

IOP | Institute of Physics
In Ireland

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Mr John Halligan, TD
Minister of State
Department of Jobs, Enterprise and Innovation
23 Kildare Street
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15th July 2016

Re: Funding proposal for basic research in physics

Dear Minister

Thank you for the opportunity to meet with you on 13th July. As discussed at the meeting there is a crisis in funding for basic physics research in Ireland. As suggested we have drawn up a short document highlighting these issues and proposing a relatively inexpensive solution. The Institute of Physics believes that it is critical that such funding is made available.

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

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Basic Physics Research Funding Proposal from The Institute of Physics

15th July 2016

Summary

Physics is an essential field of knowledge, underpinning progress across all other sciences and engineering and contributing significantly to the economy. However, there is a crisis in the funding of physics research in Ireland : researchers nationwide in fields including, but not limited to astrophysics and particle physics cannot access funding for their research – even the basic funding necessary to present results at international conferences (travel, subsistence and conference fees). Without additional support physics research in Ireland, and ultimately the research and growth that it underpins, faces a precarious future.

This situation is a result of current funding policies which have (i) become very skewed towards applied research with a practical outcome in the short term and (ii) tended to favour the creation of large centres focussed on such outcomes, while largely ignoring the smaller groupings which tend to conduct basic research in physics.

A major reason for this is that the great bulk of funding of scientific research is distributed through Science Foundation Ireland, an organization that is run out of the Dept of Jobs, Enterprise and Innovation and thus understandably places its emphasis on its primary focus of jobs. In most countries, though, this budget is administered by the Department of Education leading to a broader interpretation of the need for research.

Some additional funding is available through the Irish Research Council (IRC) but their budget is less than 10% of that of SFI, and covers research in all areas including humanities and social sciences. In addition, IRC grants mainly fund postgraduate and postdoctoral stipends. A further complicating factor is that the IRC is funded through the Department of Education and there are many examples of one government department considering that another department should look after a particular type of project and invariably, basic research falls through the cracks.

The net result is that there is currently no scheme for research project funds for basic science. A small amount of funding would make a very large difference to physics researchers in Ireland.

The Institute of Physics in Ireland (IOPI) would like to suggest two proposals to address this situation.:

- The first is a fund for grants of the order of €20,000-€200,000 to be awarded solely on the basis of academic excellence in any area, totalling around €20M annually.
- The second is for a small travel fund and would be of the order of €5000 per physics researcher per annum for around 100 recipients, totalling around €0.5M annually.

These two funds together would be of enormous benefit to Irish physics, supporting the basic research that is essential for the future of Ireland and allowing Irish researchers to leverage external sources of research funding.

Physics and the Irish Economy

Physics has a critical role to play in the Irish economy, with physics-based industries providing over 86,000 jobs and gross value added to the economy of €7.4 billion in 2010¹. These figures are consistent across Europe with studies noting that for every €1 increase in physics-based output, the

economy-wide increase in output is €2.28 within the EU27 countries². Additionally turnover per employee in the physics-based European sector averaged €240,000 per annum— almost twice the equivalent figure for the construction industry.² The robustness of this sector is one of the main reasons why Ireland is now emerging from the economic crash of 2008. Hence it is essential to support the ecosystem underpinning this aspect of the economy.

Research funding in Ireland

The Institute very much welcomed the launch of Innovation 2020, the new five-year strategy for science and innovation in December 2015. IOP is particularly keen, though, to ensure that there is a sustained programme of funding for research and that there is a balance between basic and applied research funding. Basic research helps to inform and underpin many areas of applied research. However, funding for applied research is continually being prioritised over basic research which leaves the risk of stunting future economic growth by missing out on opportunities that emerging global technology markets present.

Science Foundation Ireland currently funds ‘basic-oriented’ research within the priority research areas. While this is welcome funding it **differs radically** from what is termed ‘basic’ research elsewhere in developed economies. What is being funded in Ireland is essentially directed research – i.e. the research seeks to find solutions to already defined problems. Basic research seeks new knowledge, the use of which cannot necessarily be predicted but which is the type of knowledge which can lead to a sea change in innovation and allows new ideas to be absorbed and exploited.

It is understandable that in the economic climate which has prevailed over the past number of years the government should seek to invest carefully in science and should be able to demonstrate the value of that investment to the general public. Such considerations were part of the proposals by the National Research Prioritisation Exercise (NRPE)³ in 2011 to focus funding on a number of key research areas. However, there is a strong case to be made to ensure room for outstanding fundamental research for knowledge outside the priority research fields. This was also clearly indicated in the NRPE report. While targeting funding at the priority areas has some benefits, there is a distinct risk that when new, unpredicted areas of science open up there will not be the expertise in Ireland to develop them. It is essential therefore to keep a significant degree of agility within research funding to ensure that Irish science can be of maximum benefit to the economy.

Crisis in funding for physics

SFI previously funded basic research under an instrument known as the Research Frontiers Programme, RFP. This has now been discontinued but was the primary source of funding for much of fundamental physics research in Ireland. In the last year of RFP (2011) it made payments of €11 million which was around 7% of the SFI budget that year.

Physics research straddles both the basic and applied sectors and both are essential to the teaching of the whole subject at third level. However, since the RFP scheme ended many areas of physics were effectively left without any possible avenues for support. This is particularly the case in areas such as astrophysics and particle physics— areas which seek answers to key questions in our understanding of the world around us and which are leading attractors for young people interested in pursuing a career in science. The international profile of such areas is such that they have the greatest potential to enhance Ireland’s reputation to do science. The resulting PhD graduates from such programmes are highly trained and very employable within Ireland’s existing industries such as communications, energy generation and storage, advanced functional materials, big data analysis, quantum processing, and many more. They are also people who are in a position to establish new

businesses within the niche high-tech markets in for example, space technology and quantum computing.

However, the lack of research funding in these areas has given rise to the situation where hundreds of academics employed in Irish universities lack the resources to even travel to conferences or international research facilities. They are unable to keep research groups intact by the normal process of taking on PhD students and postdoctoral research assistants. This is leading to a significant loss of talent in Ireland as these potential students leave the country to find opportunities elsewhere and academics here becoming research inactive. It is also having a knock-on effect on the teaching of physics at third level which relies on research active staff to inform its teaching. If left to continue, this situation will have long term effects. Scientific research is a long term endeavour, and it is difficult to restart work in fields of research which have been forced to close.

Case study 1: Dr Mark Lang of NUI Galway who, for over two decades received modest levels of funding under various schemes including SFI's RFP fund for basic research in the area of gamma ray astronomy. He is a member of the highly successful international VERITAS project with access to a world-class observatory in Arizona. The group is now unable to send students to facilities abroad, unable to purchase basic computing equipment and cannot take on a new student due to lack of funds.

Case study 2: The School of Physics at UCD has gone from about 75% of academics being in receipt of SFI research funding at any given time (i.e. about a 15% success rate) to under 20% in receipt of funding. The Spectroscopy research group has 15 graduate students and no funding from SFI. This is leading to a situation where the department is eating into the equipment base, without almost any funding to replace or maintain it as it fails. Profs Martin Grunewald and Ronan McNulty are both involved in frontier research at CERN connected to the Higg's Boson & the B-quark. Neither are able to access funds from SFI to travel. Prof McNulty has just been awarded an IRC Postdoc 2-year award, and the postdoc will have more funds available to travel than the Principal Investigator does.

Case study 3: Dr Cormac O'Raifeartaigh, lecturer in physics at WIT who achieved international acclaim for the discovery of a hitherto unknown theory by Albert Einstein and has had his research discussed in the New York Times, Scientific American and Nature, yet cannot access funding to present ongoing results in the UK and the US.

Case study 4: Prof. Enda McGlynn and Prof. Martin Henry, DCU, have received funding from various schemes until recently to study the origin and properties of defects in semiconductors, and have interacted with major international facilities such as CERN, now cannot afford to take on new postgraduate students or fund costs to maintain interactions with facilities such as CERN.

Case study 5: Prof Andy Shearer, NUI Galway. His research group built a key instrument, an astronomical polarimeter, GASP, with an RFP grant. This is now operational but the group have no money to take it to observatories etc. Through some cobbling together some funds (EU and NUIG) the researchers have managed to get it to the US for one observing season and more recently to La Palma. In both these cases the science was rated good enough to get the very expensive observing time but there was no travel funding available for transportation - people and equipment. In the past this work has produced Science and Nature papers with Irish lead authors. To give an idea of costs – in December 2015 the project had 5 nights on the WHT Telescope in La Palma. The estimated cost is €20,000 per night which the group did not have to pay. The costs to the group were roughly €10,000. (Shipping (€6000 and travel and subsistence for one lead researcher and two PhD students

for ten days at about €4000. The telescope time was awarded after peer review of the science. This €10,000 investment enabled €100,000 of infrastructure.

Case study 6: DIAS applications: Dr Alessio Caratti o Garatti, DIAS, submitted a proposal to SFI Career Development Award. This scheme is for people who are 3-15 years after their PhD completion. The application was deemed to be ineligible under the SFI legal remit. The researcher was then encouraged to apply to the IRC for funding under their early career award scheme. However, the IRC scheme is only for applicants who are within two years of completing their PhD. A very similar proposal from this researcher to the EU Marie Sklodowska-Curie scheme was scored very highly and is on the reserve list for its funding. In a very similar situation, Dr Rebecca Garcia Lopez had a proposal deemed ineligible for consideration as the research proposed was considered 'basic' not 'basic oriented' research. She was also encouraged to apply to the IRC but likewise is not eligible for their funding because of the time lapsed since her PhD. A similar proposal to EU H2020 has been funded. This situation highlights that excellent research which is highly regarded internationally cannot attract funding locally in Ireland.

Case study 7: Dr Asaf Pe'er, theoretical astrophysicist who joined UCC in 2012. He was successful in attracting EU money which enabled him to hire one Ph.D. student. However his work has been deemed ineligible for SFI funding on several occasions on the basis of its legal remit. In UCC he knows of at least one excellent student (in fact, top student of his year) who wants to conduct Ph.D. research with him, but he cannot offer him a position and there is every likelihood that he will leave Ireland to go and study abroad.

Striking the research balance

Globally it is recognised that the research ecosystem needs a mix between basic and applied and while the exact spread varies between countries it is not unusual for governments to put around 20% of their research investment towards basic research.

Country	Percentage of government R&D funding on basic research
Denmark	24%
Israel	20%
New Zealand*	32%
UK	32%
USA	17%

OECD Figures for 2012 *except New Zealand, 2011 <http://stats.oecd.org>

Table 1

Proposal 1: Research for Knowledge Programme

'Research for Knowledge' or 'basic research' funding now seems to be confined to the postgraduate and postdoctoral schemes operated by the Irish Research Council (IRC). These are welcome schemes but they do not support research directly. IRC schemes should also include travel costs for the supervisor as well as the student - for example it is not unusual to find that an IRC funded PhD student can travel to a conference but the student's supervisor has no funding to also attend.

Such research is not hugely expensive but can lead to sustained impact at an international level and is key to Ireland's ability to obtain large European grants, such as the ERC Starting and Consolidator grants, where the sole criterion for selection is excellence in any discipline in any topic. Researchers need to be able to show that they have international collaborations and have a track record in obtaining funding at a national level, and importantly, have the ability to forge significant research programmes in high quality, influential basic research.

In the interests of efficiency, a modest Research for Knowledge programme would enable researchers and academics outside the priority areas to be much more productive. Such a programme would also allow for an enhanced degree of agility within the research landscape of Ireland. Such grants would allow Irish-based academics to use world-class facilities (international collaborations, telescopes, satellites, synchrotrons, lasers etc.) to do internationally significant science in areas of fundamental importance to the discipline and ultimately to the benefit of society.

Areas of science that are outside the national priority areas, but at the forefront of new science, often require facilities that typically cannot be developed by a single nation. Such research has led to significant economic benefits, and a surge in interest in STEM subjects, from which the next generation of fundamental and indeed applied indigenous researchers will come. For example, research in gamma-ray astronomy at UCD which was funded previously by SFI has led to a proof of concept proposal being funded by EI, through the potential medical application of this technology. In Cork, research in microelectronics led to the creation of the highly successful security and imaging company, Farran Technology. The IOP has highlighted many such examples of the impact of basic research in its case studies.^{4,5,6}

Research for knowledge funding instrument

Ideally the Institute would urge the government to commit to a long term goal of putting 20% of the total research budget towards a fund for basic research.

However, given the urgent need to enhance basic research in Ireland, the IOP suggests instigating a funding instrument, perhaps through the Irish Research Council, which would allow for grants in basic research ranging from €20,000 - €200,000 in areas outside the priority areas. A grant of €150,000, would, for example cover the cost of one PhD student for 4 years and the cost of small equipment, materials and travel for the lead researcher and student. However, in many cases researchers need access to much smaller amounts, typically of the order of €20,000 - €50,000 to allow for the purchase/replacement of equipment and/or to travel to international instruments and maintain vital collaborations over periods of around 6 years. A flexible grant system which would allow for a range of such grant values would be highly useful. We estimate that a budget of €20M per annum would give an initial significant stimulus to this vital part of the science economy.

Proposal 2 : Travel fund for physics researchers proposal

Allied to the overall problem of the lack of funding for basic research is a specific lack of funding for travel. This has led to situations where many academics are not even able to travel to overseas research facilities or to present their work at conferences.

The Institute suggests that a fund should be established so that researchers can have relatively quick and easy access to small travel grants. This should be of the order of €5000 per researcher per annum for around 100 recipients in the area of physics, totalling around €0.5M annually. This fund should only be open to researchers not currently funded by SFI. Small travel grants should not be

restricted to mid-career physicists but to all physicists maybe with a quota for different career stages.

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