

## **House of Commons Science and Technology Select Committee**

### **Inquiry into the Impact of Spending Cuts on Science and Scientific Research: Submission from the Royal Astronomical Society (RAS)**

1. The RAS welcomes the opportunity to provide input to the Committee's inquiry. Our Fellows who work in the astronomy and space science research communities have been greatly affected by recent spending cuts and shifts in spending priorities, particularly at the Science and Technology Facilities Council (STFC). A separate submission to the Committee will come from the British Geophysical Association (BGA), which represents those RAS Fellows who work in the area of Solid Earth Geophysics.
2. This submission has been assembled following extensive discussion within the RAS, the Astronomy Forum (representing university astronomy groups around the UK) and with the Institute of Physics.

#### **The process for deciding where to make cuts in SET spending**

3. The Society does not wish to comment on the *overall* balance of the SET budget nor express a preference for one part of its Fellows' work over another. We support a balanced portfolio of investment, with sufficient resources to allow internationally competitive curiosity-driven research (including astronomy and space science) to flourish.
4. For any future cuts, we strongly support a decision making process that is open and transparent across the different levels of Government, with the reasoning behind strategies adopted in the public domain.
5. Within the Research Councils, the RAS believes that investment should follow scientific priorities established by broad consultation with the research community. For example, in the most recent round of cuts, there is a concern that STFC did not follow the advice of its scientific Panels covering the astronomy area. The Council supported a number of less favoured projects and did not seek to prioritise investment in people, both actions that are contrary to Panel advice.

#### **The feasibility or effectiveness of estimating the economic impact of research**

6. The RAS concurs with the premise that scientific researchers should facilitate the exploitation of their work by society and industry. In astronomy and space science, there are many examples of this taking place, for example in imaging techniques in medicine, in the Terahertz imaging scanners now being introduced at UK airports and in signal processing in telecommunications.

7. However, the Society strongly opposes the introduction of 'economic impact' in the assessment of research, both retrospectively (via the proposed Research Excellence Framework or REF) and in applications for future funding. Our opposition is based both on the lack of feasibility of this approach and the distortions it is likely to introduce to research funding.
8. In our science, researchers are rarely able to predict the impact of their research at the outset or during the first few years. Impacts that do arise are often a consequence of many years (or even several decades) of further work and extremely difficult to attribute to the original research. For example, the development of wi-fi from radio astronomy took more than 30 years and relied on contributions from other disciplines.
9. We find implausible the proposals contained in the REF for a new 'approach' to be developed to tackle this time lag and it is certainly hard to see how this will give due credit to the many different contributors to a resulting impact.
10. With very few exceptions, it is then almost impossible to trace the ultimate economic impact that follows from a new product or technique back to a single original piece of research.

#### **The implications and effects of the STFC budget cuts**

11. The RAS believes that the STFC budget cuts are very damaging to UK research in astronomy and space science. This is contrary to the stated Government policy of attracting students into STEM subjects, given the evidence that astronomy, cosmology and particle physics attract students to study undergraduate physics degrees, where applications increased by 19% between 2002-2007. The number of UK astronomy academics increased by 13% between 2003/04 and 2007/08, following the average 14% growth in academic numbers nationally over this time frame.
12. The cuts themselves are described in detail in the STFC investment strategy announced in December 2009. They result from a combination of factors: (a) the £80m shortfall in the STFC settlement resulting from the 2007 Comprehensive Spending Review (CSR07); (b) the inability to withdraw prematurely from long term, international commitments without severe financial penalties; (c) forward budget planning made on the assumption of flat cash settlements in future spending rounds. The initial CSR07 announcement was particularly ill-timed for STFC since this new organisation lacked community input to prioritisation via advisory panels. Delays in the establishment of such panels prevented the outcome of a scientific prioritisation exercise until now, accruing £46m in loans over 2008/09 and 09/10, which have to be repaid in 2010/11.
13. Further financial pressures have arisen from the decline in the Net National Income (NNI) of the UK, calculated on the basis of GDP and exchange rate. With a weaker

pound, subscription levels for international organisations including ESO and ESA have increased sharply. So far, these potentially crippling costs to STFC have been reimbursed by DIUS/BIS to the value of £17m (for the financial year 08/09), £42m (09/10) and an anticipated £60m in 2010/11, but this has inevitably led to financial tensions within RCUK, including a contribution of £14m to STFC from other Research Councils for 2010/11.

14. This combination of factors has nevertheless resulted in a devastating impact upon STFC science including (a) a 25% reduction in the volume of exploitation grants over CSR07; (b) major cuts to the current and future scientific facilities required by STFC's scientific user base, with UK-led programmes lacking formal agreements with international partners hardest hit and (c) the inability to maximise the return from major subscriptions or national facilities. On the latter point, in the Particle Physics Astronomy and Nuclear physics (PPAN) area the current ratio of STFC investment between facilities and exploitation grants is around 3:1, which many researchers believe to be too low for that exploitation to be effective. However, the current strategy is that funding for astronomy Post-Doctoral Research Assistants (PDRAs) will reduce even further, with a planned reduction towards 60 PDRAs / yr, 45% below the 2007/08 level of around 0110/PDRAs / yr, leading to a yet greater imbalance between astronomy facility provision and exploitation grants.
15. The chair of the STFC Astronomy Grants Panel (AGP) believes that these savings could mean that 70% of UK astronomy rolling grants (those extending over a 5 year period) to research groups in universities will no longer be viable as they will lack a critical mass of postdoctoral researchers. This loss will make it almost impossible for them to compete with their peers both in the UK and overseas.
16. Such a profound shift will remove the ability of virtually every research group to provide leadership in international projects. This in turn could threaten the viability of many physics departments around the UK that have a significant fraction of their work funded by STFC. The combination of cuts to previously announced STFC research grants and the general outlook for STFC supported science in Universities will inevitably lead to a rapid decline in academics within these areas, unless confidence can be rapidly restored through greater stability in funding.
17. STFC has also announced a 25% cut to the education and training budget for 2010/11, a reduction in the number of postgraduate studentship awards and cancellation of the 2010 postdoctoral fellowship round at late notice. It will become more difficult to receive postgraduate training and far harder to take the first step on the ladder of an academic career, further accelerating an exodus of the brightest young scientists overseas, a process which had started before these latest announcements. Urgent changes need to be made to offer hope of a future within the UK to current STFC-funded postgraduates and PDRAs.

18. In terms of facilities, these savings include UK withdrawal from a swathe of ground-based research projects and observatories, including the Auger Cosmic Ray Observatory in Argentina, the Atacama Large Millimeter Array (ALMA) regional centre, the Joint Institute for Very Long Baseline Interferometry in Europe (JIVE), the UK Infrared Telescope (UKIRT) in Hawaii, the Gemini Observatory in Hawaii and Chile and potentially the Isaac Newton Group (ING) in La Palma in the Canary Islands.
19. One dramatic consequence of the cuts to ground-based facilities is that after 2012 UK astronomers may no longer have access to any optical telescopes in the northern hemisphere, effectively denying British researchers the opportunity to observe the sky above their heads.
20. Support will no longer be available for researchers working on data from the ongoing and highly successful space missions Cassini (studying Saturn and its moons), Cluster (studying the Earth's magnetosphere), the Solar and Heliospheric Observatory (SOHO), Venus Express and the X-ray observatory XMM. In all these cases UK scientists were involved in designing instruments for and held key roles in planning the missions.
21. STFC has also planned for a further £16m in savings from the budget for ground-based astronomy and a further £28m from space-based astronomy research. Alongside this there is a proposed shift of £24m from the Particle Physics, Astronomy and Nuclear Physics (PPAN) area to the Physics and Life Sciences (PALS) area.
22. At present the UK has enormous strength in astronomy and space science. It is one of the few scientific areas where we are genuinely world-leading, with the number of citations of scientific papers second only to the United States. This reputation helps attract the best talent from overseas and also has the effect of encouraging young people to careers in science and engineering. In UK universities, many academics working in other more 'applied' areas of physics and engineering state that they were drawn into science by their enthusiasm for 'blue skies' subjects like astronomy (examples are outlined in the RAS submission to the RCUK review of physics in 2008 led by Professor Bill Wakeham).
23. Given the scale of the proposed cuts, the Society believes that if they are implemented UK astronomers will lose their leading position and that this change would likely be irreversible. It will also remove the technical base (for example in instrument development) that forms the heart of knowledge exchange activities in this area as well as much of the motivation for scientists to engage in outreach activities.

**Comment [RM1]:** Just to check – is the PPAN to PALS shift partly driving the further savings or is it additional to those?

### **The scope of the STFC review**

24. The RAS welcomes and has actively engaged with the review of STFC announced by the Science Minister on 16<sup>th</sup> December 2009. Our proposals for the Science Minister are set out in the following paragraphs.
25. Firstly, we acknowledge and welcome the positive action taken by DIUS and then BIS since 2008 to mitigate the detrimental effect of increases in international subscription costs. We also recognise the efforts made by STFC management to better engage with the research community (at least via the RAS) in the period since their CSR07 settlement and the welcome consultation exercises that have followed.
26. Nevertheless, the Society believes that structural issues remain whilst the risk associated with international subscriptions are largely the responsibility of the Research Council. Their fluctuations are essentially beyond the control of STFC, yet major subscriptions now amount to ~50% of STFC's near-cash allocation in 2009/10.
27. To provide a permanent, rather than ad hoc solution we believe that the Government should move the risk associated with changes in NNI to the level of BIS or HM Treasury, which would allow far greater certainty in forward planning. This compensation should ultimately be cost neutral, as in many years BIS would also benefit from positive movements in exchange rates (and hence NNI).
28. The Society accepts that international subscriptions to which STFC's user communities are the sole users should be tensioned against other components of their programmes, except for ESA subscriptions or bilateral agreements which are in the wider UK strategic interest.
29. The STFC structure grew out of the merger of the Particle Physics and Astronomy Research Council (PPARC) with the Council for the Central Laboratory of the Research Councils (CCLRC). STFC is now responsible for and has active involvement in both the science exploitation and the facilities provision on the PPAN side but only the facilities in the PALS area. Consequently only the PPAN part of the UK science programme is tensioned against the PALS facilities, which serve communities funded by the other Research Councils and are effectively 'national laboratories'. The merger was justified on the basis that the previous arrangement ran the risk that the UK did not fully exploit its investment in large scientific facilities. To date, underfunding has led to STFC failing in this regard.
30. We therefore urge the Government and RCUK to treat the PPAN and PALS areas of STFC separately, at least for financial purposes. STFC would benefit from a more transparent division between science and multi-disciplinary national facilities if those were considered by separate Boards. Future science budget allocations and associated technology development in the PPAN area could then be made explicitly for this new Science Board which would gain a more executive role. Costs for the Facilities Board would be met at the time of the next CSR by those Research Councils requiring the

use of the national facilities, in proportion to their proposed use. Membership of this Board would then need to have representation from across RCUK.

31. The RAS believes that this would remove the direct tensioning between national facilities and the PPAN research community, although the national facilities would still need to be tensioned against their own user communities from different research areas. However, future STFC science budget allocations could still be distorted by the 'non-cash' costs associated with the depreciation of capital assets like Diamond and ISIS included in Treasury accounting rules. A standalone National Laboratory, located on multiple sites and reporting to a stakeholder board, could provide large-scale engineering and computing facilities for both the public and private sectors. The Innovation Campuses would also sit naturally inside an organisation of this type. The Astronomy Technology Centre should remain within STFC, since its primary role is the development of instrumentation for ground-based astronomy facilities with UK involvement.
32. If the new approach is adopted, the RAS believes that this will stabilise the STFC research grants line, provided that subscriptions to major international organisations are stabilised, although it is recognised that increases in these costs may be imposed on the UK through majority voting amongst international partners. At the very least, these revisions would create a more transparent decision making process, where changes to the Council budget would translate more seamlessly into research activity.
33. We also believe that these solutions are preferable to shifting the grants line into another Research Council, thereby fragmenting the responsibilities for UK research in astronomy. PPAN research is characterised by long lead times, sometimes a decade or more, supported by the 'Rolling Grants' model which better ensures continuity of funding over project lifetimes and has been instrumental in allowing the UK to take its world-leading position in astronomy and space science. This model is not used in for example, EPSRC, where research projects are more impact-led and expected to deliver results on a much shorter timescale.
34. One other aspect of astronomy and space science funding so far not covered by the review of STFC is the role of the new freestanding Space Agency.
35. The RAS welcomes the creation of the Agency, with the view that its leadership could be far more effective than the present BNSC partnership. Our proviso is that additional costs associated with the Agency should not be met at the expense of the science research budget. Since the Ministerial announcement last December, we also remain unclear as to the shape of the Space Agency and the areas it will be responsible for. We therefore request the Government to publish its proposed Agency model in the near future and to work with the scientific community to devise an appropriate structure for the new organisation.

### **The operation and definition of the science budget ring-fence**

36. The RAS welcomes the public commitment of the Science Minister to retain the science budget ring-fence. We note however that the additional costs arising from the impact of NNI fluctuations discussed above are at present funded by shifting resources within the ring fence, making it less effective at protecting research funding than might be assumed.

### **Government objectives set out in the ‘Science and Engineering Investment Framework 2004-14’**

37. The Society notes the ambitious vision for Science set out when the Framework was published in 2004. With the planned contraction of research in astronomy and space science, that vision will be harder to realise.
38. With Governments of other nations like the United States and Germany committed to increasing investment in science, the UK’s world ranking as second to the US for research excellence is unlikely to be sustained. It is also hard to see how the UK will continue to be an attractive destination for researchers from other countries if the reputation of our science is so diminished.
39. In 2004 the Framework set out the ambition that Research Council’s programmes should be more strongly influenced by and delivered in partnership with end users of research. Although matters have improved greatly since 2007, there is still well-founded concern in the astronomy and space science community that STFC is not responding to scientific recommendations in the way that it should.
40. One final note concerns the provision of science teachers in schools and the ‘step change’ in their numbers sought by the Framework. Despite welcome efforts made to improve recruitment in the form of bursaries and other incentives, 50% of secondary schools in inner London have no physics graduates teaching science. This has long-term and well documented implications for the supply of future graduates in physics and astronomy and we urge the Government to look again at policy in this area.