

Institution: University of Kent
Unit of Assessment: 9 Physics
<p>a. Context</p> <p>Physics at the University of Kent is based in the School of Physical Sciences (SPS), which has 32 faculty members organised within four research groups: Applied Optics, the Centre for Astrophysics and Planetary Science (CAPS), Forensic Imaging and Functional Materials. The focus of the overall submission in this UoA is CAPS. However, impact in physics accumulates from all four research groups and is organised and enabled at School level as a whole. Accordingly, the case studies here are based on research by Physicists inside the School during the relevant period.</p> <p>The impact of research undertaken by physics staff is focused on three main user groups:</p> <ol style="list-style-type: none"> 1. National and International businesses that include space technology and applied optics companies, for example Astrium, Qinetiq and Optos (see OCT case study). 2. National and International public bodies that includes NASA, law enforcement agencies and the judiciary (see EFIT-V case study). 3. Education at schools and through public engagement, via an extensive, proactive outreach programme described further below.
<p>b. Approach to impact</p> <p>Stakeholder engagement</p> <p>Impact is achieved by activities at school, university and wider levels as described below. We liaise with external bodies via direct links and also via links organised by Kent Innovation and Enterprise (KIE), a University unit that maintains expertise and links to businesses (multi-national and SME), Government bodies (national and local) and which effects introductions and new links.</p> <p>School support for impact</p> <p>The School assists its staff in developing impact as an embedded component of their research activity. The School operates a Workload Allocation Model (WAM) that includes specific time allocation for industrial partnerships and knowledge-transfer activity at the same levels as for traditional research. The WAM also allocates points for the supervision of students and PDRAs associated with industrial and organisational grants outside of the research councils. Study leave for academic staff, which may be from a few weeks to up to a year, enables staff to develop research and enterprise or foster the impact of their work; for example, since 2008 Dr Solomon benefitted from study leave to develop/promote his work in facial recognition (EFIT-V case study).</p> <p>University support for impact</p> <p>The University has directly invested in physics to help maximise impact from its research via the following mechanisms:</p> <ul style="list-style-type: none"> • Patents: the University of Kent (via KIE) provides the administrative assistance necessary to enable researchers to obtain patents for inventions that have development and marketable potential. This has been used numerous times (e.g. the OCT case study where 14 patents name Kent staff as inventor or co-inventor and generate royalties). • Investment: If a researcher sets up a spin-out company, the university will invest (via KIE) in research that has commercial potential in return for a shareholding in the company. The EFIT-V case study has benefitted from this approach. • Media: the University has a dedicated media office and science results of potential public interest are passed to them for dissemination through the local and national media. Many SPS members provide national and international media interviews and information (e.g. Dr Stephen Lowry, following the Russian Chelyabinsk Meteor in February 2013, appeared in national and international media interviews; Dr Mark Price filmed for BBC Horizon, Canadian TV and quoted in over 20 major media outlets including 2 international radio stations in 2013). • Innovation Vouchers: Funding is available (via KIE) to support smaller project collaborations between SMEs and the university with the latter providing a 50% contribution towards the cost. This stimulates collaborations and provides opportunities for fostering longer term partnerships,

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such as that between Physics staff in SPS and staff in the School of Engineering, and the company **EMS Radio Fire and Security System** to develop a Single Circuit Board Radio Smoke Detector as part of a Knowledge Transfer Partnership contract during the REF period.

- **KIE** staff provides support by proactively searching for research partners, and introducing academics with potential business partners, as well as disseminating calls for expertise and assistance from companies and organisations.

Wider Support for Impact

South East Physics Network (now SEPnet-2) is a HEFCE funded alliance of nine physics departments in the south east of England. It enables Kent to share graduate teaching resources and research facilities across the region, and provides a strong platform for outreach and employer engagement. Directors in graduate studies, outreach, employability, and diversity and equality coordinate a team of associated officers at each of the sites. Sharing resources and experience, such as research equipment, and lectures broadcast via videoconference, enables SPS to provide a richer and more fulfilling environment for its students and staff. The escalating numbers and diversity of the undergraduate and postgraduate population in physics at Kent is widely attributed to a substantial extent to the success of SEPnet.

Examples of the successful exploitation of the impact support above include:

AUTODYN: A major piece of software used by Dr. Price is AUTODYN, a commercial hydrocode to model high velocity impacts. The computer code is developed and supplied by ANSYS UK. Dr Price has a symbiotic relationship with the developers, exchanging knowledge through tracing errors in the code not seen by standard users. In return for technical assistance with the code, Dr Price updates ANSYS on their material strength models through hydrocode validation tests.

Space School: Initially supported by STFC (until 2011), Space School is now an established event supported by SEPnet and SPS. Space School is a weekend summer residential camp for space enthusiasts aged 11-18. There are typically 80 – 100 attendees each year. It is staffed by CAPS academics, former CAPS members and the outreach team. As a result of its success we recently introduced a Forensic Science weekend.

SEPnet Outreach: SEPnet provides a strong platform for Outreach. A full-time Outreach Director coordinates many of the activities of a team of Outreach Officers, one based in each member department. Sharing resources and experience enables SPS to develop and disseminate best practice which has contributed to the increased numbers and diversity in the UG and PG populations. CAPS members are constantly invited to schools and events requiring science demonstrations, theme-led discussions or lectures. SPS has also hosted SEPNet GCSE Physics Revision Events. CAPS staff have considerable public speaking experience giving talks to local astronomy groups on astrophysical topics, particularly their own research. The Astrodome is a very popular portable, inflatable planetarium acquired in 2008. It 'sets the scene' for space science events. The campus observatory, consisting of two telescopes and domes, is mainly used for outreach. It is also used by the Student Astronomy Society (IoP 'Best Overall Student Society' award, 2008). Overall, Outreach from the School sees 15,000 – 18,000 young people per year.

Impact Lab: The Impact Lab is an experimental facility where we can fire projectiles and record their impact into various media, from oceans and deserts to spacecraft. The Lab's international profile attracts a constant stream of external users.

c. Strategy and plans

The School of Physical Sciences has developed explicit impact objectives and mechanisms to enable impact to grow, which are supported by central services within the university, including the **Kent Innovation and Enterprise unit (KIE)**. They result in a clear path to identifying impact opportunities and building relationships with external stakeholders. As a result of this accumulative and purposeful strategic investment in research impact, from 2009 to 2013 SPS grew from **4% to 15%** of the total Innovation and Enterprise income at the University of Kent. Key components of this approach include the following:

- A School **Director of Innovation and Enterprise (DoIE)** was appointed to enhance growth, identify new opportunities to exploit discoveries within SPS and liaise with **KIE**.
- The Research and Enterprise Committee of the University of Kent oversees physics

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impact strategy and receives regular impact reports as well as research reports.

- Impact achievements and plans are an explicit part of the annual **appraisal** for all academic staff.
- The Sale of Service/Enterprise service inside the School has been re-organised and re-launched to make it more prominent. It is publicised via SPS/CAPS webpages, IoP, PhysicsConnect initiative and the SEPnet Kit List which lists technologically advanced capabilities consultable by any enterprise with demands for particular scientific equipment. Bodies that have taken up our expertise include NASA, Lockheed-Martin and the Netherlands Forensic Science Service as well as local SMEs.

We monitor and measure the extent of our impact by the number and size of contracts (spanning a range from broad fundamental research to specific issue research and development consultancies), patents and feedback from partners. The School is extending the range of industrial partnerships and the use of the School's facilities for consultancy activity.

SPS has three teaching strands: Physics, Chemistry and Forensic Science. The **collaboration** and **interdisciplinary nature** of its teaching is reflected in its research program and enterprise activities. There are numerous activities spanning across research groups, such as joint colloquia and sharing of resources, such that the activities within physics are supported by the infrastructure of the school as a whole. For example, the recent University of Kent funded £100k computer cluster upgrade, new SEM and new Raman spectrometer, all support solar system studies as well as functional nanomaterials research and are available for use on external industrial contracts. The collaborative way that the school operates forms a clear mechanism to enhance impact, compared to what would be possible if the school operated its components independently.

SEPnet provides a major strategic vehicle to deliver impact in physics at the University of Kent. By leveraging its scale and diversity of expertise, the impact SEPnet can create is greater than the sum of its parts, not only through collaborative activities such as equipment sharing, but also generating greater exposure to potential industrial partners. This is achieved, in part, through the SEPnet industrial advisory panel that reviews and plans industrial partnerships. More recently, we have built upon the success in employability across the SEPnet partner, by each appointing its own employment officer to create closer ties with regional companies.

Future impact plans include additional work with industry (e.g. via AUTODYN computer code validation) and the extension of outreach activities. CAPS will use its international research networks (e.g. NASA's Stardust Interstellar Preliminary Examination team, LoFAR) to extend public engagement in our research.

Physics also plans impact beyond the UK. As the UK's European university, Kent actively seeks collaboration with European partners and service providers (see EFIT-V case study).

d. Relationship to case studies

Ten years ago, the **Applied Optics** group led by **Professor Podoleanu** undertook fundamental research into the physics of optical coherence tomography (OCT), which has led to new eye-imaging instrumentation. The OCT case study demonstrates the translation of this lab research into health technology and industry. Professor Podoleanu has been provided with all levels of support described in the **Approach to Impact** section. These include university support for funded studentships, assistance in writing patents, guidance from **KIE** in negotiations with external companies, and the setting up of a spin-out company Optopod. The SPS WAM has facilitated a reduction in administrative and managerial duties usually expected of professors.

The imaging software that was initially developed to interpret craters on moons and planets resulted in a breakthrough in facial imaging. The EFIT-V case study describes the formation of the facial imaging research group. **Dr Solomon** has also benefitted from interaction with **KIE** in setting up the Visionmetric company and from the flexibility of the WAM to visit at short notice police who have problems implementing the software. **Dr Solomon** has also made good use of the media facilities and has appeared on TV and in the national press many times.