Review of Physics – STFC Perspectives

Keith Mason, CEO

(SLIDE 1)

Mr Chairman, the Earl of Selbourne, my fellow speakers Professor Bill Wakeham, Dame Jocelyn Bell-Burnell, the President of the Institute of Physics, my fellow Research Council CEO David Delpy from E P S R C, Foundation members, guests and colleagues.

At the outset let me, on behalf of the Research Council family, again thank Bill and his panel for their sterling work on the review of the health of physics. They put a great deal of effort and careful consideration into the report, which we very much welcome.

What I thought I'd do this evening is expand on some of the themes that run through the Wakeham report from an STFC perspective including (SLIDE 2)

- The Health of Physics
    - Role in underpinning the multi-disciplinary research base
- The funding of large facilities
- Skills
- How we maximise the benefits of investment in the research base
    - Balance between curiosity driven research and the application of research

- How we make the case for continued/increased investment

So let me first remind you of STFC’s role within the research council family, which is to lead on the provision of large-scale facilities:

SLIDE 3: STFC facilities cover the full research base, from investigating the very small to the very large, and all things in between, as illustrated in this slide. At the two extremes lie the sub-atomic world of particle physics, and the vastness of space and the Universe in toto. STFC is solely responsible for these subjects, providing facilities, generally though international collaboration, and supporting their exploitation by academic groups. On the intermediate scales of the world around us, STFC’s physics-based facilities are used by researchers supported by all the research councils, for topics as diverse as developing new drugs, designing new materials, and archaeology.

Bill Wakeham and his panel highlight the fact that Physics is no longer confined to Physics Departments, but is an essential tool across the research base. STFC is the embodiment of this multi-disciplinary approach. But at the heart of everything we do are a common set of core skills and technology firmly rooted in physics.

As Bill has indicated, the review confirmed that physics in the UK is strong, healthy and internationally respected.

This is the result of sustained public investment over a number of years. From the STFC viewpoint premier research needs premier equipment, and UK researchers now have access to the best facilities in the world. SLIDE 4 illustrates some of these:

- The Diamond light source, opened by Her Majesty the Queen last year, and the largest single investment in UK scientific infrastructure ever.
- ISIS TS2, opening to researchers in 2009 and providing a substantial enhancement to an already world-beating facility
- The Large Hadron Collider at CERN, the most powerful collider in the world build with substantial financial and intellectual contributions from the UK
- World-leading laser facilities
- Cutting-edge space research funded through the European Space Agency
- And access to the world's best ground-based telescopes.

Providing cutting-edge facilities for the UK research base is an essential part of a long term strategy to retain and grow the UK's competitiveness in the global economy.

But *building* facilities in itself it is not sufficient. We have to realise that many of these national and international facilities, like Diamond, ISIS and the LHC, have a lifetime measured in decades. We need not

only to build these but to also provide sustained investment in their operation if they are to deliver their potential.
It is a fact that some 85% of the cost of operating a facility like Diamond is incurred just by owning it, before you use it to do any science (that is keeping the machine maintained and safe, and providing the skilled staff to operate it). Thus sustained long-term investment and planning is essential – it's not the sort of thing you can turn off and on in the face of short-term financial pressures. This applies equally well to large facilities we support through international subscriptions.

Taking this long term view requires courage, particularly in difficult financial times as at present, but it is absolutely essential if we are to achieve our aims as a nation to be a competitive knowledge- and skills-based economy.

Planning for Diamond, for example, began more than a decade ago, and its construction was agreed on the understanding it will have a 30 year operating life. Clearly, these are not decisions taken lightly.

The research benefit of a light source to the medical, bioscience, cultural heritage and environment communities, not to mention physics, amongst many others, was a key determinant in the decision to establish Diamond.

Understanding these benefits is only possible through extensive discussion, sharing of ideas, and by a degree of prediction about future opportunities and about our ability to meet the engineering and technical challenges of those opportunities.

I think that the Diamond experience shows that when we do it well, we can achieve very impressive results from this forward planning process. But I also think we can collectively get better at this, and that the key is closer consultation and a conscious effort to break down the barriers between disciplines.

Machines themselves are, of course, useless without sufficient numbers of skilled scientists, engineers and technicians to operate and exploit them. Bill's report had quite a lot to say in relation to the need to maintain and expand investment in education for physics. Again, this is a long-term requirement and requires long-term commitment. It takes 13 years of formal education to produce a secondary graduate capable of even undertaking, let alone finishing, a physics undergraduate degree, before further years of effort to achieve post-graduate qualifications.

That kind of world-class long-term education system requires an enormous and sustained investment by government, and of course by the individual students, their parents and carers, not to mention teachers and lecturers.

So why do we do this? Why do we go to all this effort and expense to build up our scientific infrastructure and train people to use it? It is based on the conviction that scientific research is now central to the future prospects for our society, for driving forward the economy, dealing with global threats to security and the environment, enhancing the quality of life and in making the UK an attractive place to live, and invest in.

This is at the heart of the mission of DIUS, as our sponsoring department.

SLIDE 5: shows the DIUS vision in which a combination of research and skills, through innovation, leads to economic prosperity and social justice.

I have discussed the research and the skills, but we also need to pay attention to the ‘innovation’ part of the equation, to ensure that the fruits of the investment are felt by the people who paid for it, the taxpayer. Ultimately, only if we do this effectively, and communicate this to the public, can we justify continued and increased investment in science.

The truth is that this process of innovation is already happening and gathering pace.

Let me give you a few brief examples from STFC.

Thruvision is a physics-based spin-out company from STFC Rutherford Appleton Laboratory, using Terahertz radiation technology, originally developed for space research, for security applications, such as spotting explosives hidden under clothing – something not previously possible. It is now providing commercial systems to airports, sporting arenas and Canary Wharf.

The technique called SORS (Spatially Offset Raman Spectroscopy) was created at STFC's Central Laser Facility to study the contents of a bottle or packet without opening it. This is now being developed by a spin-out company called Lite Thru and can simplify quality control on pharmaceuticals, searching for illegal drugs and is also being examined as a possible non-invasive medical technique to look at cancer.

Atmos Technologies, based at our Daresbury Laboratory, has developed a new, non-toxic photo voltaic diode based on physics technology that has the same efficiency as current silicon devices but only uses a 1/60th of the energy compared to conventional techniques. As a result, they are developing clean and efficient methods to produce hydrogen from seawater, with potentially huge implications for clean fuel sources.

I could go on, and I know that David's EPSRC has a long list of similar success stories, as do all the other research councils.

It is important that we record these examples and publicise them. It is also important that we assess the impact of our large facilities overall. Many of you will be aware that we recently closed the second generation synchrotron machine SRS at Daresbury after 28 years of operation, and we are taking the opportunity to assess the overall impact of that machine.

This will be made available in due course, but to give just a flavour: the total investment in SRS over its lifetime was approximately £500m. However one company alone has created a business worth half this amount, £250m, simply from a relatively small piece of cutting edge technology it developed to build SRS. The economic impact of the research itself is massive – just unravelling the structure of the foot and mouth virus, one of many pieces of similar work done on SRS, has a potential economic impact of billions.

Particularly in harsh economic times, we have to be conscious of the 'business case' for investing in science and the wider research base. It is very clear to all of us involved that, particularly in times of economic downturn, continuing to invest in the research base, and even increasing investment, is vitally important. Only in this way can we position the nation to take full advantage of an economic recovery.

This is a message that we should all be promoting vigorously.

It strikes me that we are very good at promoting our scientific successes to our fellow scientists – after all, the peer review system operates to enhance that requirement.

We remain less good at explaining to the broader community who fund us how we use their money to make their lives better.

For example, I have heard leading particle physicists and astronomers defend the importance of their fundamental science because of its impacts - things like the ability to attract students into STEM subjects, the development of MRI, the world wide web, and the impact of scientists on the financial sector.

These impacts on society are critical outputs of what we do, and are indeed a strong justification.

However, many of these same scientists also express suspicion about what they feel is a growing expectation by government that they should be judged in part by, and expected to increase, those kinds of impacts.

Yet -- if that is such an important benefit of the science -- how can it be so bad to ask for more of it?

The underlying issue is that the reason most scientists do science is not the same reason that society funds it. If we are honest, most of us carry out our research because we enjoy it -- we find understanding the universe deeply fulfilling, revelatory even, and it taps into something basic in the human psyche. There is nothing wrong with that. Indeed it is more than just cultural enrichment, since it is the drive that inspires us to break the mould in what we achieve as human beings.

The key challenges of this century - climate, aging, third world food shortages, HIV - clearly require scientific advances if they are to be addressed. These global challenges form a strong and compelling case for the growing importance of science, and it is a case that we should make with enthusiasm.

If government and society want to see relevant impacts from our science, we should embrace that challenge, and not recoil from it. To give just one example, if we say - as we often do - that an important impact of astronomy is attracting and training students who then go on to have an impact in industry, then we need to be sure our value system no longer implies that getting a postdoctoral post and then a faculty job is the only measure of success.

Deep down inside, the societal and economic impact of our science may not be why we do it, but it is a large part of what we promise society in return for support, and that support not unreasonably comes with an expectation that we'll deliver.

It follows therefore that there is a responsibility on us to provide tangible evidence that we are serious about those issues and that we are delivering on those promises.

I earlier gave three specific examples of physics-related research which has led to spin-off technologies of direct benefit to the UK community. There are plenty more, and to me they include not just pounds and pence examples but also the "excitement and inspirational value" of an LHC or a deep space or astronomy programme.

I am committed to ensuring STFC's programmes continue to support curiosity driven science, as well as the application of that science. To ensure I have the funds to do so, I believe we must give government more ammunition with which to fight off any temptation to reduce the science vote.

This isn't a call for partisan politicking, or for deliberately skewing science investment toward commercial outcomes. Time and again history shows us that the most disruptive advances stem from curiosity-driven research.

But we must also put in place structures to extract the maximum benefit from the research that we do. This is high on the priority list of all research councils. In STFC we are developing the Daresbury and Harwell Science & Innovation Campuses as vehicles for doing just that! And these campuses will facilitate more and better fundamental research as well as delivering impact.

Yes, science should and must be funded.

But it isn’t a right, and I think it is beholden on all of us in these tough economic times to do more to demonstrate to the wider community that we appreciate the fact that our money comes at the expense of something else, but that we’re worth it!

Thank you

Science & Technology
Facilities Council

Perspectives on the Review of Physics

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Outline

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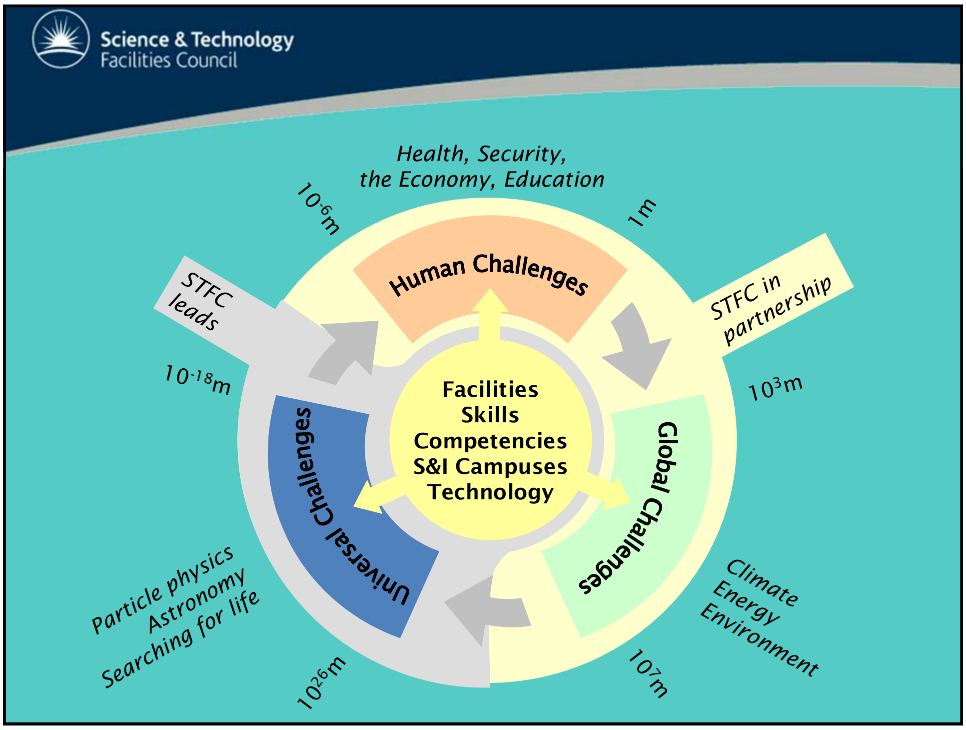
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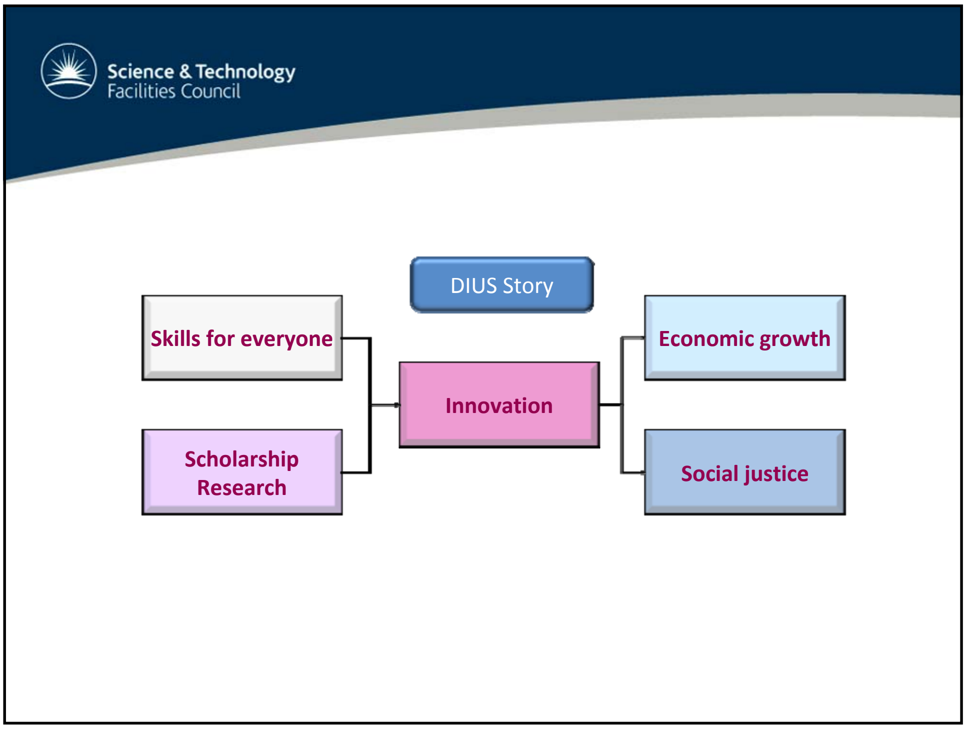
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