
rcuk physics review bill wakeham

Holistic review provides for the future of physics

In December 2007, Research Councils UK asked me to chair a panel to review the state of physics in the UK, which the council published last Wednesday. Let me now reflect on the experience of the past nine months with the aim of informing future reviews—not only in physics, but in other academic disciplines.

The report represents, perhaps for the first time, a holistic, high-level review of a complete discipline. Previous reviews have often focused on specific aspects. For example, the 2000 and 2005 International Benchmarking Reviews of UK Physics and Astronomy had remits that concentrated on academic research quality, and they were co-supported by the Engineering and Physical Sciences Research Council, the Particle Physics and Astronomy Research Council, the Royal Astronomical Society and the Institute of Physics.

However, the RCUK review cast its net much wider. It looked at the range of factors that will influence the medium-term strength of the discipline of physics in the UK. These factors include the pipeline of students, the impact

on the economy, the provision of research facilities, and the funding of the discipline, as well as the strength of research internationally. Such was the breadth of its terms of reference and the shortness of the timeframe in which the results were demanded that the review had to remain at a rather high level, unable to deal with the full detail of every single aspect of the subject despite extensive input from a wide variety of stakeholders.

A further complication was the timing of the review, which followed concern from certain parts of the physics community after the 2007 Comprehensive Spending Review. Specifically, we were not asked to examine this particular issue; our focus was how the discipline moves forward, not how the immediate situation had arisen. As a result, the panel examined the history only to inform its views about some aspects of future arrangements.

However, the panel's appointment in such a febrile atmosphere fuelled expectations of what the review would achieve. So, it was important throughout the exercise to ensure that the anticipations of interested

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Hardly worth the wait...

The furore over the funding cuts in astronomy and particle physics by the Science and Technology Facilities Council has faded during recent months. UK researchers have been waiting and hoping that the Wakeham review for Research Councils UK would bring financial relief and proposals for significant re-structuring of that hybrid body, the STFC, for which the Royal Society, among others, has argued a proper case was never made.

That the lengthy and detailed review (63 pages plus annexes, with 17 recommendations) offers neither will be a disappointment to many in the physics community.

While a call for new money was perhaps always a vain hope, there must surely be scope for flexibility within a Science Budget of £3.5 billion. Though outside its terms of reference, pressure from the Wakeham panel could have been significant in limiting the now imminent damage to

university departments as funding cuts begin to have an impact on the physics base the panel was investigating.

In a broad-ranging review of physics in the UK, Wakeham confirms that the discipline is in good health, albeit with a reduced academic base, and is contributing strongly to GDP. But there remain concerns on declining A-level entries and the lack of graduate physics teachers in many state schools. Relevant to the funding crisis, which led to the review, is Wakeham's confirmation that many of the strongest areas of UK physics are dependent on STFC support, and are often also those most attractive to students, of both genders. It may be timely to contemplate the dire state that UK physics could now be in if the Particle Physics and Astronomy Research Council had suffered deep cuts, as some predicted, when the protective arm of the old Science and Engineering Research Council was removed in 1994.

The Wakeham review is critical of physics departments for being too narrowly focused and failing to benefit from larger funding

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parties, including both the scientific community and those commissioning the review, were consistent with what could be achieved by the panel in the timeframe and with the evidence available.

The review aimed to blend both quantitative and qualitative evidence, with one helping to illuminate interpretation of the other. As such, the panel had to define 'physics' precisely, and opted for the already agreed definition of the Research Assessment Exercise.

Using bibliometric analysis, the panel was able to identify research output volume and citation counts at both a disciplinary level, and at a sub-disciplinary level for a number of comparable countries. However, in the panel's opinion, such data would be even more useful if the inputs that generated them were known.

So, the panel set out to compare research expenditure on physics in the same range of countries. However, while on the surface this might seem a straightforward task, it proved to be anything but. The complexity of the different funding cultures, systems and agencies in other countries, as well as differences in subject definition, mean that comparisons, even at a broad disciplinary level (let alone a sub-disciplinary level) are fraught with difficulty. Attempts by the panel and by the Department for

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Innovation, Universities and Skills to collate this data proved impossible in the time available. We recommend that governments and national academies come together to agree mechanisms whereby such data can be systematically collected and compared in an effort to better understand research productivity.

Such a development would help to provide insight into that most difficult of questions for government: what is the correct amount to spend on particular branches of science? While there is no absolute answer and it is obviously the prerogative of an elected administration to determine the size of the overall budget, knowing the proportion of total expenditure on various branches of science in other countries could provide a benchmark. It may also assist research councils to ensure an appropriate balance of support at disciplinary, and even sub-disciplinary levels.

Finally, it is my hope that the publication of the panel's report is not the end of the review process. Rather, I hope that the debate it stimulates will lead to a greater understanding of how vital the discipline of physics is, and that, as a consequence, it becomes ever stronger.

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'It was important throughout the exercise to ensure that the anticipations were consistent with what could be achieved.'

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...though contribution recognised

Bill Wakeham and his panel should be commended for their very thorough analysis in their review of physics for Research Councils UK, published last week. While some may take issue with the odd detail, the document overall provides much useful material and informed comment.

The panel demonstrates the importance to the UK economy of a vibrant physics community and emphasises the need to attract more students, particularly females, to study physics at A-level and at undergraduate level. It identifies the strong international standing of the UK's physics research, and recognises that some of the most successful fields, such as fundamental particles, nuclear physics and astrophysics, are also those that most attract students onto physics undergraduate courses.

Two thirds of the 28 physics departments that have closed since 1995 have been lost from post-1992 uni-

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versities where, typically, there is more emphasis on applied research. This leaves undergraduate physics teaching concentrated in the pre-1992 research-based universities. As a result, the review reports that much of the applied physics research that happens in the university sector is now found in departments other than physics. And while employers express a high level of satisfaction with physics graduates, and offer them salaries well above the average for graduates, the review does note employers' concerns about their lack of laboratory skills. This reflects, the review suggests, under investment in teaching laboratory equipment and increased focus on cheaper, computer-based alternatives.

The panel also suggests that the 34 per cent increase in physics funding over the past decade, against a science budget increase of 82 per cent, may indicate that physics departments have not better aligned their priorities with government themes. Instead, pressures on departments to retain their international research excellence and attractiveness

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increases elsewhere. While this criticism has some validity, with roots partly in the Research Assessment Exercise, it would be dangerous if funding from other research councils is seen as an easy substitute for major cuts about to be imposed in the forthcoming STFC grants rounds. Encouragement to compete for alternative funding in areas such as medicine and biophysics will be of little help to new postgraduates seeking their first posts in astronomy or particle physics, nor will it re-assure others who had been planning to return to the UK.

So, will Wakeham make a difference? The call for a strengthened STFC Council appears likely to be accepted by the government, which is a welcome move. More widely, my experience at PPARC supports the proposal that the director general of RCUK would benefit from independent scientific advice from outside the Department for Innovation, Universities and Skills in the run-up to the next Comprehensive Spending Review.

Strengthening the STFC Council must be a priority, as it is difficult to believe that a stronger scientific voice would have presided over the executive's mistakes in the organisation's first year. Two non-executive scientists are unlikely, on their own, to be sufficient given the broad remit of the STFC. But clear separation of the funding of astronomy and particle physics from that of running national facilities, as Wakeham recommends, could be the basis for a model that worked well in the days of the SERC. This would provide more widely representative

boards for science and facilities operating within a policy and budgetary framework set by Council, but having substantial delegated powers. Board Chairmen would be ex-officio members of Council, relieving the executive from being the only source of expert advice to Council.

Where the Wakeham panel does comment on details of the STFC's priorities, its views are well made. The STFC decision to cut funding of ground-based solar-terrestrial physics was both a scientific and—in terms of the current political priorities relating to climate change—a strategic error. In calling for the Natural Environment Research Council to take on that responsibility, it will be ironic if the STFC is obliged to hand over the funding that it has been determined to cut from its own research groups!

High Performance Computing is another area where Wakeham identified a failure of STFC policy. The long and relatively inflexible lead times of large general-purpose machines, such as HECToR, continue to leave that route not well matched to the needs of the STFC community, and the CSR included an allocation of £13 million to fund new, unified HPC facilities for astrophysics and particle physics theory. The fact this much-needed capital investment is still undecided reflects both the lack of a coherent policy at STFC, and conflicting local interests where international peer input could be very helpful.

So, UK physicists facing cuts of 20 per cent or more are likely to give Wakeham the thumbs down. As with the economy at large, taking the long view might no longer be an adequate response.

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to students have shaped the physics landscape in the UK to the possible detriment of departments that might otherwise have offered more of what the government desires. However, while raising concerns in several places about the impact of the Research Assessment Exercise, the panel stops short of accusing the RAE of posing a significant barrier to greater short-term industrial relevance.

From a particle physics perspective, I welcome the panel's acknowledgement of the world class excellence of the UK high energy physics programme. The panel also highlights the major contributions of curiosity-led research to non-incremental technology development.

I also welcome the panel's support for more investment in High Performance Computing, and its recommendations that funding for international facilities should not be separated from grant funding (as nonsensical when the same scientists need to plan and bid for both together).

While the panel's comments on the operational problems of the Science and Technology Facilities Council are important, the significant underfunding of last year's merger of the Particle Physics and Astronomy Research Council and the Council for the Central Laboratory of the

Research Councils to create the STFC, which is equally important, is not discussed at all, presumably because it falls outside the review's remit. However, for many of us, the impact of the resulting severe cuts, forced on the STFC at a time when decades of investments are just coming to fruition, is particularly frustrating and also worrying in terms of job losses. At risk is the UK's ability to exploit the major new international facilities.

In discussing QR income, the review misunderstands how physics departments engage with international facilities by implying that their income could be reduced because they will not need local ones. As someone whose group built, at Liverpool, two detector sub-systems for experiments at the Large Hadron Collider, I can confirm that these suggestions show little understanding of the nature of large international collaborations.

Nevertheless, the main thrust of the report is to recognise the very welcome previous investments and encourage further increases in government support for physics to both retain and promote the UK excellence in this discipline. As well as its own inherent excitement, the report emphasises how physics underpins many other fields and has a vital role to play in supporting the UK economy.

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