Institution: University of Sussex

Unit of Assessment: UoA 9 Physics

1. Context

The University of Sussex's submission under UoA 9 coincides with the Department of Physics and Astronomy (hereinafter the Department). The Department forms part of the University's School of Mathematical and Physical Sciences. Research in the Department is currently organised into four research groups – Astronomy, Theoretical Particle Physics (TPP), Experimental Particle Physics (EPP) and Atomic, Molecular and Optical Physics (AMO). Across these groups, research since the 1990s has been predominantly of a basic nature, from which most of our current impact arises, with some applied research arising from the AMO and EPP groups.

Our basic research has great potential for impact through public engagement. The recent Higgs boson discovery generated coverage across all major print, TV and internet media. Evidence published by the STFC shows that 90 per cent of new UK UG physics students cite TPP, Nuclear Physics and Astronomy research as their motivation for studying physics. The Department recognises this through a large and systematic engagement effort, which has been vigorously expanded in recent years through the HEFCE-funded SEPnet consortium.

Besides this, we have a growing base of more-applied research and the Department facilitates technological impact through policies and designated staff roles. The Department has seen an approximate doubling in faculty over the REF period and further substantial expansion is planned. Impact is integral to this strategic expansion. Four recent appointments in the AMO group have close connections with industry and pave the way for establishing a new applied group.

Our main beneficiaries are school teachers and pupils, the general public and industry (specifically through measurement technology). The public is engaged with departmental research in all research groups through our in-house schools laboratory and master classes, as well as frequent research talks at schools; through active staff engagement with broadcast and print media; and direct public participation through the Galaxy Zoo 'citizen science' project.

2. Approach to impact

The Department's approach is based on the strategic vision of the University, which prioritises knowledge exchange activities and the translation of research to the benefit of society and businesses. In order to realise and record impacts, the Department has, in recent years, organised and formalised its approach strategically. In particular, we engage the public with the fundamental research in physics that is the focus of our activities, and which has a particularly powerful appeal to the non-academic public who are enthralled by the 'big' questions. At the same time, we are committed to promoting innovation in industry and elsewhere as a result of our research outcomes.

Strategic public engagement and SEPnet strand

We have a well-established public engagement programme, which communicates our research directly to a wide variety of audiences, from students and teachers at all levels of education (including primary, secondary, A-level and adult education) to amateur scientists and the general public. For example, over the REF period we engaged more than 15,000 pupils with our current research (see case study). We have also dramatically extended and professionalised our activities. We have appointed one permanent academic, Professor Mark Hindmarsh, as Outreach and Engagement Director, dedicating 15 per cent of his time to this role. The Department has hosted Dr Jonathan Hare, a visiting lecturer in Science Communication and a member of the BBC TV's Rough Science team, and has been hosting Dr John Gribbin, a science writer with a prolific output of books and broadcasting, who heavily consults with, and draws on research done by, Sussex academics in his works. In 2009, Gribbin won a Lifetime Achievement Award from the Association of British Science Writers.

Our public-engagement activities have been bolstered by the successful bid for SEPnet (the South East Physics Network), a HEFCE-funded consortium of University physics departments working

together to promote physics in the South East, of which the Department has been a founding member since 2008. SEPnet includes a strand which supports public engagement for impact. The Department was involved with the design of this strand. Since January 2009, as part of this programme, our public-engagement activities are supported by a dedicated full-time PhD-educated astrophysicist, Dr Darren Baskill. A major part of Baskill's role is to support the entire Department (from students to academics) and to liaise with external partners in engagement activities. He has been very successful in enthusing staff and developing a network of external connections. In addition, he contributes advice and feedback to impact-related aspects of grant applications. Examples where Dr Baskill has provided support include the management of the particle physics masterclass for local school and college students (with talks given by our leading researchers), and star-gazing live events for the public. SEPnet encourages research to be embedded in all activities, such as faculty presentations during weekly Sussex Schools Lab days.

SEPnet allows public engagement with research to have a greater impact. The collaboration allows greater reach by rolling activities out through the partners and supporting attendance at a wider number of festivals such as the Brighton Science Festival. The significance of activities can be increased through the officer's expertise and links with local stakeholders. The officer also has expertise in evaluation (we use feedback forms and keep track of attendance at all events) and allows a better assessment of public-engagement activities.

In addition, SEPnet involves shared teaching between nodes, through which departmental research can impact students at partner HEIs through their studies. The Department has taken a lead role in the successful 5-year successor bid to HEFCE (2013–18), as part of our strategic commitment to engagement and impact [see also Section 3].

Strategic expansion

The Department has grown substantially – from 20 to 38 faculty – over the REF period, and has been conscious of impact generation in doing so. New appointments were made in each of the four SEPnet research themes, in line with SEPnet's goal of enhancing research diversity. Of these, *Radiation Detection and Instrumentation (RDI)* has particularly high potential for impact on industry. Fifteen appointments were made during 2013 and, while the rules for REF impact preclude their contributing to our unit's impact case portfolio, the expansion is expected to contribute substantially to industry-related impact from the Department to 2020, in particular with the four new AMO/Quantum Technology faculty (Pasquazi, Peccianti, Porras, Dunningham).

Engagement with Industry

The Department has appointed Dr Winfried Hensinger, a permanent faculty member in the AMO group, as its business representative. Hensinger was a London Technology Network Business Fellow 2008–2011. In his role he promotes interaction between industry partners and the Department, including through the creation of marketing materials, through advice on patents and on the University's commercialisation procedures, and by acting as a contact point for external industry collaboration or contact requests. The Department liaises with the University's Sussex Innovation Centre, one of the premier business incubators in the UK (e.g. Director Mike Herd's Queen's Award for Enterprise Promotion in 2013). Projects include a major pharmaceutical company developing a sorting device for biological samples, with the ideas originating from quantum technology research; a US high-technology company working on a joint application to a US Defence organisation to develop electronics for quantum technology applications; and a number of laser companies looking at the commercialisation of a novel laser that has been developed for the manipulation of trapped ions.

3. Strategy and plans

We will:

- build on and develop our successful approach to impact from public engagement;
- embrace and exploit Phase 2 of SEPnet (2013–2018);
- systematically identify potential impact from our newly expanded applied research base, and from our 'blue-skies' research, and nurture the knowledge transfer into the non-academic sector; and
- further broaden and deepen our research portfolio through strategic expansion, to grow our

potential for impact.

Public engagement

We will make improvements to our public-engagement strategy to further enhance the already high reach and significance of the impact arising from it. Keeping the basic structure in place, we will make enhancements to data capture, longitudinal monitoring and feedback. Improved feedback forms have already been developed and trialled during the preparation of our REF submission and will increase the amount of high-quality written testimonial in relation to our already very complete quantitative information. This will allow us to improve our engagement and provide an in-depth assessment of public-engagement impact.

SEPnet impact strategy

Our approach will benefit from the new 5-year SEPnet agreement, which has been hailed as 'a very successful intervention to support what was once a vulnerable subject', for which HEFCE was 'pleased to provide funding for a new phase' by HEFCE Director of Research, Innovation and Skills, David Sweeney. HEFCE awarded the SEPnet consortium £2.5 million for the period 2013–2018, to extend and develop the network to a plan in which Sussex took a leadership role. This includes the new GRADnet network, which builds on SEPnet activities such as the NExT particle physics graduate school, and will include a collaborative impact strategy, the sharing of best practice in public engagement, a programme of transferable and leadership-skills training for PhD students, and employer engagement – including placements and industry-sponsored PhDs and consultation with the SEPnet employers group. In particular, we will benefit from SEPnet's renewed emphasis on impact – which includes a Diversity and Impact Lead, Professor Averil MacDonald – and from consulting with the SEPnet teachers' network. We will exploit and actively develop these elements to support our impact generation.

Generating technological impact

Developing the idea of a Departmental Industry Contact, we will provide support to academics in all stages of impact-related activities, to ensure both basic and applied research results in practical applications in industry and public services where possible. We now systematically scrutinise and feed back on grant applications and Pathways-to-Impact statements as part of the internal application review process – these findings will be used to alert researchers to the potential impact of their work, and advise on publications, patents and related University services. We share examples of good practice and review pathways to impact annually. During the REF period several areas of potential impact have been identified and are being developed. One example is the adaptation of database algorithms developed for astronomy to medical archives, with possible large-scale applications in the NHS and abroad. The strengthening of employer relations through Phase 2 of SEPnet, which includes industry placements and industry-sponsored studentships, will form a direct path for knowledge exchange, and underpin our generation of technological impact.

Further strategic expansion

The University, as part of its new 2013–2018 strategic plan, is renewing its Science Campus, including new buildings. The University expects to invest £120 million in Science Estate and further growth in Physics faculty numbers by around 12 is expected. Our intention is to introduce a new applied physics group, specifically to enhance our impact.

4. Relationship to case studies

Two of our case studies draw heavily on our professionalised approach to public engagement [see Section 2], especially the skills and capacity of Dr Darren Baskill. One relates to our engagement with the general public, improving scientific literacy not only through high-profile research findings in the media and arts, but also by engaging the public with the research process itself. The second concerns the improvement of physics teaching and up-take at A-levels and at university, making a direct impact on science education. The third case study comprises technological impact springing from research in the 1990s [Section 2] and illustrates the potential of fundamental research to underpin commercial innovation over long time-scales.