

## STFC Programmatic Review 2013

Following on from our initial comments in a press release issued on 31 March 2014 ([http://www.iop.org/news/14/mar/page\\_62895.html](http://www.iop.org/news/14/mar/page_62895.html)) we have solicited input from the IOP's membership in response to a number of key recommendations in STFC's Programmatic Review report.

***R5: We recommend that, in the event of a flat cash settlement, STFC's highest priority be to maintain key scientific and technical capabilities in order to minimise an irrevocable decline in the UK's science base.***

There is also a need to strive to achieve maximum value from past investments. Too often, STFC has moved from a 'construction' phase almost immediately to a 'managed withdrawal' phase. In a flat cash scenario, it should be possible to maintain activity in key areas with the natural timescale for some projects closing offsetting the reduction in the true budget due to inflation. The grants lines (non-project) must be maintained in order to fully realise the underpinning exploitation.

***R6: We recommend that STFC work to ensure that the UK is seen as an excellent and reliable partner in international facilities in order to reap the benefits (such as access to world leading science), and to realise our ambition to host world-class international facilities in the future.***

The fact that this recommendation appears is a tacit acceptance that in the recent past the UK has not been a reliable partner which has damaged our international reputation. This is an important issue, given that many new international facilities will be coming on-line in the near future.

In the context of astroparticle physics, the community has been working closely with international partners towards the construction of CTA and LUX-ZEPLIN, and continuing development of gravitational wave infrastructure in, for example, Advanced LIGO. Not to commit to any of these projects now would compound the poor reputation recently developed.

Similarly, there has been nervousness on the part of STFC to fully commit to agreements which underpin the future health of UK nuclear physics, for example, FAIR and AGATA.

***R8: We recommend that protecting the PPAN grants line be a high priority in any financial scenario.***

This is essential and a high priority as the grants line provides the baseline funding for researchers. Furthermore, the ongoing review of how consolidated grants are managed should consider whether additional procedures might be put in place to increase the stability of the grants lines. At present, consolidated grants are

composed of multiple 'themes' that are considered separately. A research group's consolidated grant can potentially fluctuate dramatically from one period to the next depending on how the individual themes are ranked.

It is also particularly important that when budgets are being reduced in real-terms that the grants are announced early enough that groups can make provision for the loss of posts. In the past the late announcement of awards has caused difficulties. Also at present there is no dedicated astroparticle physics grants line and there is some ambiguity as to whether core consolidated grant staff funded on either astronomy or particle physics consolidated grants are eligible for support from the consolidated grants to work on astroparticle projects. A clarification on how the consolidated grants can support astroparticle projects would be beneficial.

***R9: We recommend that, in all financial scenarios, the number of PhD studentships be scaled with the size of the PPAN programme, and R10: We recommend that, if resources permit, a high priority be given to reinstating the post-doctoral fellowship scheme.***

Support for PhD studentships and PDRA fellowships is now at a dangerously low level, putting at risk the UK's ability to provide the trained people we need for the foundation of PPAN activities and the wider economy. Furthermore, the implication of this recommendation is that the balance between PhDs and PDRAs should be adjusted in favour of more PDRAs. We would argue for a better overall strategy for how we develop young researchers, having a balanced strategy between support for PhDs and PDRAs, and integrating the needs of the science programme with that of industry within the UK.

***R11: We recommend that the LHC experiments remain the highest priorities for the UK particle physics programme, and R12: We recommend that investment be made in international neutrino projects to allow the UK to exert major influence in the development of this science area worldwide.***

Leadership at the forefront of the high energy frontier will be ensured by the UK's continued leading participation in the future upgrade of the LHC. It is therefore crucial that, in the tensioning of resources, STFC's support continues at an adequate level also for the ATLAS Phase-II upgrade (e.g. the UK-led L1Track project). Adequate support to Grid computing is also a key ingredient for the success of the LHC exploitation programme and of other computing-intensive projects.

The study of neutrinos will remain one of the top strategic priorities in experimental particle physics for many years to come. It is therefore important that in the future, STFC continues to provide adequate support to key projects building on existing established UK leadership (e.g. SNO+, MINOS, NOvA, SuperNEMO, etc.).

***R13: We recommend that the highest priorities for the astronomy programme be continuing exploitation of major current facilities (ESO telescopes including ALMA, ESA space missions) and strong participation on the E-ELT and SKA.***

This recommendation is critical, as it is the only one that addresses the operation of the 'dual key' mechanism with UKSA. However, it is too restrictive in its scope; there is more to be exploited outside ESA, either with other major international agencies (e.g. NASA, China, etc.) and other UKSA initiatives (e.g. UK Cubesat programme,

bilaterals, etc.), which fill niche areas and pave the way to participation in next generation missions through the development of the appropriate technology.

***R14: We recommend that maintaining a balanced nuclear physics programme be a priority for the UK, enabling participation in new projects as well as exploitation of existing facilities.***

The recognition that the nuclear physics programme in terms of projects is too narrow is welcomed. Currently, the UK has only one funded project which is NuSTAR at FAIR. Following the Programmatic Review, STFC has put in place a process which could see limited funding for additional projects which include the ALICE upgrade (LHC), a storage ring at ISOLDE and contribution to the 12 GeV upgrade at the Jefferson Lab in the US. This would result in two projects with a nuclear structure/astrophysics emphasis and two associated with hadronic physics. It is important that STFC also keeps open the funding line for projects to ensure that there is capacity to fund, for example, the NuSTAR upgrade which will occur close to 2018/19.

***R15: We recommend that maintaining involvement in gravitational wave, dark matter, and high energy gamma ray experiments be a priority for the sake of the diversity of the UK programme.***

Gravitational waves, very high energy gamma rays and dark matter are key areas with the capability to transform our understanding of the universe. In 2008, the UK had a vibrant programme in gravitational waves research and small but highly significant programmes in very high energy gamma rays and in dark matter. Unfortunately, the financial crisis that hit STFC coincided with the period when significant scale up and internationalisation were required for these projects. Subsequently, all have suffered, especially research in gamma rays and dark matter.

The reduction in these programmes, and others, has led to a much narrower portfolio of STFC-funded research. However, through careful consultation, and difficult but necessary consolidation within the community, the UK has rebuilt its capability in these areas. The UK continues to make major world-leading research contributions in gravitational waves and is building major leadership roles in CTA and in LUX-ZEPLIN. UK participation in the latter two projects will require significant capital investment in the near future, together with support of the teams leading the research.

We note that in the Programmatic Review it was hinted that CTA and the dark matter experiments would be tensioned against each other. For the most part the experiments have different science goals and we believe that, consistent with the stated remit of the Programmatic Review, projects should be tensioned across the STFC portfolio, not paired in an artificial way. Should narrower tensioning be necessary, CTA involvement should be tensioned against other astronomy commitments and dark matter against particle physics commitments.

***R16: We recommend that STFC work to ensure continuing participation in future major international experiments in the PPAN programme, and seek to secure the necessary capital investments.***

Within the context of astroparticle physics, it is imperative that the UK commits to the Advanced LIGO, CTA and LUX-ZEPLIN projects. These are major international projects, with significant capital investment required.

It is also essential to recognise that for some subjects, such as nuclear physics, that new project opportunities can materialise on timescales which are months to years, rather than tens of years. For this reason it is important to protect budget planning lines associated with such subjects in order not to close off compelling opportunities that arise in the future.

For particle physics it is vital that a strong case is made for the capital support for the LHC upgrades and subsequent energy-frontier machines such as the ILC and also that capital is available to enable the particle physics programme to be broadened; for example, support for future long baseline neutrino experiments, neutrinoless double beta decay and intensity-frontier experiments. Without additional capital support the UK will not be able to maintain or establish leadership in these future projects.

***R18: We recommend that Science Board lead reviews in the areas of neutron and photon provision and develop a coherent strategy for UK large facility provision.***

The Photon Science review appears to have a heavy emphasis on '5th Generation' light sources without really defining what these are and how they may have an impact on science in the next few decades, whereas the emphasis on 4th Generation (i.e. X-ray FELs) light sources appears rather equivocal in contrast. To be clear, the 'current' 3rd Generation began with the opening of the Daresbury Facility in 1981 and continues with the Diamond Light Source. Thus, the 3rd Generation will be of relevance for at least 50 years. In contrast we appear to be planning to skip the plan for a UK 4th Generation (FEL source) in pursuit of an undefined '5th Generation'.

***R19: We recommend that the Large Facilities Funding Model be replaced with a well-thought-out science-driven scheme capable of ensuring a coherent facilities programme for the UK.***

The IOP's Large Facilities Forum has repeatedly stated that the current funding model for the UK's large facilities is flawed and inadequate resulting in the significant under-exploitation of major investments by the UK government. In recent years two facilities operated by STFC (i.e. ISIS and the CLF high power lasers) have been running at 50-70% capacity due to a lack of running costs. This is having a significant and disproportionate impact on the scientific output of these facilities and in return on the UK science base using these facilities. Any new facility should be planned with full consideration of lifetime costs which includes sustainable operation, upgrades, the replacement of instruments and decommissioning. An appropriate budget should be established for running costs to meet the demands of the broad user base across academia and industry.

***R20: We recommend that STFC, together with the UK Research Councils, pursue the development of ISIS into a European high-power short-pulse neutron spallation source.***

The UK government has recently announced its intention to participate in the construction of the European Spallation Source (ESS) and by doing so acknowledges the importance of neutron scattering to our understanding and further development of modern materials. Optimistically, the first instruments at the ESS are expected to be available for research by 2023. For the UK's neutron users to be able to effectively exploit the UK investment in the ESS, it is essential that the growing UK neutron community continues to have sufficient access to the best existing neutron sources, i.e. to the ISIS pulsed neutron source in the UK and the ILL research reactor in Grenoble. This will require an increase in the operation of the ISIS facility to at least 180 days per year and ideally 240.

***R21: We recommend that STFC pursue the objective of UK Free Electron Laser access in collaboration with the other Research Councils and the scientific community.***

The IOP supports this, but questions need to be asked as to whether this will satisfy the need for capacity in the future.

X-ray FELs, with pulses as short as 10fs and peak brightness at least nine orders of magnitude higher than 3rd Generation facilities, are opening completely new research fields with impact across all of science. The UK, via the STFC, must invest in R&D towards a 4th Generation FEL facility if a wide range of UK science is not to be left straggling behind our competitors. This should go in concert with greater involvement with Euro XFEL as a full partner. This would give us the leverage to guarantee adequate access and to influence the scientific and technical directions of the Euro XFEL facility in the future. A UK based FEL is needed in the longer term to satisfy the projected growth in demand for access and to deliver advanced capabilities not available at other machines.

***R23: We recommend that STFC invest in future laser technologies to ensure that the UK can remain at the forefront of laser driven science should capital funding become available.***

It is essential that investment is made at the Central Laser Facility to enable the UK to maintain an internationally leading position in the relevant science areas (e.g. laser-plasma). There is general consensus in the UK laser-plasma community for the need for:

- Investment in Vulcan – both developing a 20PW and a 20kJ capability – will keep UK the community ahead in ultrahigh intensity science and related areas of high energy density science, and ICF/IFE physics. A third target area would also address over-subscription.
- Investment in Gemini: this would support the development of novel laser-driven particle and radiation sources and exploitation for applications and innovation. Multiple target areas, dedicated to specific functions, are required, and this will also address over-subscription.

- Investment in Artemis: to offer the world's first open access attosecond-sources.

Additionally, there is a need for investment in university-scale high power laser systems, as these systems enable related research to be done in-house, particularly research that cannot easily be done during short periods of access to big facilities. The big facilities are essential to break new ground and explore new physics at the forefront of what is possible with high intensity lasers, but smaller in-house facilities do have an important role in the overall development of the science. Another important consideration is that university-scale laser systems enable training of researchers to make better use of time-limited access to large-scale laser facilities.

***R29: We recommend that Science Board, in conjunction with the Accelerator Strategy Board, develop and maintain a science-driven strategy for accelerator-based science, technology and facilities.***

This should include consideration of laser-plasma accelerator science and technology.

#### ***Additional comments***

There are no recommendations specifically concerned with particle theory in the Programmatic Review report, despite the research area having world leading status. The 2012 PPAP Roadmap contained the following, specific recommendation that should have been included in the Programmatic Review:

*Recommendation 22: The UK must continue to support a world-leading long-term programme in theoretical particle physics, particularly in fundamental theory, phenomenology, lattice theory and particle cosmology.*

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