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22nd December 2016

Re: Consultation on the Northern Ireland programme for government 2016-21

To Whom It May Concern,

The Institute of Physics in Ireland welcomes the opportunity to submit a response to the Northern Ireland Executive on the programme for government 2016-21.

The Institute of Physics is a scientific membership organisation devoted to increasing the understanding and application of physics. It has over 2000 members in Northern Ireland and the Republic of Ireland.

The Institute of Physics has a world-wide membership of over 50,000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

This submission was prepared in consultation with the IOP in Ireland's governing committee, its Education Group and with input from members of the IOP working in business and education at all levels. The attached document highlights key issues of concern to the IOP.

If you require any further information or clarification, please do not hesitate to contact the IOP at the above address.

Yours sincerely



Dr Mark Lang
Chair IOP Ireland



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Consultation on the Northern Ireland programme for government 2016-21

Response from the Institute of Physics December 2016

This response from the Institute of Physics (IOP) focusses on issues which relate to education and the economy.

The IOP considers that strengthening Northern Ireland's research, technological development and innovation base is essential for driving the economic growth in Ireland. As such, we strongly believe that measures to protect and enhance the teaching and learning of science and technology need to be implemented across all departments. While the draft document makes references to indicators relating to improving education and the skills of the workforce, we are concerned that there is little mention of the importance of science in this area.

Importance of physics to the Northern Ireland economy

There is ample evidence to show that innovation is a major driver of economic growth; and a critical aspect of innovation comes from research in physics. In the UK, physics-based businesses have long punched above their weight in the economy, accounting for as many jobs as the construction sector and as much gross value added (GVA) as finance, banking and insurance.¹ Areas such as communications, medical technology, the aerospace industry and energy are all significant drivers of the Northern Ireland economy providing highly productive jobs. It is clear that it is growth in this type of employment which is essential for the region. Northern Ireland's economy is particularly weak in relation to high tech manufacturing. **Further investment in research and development in higher education and business in areas fundamental to physics, as well as in related innovated funding, would make a significant contribution to Northern Ireland's future economic success. There is a need to work with industry to review the manufacturing base in Northern Ireland and identify opportunities for growth in physics-based industries.**

Securing the supply of skills

For Northern Ireland to best take advantage of investment in research and development there is a need to ensure a supply of suitably qualified technicians, scientists and engineers.

The consultation document notes the shortage of suitably qualified people within the areas of science, technology, maths and engineering. This shortage requires action at all levels of education, not just at postgraduate level. For example, there **needs to be more support in schools to ensure uptake of the physical sciences, plus support to provide effective careers information at all stages.** To facilitate this and to act as a driver for change, **the IOP strongly recommends the full implementation of the Northern Ireland STEM Review² proposals and in particular the rapid appointment of an independent chief STEM advisor.** This is vital to ensure a strong, fully coordinated approach to the implementation of proposals in this area.

¹ Institute of Physics. *The importance of Physics to the UK Economy*, 2012. http://www.iop.org/publications/iop/2012/page_58712.html

² Department of Education. *Report of the STEM Review, Department of Employment and Learning*, 2009. http://www.delni.gov.uk/report_of_the_stem_review.pdf

Support for science in schools

Primary Level

The consultation document notes the importance of 'supporting schools to embed innovation, creativity and entrepreneurship at levels of education from primary to career development'. Children who identify with science from an early age can begin to pursue and develop their own interests and talents in the subject, making them more likely to choose it in secondary education and therefore open doors in higher education and in their careers.³

However, there is no separate teaching of science in primary schools in Northern Ireland. Science is taught as part of a wider curriculum alongside history and geography and there is no statutory duty on teachers to teach these subjects equally. Only 1.5% of registered teachers in primary schools have a science qualification. As such, primary school students in Northern Ireland are not likely to have a realisation that science can be for them -- and many students, particularly those from some of the most deprived backgrounds, are likely to have had no scientific stimulus until they reach secondary education, or what the ASPIRES project refers to as a lack of 'science capital'. A number of studies show that attitudes towards science become fixed at primary school age, and relying on good science education beginning at secondary school is likely to be too little, too late.³ **As such, the primary science curriculum should be reviewed to explore ways to re-introduce a requirement to teach the sciences in an appropriate way in primary schools.**

Second Level

Students who study physics in school are in particularly high demand by universities and physics is one of the most frequently cited facilitating subjects for admission to science, technology, engineering and mathematics (STEM) and also for non-STEM degree courses. Physics graduates have high earning potential and their skills are valued in a huge range of jobs. Students deserve to benefit from a physics education and should have an equal opportunity to study physics.

However, studying physics is not accessible to many students in Northern Ireland, with less than 40% of second level schools offering the subject at A-Level. Many post primary secondary schools have no physics graduates as science teachers. As noted in the 2009 Northern Ireland STEM Review³ 15% of physics teachers in non-selective schools do not have a primary qualification in physics. Hence, in many schools, there is very limited capacity to teach physics even in partnership with other schools particularly at A-Level. This also limits capacity at Double Award Science and Physics GCSE where the reality of the situation is that they will be taught by a biology or chemistry teacher teaching out of their specialism. The impact of this is the non-specialist teacher will have less knowledge and enthusiasm to inspire students to continue in physics to A-Level (if that was even an option at the school), also the non-specialist teacher will be less likely to inspire the student to reach their full potential at GCSE level.

In addition, students in Northern Ireland are not required to study any of the sciences beyond the age of 14. As noted by the Association for Science Education⁴ and other sector bodies, this is in stark contrast with the rest of the UK and many other countries where

³ King's College London. *Aspires project report*, 2013.

<http://www.kcl.ac.uk/sspp/departments/education/research/aspires/ASPIRES-final-report-December-2013.pdf>

⁴ Association of Science Education. *ASE has concerns about science education in Northern Ireland*, 2013. <http://www.ase.org.uk/news/ase-news/ase-has-concerns-science-education-in-northern-ireland/>

science education is required up to the age of 16. Compulsory status of Post 14 science is a significant issue due to the potential for students from Northern Ireland to be disadvantaged on application to any UCAS course (not just science based) in an English university. In order to be deemed to have met the specific “Ebacc” suite of subjects (Gold standard GCSE subjects) at GCSE, students must have either completed Double Award or Combined Science at GCSE or studied all three separate GCSE Sciences (biology, chemistry and physics). For example, a grammar school student gaining an A* in both GCSE biology and physics and A* in maths, English Language and history and 4 other subjects from Northern Ireland would not be deemed to have met the requirements for the Ebacc suite of subjects because will not have met the required minimum level of KS4 chemistry as set out in the National Curriculum for KS4 for England. It is worth noting that it is a requirement for all schools to offer at least GCSE combined science to all students in an English school. Unless a similar requirement is made for this in Northern Ireland, students looking to gain entrance to popular courses in England may face increased barriers due to some Northern Irish students failing to meet Ebacc requirements used by university admissions tutors as a tie break criteria on students with the same GCSE grades

Science should be considered a core subject of the curriculum up to the age of 16 and a review should be conducted to identify and tackle the barriers to physics becoming a realistic option to pursue at A-level for all students.

Girls in physics

Currently, girls make up just 25% of the physics A-level cohort. Action needs to be taken to address this loss of opportunity and talent. **In England, Scotland and Wales the IOP is working with governments there to improve the gender balance in schools through a whole school approach on this issue.⁵ We would be keen to discuss with the Executive ways to help implement similar schemes in Northern Ireland.**

Teacher Support

There has been a steady reduction in the amount of support, including financial and capacity, for the professional development of science teachers. Given the rapid pace of change in science and technology it is essential that teachers are fully equipped to both understand these developments and to confidently communicate these to their students.

Access to new and exciting developments – both within the sciences and in the way that they are taught - is an important component in encouraging the uptake of science at all levels. As noted in the 2009 Report of the STEM Review, the quality of STEM teaching is fundamental to pupils’ attainment. For example, the qualification of physics teachers has been shown to be the second most powerful predictor of pupil achievement in GCSE and A-level physics after pupil ability (measured by prior attainment).

In Northern Ireland the IOP are involved in teaching support. We have three part-time teacher network coordinators who deliver workshops, conferences, mentoring and resources. Feedback from these workshops and events has shown that teachers find this support to be useful. **By providing more resources to systems and programmes that provide professional development to teachers and improve their confidence and subject knowledge, much more could be achieved.**

⁵ Institute of Physics. *Improving Gender Balance*.
http://www.iop.org/education/teacher/support/girls_physics/improving-gender-balance/page_63795.html

In England, the IOP has been addressing the need for teacher support, particularly for non-specialist teachers of physics, through its Stimulating Physics Network which provides bespoke support for teachers in their schools.⁶ Funded by the UK Department for Education, the programme has shown significant uptake of physics in the partner schools. Teachers have reported an average of 70% increase in the uptake of physics A-level by boys and a doubling in the number of girls choosing to study A-level physics.

Support for science in further and higher education

Science and technology-based careers have a wide range of entry points from apprenticeships to PhD studentships. All of these are essential to the provision of the skill set necessary for a well-balanced economy. It is vital that all of these routes are supported.

An essential element in increasing the number of people studying STEM subject is to find ways to widen participation in higher education. Therefore it is necessary to promote the uptake of science education by women and by people from low socio-economic backgrounds. The Department for Employment and Learning has previously noted this in its corporate business plan for 2013-15.⁷ **The higher salaries and wider range of employment opportunities enjoyed by STEM graduates, including those in physics, should be communicated and used to encourage students from a wider range of backgrounds to study STEM subjects.** For example, a 2012 report from the IOP notes that graduates in the physical sciences are commanding salaries 14% above the average graduate.⁸ **Likewise it is essential that the Department for the Economy should look to build upon the implementation of the DEL Research Agenda for the period 2012-15 'Underpinning Success'.⁹**

STEM graduates are in high demand, and estimates suggest that across the UK there is a need for 40,000 more STEM graduates a year.¹⁰ The engineering sector in Northern Ireland is no exception. Universities also provide crucial support and impetus for many of the innovative businesses that drive the Northern Irish economy, such as in high-tech manufacturing and aerospace engineering. However, universities in Northern Ireland receive between £1000 and £2500 less per student than universities in England – the average received for Band B subjects, which includes physics, is around £9,598 in Northern Ireland compared to £10,500 in England.¹¹ While tuition fees in both countries are capped, the lower cap of £3805 a year in Northern Ireland has not been met with additional funds to bridge the gap. **It is critical that this issue is addressed, particularly for higher cost subjects such as physics, and that commitment is made to providing funding to close the gap between universities in Northern Ireland and England.**

⁶ Institute of Physics. *Stimulating Physics Network*.

http://www.iop.org/education/teacher/support/stimulating_physics/page_41515.html

⁷ Department for Employment and Learning. *Corporate business planning*. <https://www.education-ni.gov.uk/corporate-and-business-planning>

⁸ Institute of Physics. *The career paths of physics graduates*, 2012.

http://www.iop.org/publications/iop/2012/page_55925.html

⁹ Department for the Economy. *Underpinning success - progress report on the Department's research agenda 2012 – 2015*, 2014. <https://www.economy-ni.gov.uk/publications/underpinning-success-progress-report-departments-research-agenda-2012-2015>

¹⁰ Social Mobility Foundation. *In the Balance: the STEM human capital crunch*, 2013.

<http://www.smf.co.uk/wp-content/uploads/2013/03/Publication-In-The-Balance-The-STEM-human-capital-crunch.pdf>

¹¹ Northern Ireland Executive. *The Higher Education Big Conversation*, 2015.

https://consultations.nidirect.gov.uk/df/higher-education-big-conversation/supporting_documents/BIG%20CONVO%20STAGE%20ONE.pdf

Brexit

The programme for government documents make only a brief mention of the impact of the UK's vote to leave the European Union in its introduction. While the picture remains cloudy as to what actions might be taken at UK level, what is clear is that **the Northern Ireland Executive must highlight areas of particular concern to Northern Ireland to the UK negotiating team. In relation to science, this means addressing challenges relating to people, funding and collaborations.** Universities in Northern Ireland have certainly punched above their weight in terms of securing EU funding. For example 20% of the total grant income of the School of Maths and Physics at Queen's University stems from EU funded research collaborations.¹² In addition, 58% of the research staff and 49% of the academic staff from Queen's maths and physics department come from outside of the UK; how Brexit is implemented has the potential to affect a large number of staff.¹²

¹² Institute of Physics report on Northern Ireland issues around Brexit. <http://www.iopblog.org/physics-in-northern-ireland-uncertainty-uncertainty-uncertainty/>