**STFC Balance of Programme (Skills) review**

**Community Consultation**

**Response from the PPAP**

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**Background**

The purpose of the Balance of Programme (Skills) exercise is to periodically review the balance of activity and funding across STFC’s skills programme.It has the overall objective of identifying a desirable skills programme balance over the next 5 year period.

For the purpose of the review, STFC’s skills programme is defined as formal, funded training and engagement schemes in the following skills areas; public engagement, apprenticeships, graduate trainees, studentships, fellowships. The review will only consider skills activities directly funded by STFC.

The Balance of Programme (Skills) review will be used by STFC to inform planning decisions, to optimise their impact in any financial scenario (positive, negative or neutral) and to position STFC to exploit future funding opportunities.

STFC would value community input to the review through its Advisory Panels. Panels are invited to respond to the following questions.

**Consultation Questions**

1) What would be the impact on research programmes of reduced/increased funding for skills activities relevant to them?

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It is vital for the UK particle physics programme that the skills pipeline is kept well filled. The Ph.D. studentship programme provides a source for future generations of particle physicists however the technical and engineering skills required for a successful programme can enter the system through different routes. Strong reservoirs of skills at the universities and the national laboratories are required both to support the programme and educate new generations.

There have been very significant pressures on the numbers of staff at all UK institutes for many years now. This had led to an erosion of skilled staff in university groups and RAL PPD. While a recent influx of studentships is to be welcomed for the UK community to be effective there must also be a strong and well-maintained reservoir of more senior staff and RAs. These staff are not least required to educate the incoming students in the required skills. Furthermore there must be a route for the Ph.D. students emerging from their degrees to continue within the programme. The reduction of RA positions severely constrains this important element of the skills chain.

A concern is that while additional studentships are very welcome significant constraints are being placed on the activities of the students through targeted scheme. An increase in quota studentships is preferable to the targeted and constrained schemes that are emerging.

Any increase in funding should go to support all levels of skills from junior RAs to senior staff including technicians and engineers. While we acknowledge significant increases in funding are unlikely in the immediate future in the interim the available skills could be improved through the provision of centrally run schemes to educate existing staff in new skills. The government has stated that it wishes learning to be life-long. If this implies that funds could be made available to particle physics for skills training of existing staff this would be welcome.

2) What is the most appropriate balance between skills areas and activities at different stages of the skills pipeline (public engagement, apprenticeships, graduate trainees, studentships, fellowships), in order to ensure a sustainable skills programme?

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A healthy population at all stages of the skills pipeline is required to ensure a sustainable set of skills within particle physics. The skills required in particle physics can broadly be grouped under:

- detector design, construction and operation: This requires skills in sensors, readout systems, large scale system design and construction, commissioning and operation.

- software and computing: online and offline software, large scale complex computing systems, exploitation of evolving hardware technologies.

- data analysis and development of theoretical physics. Analytical and mathematics skills.

- soft skills: project management, outreach, scientific writing, presentation skills, etc.

These skills map somewhat differently onto the various cohorts where apprentices and graduate trainees are more likely to focus on technical skills.

The breadth of skills required by particle physics remains fairly constant over time however as technologies evolve certain areas of skills come into greater demand, an example being the writing of firmware. This is now of increasing use to physicists and people with such skills are in great demand. Software and computing technologies are similarly evolving. Centrally organized training for such areas as these would be of great benefit to the community.

The gradual reduction in RA positions is depleting a vital part of the skills pipeline and is having an impact both in experimental and theoretical work. The relative balance of the population of RA positions to studentships and the more senior fellowships funded through Rutherford Fellowships could be reviewed. We wish to further consult the community on the current balance of positions.

The recent increase in the availability of studentships is to be applauded however these are increasingly being constrained to specified types of activity. While useful in these areas this will increase pressure on the skills areas that are not currently flavor of the month. Maintaining a strong cohort of students whose areas of activities are not constrained is very important to the health of he particle physics programme.

The recent government enthusiasm for apprenticeships has the potential to be exploited by particle physics if the rules governing them evolve in an appropriate manner. The technological expertise available to particle physics could be enhanced through the training of these people. The national laboratories have long had apprenticeships programmes and are hence well placed to increase this activity and provide useful expertise to the particle physics community.

3) What are the opportunities for STFC in the skills domain to increase industrial impact and respond to the Industrial Strategy, GCRF and Newton Fund?

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It is generally acknowledged that particle physics activities encompass a very broad range of cutting edge skills that are useful in industrial contexts. Despite apparently recognising this whenever new schemes are created by government, supposedly to build industrial capability a very narrow view is taken that in generally focuses on relatively immediate and specific applications. If STFC were in a position to help define these schemes in the first place and to ensure that it is properly taken into account that the skills that are generated by particle physics are very broadly applicable in most areas of technological application this would be of great benefit in acquiring funds. One of the functions of UKRI is to provide UK science with a greater voice in government. It is to be hoped that this route will enable STFC’s voice to be heard more clearly.

Particle physics activities encompass a very broad range of skills required for the design, operation and data analysis functions of experiments as well as the mathematical skills required for theoretical physics. In addition to these particle physicists operate in large international collaborations, which can provide industry with people able to operate effectively in technologically challenging international environments.

For reference we list the set of industrial strategy areas. While it is hard to directly link the bulk of particle physics activity directly to an immediate application the skills relevant to particle physics are applicable to almost all of the areas listed below. Embedding this message in the construction of the mechanisms for allocating such funds would be the most effective way of getting such funds to STFC activities.

* Smart, flexible and clean energy technologies (such as storage, including  
  batteries, and demand response);
* Robotics and artificial intelligence (including connected and autonomous  
  vehicles and drones);
* Satellites and space technologies;
* Leading-edge healthcare and medicine;
* Manufacturing processes and materials of the future;
* Bioscience and biotechnology;
* Quantum technologies; and
* Transformative digital technologies including supercomputing, advanced  
  modelling, and 5G mobile network technology.

The overall overseas aid objectives addressed by the GCRF fund could be greatly helped by training people in particle physics. Many of the developing counties recognise this and create particle physics programmes to the end. There is an obvious role that the UK could play in educating people from these countries in the techniques used in particle physics. Despite this a recent bid to the GCRF that was well supported by numerous developing countries was turned down. If the bodies awarding these funds in the UK could be made better aware of the applicable skills that particle physics can foster it would be of great help in securing these funds.

Two potential activities to help with this could be to create some concise documentation on the types of skills required in particle physics, including some examples, that could generally be made available to the bodies of people who define schemes and make up the assessing bodies. A second useful function for STFC could be to help the particle physics community structure bids that meet the criteria of the various funds. Bids through university structures face the challenge of competing with other areas such as the biological sciences that universities may feel have a greater chance of success. To combat this one possibility could be to have community wide bids coordinated through PPD and submitted as part of an STFC application.

4) Our science programmes depend on a pipeline of skilled people.

- Do you feel the current balance that exists for students, PDRAs, academic staff, technicians, engineers, software engineers etc. is roughly correct in your field?

- Are there sufficient skills, experience and leadership for the current and projected future programme or are there areas where these are lacking?

- Please comment on how this field generates skills impact for the UK

Max. 2 sides A4, as an update to your original response to this question during the PPAN Balance of Programme review.

An appropriate balance of people is essential for the health of the field. New people in the form of students and RAs need to be trained to produce not only the next generation of particle physicists, but also to deliver skilled people to the UK work force. This set of people is however transient and a solid base of permanent staff with skills across the board are required. This latter set of people is provided by academics, core staff at universities and staff at the Particle Physics Department at RAL. The Technology Department, whose staff are not dedicated solely to particle physics experiments, provides engineering staff on a project-by-project basis.

Studentships are a vital and relatively cheap resource for all aspects of the physics programme, and a well-constructed studentship should address several of these aspects. Any reduction of studentships, or redirection into other schemes (e.g. commercially-facing data science) will be to the detriment of the overall programme and limit the UK particle physics output. The breadth of skills acquired during a particle physics PhD are highly valued by UK companies.

There is high demand for certain skills that is growing with the evolution of technology, examples being firmware and software engineering skills. The community would benefit from training programmes run by the community in such areas (a recent example being the FPGA course at RAL), to help increase the reservoir of skills.

Recent funding cuts have led to a reduction in core staff positions at the universities and within PPD. One unfortunate effect of this is to focus considerable available effort on current projects leaving little available for the development of future programmes. The concomitant reduction of effort in operational roles on the experiments has created the risk of loss of expertise in this area, one of many examples being in software engineering.

There is a growing community of academics both in experiment and theory to lead the future programme of Particle Physics. The overall reduction of RA positions is a general issue, and of very marked concern within the theory community where this is the only source of non-academic effort. The relative merits of funding senior fellowships (Rutherford fellowships) verses RA posts could be further considered in the light of this observation. While the academic community is growing both in experimental and theoretical particle physics the diminishing fraction of academic FTE that is funded relative to possible support for academics in areas of physics supported via other funding agencies such as the EPSRC, could in the longer term, lead to universities regarding particle physics posts as less attractive options.

Particle physics is an efficient generator of skilled people for the UK workforce. Students and RAs that are trained in the field are exposed to a wide range of problems and develop a breadth of skills to solve them. It provides generic training in analysing and solving complex problems and specific training in areas such as software development, system administration, applied physics, electronics and engineering skills. And as many other areas of post-graduate training, it imparts softer skills in areas such as time management, communication and scientific writing.

5) Any other comments?

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**Confidentiality**

Please indicate if there are any parts of your response that you wish to remain confidential to STFC and the Review Panel.

**Further Information**

If you have any questions about the review, process or consultation, please contact Emily Swaine [emily.swaine@stfc.ac.uk](mailto:emily.swaine@stfc.ac.uk).