, due the difficulties and challenges of trust, transparency, GDPR, and sensitive data. The IOP therefore supplements it's membership database with a Diversity and Inclusion survey of members every four years. This is an anonymous survey of members, undertaken to better understand the make-up of our membership community. On average, 10-15% of members respond, meaning this represents a sub-set of members.

We acknowledge that using data from our membership does not directly reflect the physics sector in full, but offers a picture of a sizeable group of physicists. The IOP further encourages the physics community to collect data on diversity, so that we can monitor progress within the sectors. We encourage the collection of both qualitative and quantitative data and use this in our work to ensure the retention of physicists and STEM colleagues in a positive and inclusive working environment.

Underrepresentation of women, LGBT+, BAME, people with disabilities and physicists from low-socioeconomic background

Our most recent member Diversity and Inclusion survey, and data from our membership database, shows a lack of representation across many underrepresented groups. Among IOP members who are working in physics, there are too few women; too few Black people, especially of Black Caribbean descent; too few people with disabilities; too few LGBT+ people; and too few people from less well off or disadvantaged backgrounds. The diversity of thought that makes for better physics is currently narrower than it both could, and should be. A more thriving and diverse physics community will make an even greater contribution to our economy, creating more jobs and economic growth, as well as help solve the global challenges we face as a society.

Greater focus to be considered for recruitment and retention of under-represented groups

This lack of diversity has two causes - first, the challenges surrounding an inclusive environment, and second, not enough numbers coming into physics. For example, some people from underrepresented groups study physics, join the physics community, but then find it unwelcoming and sadly leave. Many young people miss out on having ***a specialist physics teacher*** at school to prepare them for further study or a career using physics. The IOP is committed to addressing both these root causes and thus make our community better reflect society. We have launched our 'Limit Less' influencing campaign to diversify the pipeline coming into physics and we are expanding our 'Project Juno' gender equality scheme for physics institutions, departments, and organisations to include characteristics which are broader than just gender.

We can share examples of good practice from IOP initiatives that focus specifically on underrepresented groups. Our Project Juno scheme, has been able to provide evidence from its 53 engaged practitioners from across the UK about how physics workplaces can become more inclusive, especially for women. Our LGBT+ report explored the workplace for LGBT+ physicists, to understand why 28% had considered leaving their workplace because of the climate or discrimination towards LGBT+ people, and provides recommendations to individuals, employers and learned societies to address this. Other reports focus on disability and ensuring greater accessibility for all, the impact and importance of professional conduct in a working and studying environment free from bullying and harassment, and the considerations and impact of mental health.

Wider collectives, networks, and initiatives

The IOP supports, sponsors, and contributes to wider STEM initiatives that focus on a sector-wide approach. Examples such as the Science Council and Royal Academy of Engineering's Progression Framework[7], the Athena Forum[8] and the LGBT+ Physical Sciences Network[9], focus on issues facing the STEM community and recognise the benefits of collaboration, sector benchmarking and sharing good practice. The IOP champions the need for these, especially given the impact that COVID-19 will have on the sector and the people working within it, whilst also forging relationships and exchanges outside STEM.

[7] https://sciencecouncil.org/professional-bodies/diversity-equality-and-inclusion/diversity-framework/
[8] https://www.athenaforum.org.uk/
[9] https://www.iop.org/about/iop-diversity-inclusion/LGBT-physical-sciences-network

1. What are the demographics of STEM workers in your organisation or sector?

The IOP's membership comprises of physicists working and living in the UK and Ireland. The IOP maintains a database of member information, which details age, gender, employer, and the address of members, recorded at the time when members join the IOP. This allows the IOP to understand the characteristics of its members.

The IOP also has several different membership categories, including: Associate Membership, for undergraduates, apprentices, trainees and professionals with a connection to physics; Full Membership, for Graduates, early, mid and experienced career professionals; and Fellowship, for distinguished physicists in recognition of their accomplishments. This allows the IOP to understand the stage that members are at in their careers and provide appropriate continuing professional development, as well as other services.

A snapshot from December 2020 shows that the IOP has around 13,700[10] members who the IOP believes are working physicists in the UK. This membership data can be used to paint a picture of the demographics of the UK's physics workforce and has been used to respond to the first inquiry question. The database was filtered to analyse the characteristics of members who are employed in physics and based in the UK[11]. The number of UK-based working members who represent the protected characteristics has been detailed, and this has been expressed as a proportion of the total number of UK-based working members.

Whilst the membership data curated by the IOP enables a characterisation of the working physics sector in the UK and Ireland, it does not include all physicists in the sector and is not entirely representative of the UK physics sector. It includes some over- and under-representation, as certain individuals are more or less likely to pay for membership. For example, IOP members aged 29 or below are less numerous than other age brackets, and it is considered that the IOP member data does not reflect a full picture of early career physicists. These limitations are explored in more details at the end of question 1. Despite this, the membership data provides information on a substantial number of physicists in the UK.

In this response, membership data is supplemented by data from the IOP's Diversity and Inclusion survey. The IOP collects information from its members in its Diversity and Inclusion survey, which is an anonymous survey of IOP members, run every four years. The most recent survey, undertaken in 2019, saw response rates of around 10% of the membership, totalling roughly 2,000[12] IOP members. This means that this data is from a sub-set of members. This survey cannot be broken down by employment status, however the finding provide important insights which build a picture of equality, diversity and inclusion (EDI) in physics across the UK.

Analysis of the IOP's membership shows the following.

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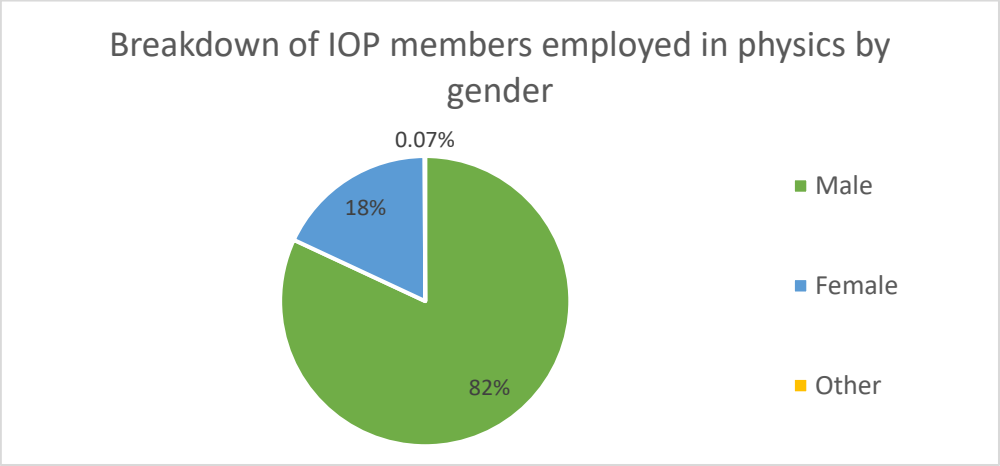
10 This figure includes members which, as of December 2020, the IOP believed to be working in physics in the UK, based on their membership type. This excludes members who are students, retired and working in other sectors. Please note, the IOP does not record occupation data on all members, however it does have a record of many member's employers and job titles, allowing estimation of employment roles and sectors.

11 The analysis removed membership data from the Republic of Ireland, as the APPG Inquiry addresses the UK. The IOP is the Learned Society for the UK and the Republic of Ireland, and therefore also has this data on Irish physicists. It is possible for the IOP to compare figures of demographics between the UK and the Republic of Ireland, if this would be helpful.

12 The last survey totaled 2,066 responses.

Gender

The IOP's member database shows that among UK-based members, who are believed to be in current employment based on membership type, and who shared their gender with the IOP, there is a larger over-representation of those who identify as male in comparison to those who identify as female, compared to the general population. This has historically been the case in STEM.



Gender data from IOP membership figures, December 2020. N=13,692.

Specific information on STEM employment, broken down by gender, is available in Scotland, from the 2017 Scottish STEM strategy for Education and Training[13]. This is more detailed data than the IOP holds from membership data and more granular than is publicly available for the entire UK. The IOP has therefore included this evidence in this response to provide greater understanding of gender equity in STEM in Scotland. Evidence from this shows that in Scotland, men are more likely to be employed in STEM industries than women, and the gender split in STEM is more pronounced than in other sectors of the economy. Males have consistently accounted for 56-57% of employment in STEM sectors since 2010, a considerably higher proportion than 51-52% for all sectors, but a much more equitable picture than seen in UK physics as indicated by the IOP membership data.

Gender reassignment

The IOP does not have data on gender reassignment in its database of member information, however the IOP collects information on this in its Diversity and Inclusion survey. As detailed, this is anonymous survey of IOP members, run every four years. The most recent survey, in 2019, saw response rates of around 10% of the membership, totalling roughly 2,000[14] IOP members. This survey cannot be broken down by employment status, however the insights are important findings which build a picture of EDI in physics across the UK.

Data from the 2019 anonymous member Diversity and Inclusion survey found that 2% of the 97% of respondents who responded to the question said their gender identity was different from the sex they were assigned at birth. This is higher than the estimated percentage of 1% for the UK population, reported in the Government Equalities Office report: 'Trans people in the UK (2018)'.

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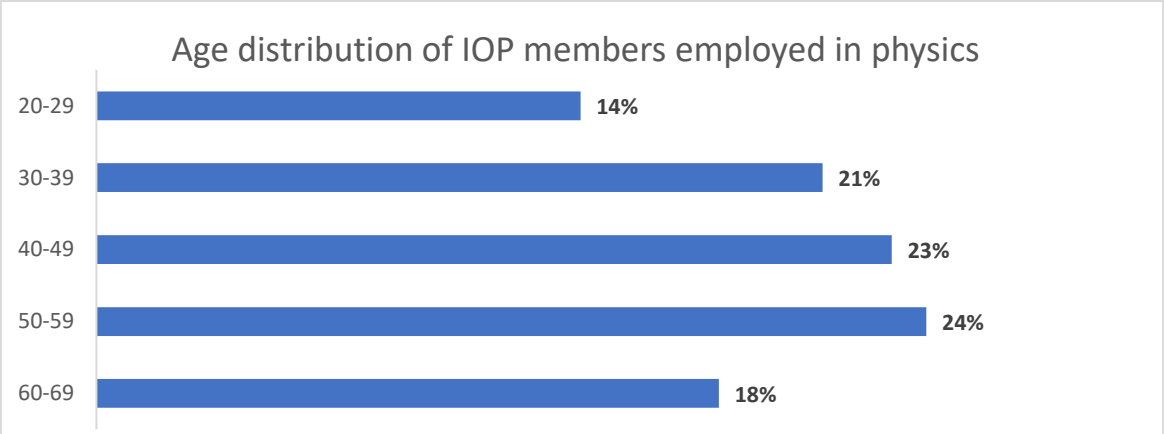
13 Ekosgen (2017). Developing a Scottish STEM Evidence Base - https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2017/10/science-technology-engineering-mathematics-education-training-strategy-scotland/documents/00526538-pdf/00526538-pdf/govscot%3Adocument/00526538.pdf

14 The last survey totaled 2,066 responses.

Age

As detailed, age is reported by members when joining the IOP, and this information is stored in the member database. When comparing the number of UK-based members in employment within defined age brackets, it was found that 78% are aged between 30-60.

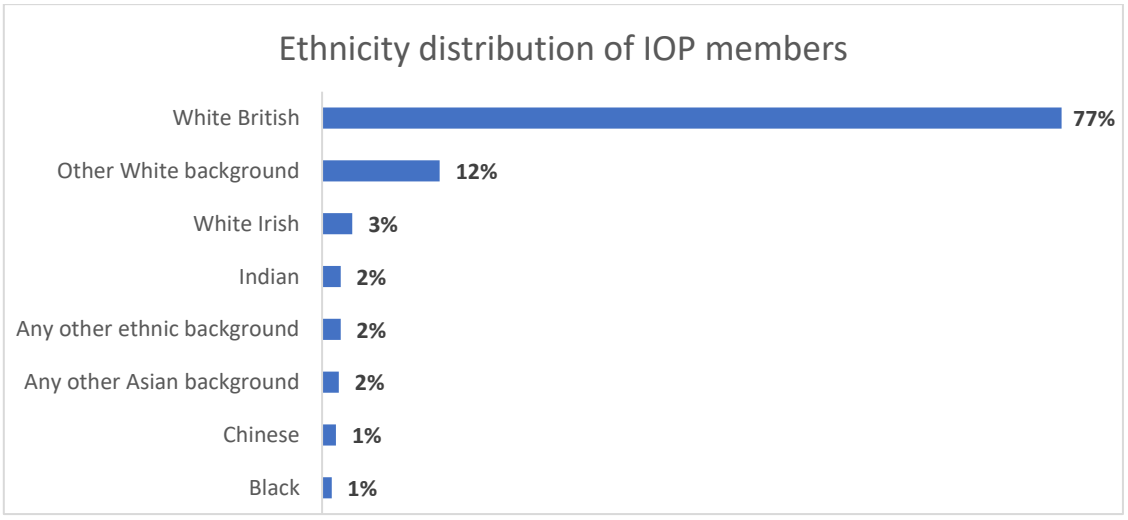
The data suggests there to be a low representation of working physicists under the age of 30. However, this is believed to be a product of the skewed membership of the IOP, where membership trends towards older physicists, with younger members being underrepresented. The IOP therefore cannot provide information on early career physicists, an issue which is raised in more detail later in this consultation.



Age data from IOP membership figures, December 2020. N=13,692.

Ethnicity

Data from the IOP's 2019 Diversity and Inclusion survey shows that, among respondents who volunteered an ethnicity[15], 77% were White British, with a further 15% from other white and White Irish backgrounds, leaving just 8% collectively from Indian, Chinese, Black and other Asian and ethnic minority backgrounds.



Ethnicity data from the IOP Diversity and Inclusion survey, 2019. N=2005.

15 This figure does not include responses from Associate Members, as most of this group are students, and therefore not yet considered part of the physics workforce. .

Disability

The IOP's 2019 Diversity and Inclusion survey found that:

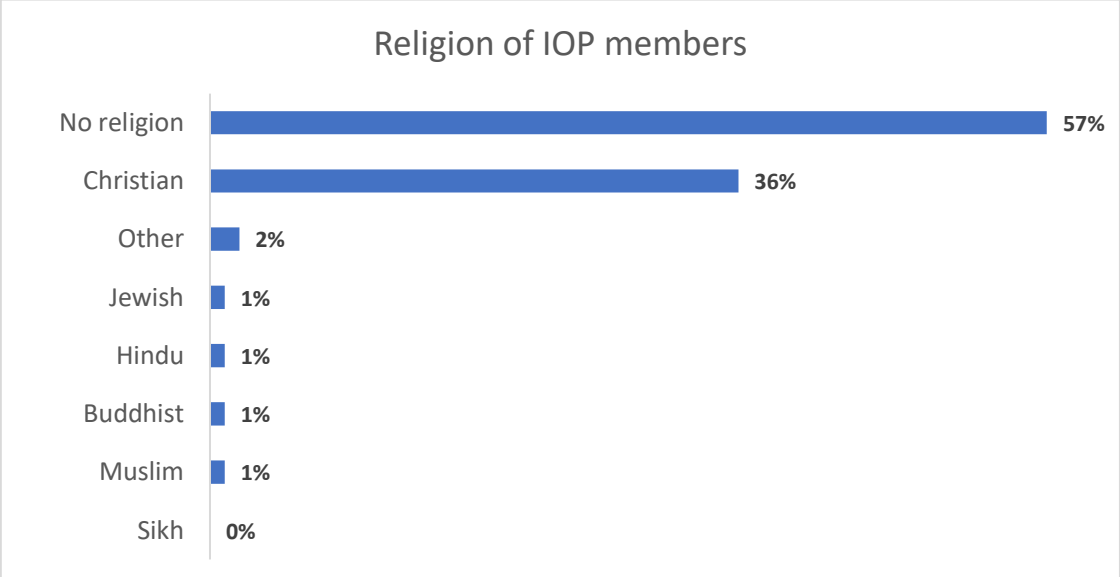
- 9% of respondents reported a disability, of whom 26% had a longstanding illness or health condition.
- 25% had a mental health condition such as depression, schizophrenia, or anxiety disorder.
- 19% had a physical impairment or mobility issues.
- 17% had a social / communication impairment such as Asperger's syndrome or another autistic spectrum disorder.

Compared to the 2011 and 2015 surveys, mental health conditions remained one of the highest reported conditions in 2019 and increased in prevalence, with 25% of respondents reporting a mental health disability, compared to 17.2% in 2011 and 18.3% in 2015. Additionally, in 2019, of those who reported having a disability, 26% reported having a longstanding health condition.

Religion or belief

The IOP's Diversity and Inclusion survey shows that, in 2019, among IOP members who responded to the survey, 57% who responded to our question on belief had no religion.

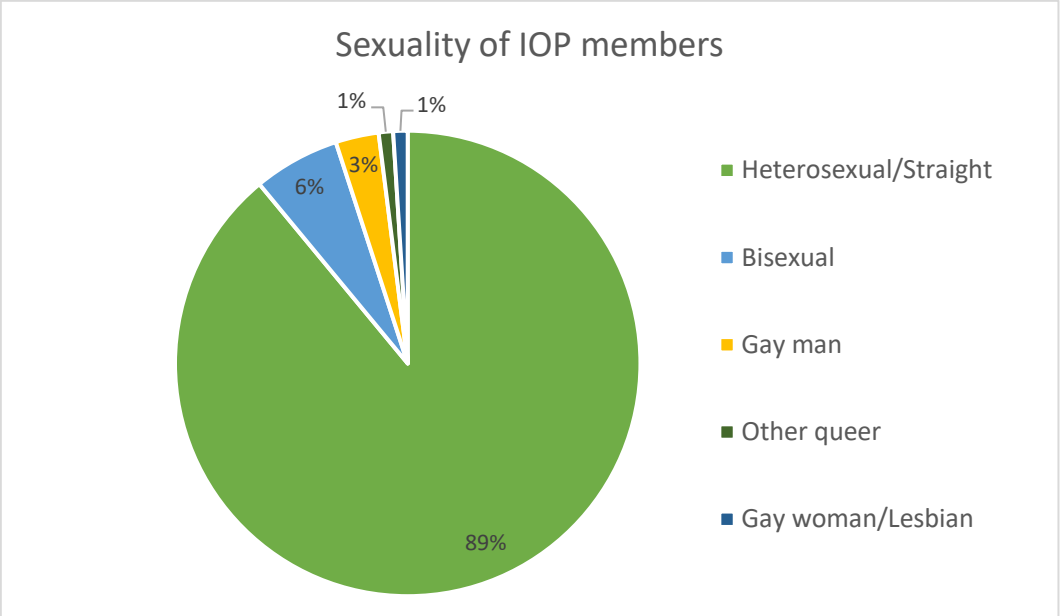
The religion with the largest representation was Christianity, with 36% identifying as Christians. This was also the most prevalent religion in the previous two surveys; 35% in 2011 and 29% in 2015. All other religions collectively represented 7% of the surveyed members.



Religion data from the IOP Diversity and Inclusion survey, 2019. N=1954.

Sexuality

The IOP's Diversity and Inclusion survey shows that, in 2019, 89% of respondents identified as heterosexual. Collectively, 11% identified as LGBT+, with bisexual the sexuality with the largest representation (6%).



Sexuality data from the IOP Diversity and Inclusion survey, 2019. N=1908

Socio-economic background

While socio-economic background is not currently a protected characteristic under the Equality Act 2010, the IOP still collects this data every four years in its anonymous Diversity and Inclusion survey, as we see it as an important metric and influencing factor. It can be difficult to accurately measure an individual's socio-economic background accurately, and a variety of proxy measures are frequently used. For the 2015 and 2019 surveys, the IOP used highest parental qualification as a proxy for the socio-economic background of respondents.

In 2015, 11% of respondents reported that their parents held no qualifications and 53% had a first degree or higher, compared to 2019 where 7% of respondents' parents held no qualifications and 55% had a first degree or higher. For many, particularly older respondents, their parent's qualifications were not known to them. Although not directly comparable with the data we collected in the survey, the ONS 2011 UK census reported that 27% of the UK population aged 16 and over had achieved a Level 4 or above qualification such as a degree or other higher qualification or equivalent, a figure significantly lower than that reported by IOP survey respondents. In the ONS data, 23% held no qualifications.

Are there gaps in the quality of evidence, monitoring or reporting?

Equality, diversity and inclusion (EDI) are key pillars in the IOP's strategy, Unlocking the Future[16], and the IOP works continuously to promote EDI in the workforce. To be able to measure its progress in this area, the IOP must maintain data on the demographics within the sector, and works to ensure these are up to date. Whilst the IOP maintains a comprehensive database of core characteristics of members, and runs frequent Diversity and Inclusion surveys, there are some limitations to the data. These are discussed here.

The IOP's member database

The IOP maintains a database of member information; this data includes age, gender, employer, and address of members, recorded at the time when members join the Institute. Members can amend their personal information, and update their addresses, via the member platform; IOP Connect. However, some may not keep this information up to date, which could mean that the data is not current and thus does not truly reflects the member's immediate situation. Furthermore, employer data is indicative based on their reported employer, and does not identify job role/position.

As detailed, the IOP also has a number of different membership categories, including: Associate Membership, for undergraduates, apprentices, trainees and professionals with a connection to physics; Full Membership, for Graduates, early, mid and experienced career professionals; and Fellowship, for distinguished physicists in recognitions of their accomplishments. While this allows the IOP to broadly understand the stage that members are at in their careers, the full membership option largely encompasses the bulk of those in the middle of their career.

It is important to note that the IOP's database includes some over- and under-representation, as certain individuals are more or less likely to pay for membership. For example, IOP members aged 29 or below are less numerous than other age brackets, and it is considered that the IOP member data does not reflect a full picture of early career physicists. Despite this limitation, the membership data provides information on a sizeable number of physicists in the UK.

Whilst the membership data curated by the IOP enables characterisation of the working physics sector in the UK and Ireland, it does not include all physicists in the community or sector. Indeed, no data set currently exist which fully reflects the physics sector in the UK.

Despite these limitations, collection of membership data can be used to paint a picture of the demographics of the UK's physics workforce, if the characteristics recorded for just those members who are working and are UK based, are analysed.

The Diversity and Inclusion survey

There are challenges to collecting sensitive and protected D&I data from members at the time which they join the IOP. The IOP therefore undertakes follow up surveys of members. This includes an anonymous survey of members every four years to understand the make-up of our membership. Unlike the IOP curated membership data, data from these surveys reveal a snapshot of a sub-sample of the membership, and does not represent the entire membership body, nor the entire UK physics sector.

This is further skewed by some individuals being more likely than others to respond to surveys, potentially leading to over- and under-representation within the sample. On average, 10-15% of IOP members respond to surveys. Response rates for D&I surveys usually elicit this low volume of response due the difficulties and challenges of trust, transparency, GDPR, and sensitive data. The IOP acknowledges that, as a result, this is not an exact reflection of our membership.

[16] Unlocking the Future, the IOP Strategy: https://www.iop.org/about/strategy#gref

Other limitations

Moreover, there are some demographic data which are currently not available to the IOP, or in other external data sets. These are largely highly personal data, which may elicit a lower number of responses or disclosure in surveys. These include parenthood, pregnancy and maternity/paternity history, gender reassignment, and marital status.

The IOP omitted both members from the Republic of Ireland, and Associate Members, from the database when collecting the figures to report in this response. This is due to the UK-scope of the APPG, and the likelihood that Associate Members are not yet fully employed physicists, rather studying. The IOP could offer a comparison of the demographics in these omitted groups to those UK-based working physicists reported, which could show a good comparison of EDI in a non-UK country, and among a group who will be progressing into the workforce in coming years.

The IOP has further not provided data on representation among the members who sit on IOP boards, groups and committees, nor on award winners. The IOP believes that it is important for under-represented groups to be included and active in these groups, and the IOP could analyse the demographics among these groups to assess representation among those who are highly engaged in steering and influencing the agenda of the IOP.

The response to question 2 heavily focuses on HESA Staff Records data, with some IOP membership data included. For the breakdown of STEM disciplines and (sub)sectors by age and ethnicity, this information is readily available from IOP membership data, using members' reported demographics and employer. Whilst this data is available, it has not yet been analysed. The IOP can offer this data once the analysis has been completed, and could undertake additional analysis between specifics such as public vs private employers. The present weight given to HE staff data does not represent a gap in data collection in these sectors, but timeliness of analysis for these other factors.

2. **Where is there inequity across the different protected characteristics and how are different communities impacted?**

As detailed in question 1, assessment of the IOP membership data provides a good understanding of certain demographics of the UK's physics sector, however this is not fully representative of the sector as a whole. Responses to this question which use IOP data therefore reflect the membership, not the UK physics sector in full.

The membership data includes details on members' employers, meaning the IOP can comment on the number of members who are employed in specific sectors and sub-sectors. We have focused here, where possible, on differences between representation between sectors, and due to the availability of data on staff in academia, provide greater detail for HE staff. The response does not detail specific businesses, to protect the anonymity of members and the organisations they work for. However, the IOP invited members who work for businesses to independently respond to the APPG's inquiry, on behalf of their organisation, to encourage business representation to the inquiry.

The IOP member data is supplemented in response to question 2 by external records; the Higher Education Statistics Agency (HESA) Staff Records and the Scottish Government's STEM Evidence Base. These provide further granularity on the demographics of the workforce in specific locations and physics sectors and industries. The IOP has used these two additional dataset sets as the insights and data in these were deemed appropriate to respond to the inquiry. The IOP will analyse figures of physics employees from other external datasets which detail data such as job type and salary, if these become available.

The IOP has used the outlined datasets to analyse the required factors, such as sector and qualification level, to review representation. Please note, more information on this can be found in response to this question in the Labour Force Survey[17], as referenced in the consultation's data brief.

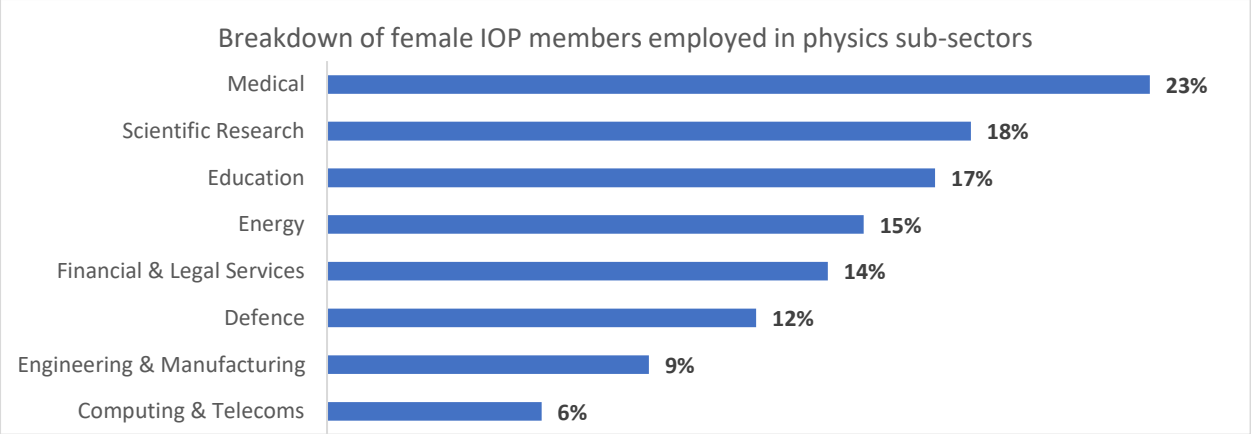
[17] ONS (2020). Labour market statistics time series: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/labourmarketstatistics#__sid=js0

2.1. STEM disciplines or sector/sub-sectors

The IOP can provide a breakdown of representation within specific physics sub-sectors. The IOP's member data shows a breakdown of the industries members work in, as members report their employer when joining the IOP. To classify this data, member's employers were classified as Public or Private, and then placed into a broad industry area, and into an organisation type. These are reported here as sub-sector groupings. This data therefore includes both private enterprise and the public/third sector, and includes, but isn't limited to, business. Individual businesses have not been reported to protect anonymity.

Gender by sub-sector

A snapshot from December 2020 shows that among IOP members, the proportion of female physicists whose employer is in the engineering, manufacturing, and the computing and telecoms sub-sectors is especially low.



Gender data from IOP membership figures, December 2020. N=6904 IOP Members with known sector. X axis represents proportion of IOP's membership who are female in each sub-sector.

Spotlight on Scotland

Specific information on STEM qualifications and employment, broken down by gender, is available in Scotland. This is more detailed data than the IOP holds from membership data and more granular than is publicly available for the entire UK. It was commissioned by Skills Development Scotland to provide an evidence base for the 2017 Scottish STEM strategy for Education and Training, and explores STEM Education provision from school to university level, and the skills pipeline[18].

STEM sectors provide a greater proportion of all employment in Scotland (37%) than the GB average (32%), employing 963,400 people in Scotland (of which 838,000 were occupational roles). 20% of all STEM workers in Scotland were engaged part-time as of 2016: this rate has remained fairly constant since 2009. The lower rate of part-time working in Scotland (the GB equivalent rate being 25%) may contribute towards lower numbers of women working in STEM industries than in England and Wales, as a higher proportion of women than men continue to carry a greater burden of caring duties and prefer flexibility. One cautionary note is that this data precedes the growth in home-working caused by COVID-19 and before

[18] Ekosgen (2017). Developing a Scottish STEM Evidence Base.- https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2017/10/science-technology-engineering-mathematics-education-training-strategy-scotland/documents/00526538-pdf/00526538-pdf/govscot%3Adocument/00526538.pdf

national employment law reforms such as shared parental leave had had time to affect employee behaviour and employer attitudes.

Employment in Scottish STEM industries is skewed towards men, with 57% of jobs held by men in 2016. This has been steady since 2010, and is above the economy-average proportion of 52%. There are also significant variations in gender profiles of different sectors. There are significantly higher concentrations of male employment in construction and engineering and of women in the health and care sectors. The most gender-balanced groupings within STEM occupations are professionals (52% female), especially in business finance, research and administration. However, the female employment rate falls to 39% for technician level, 37% for Directors and Managers, and a mere 3% for skilled trades. The imbalance is greatest in areas considered indicative of heavy industry (e.g. metallurgy and welding, machinery and tool-making). The gender imbalance is also greater in STEM-related activities than in core functions.

Spotlight on Higher Education

Information about the demographics of the physics workforce in higher education (HE) is available through HESA Staff Records[19]. The staff record is a database of individualised data on the personal characteristics of staff, the details of their contracts, and the activities undertaken as a result of those contracts. It represents the physics HE workforce in the UK.

In the academic year 2018/19[20], 75% of staff in UK HE physics identified as male. This vastly outweighs the proportion of those who identified as female, totalling 25%, and again illuminates an underrepresentation of females in the sector. Despite this, the under-representation of females in HE is less profound than the physics sector as a whole, when compared to the number of IOP UK-based members who are working physicists across sectors; where only 18% of working, UK-based IOP members are female.

Ethnicity by sub-sector

Ethnicity is not a characteristic the IOP collects from members when they join the Institute, however, questions on ethnicity are included in the Diversity and Inclusion survey, run every 4 years. However, this is an anonymous survey, meaning that it cannot be broken down by employment type or sector. This is a data gap which spans from the difficulties of collecting sensitive personal data, outlined in question 1.

Despite this, the IOP has analysed the HESA Staff Records to identify the representation of ethnicities within physics departments.

Spotlight on Higher Education

HESA data reveals that in the academic year 2018/19[21], 85% of physics staff were of white ethnicity, down from 89% in 2012/13. This is largely reflective of non-physics disciplines, where 86% of staff reported as white.

In contrast, individuals from other ethnicities are represented in much smaller proportions. In 2018/19, 4% of the HE physics workforce reported their ethnicity to be Chinese, 3% reported their ethnicity to be Asian or Asian British – Indian, and 2% reported their ethnicity as Mixed, Other, or Other Asian Background, respectively.

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19 HESA Staff Record 2018/19. Copyright Higher Education Statistics Agency Limited. The Staff record is collected in respect of those staff, employed in the UK, who possess one or more contracts of employment with the HEP and/or for whom the HEP is liable to pay Class 1 National Insurance contributions for that individual.

20 Based on 7,515 staff working in HE physics.

21 Based on 5,790 staff working in HE where ethnicity is known.

Table of Higher Education Staff by ethnicity

		2012/13			2018/19		
Ethnicity		Physics	All other Academic Disciplines	All Higher Education Staff	Physics	All other Academic Disciplines	All Higher Education Staff
White	White	**89%**	89%	89%	**85%**	86%	86%
Asian	Asian or Asian British – Pakistani	**1%**	1%	1%	**0%**	1%	1%
	Asian or Asian British – Bangladeshi	**0%**	0%	0%	**0%**	0%	0%
	Other Asian background	**2%**	1%	1%	**2%**	2%	2%
	Asian or Asian British – Indian	**3%**	2%	2%	**3%**	3%	3%
	Chinese	**3%**	2%	2%	**4%**	2%	2%
	All Asian	**8%**	7%	7%	**10%**	8%	8%
Black	Black or Black British – African	**0%**	1%	1%	**0%**	2%	2%
	Black or Black British – Caribbean	**0%**	1%	1%	**0%**	1%	1%
	Other Black background	**0%**	0%	0%	**0%**	0%	0%
	All Black	**1%**	2%	2%	**1%**	3%	3%
Mixed	Mixed	**2%**	1%	1%	**2%**	2%	2%
Other	Other	**1%**	1%	1%	**2%**	2%	2%

Proportion, rounded to the nearest one per cent.

Beyond these protected characteristics, it was also found that 3 in 5 (62%) reported their nationality[22] as from the UK (including Guernsey, Jersey and the Isle of Man), followed by 1 in 5 reporting their nationality as a European Union country (22%), and 15% reporting their nationality as other non-European.

The following table represents the ratio of proportions between the ethnicity of staff in HE physics and other disciplines. A figure of 1.0 means there is the same proportion between physics and other subjects. Numbers below 1.0 mean under-representation.

Table of Higher Education Staff by Ethnicity: Relative Representation in Physics

[22] Based on 7,510 staff working in HE physics.

	Representation level in physics compared with all staff, 2018/19
White	1.0
Asian or Asian British – Pakistani	0.5
Asian or Asian British – Bangladeshi	0.5
Other Asian background	1.1
Asian or Asian British – Indian	1.2
Chinese	1.7
All Asian	1.2
Black or Black British – African	0.2
Black or Black British – Caribbean	0.3
Other Black background	0.4
All Black	0.2
Mixed	1.2
Other	1.0

The proportional comparison shows that staff from Pakistani and Bangladeshi backgrounds are poorly represented in physics. The proportions of physics staff from Pakistani and Bangladeshi backgrounds are each half of the equivalent proportions across all disciplines. Similarly, black staff are extremely under-represented. The proportion of staff in physics who are black is five times lower than in other disciplines.

The same proportion of physics staff are white as seen in the average academic staff population, compared with other subjects. Mixed, Chinese, Indian, and other Asian staff are somewhat better represented in physics than in other disciplines.

In the 2011 census, the proportion of the England and Wales population who are classified as white was 86%[23]. People from Asian ethnic groups made up the second largest percentage of the population, at 7.5%, followed by Black ethnic groups, at 3.3%. Comparing the figures in physics to the UK population shows that there is an under-representation of BAME staff in HE physics, particularly among Black or Black British, African or Caribbean, who collectively represent 1% just of the total staff.

[23] 2011 Census, HMG.- https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/population-of-england-and-wales/latest

Age by sector

As in the ethnicity section, the IOP has information on member employer which can be broken down by member age, however the IOP has not yet completed a full analysis of this data, alike to that seen in the gender section. The IOP is committed to understanding and monitoring this data, and is completing this analysis. Results from this can be submitted to the APPG once this is complete, if requested by the committee.

Despite this, the IOP has analysed the HESA Staff Records to identify the representation of age groups within physics departments.

Spotlight on Higher Education

In the academic year 2018/19[24], the age group most represented in physics HE was 26-35, summing a third (34%) of the workforce. This age group is followed by those aged 36-45, who represent a quarter of staff (25%). As age increases beyond 40, representation decreases, with those aged 51-60 representing 17% of the workforce, and those aged 61+ representing just 7%.

Table of Higher Education staff by age

	2012/13			2018/19		
Age Group	Physics	All other Academic Disciplines	All Higher Education Staff	Physics	All other Academic Disciplines	All Higher Education Staff
21 to 25 years	4%	6%	6%	**7%**	6%	6%
26 to 30 years	16%	11%	11%	**17%**	11%	11%
31 to 35 years	17%	14%	14%	**17%**	14%	14%
36 to 40 years	14%	13%	13%	**14%**	14%	14%
41 to 45 years	12%	13%	13%	**11%**	12%	12%
46 to 50 years	12%	14%	14%	**10%**	13%	13%
51 to 55 years	10%	12%	12%	**9%**	12%	12%
56 to 60 years	8%	10%	10%	**8%**	10%	10%
61 to 65 years	5%	6%	6%	**5%**	5%	5%
66 years and over	2%	1%	1%	**2%**	2%	2%

Proportion, rounded to the nearest one per cent.

[24] Based on 7,515 staff working in HE physics.

The following table represents the ratio of proportions between the age of staff in HE physics and other disciplines. A figure of 1.0 means there is the same proportion between physics and other subjects. Numbers below 1.0 means there is under-representation.

Table of Higher Education Staff by ethnicity: Relative Representation in Physics

	2012/13	2018/19
Age Group	Representation level in physics compared with all staff, 2012/13	Representation level in physics compared with all staff, 2018/19
21 to 25 years	0.7	1.2
26 to 30 years	1.5	1.5
31 to 35 years	1.2	1.2
36 to 40 years	1.1	1.0
41 to 45 years	0.9	0.9
46 to 50 years	0.9	0.8
51 to 55 years	0.8	0.8
56 to 60 years	0.8	0.8
61 to 65 years	0.8	1.0
66 years and over	1.2	1.0

There has been a change in the age profile of physics staff over time. In 2012/13, 4% of physics staff were aged between 21 and 25, a figure well below other subjects (0.7), whereas in 2018/19, 7% were in that age range. Staff under 36 are now more prevalent in physics cost centres than among higher education staff overall.

Disability by sector

Disability is not a characteristic the IOP collects from members when they join the Institute, however, questions on disability are included in the Diversity and Inclusion survey, run every 4 years. However, this is an anonymous survey, meaning that it cannot be broken down by employment type or sector. This is a data gap which spans from the difficulties of collecting sensitive personal data, outlined in question 1.

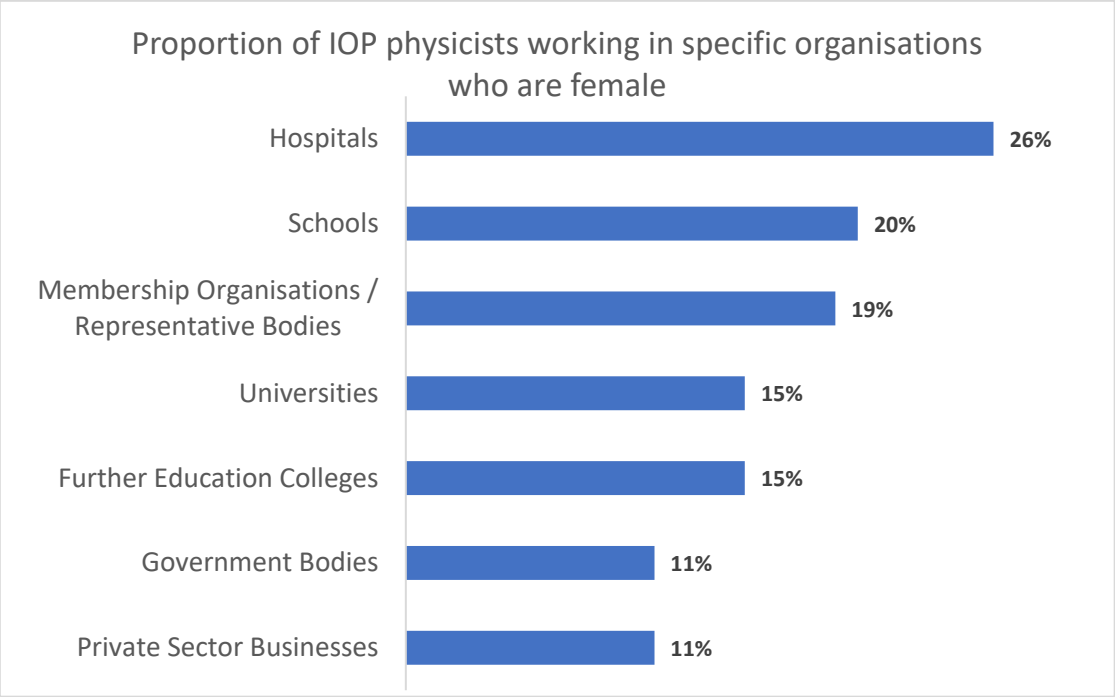
However, that IOP can report data from HESA, which found that in 2017–18, 13% of physics undergraduates in the UK had a known disability. This is below the percentage for all working age adults (19%)[25].

[25] Staff and Students in UK Physics Departments: https://www.iop.org/sites/default/files/2019-04/staff-and-students-in-uk-physics-departments.pdf

2.2. Types of organisation (e.g. private, public, non-profit)

The IOP's membership data can be broken down by working physicist's organisation type, as members disclose their employer when joining the IOP. Analysis of this revealed the following breakdown among females working in physics organisations:

Table of Specific Organisation Types: Proportion breakdown among females



The bar chart shows seven organisation types, and figures are derived from 915 female members, and their share of the total number of IOP members linked to each of the organisation types. December 2020.

This shows hospitals and schools have the highest proportion of females among their physicist workforce. Only 11% of IOP members working in the private sector or for government agencies respectively are female.

When comparing this against other demographics, the IOP's Diversity and Inclusion survey of around 2,000 IOP members found that when looking at the general picture (without specifically looking at one protected characteristic), around 23% of respondents worked in universities, and further 6% worked in schools or colleges. This suggests females working in physics are under-represented in universities, and over-represented in schools and colleges.

2.3. Type of STEM activity (e.g. academic research, education, engagement, commercial funding)

The IOP does not monitor role activities and cannot comment on differences between activities within roles between protected characteristics. However, the IOP's 2019 Diversity and Inclusion survey found that around 26% of IOP members who responded were employed in technical or scientific roles, which could reflect technician or researcher roles, and a further 7% worked in non-scientific or hybrid roles.

Please see section 2.1. which details a breakdown of protected characteristics by STEM disciplines or sub-disciplines, to see figures of staff numbers working in HE institutes, broken down by protected characteristics.

Looking at data on researchers, in 2020, UKRI published its findings after analysis of the seven Research Council's diversity data[26]. The data shows that more needs to be done to improve equality in grant awarding.

Moreover, EPSRC's peer review participation diversity data[27] shows that in 2018/19, 83% of EPSRC applications were from males, while just 14% were from females. These figures have remained statistically unchanged since 2015/16. Success rates were almost equal between the sexes, at a quarter (26% for males, and 25% for females), suggesting there is not a bias on selection. However, in absolute terms, due to the lower number of females making applications, markedly fewer applications from females receive funding compared to the number of successful applications that are submitted by males.

2.4. Job levels and/or qualification

The IOP does not record members' job levels or qualification histories.

[26] UKRI (2020). Diversity data - https://www.ukri.org/our-work/supporting-healthy-research-and-innovation-culture/equality-diversity-and-inclusion/diversity-data/

[27] EPSRC (2020) EPSRC Peer Review participation: Diversity data from 2014-15 to 2019-20 - https://epsrc.ukri.org/files/funding/edi/epsrc-peer-review-participation-diversity-data-to-2020/

3. Are there evidenced inclusive behaviours and policies within different organisations, subsectors, sectors and countries on recruitment and retention?

3.1. IOP activities

'Diversity and skills' form a core pillar in the IOP strategy, Unlocking the Future[28], and the IOP maintains a number of different policies to promote inclusive behaviours. As part of the IOP's strategy 2020-2024, we have worked on defining our organisational values – objective, open, inclusive and exemplary – which are important in shaping the culture of our organisation, and how we work with each other and other organisations. Mckinsey and Company have shown in their three-part series on the business case for diversity and inclusion there is a positive correlation between diversity and performance. The case proves that diversity of thought makes for better physics, which is currently narrower than it both could, and should be.[29]

Leadership

The IOP has been a leader in EDI for the last decade, engaging with key representatives in its membership and it has seen impact. As a learned society, we publish D&I journal articles that discuss STEM in the workplace that demonstrate us to be a peer reviewed educator in the field. We have made progress through our Diversity and Inclusion Committee which is populated by members with an interest in, and expertise across, the broad range of diversity characteristics and issues. It was at this committee that members raised concerns around bullying and harassment within the physics community and academic institutions. As a result, the committee worked in partnership with the IOP Project Juno team to incorporate addressing bullying/harassment into its framework, leading to the creation of principle 6.[30] Project Juno is the IOP's flagship gender equality scheme, that recognises and rewards departments and schools of physics, institutes and organisations that have taken action to address gender equality in physics and encourage best practice for all staff.

We participate in an Inclusive Leadership Working Group that brings EPSRC, IOP and RSC together to discuss EDI initiatives, particularly focusing on research funding, leadership training and EDI funding in STEM.

We are also a member of Athena Forum[31], that has recently merged with STEMM-DAC (Disability committee for STEM), which is a forum where representatives from the UK's leading scientific professional and learned societies, with an Independent Chair and Deputy Chair work on common issues regarding EDI in STEM.

Publishing

We first published a report on D&I in peer review[32] in 2018, where we looked at the spread of our author, reviewer and board member gender and geography since 2014. This showed under-representation of women, especially in peer review, as well as under-representation from some countries, most notably China and India. Since then we have been actively working to tackle these issues and ensure our journals are more reflective of the communities they serve. As a result of this five of our journals now offer authors the option of

[28] Unlocking the Future, the IOP Strategy: https://www.iop.org/about/strategy#gref

[29] https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters

[30] https://www.iop.org/about/IOP-diversity-inclusion/Project-Juno/Juno-principles#gref

[31] https://www.athenaforum.org.uk/

[32] http://ioppublishing.org/wp-content/uploads/2018/09/J-VAR-BK-0818-PRW-report-final.pdf

single or double-blind[33], with uptake for double-blind currently sitting between 10-20% depending on sub-discipline. We are now actively looking to flip several of our journals to exclusively double-blind in 2021. Additionally, three of our journals now offer transparent peer review, whereby the peer review reports are published alongside the article; similar to the example of 'Living within a One Planet reality: the contribution of personal Footprint calculators'.[34]

Internal recruitment

Internally, the IOP has recently started undertaking blind shortlisting, known as candidate anonymisation, when recruiting, a recognised best practice to reduce bias. In order to monitor the extent to which the IOP enjoys inclusive recruitment, we monitor recruitment data for application, shortlisting and appointments. We ask all applicants to complete an optional diversity monitoring form to review the effectiveness of our processes. We have previously offered staff unconscious bias training and have encouraged them to watch the 'Making Better Decisions in Groups[35]' Royal Society video. We have ambitions in our own EDI action plan to ensure that those who interview, or are in decision making roles, receive regular and refresher unconscious bias training. We aim for inclusive interview panels that display a variety of experience, gender, and ethnicity balance and other characteristics.

Project Juno

The IOP has been running Project Juno[36] since 2008. Project Juno works to boost the diversity of the physics workforce by recognising employers for a diverse and inclusive staff and efforts made towards gender equality.

Our Juno scheme has six principles for applicants to measure themselves against and asks for them to provide both qualitative and quantitative data to show evidence of progress. Principle one of the Juno scheme, aligns directly with the core remit of this APPG enquiry, asking for a monitoring and evidence base, as Juno is first and foremost an evidence-based initiative.

We have analysed applications and have provided best-practice examples against some of the scheme's principles that relate to recruitment and retention in the appendix.

While the Athena Swan scheme and Juno scheme operate to a similar set of principles, and are trying to achieve similar aims, there are several fundamental differences between the two. Juno is essentially a "peer review" process – all applications to Juno awards are assessed by the Juno panel, all of whom are physicists and all of whom work in Practitioner or Champion departments. All our panel members understand the issues that physics departments face and feedback is done by physicists for physicists. Physics departments are able to sign up independently, meaning that their institution does not have to have paid for Athena SWAN charter membership or achieved a level of award (Bronze) in order to take part. Additionally, Juno involves a series of site visits to offer constructive feedback and advice to physics departments to enable them to progress against the principles.

We currently have 53 institutions/departments engaged in the Juno scheme out of 62 in total in the UK. From an evaluation of Juno undertaken in 2013[37], over the first five years of operation, we saw increased awareness from staff and senior management surrounding the issues regarding women in STEM, discussion of gender issues within departments, and visibility of female staff. We are pleased to report that the proportion of female physics

[33] https://publishingsupport.iopscience.iop.org/questions/peer-review-models-on-iop-journals/

[34] https://iopscience.iop.org/article/10.1088/1748-9326/ab5f96

[35] https://www.youtube.com/watch?v=ptOhoizsHaw

[36] https://www.iop.org/about/IOP-diversity-inclusion/project-juno

[37] IOP (2013). Evaluation of Project Juno: Summary of Final Report. https://www.iop.org/sites/default/files/2020-07/Juno-evaluation-summary_0.pdf

professors increased from 6% in 2008 to 12% in 2018[38], although we are frustrated with the slow pace of progress.

We are keen to expand the Juno programme for all applicants including from industry or business, in order to improve diversity across all under-represented groups and ensure those groups do not face discrimination. The Juno panel has been reviewing the future development of Juno over this last year and is still reflecting on feedback from workshop sessions looking at ways we can improve Juno and its associated processes.

Promoting the STEM LGBT+ workforce

The IOP, the Royal Astronomical Society (RAS) and the Royal Society of Chemistry (RSC) have worked together to create a network of support for members of the physical sciences community who identify as LGBT+ and their allies and conducted a survey of members to explore the workplace culture for LGBT+ physical scientists. The resulting report[39] notes the number of LGBT+ workers leaving the physical sciences and advocates for improved retention. It recommends physical science organisations increase visibility of LGBT+ workers, build a welcoming community, review and improve EDI policies and introduce and improve staff training of EDI.

The survey found that the workplace for LGBT+ physical scientists is comfortable (75%) and improving (70%), but when taking a more intersectional approach the results showed that cisgender men felt more comfortable than cisgender women or transgender respondents. The survey also found that 28% of LGBT+ respondents had at some point considered leaving their workplace because of the climate or discrimination towards LGBT+ people.

Respondents from both academia and industry stated that working with people from cultures that are less accepting of LGBT+ people brings particular issues. In some cases, these are colleagues and students within the individual's workplace, in others, clients outside of their company or institution. How this plays out for the individual is very context driven, with varying consequences – for some, being open about their LGBT+ status causes small discomfort, while others risk losing clients and work, that could have significant consequences for the rest of their career. Such consequences are not limited to industry. An academic interview participant described his work teaching in China as putting him 'in limbo', because while being gay wasn't illegal there, it was still considered shocking. Being 'out' with colleagues would have created negative perceptions of his work.

The report's main three recommendations for LGBT+ inclusion in the workplace were:

- **Building a visible and welcoming community**: Support for LGBT+ staff needs to be visible and not just in place on paper. Senior leaders and managers should proactively act as champions and advocates by speaking out about LGBT+ issues.
- **Reviewing and improving policies**: All workplace policies and provision should be audited to ensure that LGBT+ staff are specifically protected. Policies addressing poor or difficult behaviour should be implemented to address discrimination and harassment of every kind, from the use of homophobic language in jest to the exclusion of subgroups from LGBT+ networks.
- **Introducing and improving training**: Training that supports LGBT+ staff could be used more effectively in nearly all work environments, including training on transgender inclusion and correct pronoun usage, and bystander training. LGBT+ staff groups should be consulted in the development of training and be given the

38 IOP (2020). Academic staff in UK physics departments. https://www.iop.org/sites/default/files/2020-07/Staff-characteristics-2017-18.pdf

39 IOP, RAS and RSC (2019). Exploring the workplace for LGBT+ physical scientists. https://d25f0oghafsja7.cloudfront.net/sites/default/files/2019-06/exploring-the-workplace-for-lgbtplus-physical-scientists_1.pdf

opportunity to participate in its delivery, to ensure relevance and increase visibility of LGBT+ staff.

A more detailed breakdown of these recommendations for the individual, the employer and for learned societies can be found on page 36 of the LGBT+ report. We are of course working towards implementing these recommendations ourselves. As a start, we have gender neutral toilets in our building, encourage our staff to include pronouns in their signatures and have pronoun stickers at conferences, meetings and events. We have supported Pride events at our London office and also across the regions, partnering and funding local campaigns and charities that support LGBT+ inclusion.

Disability

Our inclusive learning report; 'Building momentum towards inclusive teaching and learning'[40], published in 2017, has also been very helpful in supporting the community. It forms a guide and support manual for university's physics departments to implement good practice to support those with a disability. We share this with our members and to departments in our Juno award schemes. This work, which is comparatively young in comparison to other EDI projects, reflects how Project Juno and the LGBT+ work began.

Bullying and harassment

The IOP maintains a code of conduct[41], which all members and advocates of the IOP must adhere to when representing the IOP, such as at conferences, meetings and events. This code works to protect IOP representatives and their peers by including a broader definition of bullying and harassment. Last year, the IOP Code of Conduct was revised to include all IOP meetings, conferences and events, and now includes anyone in attendance, both members and non-members. All attendees are asked to sign up to this upon registration of a physical meeting or, more recently, online webinars. All members reaffirm their commitment to the Code through the annual renewal of their membership.

In 2019, for the first time in our member diversity survey[42], we gathered information from our members on their working or studying environment as part of our commitment to developing and promoting professional conduct and behaviours across our membership and the wider community. When asked about awareness of discriminative actions, 17% of respondents reported observing or being made aware of discriminative actions towards others over the last two years, and 19% over the last five years. Around a third of the respondents who had observed discrimination mentioned gender issues in their response. These included mentions of harassment, bullying, assault, and exclusion based on perceived gender difference, primarily towards women.

Over the last two years, 9% of respondents reported personally experiencing discriminative actions, with 11% over the last five years. Half of those who reported experiencing discriminatory behaviour in the last two years were female (50%), making up 18% of the total female respondents to the survey. Additionally, 50% of transgender respondents reported having experienced discrimination.

Bullying was the prevalent behaviour reported by respondents. It was felt that managers did not know enough about how to handle situations, how to report, monitor or reprimand such behaviours, and placed too much of the burden for resolving the situation on the victim. Much of the bullying mentioned and observed was caused by those in senior roles, directed at more junior colleagues. Causes for this included gender, sexuality and ethnicity.

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40 https://www.iop.org/sites/default/files/2019-03/building-momentum.pdf

41 IOP Code of Conduct: https://www.iop.org/about-code-conduct

42 IOP (2020). We are physicists: Results of the IOP member diversity survey 2019.

The types of actions which generated an environment of bullying or harassment for our respondents included:

- Aggressive or abusive emails
- Discriminatory statements on social media or personal blog posts
- Shouting and raised voices
- Other verbal assault, including derogatory remarks, slurs, and ill-placed humour
- Physical or sexual assault
- Overlooking individuals, accidentally blocking access to opportunities or not hearing their needs
- Deliberately withholding access to relevant information
- Plagiarism
- Exclusion through lack of access for events and conferences, including lack of safe spaces, poor timings, or physical access issues.

Additionally, while gender-discrimination dominated the comments, racism, homophobia, transphobia, ableism, and ageism were all reported, as well as discrimination against those with different beliefs, often in conjunction with one another.

As addressing bullying and harassment is also now embedded in Project Juno principle 6, we will be able to disseminate good practice from our Juno Champions, and to run good practice workshops. We regularly discuss these issues at the Heads of University Physics Departments' Forum, carrying out bespoke workshops to engage the community in the difficulties of professional conduct, and how we can work as a community to ensure the0 respect, safety and progress of our colleagues free from bullying, harassment and discrimination.

3.2. Activities in the wider community

Many of the physics organisations and departments who work closely and engage with the IOP maintain well-delivered inclusive policies and undertake activities which promote discussion around EDI and best practice, such as the following examples.

Science Council and Royal Academy of Engineering Diversity Framework

The Science Council and the Royal Academy of Engineering maintain and promote a framework, called the Progression Framework[43], to help professional bodies assess and monitor their progress on diversity and inclusion.

Professional bodies play an important role in supporting scientists and engineers throughout their careers, recognising and upholding their professional standards as well as providing continuous professional development. The framework builds on the Engineering Diversity Concordat and the Science Council Declaration on Diversity, Equality and Inclusion, and centres on identifying diversity and inclusion practice in relation to eight functions common to professional bodies. It gives professional bodies the opportunity to assess each of these functions against a four-level maturing model. The aim is to support discussion, initiation, planning and assessment of diversity and inclusion work.

Gender Inclusive Careers Guidance

As part of the Department for Education-funded Improving Gender Balance (IGB) project, the IOP education team developed support and guidance for those in secondary education who lead on Careers Education, Advice, Information and Guidance. IGB is a randomised control trial working in over 75 schools in England (with a further 70-plus in the control group). It scales up a whole-school approach to challenging bias and societal norms in

[43] https://sciencecouncil.org/professional-bodies/diversity-equality-and-inclusion/diversity-framework/

school structures, curricula, attitudes and resources to create an environment where fewer subject choices are made on gender stereotypical lines.

The guidance works with the Gatsby Benchmarks, the 2018 statutory guidance for schools to deliver careers education, and highlights where gender expectations can creep into careers guidance and suggests ways to reduce these inequalities.

The IOP had input from the Gatsby Foundation, the Careers and Enterprise Company, and the North East Local Enterprise Partnership to complete the guide.

EDI events

Events which bring together STEM communities and sectors to discuss EDI issues can be effective in boosting awareness of best practice in EDI. By way of example, we attended an international conference to share good-practice internationally on our gender programmes, of which AIP published a conference report on[44].

For example, in Scotland, the IOP, Photonics Scotland, University of Glasgow and the Knowledge Transfer Network (KTN) partnered with Equate Scotland to launch The Opening Up Photonics Initiative[45]. The initiative delivered a series of training workshops exploring practical suggestions for improving gender diversity. In addition, Technology Scotland hosted Opening Up Photonics: Fostering Innovation Through Diversity & Inclusion[46] in November 2018, where 50 professionals from across the photonics community in Scotland met to discuss promoting EDI in the sector.

The IOP works across the UK and Ireland to engage the public with physics by supporting our members to run events, working with partner organisations on shared goals. Inclusive practice is at the heart of everything we do; ranging from events for specific under-served audiences and long-running partnerships with community organisations, to the principles of accessibility and inclusion, which underpin our event and activity design process. Projects include, for the first time, the production of new Irish Sign Language signs in physics and design technology (the first of its kind) with Dublin City University, the production of a guide for academic staff on supporting STEM students with dyslexia, and a project looking at how to improve the Disabled Students Allowance needs assessments process for STEM students.

Formal networks of peers

Networks of peers bringing together those at a similar career stage can be used to discuss EDI issues and share experiences. For example, the University of Liverpool, in collaboration with the IOP and the IOP Higher Education Group, hosted a series of meetings to support the physics HE community to develop good practice for remote, virtual or hybrid learning and teaching, called the Physics learning and teaching in higher education community meetings[47]. This was an online network for departments to share good practice in EDI, and to learn more about the activities in other universities.

As mentioned above, the IOP is a co-founder of the LGBT+ Physical Sciences Network alongside the Royal Society of Chemistry and Royal Astronomical Society. A key action in our *Exploring the workplace*[48] report identified by respondents was having LGBT+ networks for staff or students. The survey indicated that environments with a focus on students were much more likely to have formal and/or informal networks in place, with student networks

[44] https://aip.scitation.org/doi/10.1063/1.5110113
[45] https://photonicsuk.org/photonicsevent/opening-up-photonics
[46] https://technologyscotland.scot/16113-2/
[47] https://www.liverpool.ac.uk/central-teaching-hub/physicslthe/
[48] Exploring the Workplace for LGBT+ Physical Scientists: https://www.iop.org/sites/default/files/2019-06/exploring-the-workplace-for-lgbtplus-physical-scientists_1.pdf

contributing significantly to the responses for teachers, doctoral students and other university employees.

4. Are there policies or activities undertaken by the UK Government, or its agencies, that advance or inhibit equity and inclusive cultures within the STEM workforce?

The Engineering and Physical Sciences Research Council (EPSRC) prioritised EDI by creating and resourcing Inclusion Matters[49] in 2018. This programme consisted of 11 projects which aimed to 'accelerate culture change with respect to equality, diversity and inclusion'. The projects are a collaboration between universities working across the UK and businesses and learned societies. They revolve around research, innovation, and embedding activities already in progress more widely, to promote a more diverse, fair and inclusive engineering and physical sciences community as well as disseminating their findings and embedding good practice more broadly in the community.

This is an example of good practice, because it places EDI at the core of EPSRC's aims. As well as being uniquely dedicated to increasing EDI, the programme engages STEM workers across sectors, from academia to industry, boosting the potential for its impact to go beyond one sector. The IOP would welcome similar EDI-led activities in future, especially focusing on the value of inclusive leadership.

In 2020, UKRI published an analysis of the seven Research Councils' diversity data[50]. The IOP welcomes the publication of this data in increasing transparency regarding equity among applicants for, and awardees of, publicly funded grants, which should enable greater scrutiny and improvements to EDI in the future. The IOP would urge action to be taken on the basis of this evidence to provide greater support and opportunities to under-represented groups.

The IOP also welcomes publication of pay data for both ethnicity and gender, and would like to see a particular focus on intersectionality to explore those further marginalised groups that the data may not initially identify.

[49] https://epsrc.ukri.org/funding/edi-at-epsrc/inclusion-matters/

[50] UKRI (2020). Diversity data. https://www.ukri.org/our-work/supporting-healthy-research-and-innovation-culture/equality-diversity-and-inclusion/diversity-data/

5. What are the impacts of COVID-19 on equity for STEM workers?

In response to COVID-19, in May 2020 the IOP consulted its membership to understand their needs and priorities arising as a consequence of the COVID-19 pandemic. Meetings and interviews were completed with more than 400 individuals across the UK and Ireland, from academia, industry, education and government. The following priorities emerged from this consultation:

- Business support: ensure physics-based businesses have access to the support and advice needed to remain operational and productive
- Physicists' careers: support career development, progression and longevity in all physics roles, but especially for early career members
- Teaching support: ensure teachers are able to teach physics effectively using distance learning approaches (covering school, college and university teaching)
- Teaching supply: ensure there is an adequate pipeline of professional physics teachers
- Assessment: support examining bodies in ensuring that revised approaches to assessment are fair, balanced and have no unintended consequences
- Exclusion: ensure school students' prospects are not permanently damaged by COVID-19.

The main issues highlighted by the consultation as potentially impacting equity in the STEM workforce included digital exclusion (i.e. limited access to high-speed broadband and/or ICT equipment) as well as the challenges of home working environments and managing caring responsibilities.

In September 2020, Equate Scotland surveyed women, students and employers in STEM on the impact of COVID-19[51]. The research showed positive examples of how women and their employers adapted to the changes caused by the pandemic. However, it also identified that many women were impacted by a change in the balance between caring responsibilities and work, a finding which reflects themes from broader research on the distribution of responsibilities during the pandemic. For example, a study from Kings College London and Ipsos Mori[52] found that under lockdown, women in the UK who are parents were doing more childcare than men who are parents, and just a third of working women reported that their responsibilities under lockdown didn't impact their paid work. This imbalance could help to explain reports that female academics have been publishing fewer articles than their male counterparts during the pandemic[53]. Equate Scotland will repeat its survey in March 2021 to assess the longer-term impact of COVID-19, including prolonged periods of disrupted work patterns, online learning, and the removal of the Job Retention Scheme.

There is also the potential for COVID-19 to have a disproportionate impact on those in the early stages of their careers, who are likely to be younger than the average age in the workforce. For example, we have heard reports that early career researchers are taking on a significant amount of the increased online teaching activity in higher education. Any consequent reduction in the time early career researchers can allocate to research could potentially limit their chances of promotion and ability to compete for jobs.

We are also concerned about the disruption to teacher training and the impact on newly qualified teachers (NQTs), in what is a challenging period even for experienced teachers.

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51 Equate Scotland (2020). COVID-19 impact report. https://equatescotland.org.uk/download/equate-scotland-covid19-impact-report/

52 King's College London (2020). Women doing more childcare under lockdown but men more likely to feel their jobs are suffering. https://www.kcl.ac.uk/news/women-doing-more-childcare-under-lockdown-but-men-more-likely-to-feel-their-jobs-are-suffering

53 Nature News (2020). Are women publishing less during the pandemic? https://www.nature.com/articles/d41586-020-01294-9

Without adequate support, promising new teachers could leave the profession, which already faces significant challenges in terms of recruitment and retention.

In education, the potential for COVID-19 to exacerbate the attainment gap between the most advantaged and disadvantaged students and other educational disparities may have longer term implications for equity in the STEM workforce. Students from disadvantaged families are already less likely to take physics post-16[54], and any widening of the attainment gap arising from the shortened in-school year and uncertainty of examination method is likely to further limit the number of young people pursuing further study and careers in STEM.

Teachers report that some students' limited access to the internet and/or ICT equipment, in particular, has meant they are unable to access effective remote learning, and this is more likely to be the case for disadvantaged students (as low-income households are less likely to have an internet connection in the home[55]). Alternative assessment arrangements also have the potential to disadvantage particular groups of students; for example, the IOP has previously raised concerns about the potential for unconscious bias to negatively affect the predicted grades awarded to girls and students from lower socio-economic groups and ethnic minority groups.[56]

54 IOP (2014). Raising Aspirations in Physics. http://iop.cld.iop.org/publications/iop/2014/page_64464.html#gref

55 ONS (2019). Exploring the UK's digital divide. https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/articles/exploringtheuksdigitaldivide/2019-03-04

56 IOP (2020). Submission to House of Commons Education Select Committee inquiry on the impact of COVID-19 on education and children's services. https://www.iop.org/sites/default/files/2020-06/Ed-select-com-impact-COVID-19.pdf

Appendix: Project Juno principles

Our Juno scheme has six principles for applicants to measure themselves against and provide evidence-based progress. Here, we have analysed applications and have provided best-practice examples against five or the six scheme's principles that relate to recruitment and retention.

Principle 1. A robust organisational framework to deliver equality of opportunity and reward

1.1. Establish organisational framework

1.1.1. Evidence of senior management commitment

1.1.2. Effective consultation, communication, monitoring, evaluation and reporting mechanisms

1.1.3. Clear accountability for implementation and resources allocated (time and money)

1.2. Monitoring and evidence base

1.2.1. Monitor over time, quantitative data by gender. Include all student admissions and performance. All staff applications, shortlists, appointment and promotion, looking at the proportion of women at each stage

1.2.2. Obtain qualitative data from staff

1.2.3. Identify any discrepancies in gender representation and/or progression and identify factors that might be causing them

Principle one requires applicants to present a robust organisational framework and a monitoring and evidence base. Applications to the scheme are confidential, and any data provided is limited to the panel only. We are unable to summarise the data provided to the scheme due to the limitations of data collection, the varying timescales in which they have been collected and the confidential nature of applications. We are, however, able to share our own data and evidence as requested in the first 2 questions of the submission and the below evidence that can be presented against the following principles.

Principle 2: Appointment and selection processes and procedures that encourage men and women to apply for academic posts at all levels

2.1. Ensure that processes and procedures are fully inclusive

2.1.1. Ensure career breaks are taken into consideration

2.1.2. Gender awareness included in training for all staff who interview

2.1.3. Provide induction for all new staff, including research assistants, on appointment

2.2. Take positive action to encourage under-represented groups to apply for jobs

2.2.1. Monitor applications, shortlists and appointments, looking at the proportion of women (internal and external) at each stage

2.2.2. Identify any discrepancies and investigate why this might be the case, taking action as necessary

Successful applications that have achieved Juno Champion status have demonstrated the following examples of good practice in recruitment. Part time working is encouraged in recruitment and career breaks are taken into consideration when evaluating applicants. Mixed gender interview panels are embedded practice and to prevent overloading of underrepresented staff, there are exchanges of interviewers with other disciplines.

“Job advertisements explicitly declare that applications are welcomed from women and other underrepresented groups and female and male contacts for further information are included in the vacancy advertisements. STEM vacancies are advertised in places where potential female staff will see them, such as the WISE newsletter”.

Close attention is paid to the wording of job adverts and supporting materials, gender bias is removed and there is specific mention of support for parental leave. There are personal invitations to female candidates to encourage them to apply for academic vacancies (including postdocs).

Software is in use to check for gendered wording in adverts. Department has a policy of establishing search committees that positively engage with strong women applicants for posts. There is a University-wide Parents’ and Carers’ Network supporting staff with caring responsibilities.

Principle 3: Departmental structures and systems which support and encourage the career progression and promotion of all staff and enable men and women to progress and continue in their careers

3.1. Transparent appraisal and development

3.1.1. Appraise all staff, including researchers and PDRAs

3.1.2. Mentoring scheme in place with training and guidance available for both mentors and mentees

3.1.3. Ensure all staff, including PDRAs, have access to impartial career guidance

3.2. Transparent promotion processes and procedures

3.2.1. Ensure promotions process is transparent and fair to all staff at all levels, including those who have had a career break

3.2.2. Ensure all staff are aware of promotion criteria and process and the support available to them throughout the process

3.2.3. Take steps to identify and encourage potential candidates for promotion

Examples from successful applications that have evidence to meet principle 3 include creating career guidance that is included in the staff handbook. The inclusion and recognition of Postdocs by having their own forums, invited them to staff meetings and encouraging them to lead their own bullying and harassment workshops.

In some universities there are compulsory Professional Development Review (PDR, appraisals) measures in place to ensure 100% uptake from academic staff, and promotion discussions are embedded in the PDR. Postdocs have their PDRs with someone who is not a grant holder and careers guidance is a compulsory part of this process. In support of this, there is training for all appraisers and appraisees.

For fair promotions, the promotion process takes into account career breaks and alternative routes such as teaching and scholarships. There is interview training available for candidates for promotion and unsuccessful candidates for promotion receive in-person feedback from the HoD and/or Dean. It is considered fair and best practice when all academic staff are considered for promotion annually via scrutiny of CVs. Additionally, a small panel of professors look at potential promotion cases in advance of submission.

Promotion should be available for postdocs and there is availability of recognition pay. Some universities allow new academic staff a 50% reduction in teaching/admin during their first year to assist with settling in and building their research.

There should be support for those applying for research grants and fellowships including mock interviews, workshops, lectures. There is an action to support and discuss unsuccessful applications.

Career guidance is offered to technical staff and PDRAs including support for organising the annual University technical conference

There is support from the department for training aimed at professional development such as the schemes for early career academics wishing to become lecturers, the Aurora leadership training for female HE staff and the Professorial training programme for staff at professor level

Principle 4: Departmental organisation, structure, management arrangements and culture that are open, inclusive and transparent and encourage the participation of all staff

4.1. Promote an inclusive culture

4.1.1. Ensure departmental processes, procedures and practices are fully inclusive

4.1.2. Gender awareness included in the training for all staff and demonstrators

4.1.3. Promote inclusive social activities and other opportunities for mutual support and interaction

4.1.4. Use positive, inclusive images in both internal and external communications

4.1.5. Encourage and support female seminar speakers

4.2. Transparent work allocation model

4.2.1. Recognise the full range of types of contribution and departmental role, including administration, welfare and outreach activities

4.2.2. Ensure all staff are aware of the criteria used to develop the model and that the allocation is transparent

Examples from successful applications that have applied principle 4 include a Faculty-level best practice guide on organisation of events (including gender balance of speakers, accessibility for disabled people, and how to deal with inappropriate behaviour). Alcohol has been removed from compulsory events. Family friendly events take place that are not associated with alcohol.

Line-managers have mandatory appraisal training, monitored by the central university, which includes unconscious bias training and they are now offered a new ‘managing diversity’ training. In some universities there is an online ‘Appraisal Skills Workshop’ offered to all academic staff to prepare for appraisals.

Applicants who meet principle 4 have strong support for staff participation in external committees, which links into appraisal and career development. There are non-professorial staff lunches to encourage networking and input to departmental policy. Additionally, every member of school is expected to do a certain amount of mandatory training (such as Prevent, Equality essentials, Unconscious bias, GDPR, safeguarding) and all training is refreshed every three years. There is a training day held annually for all staff to check their training is up to date. In conjunction with this, there is Diversity and Inclusion training for Graduate Teaching Assistants and new student induction session that includes presentation on diversity issues.

Principle 5. Flexible approaches and provisions that enable individuals, at all career and life stages, to optimise their contribution to their department, institution and to STEM

5.1. Support and promote flexible working practices

5.1.1. Clear support from Head of Department for flexible and part-time working

5.1.2. Consistently applied policy on part-time and flexible working

5.1.3. Promote the benefits of flexible working for both men and women, particularly for those with caring responsibilities

5.1.4. Explicit support for those returning from career breaks or maternity leave

5.1.5. Encourage take up of shared parental, paternity and other caring leave.

Best practice for the promotion of flexible working, usually sees applications having a formal flexible working policy with a clear process for considering requests for staff to change working pattern, or change from a full-time to part-time contract. Staff can transition from Full Time to Part Time and back again via amendments in their contract. Postgraduate students receiving fully funded maternity leave for 26 weeks via university scholarships.

Successful applications have a culture of support within the department for flexible working and this has been promoted, i.e. using an innovative postcard campaign or other case studies have illustrated the benefits of flexible working. In order to ensure fair and equal opportunities, academics returning from career breaks are prioritised for investment in equipment and personnel to develop new research initiatives.

In some universities, faculty have introduced a carers' fund enabling academics with caring responsibilities to be able to apply for additional funds to help cover their caring needs in order for them to be able to attend conferences and talks related to their professional development. Part-time teaching cover for maternity leave, plus support to maintain research activities is provided to academics on maternity leave. Additionally, there is support for those returning to work following a career break.

In order to measure this, questions in the staff survey included around flexible working and evidence from the feedback from the survey indicates that a large percentage of staff feel they are able to work flexibly. There should also be a leave and returners scheme in place with good take-up of the leave by men and the scheme has been adopted by other Schools.

Principle 6: An environment where professional conduct is embedded into departmental culture and behaviour

6.1. Ensure that all staff and students are aware of expected professional conduct.

6.2. Address bullying, harassment and misconduct

6.2.1. Ensure all staff and students are aware of how complaints of bullying, harassment or other misconduct will be dealt with through an enforceable formal policy.

6.2.2. Ensure there is a transparent reporting mechanism within the department to address any complaints.

The university has an 'It Stops Here' campaign (which is a collaboration between staff and student union) which includes sexual harassment and has been expanded to include religious hate crimes.

The department working with the faculty and postdocs have developed a bullying and harassment workshop, which has been trialled for postdocs and will be rolled out to staff and PG students.

The IOP introduced Principle 6 in 2018 to address concerns around professional conduct. This was 10 years after the Juno scheme was initiated and therefore there is less evidence around this principle. However, examples of good practice that we have seen in applications include sessions on harassment, bullying, and 'lad' culture in undergraduate and postgraduate inductions. Universities have undergone bystander training and unconscious bias training, and this is made available to all students with a 'consent matters' module.

Questions are included in the staff and student surveys and there is monitoring of responses to questions regarding workplace culture, harassment and bullying in the staff survey. Responses to staff surveys demonstrate an understanding of the importance of the need to practice professional conduct

Most universities ensure that all staff are made aware of Dignity at Work & Study policies and ensure that survey evidence shows the policy is understood and there has been an increase in confidence in line manager ability to deal with bullying and harassment behaviour.

More recently we have seen new reporting systems (which can be anonymous) for anyone to use and the head of schools have written to all staff and students to announce the system.