IOP Institute of Physics

Inquiry into Women in STEM Careers

Institute of Physics response to the Science and Technology Select Committee call for written evidence

A full list of the Institute's submissions to consultations and inquiries can be viewed at www.iop.org

3 September 2013

3 September 2013

The Clerk
Science and Technology Committee
House of Commons
7 Millbank
London
SW1P 3JA

Dear Sir/Madam

Call for evidence: Women in STEM Careers

The Institute of Physics is a leading scientific society promoting physics and bringing physicists together for the benefit of all. It has a worldwide membership of around 40,000 comprising physicists from all sectors, as well as those with an interest in physics. It works to advance physics research, application and education; and engages with policy makers and the public to develop awareness and understanding of physics. Its publishing company, IOP Publishing, is a world leader in professional scientific communications.

The Institute is pleased to submit its views to inform the Science and Technology Select Committee's call for evidence. The attached annex details our response to the questions listed in the call for evidence.

If you need any further information on the points raised, please do not hesitate to contact me.

Yours faithfully,

Professor Peter Main

Executive Summary

1. The Institute of Physics is a leading scientific society promoting physics and bringing physicists together for the benefit of all. Since 2004, the Institute has run a specific Diversity and Inclusion Programme[1], staffed and funded by the Institute, which aims to increase diversity along the whole of the physics pipeline, from education through to employment. So far, we have committed well in excess of £1.5m to diversity in physics in the last decade. One of the main issues is that, while women struggle to fulfil their potential in many different STEM careers, in physics we also face the problem of initial recruitment to the discipline.

2. For women in physics academia, there is one professor for every four senior lecturers or lecturers, whereas for men the ratio is 3:4. Of the 39 physics cost centres with five or more professors, 20 (51%) did not have any female professors in 2009/10[2]. The proportion of female non-UK nationals in physics has remained consistently higher than males, rising from 46% in 2003/04 to 51% in 2009/10.

3. The Institute believes that there are a number of key obstructions in the academic "pipeline", some of which may be more likely to affect women. These are
   - The experiences of postdoctoral researchers
   - Age of appointment to permanent positions
   - Taking, and returning from, career breaks
   - The impact of childcare on attending events and conferences
   - Part-time working in academia
   - Dual Careers
   - *Unconscious bias*

4. There are no national datasets, outside of the Labour Force Survey, covering what happens to people's careers once they are in employment. Some universities keep data on postdoctoral leavers' destinations, but this is not always comprehensive, and is often done ad hoc.

5. There needs to be a whole-scale culture change in STEM higher education, covering both staff and students. The Institute has initiated this culture change for academic staff in physics departments through Project Juno[3], an award scheme that recognises and rewards physics departments that are working to address the under-representation of women. At each stage they receive individual guidance and feedback from an independent panel on their work. We currently have seven Juno Champions, nine Practitioners and a further 23 Supporters working towards Practitioner. This represents 39 out of the 56 physics departments in the UK and Ireland. It is the supportive nature of the Juno process that physics departments have particularly commended when engaging with both Juno and Athena SWAN.

6. The Institute believes that if many of the issues raised in this paper around women in academic careers are to be tackled, it must include a focus on understanding the need for holistic cultural change, tackled on different levels involving partnerships between educators, Government and professional bodies like ourselves. There are, however, issues that can only be initiated and tackled by Government, at a national level.
   - *Addressing the physics pipeline in schools*
   - *Long-hours culture, part-time working in HE and career breaks*
   - *Dual Careers*

[1] For more information, visit www.iop.org/diversity
[2] All figures are taken from: Statistical Report: Academic Physics Staff in UK Higher Education Institutions, Institute of Physics, 2012 http://www.iop.org/publications/iop/2012/file_53617.pdf
[3] For more information, visit www.iop.org/diversity/juno

- *Equality Schemes and Publishing data*
- *Good practice in childcare*

Introduction

1. The Institute of Physics is a leading scientific society promoting physics and bringing physicists together for the benefit of all. It has a worldwide membership of around 40,000 comprising physicists from all sectors, as well as those with an interest in physics. It works to advance physics research, application and education; and engages with policy makers and the public to develop awareness and understanding of physics. Its publishing company, IOP Publishing, is a world leader in professional scientific communications.

2. Since 2004, the Institute has run a specific Diversity and Inclusion Programme[4], staffed and funded by the Institute, which aims to increase diversity along the whole of the physics pipeline, from education through to employment. So far, we have committed well in excess of £1.5m to diversity in physics in the last decade. One of the main issues is that, while women struggle to fulfil their potential in many different STEM careers, in physics we also face the problem of initial recruitment to the discipline. Our long-standing Girls in Physics programme[5] in schools has aimed to encourage teachers to examine their teaching methods and share information on successful teaching and learning strategies to engage girls with physics. In 2012, the Institute's, It's Different for Girls[6], threw a media spotlight on this issue by highlighting the fact that almost half of all maintained co-ed schools in England (49%) sent no girls on to A-level physics in 2011.

Question 1: Why do numbers of women in STEM academic careers decline further up the career ladder?

3. In 2009/10, in physics, 19% of men and 6% of women were professors, 26% of men and 25% of women were senior lecturers or lecturers and 55% of men and 69% of women were researchers. To put this in perspective, for women there is one professor for every four senior lecturers or lecturers, whereas for men the ratio is 3:4. Of the 39 physics cost centres with five or more professors, 20 (51%) did not have any female professors in 2009/10[7].

4. The proportion of female academic staff in physics has risen, across all grades, from 13% in 2003/04 to 16% in 2009/10, but remains significantly lower than the HE sector average of 41%. The proportion of male non-UK nationals in physics has risen from 31% in 2003/04 to 40% in 2009/10 but the proportion of female non-UK nationals has remained consistently higher, rising from 46% in 2003/04 to 51% in 2009/10. Therefore, whilst the numbers of female staff do seem to be rising, this is attributable to more staff coming from abroad.

5. When we analysed academic staff in physics by gender and age, we found that, in all physics cost centres and in the 41-50 and 51-60 age bands, smaller proportions of women permanent academic staff are at professorial level in physics than men.

6. The Institute believes that there is no one simple answer to this question, but that there are a number of key obstructions in the academic "pipeline", some of which may be more

[4] For more information, visit www.iop.org/diversity
[5] For more information, visit http://www.iop.org/education/teacher/support/girls_physics/page_41593.html
[6] It's Different for Girls: The influence of schools , Institute of Physics (2012) http://www.iop.org/education/teacher/support/girls_physics/file_58196.pdf
[7] All figures are taken from: Statistical Report: Academic Physics Staff in UK Higher Education Institutions, Institute of Physics, 2012 http://www.iop.org/publications/iop/2012/file_53617.pdf

likely to affect women. We have highlighted below the issues that we believe are most pertinent to physics, and also the action that the Institute has taken to try to address some of them.

The experiences of postdoctoral researchers

7. In 2011, the Institute together with the Royal Society of Chemistry (RSC)[8] undertook a comprehensive survey of postdoctoral researchers in both disciplines to find out whether there were gender differences in the motivations for postdoctoral study and future career intentions. We highlight here only the findings for physics.

8. Our survey found that male PDRs seemed more intent on a career in academia and that they became more focused on an academic career as time went on. Male postdoctoral researchers were more likely than females to select To gain a permanent academic post as a reason for undertaking postdoctoral research (53% compared to 42% respectively).

9. In terms of longer term career plans, for those on their first PDR contract, similar numbers of males and females selected Academic on a permanent contract as what they were most likely to be doing in 6-10 years' time (average 65%). However, for those on second and subsequent contracts, the number of females selecting this stayed more or less the same (falling from 57% to 55%) but the number of males rose from 63% to 76%. Therefore, whilst undertaking postdoctoral research does not have a negative effect on the intentions of females to have a career in academia, it has a highly positive effect on that of males.

10. One of the most disheartening findings, however, was that only 40% of all the PDRs reported that they felt that they were respected and well regarded in their department. Factors such as a lack of a comprehensive induction, poor appraisal, lack of mentoring and lack of impartial careers advice all contributed to this. It may be that, when combined, these factors are more likely to affect women to a greater extent than men.

Age of appointment to permanent positions

11. From our analysis of the data[9], the average age for appointment to lecturer grade was 34 for women and men. Knowing this means that women may have to make difficult decisions about when to settle down and start a family. Having a child before a permanent appointment may mean losing a huge amount of time in the early career stages, but waiting until a permanent appointment may mean progressing to senior levels less quickly.

Taking, and returning from, career breaks

12. We have anecdotal evidence from many of our members in academia that maternity leave is often organised ad-hoc, poorly implemented at the departmental level and women are not properly informed of their entitlements. The Institute's Project Juno (see paragraphs 38-40 below) seeks to address this, and other issues. In the Institute's most recent Salary Survey (2010), we found that only 6.4% of respondents had taken a career break in the last five years and that, proportionately, women were almost three times as likely to have taken a career break in the last five years as men (14.3% compared to 5%).

The impact of childcare on attending events and conferences

[8] Mapping the Future: Physics and Chemistry Postdoctoral Researchers' Experiences and Career Intentions. Institute of Physics and Royal Society of Chemistry, 2011

[9] Survey of Academic Appointments in Physics, 2004–2008

13. The Institute conducted a childcare survey of its members in 2009[10]. Over half (58%) of respondents thought that their career progression had been affected by childcare issues and women were almost twice as likely to report this as men (80% compared to 47% respectively). Respondents selected three main reasons for this: attendance at conferences and events, and having to restrict travel; the need to restrict hours to meet childcare responsibilities; and the relative lack of flexibility.

14. Attending conferences and events, particularly international ones, are essential to any academic career as they provide invaluable opportunities to discuss research with experts and find out about the most up to date research. The fact that almost 75% of respondents reported attending fewer conferences and events once they had caring responsibilities and 70% reported that they had not attended conferences solely because of childcare issues was extremely striking, particularly as this was more frequently reported by respondents in academia, and women were significantly more likely to report this than men. When asked about recovering additional childcare costs, 86% reported that they had not been able to recover these.

15. The Institute has implemented a Carers' Fund, which provides additional financial help to cover the costs of additional care (including childcare) for IOP members to attend events and conferences. The take-up of the fund, however, is still quite low, indicating that childcare barriers may not simply be financial but also logistical and structural.

Part-time working in academia

16. Our childcare survey found that less than 20% of respondents worked part-time, but that the overwhelming majority of those that did were women. A significantly smaller proportion of women with childcare responsibilities worked part-time in permanent university roles than in other areas.

17. When we asked respondents to our Salary Survey to report what their contractual hours were and how many hours they actually worked, 73.2% of those in education reported that they worked more than 40 hours, compared to 50.3 in industry. 28.2% of respondents in education reported they worked more than 51 hours per week, compared to 8.6% in industry. There is clearly a long-hours culture in academia and, anecdotally, there may little point in working part-time in a university, particularly if the reality is that full-time working means regularly working 60 hours per week.

Dual Careers

18. Little is known about the number of academic couples, or even science workforce couples, in the UK. The ASSET 2010 Survey[11] found that, of 4503 (F 1395, M 3108) STEMM (Science, Technology, Engineering, Maths and Medicine) staff surveyed at lecturer level or above, 84% of females had partners, compared to 89% of males, and 42% of females had partners working in STEMM (compared to 29% of males). In a subject like physics, where there are only 47 departments and a handful of physics laboratories where research can be pursued in the UK, the opportunities for both partners to pursue specialised research are incredibly limited. By not addressing this issue, the science sector is losing potential talent in the science pipeline, as couples make extremely difficult decisions around whose career takes precedence, and where to live.

Unconscious bias

[10] IOP Childcare Survey http://www.iop.org/publications/iop/2010/page_45280.html
[11] Athena Survey of Science, Engineering and Technology (ASSET). For more information, visit http://www.athenasurvey.org.uk/index.html

19. The concept of unconscious bias is starting to enter the mainstream and it may be that this also plays a role in the seeming lack of progress for women in physics and STEM more generally. Research from the USA[12] has shown that, at the school level, teachers' stereotypical assumptions about gender and science are prevalent in the classroom as teachers attribute girls' achievements in physics to hard work, but boys' to natural talent, even where boys attain less well. It seems likely that some of these assumptions also follow women into their academic careers.

Conclusions

20. As said above, it is likely that it is a complex combination of all the above factors that contribute to the decline of women in STEM as their academic career progresses. Experience of postdoctoral research does not necessarily put women off an academic career, but it does not seem to make them positive about it in the way it does for males. The average age of appointment to a permanent position is 34, when many women are thinking of settling down and having a family. When the family does arrive, there are major issues around taking a career break and negotiating a return to a long-hours culture as an academic, combined with the logistical and financial childcare issues that make it extremely difficult to attend the national and international conferences and events that underpin an academic career. Where a woman also has a partner in an academic career, these difficulties are compounded, given that two people are juggling long-hours, often in different locations, and difficult decisions must be made about whose career ultimately takes precedence. Finally, women are simply less likely to reach professorial level by the same age as their male peers.

Question 2: When women leave academia, what careers do they transition into? What are the consequences of scientifically trained women applying their skills in different employment sectors?

21. There are no national datasets, outside of the Labour Force Survey, covering what happens to people's careers once they are in employment. Some universities keep data on postdoctoral leavers' destinations, but this is not always comprehensive, and is often done ad hoc.

22. In physics, there are two pathways for an undergraduate degree: the traditional 3-year BSc, and the enhanced 4-year undergraduate Masters, the MPhys or MSci[13]. The MPhys is now seen as the preferred route to a career in physics research. We have found that women are more likely than men to take BSc degrees in physics compared to the MPhys and that, based on results, this is not for reasons of attainment.

23. In our longitudinal study of physics graduates, we found that 39.2% of physics graduates went into employment. Of these, respondents with MPhys degrees were most likely to have an occupation related to physics, and women with BSc degrees were the least likely to, and the least likely to report that their physics background was useful for their occupation. Respondents with MPhys degrees, particularly females, were more likely to go into scientific and technical industries, energy and environment or government research. Women were more likely than men to go into education (an employment role, rather than a training role) and were less likely to work in electronics/IT/software. Those with BSc degrees were more likely to be working in media and communications and retail sectors.

[12] Carlone, H B (2003). (Re)producing good science students: Girls' participation in high school physics. Journal of Women and Minorities in Science and Engineering 9 (1) 17-34

[13] Some universities offer the MSci degree (as opposed to MPhys). For the purposes of brevity, this document refers only to the MPhys, but includes those registered on and graduating with either MPhys or MSci.

24. In terms of the sectors that our members work in, respondents to our Salary Survey in 2010 provided information on the main sector that they worked in and what their main functions were. The largest two sectors that of respondents worked in were Industry (37.2% overall; gender split was 87.2%M, 12.8% F) and Education (36.7% overall; gender split was 79.6%M, 20.4%F). When asked about Education, 83% responded that they worked in a university. When asked about main functions, we found that the largest proportions of females were in administration and other, and the largest disparities between men and women were in 'development', 'management' and 'other'.

Question 3: What should universities and the higher education sector do to retain women graduates and PhD students in academic careers? Are there examples of good practice?

25. We have already mentioned the data we have found about women's choices of degree paths at undergraduate level. Universities need to investigate this phenomenon and find out the reasons why women may be choosing not to pursue the enhanced degree, and whether this is a problem unique to physics or is true across all STEM subjects.

26. For all the reasons listed above, there needs to be a whole-scale culture change in STEM higher education, covering both staff and students. The Institute has initiated this culture change for academic staff in physics departments through Project Juno[14], an award scheme that recognises and rewards physics departments that are working to address the under-representation of women. A department moves through levels of recognition as they identify issues, develop an action plan and work through it. They start out as Supporters then progress through Practitioner and to Champion level. At each stage they receive individual guidance and feedback from an independent panel on their work. We currently have seven Juno Champions, nine Practitioners and a further 23 Supporters working towards Practitioner. This represents 39 out of the 56 physics departments in the UK and Ireland.

27. Project Juno requires physics departments to establish their baseline, both quantitatively and qualitatively, and then to build on this. Departments must address issues such as ensuring their recruitment procedures are fair and transparent for all staff, including PDRs. Departments must also review their promotions, appraisal and career development processes and ensure that their workload allocation model is fair and transparent, taking account of all types of activity, including administration, welfare and outreach. Finally, departments must also provide evidence of how career break, part-time and flexible working policies operate in practice at the departmental level.

28. Juno runs parallel to the Athena SWAN award process and there is the availability of a fast-track between departmental Athena Silver and Juno Champion. There are however, subtle differences in the approaches of both schemes: Juno takes a bottom-up approach to change; is smaller and more intimate than Athena; and, crucially, provides constructive feedback and support to physics departments throughout their entire Juno journey, including a visit to potential Champion departments to identify good practice and highlight areas where improvement is still needed.

29. It is the supportive nature of the Juno process that physics departments have particularly commended when engaging with both Juno and Athena SWAN. Nevertheless, there is still a long way to go to embed culture change within departments: there remain departments who have not yet engaged in either scheme, and physics still does not have a department which has attained the highest level, Athena Gold.

[14] For more information, visit www.iop.org/diversity/juno

Question 4: What role should the Government have in encouraging the retention of women in academic STEM careers?

30. The Institute believes that if many of the issues raised in this paper around women in academic careers are to be tackled, it must include a focus on understanding the need for holistic cultural change, tackled on different levels involving partnerships between educators, Government and professional bodies like ourselves. There are, however, issues that can only be initiated and tackled by Government, at a national level.

Addressing the physics pipeline in schools

31. The Institute believes that the questions missed one vital issue, particularly pertinent to physics, and that is of the pipeline into university physics education. Only around 20% of those taking A Level physics are girls, and this means we can only at best achieve 20% participation at higher levels. The Institute has been addressing this issue for many years through its Girls in Physics programme and, now, through our Stimulating Physics Network (SPN). Our SPN, funded by the Department for Education (DfE), works directly with schools to raise the quality of teaching of physics and, through this, in the SPN partner schools, we have seen increases in progression to A-level Physics for both boys and girls, the latter at twice the national rate. This clearly shows that targeted initiatives can and do work. However, crucial action is needed nationally to raise the participation/ expectation at school level above and beyond what the Institute can do alone. We need action within the school system and, more challengingly, to address ingrained social perceptions and family expectations, particularly the lack of science capital that is vital to developing and maintaining an interest in science. Primary teachers, too, need better qualifications to teach science within the primary curriculum. All of this falls on government as the responsible body to take this forward, and until this responsibility is accepted and engaged with, then actions at higher level will be limited to modest gains.

Long-hours culture, part-time working in HE and career breaks

32. The government needs to enable universities to address the issues around the long-hours culture in academia and the perception and role of part-time working in a STEM academic career. Action needs to be taken nationally on this issue, ideally driven by UniversitiesUK who could encourage the sharing of best practice. Universities need to recognise that the average age at which a permanent appointment is made may be a barrier in itself, and that explicit measures need to be taken nationally not only to encourage more female applicants, but to take account of career breaks already taken. The Funding Councils play a role in ensuring that diversity is promoted through the REF, rather than simply taken account of.

Dual Careers

33. The government cannot ignore the issues around dual academic careers any longer, where the long-hours culture, the necessity to travel to conference and events, and the very fact that often two academics will live separately in order to pursue their research must be addressed nationally. Universities needs robust, practical guidance on dual hiring (as happens in the USA) to ensure that it is transparent and fair and allows two STEM academic careers to progress, given the issues raised in this paper. UniversitiesUK will play a role in developing and implementing this along with professional bodies like ourselves.

Equality Schemes and Publishing data

34. When participating in schemes such as Juno and Athena SWAN, universities and departments must gather gender-disaggregated data to enable them to identify where the gaps really are. The Government could require all universities to collect and publicise this data prominently on their websites (regardless of whether they participate in one of the schemes) and to explain any obvious inequalities. This should, as with Juno, not

simply include proportions of females at various grades but also include data such as the proportions of women applying, being shortlisted and being appointed for jobs.

Good practice in childcare

35. The Government could review good practice in terms of childcare, such as the IOP Carer's Fund, and extend this to allowing additional childcare costs as part of a research funding grants, which would make a huge difference to many researchers, particularly early career researchers, with childcare responsibilities. The issues around the provision (particularly for school-age children) and flexibility of childcare are also important, as highlighted by our report.