

STFC Impact Report 2012



Science & Technology
Facilities Council



STFC's high performance computing capability is accessible to industry, speeding up the innovation cycle and accelerating economic growth.

STFC Impact Report 2012

Contents

Executive Summary	2
Introduction	4
World Class Research	6
Research statistics	6
Generating new knowledge	7
Creating long term impact	8
Solutions for Global Challenges	10
World Class Innovation	12
Innovation from grant-funded programmes	12
Commercialisation of STFC IP	13
Supporting UK businesses to take advantage of our facilities and subscriptions	14
Delivering impact through the Science and Innovation Campuses	15
Investment in e-infrastructure	19
World Class Skills	20
Highly skilled people	20
Inspiring and involving	22
Collaboration activities	23
Methodological developments and future challenges	24
STFC impact evaluation programme	25
Appendices	27
Appendix 1: STFC publication statistics	27
Appendix 2: STFC Statistics	28
Appendix 3: Glossary	29

*Note: All images are courtesy of STFC unless otherwise stated.
Cover image courtesy of Dreamstime.*

Executive Summary

The Science and Technology Facilities Council (STFC) is one of seven UK research councils. Our research seeks to understand the Universe from the largest astronomical scales to the tiniest constituents of matter, yet creates impact on a very tangible, human scale. From cancer treatment to airport security, high-tech jobs to hydrogen-powered cars, energy generation to accident-scene emergency care, our impact is felt within and beyond the UK in many aspects of daily life. To sustain the UK's position as one of the world's leading research nations, we maintain a focus on research excellence and leadership. This creates an immediate impact on skills and training, and by pushing the boundaries of science and technology, supports the growth of a high-technology UK economy.

Creating capability and advancing the UK's skills base

- STFC research inspires future generations to study STEM subjects. Research shows that the areas of physics that spark the most interest are those supported by STFC, and applications to university physics courses continue to rise. New discoveries attract strong public interest – an estimated 26 million people followed TV and radio coverage of CERN's announcement of the discovery of a new Higgs-like particle.
- Graduates from STFC-supported PhDs enjoy near complete employment (93%), and develop the high-level computing, quantitative and transferable skills that drive a knowledge-based, innovative economy.
- In 2011/12, STFC also provided over 12,000 training days to students from many disciplines, supported by other research councils, in a variety of skills across our facilities and departments.
- STFC is a focal point for the UK's national capability in areas such as microelectronics, high performance computing, and in research techniques such as neutron and X-ray scattering.

Improving the performance of existing businesses

- Industrial access to our facilities maintains the vibrancy and innovative capacity of a range of key sectors, including aerospace, nuclear, low-carbon, oil and gas, automotive, and space. In 2011/12 over 60 commercial organisations used STFC's UK facilities, and around 50 UK companies accessed the ESRF and ILL, to develop new products and improve existing ones.

- UK companies have been able to commercially exploit technology advances from fundamental physics research, and access new markets, through collaboration with STFC and its university research communities. The economic benefit of these interactions to two UK companies, Oxford Instruments and e2v, is estimated to be £500 million - £700 million.
- The thriving National Science and Innovation Campuses, Harwell Oxford and Sci-Tech Daresbury, support nearly 5,000 jobs and created over 90 new jobs in the last year.

Creating and nurturing new businesses

- STFC's Business Incubation Centres and Innovation Technology Access Centres support nearly 50 new high-technology start-up businesses.
- Technology originally developed for STFC science is being redeployed for economic and social benefit. For example: satellite technology has been used to create portable X-ray scanners for improving accident-scene emergency care; software for spacecraft control is revolutionising the graphics and gaming industries; data handling expertise from CERN is improving the efficiency of the architecture and construction industries.
- One of STFC's earliest spin outs, Nominet, has had a profound impact on the UK economy. Nominet manages the '.co.uk' domain, one of the world's largest Internet registries with over 10 million UK business domain names.
- Knowledge arising from STFC research into particle accelerators was a key enabler for Magnetic Resonance Imaging (MRI). This powerful medical diagnostic tool created a

significant sector in the UK, which now supports over 2,200 jobs and contributes £111 million annually to UK GDP.

Improving public policy and public services

- Research at STFC's ISIS facility supported 5-year life extensions to two UK nuclear power stations, deferring the need for decommissioning and replacement at a cost of £3 billion.
- STFC is playing a key role in developing a UK space weather strategy. Extreme space weather can cause severe disruption to communications, electronics and power grids, and is identified as a significant risk in the UK's National Risk Register.
- STFC spin-out Cobalt Light Systems Ltd secured approval for use of its INSIGHT100 bottle scanner at European airports, which can rapidly detect the presence of a dangerous liquid in a closed bottle. It is anticipated that this will enable a relaxation of the ban on liquids in air passengers' hand luggage, and is being trialled at several major airports.

Attracting R&D investment from global business

- Element Six, world-leaders in synthetic diamond supermaterials, selected the Harwell Oxford Campus as the best place in the world to locate their new innovation centre. The £20 million investment will create employment for over 100 scientists, engineers and technicians.

- STFC spin-out Cella Energy attracted \$1 million investment from Space Florida, which will enable it to set up research facilities at NASA and at STFC, and double its employee numbers. Cella's innovative, safe, low-cost solution to hydrogen storage could provide a future alternative to petrol fuelled vehicles.
- A major collaboration between STFC and IBM has established one of the world's foremost centres in high performance computing and software development. Following a £37.5 million e-infrastructure investment from BIS, STFC's Daresbury laboratory hosts the UK's most powerful supercomputer and the 13th most powerful globally. Establishing high performance computing as a highly accessible and invaluable tool, its capabilities are already attracting global businesses.

STFC's vision is to maximise the impact of our knowledge, skills, facilities and resources for the benefit of the United Kingdom and its people. In 2010, STFC set out a ten-year strategy¹ to deliver this vision, through our three strategic goals of world class research, world class innovation, and world class skills. By monitoring and evaluating our impact, we track our progress towards realising our vision. In this, STFC's second Impact Report, we present quantitative data and case study examples which illustrate the breadth and depth of our economic and societal impact, across the whole of the UK's science and innovation landscape.



The 25 metre antenna at STFC's Chilbolton Laboratory, which received the first signals from the first satellite of Galileo, the European satellite navigation system.

¹ <http://www.stfc.ac.uk/resources/pdf/STFCCS2010.pdf>



*World Class Research
World Class Innovation
World Class Skills*

One of the first images from the ALMA telescope, which UK researchers and industry have helped design and build. ALMA will provide an unprecedented view of the earliest and most distant galaxies. Credit: ESO

Introduction

STFC creates impact in research, innovation and skills through three distinct but interrelated functions:

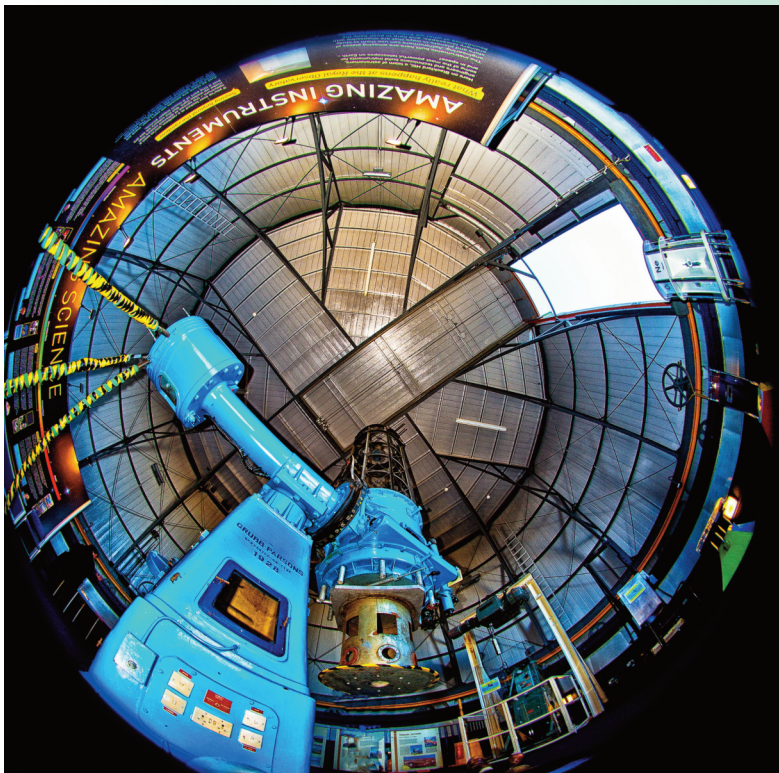
- **Grant-supported programmes:** Supporting fundamental research in particle physics, astronomy, nuclear physics and space science through UK universities.
- **Facilities:** Providing UK university and industrial researchers with access to a range of world-leading, large scale facilities across a range of science, within the UK and abroad.
- **Campuses:** Developing the Science and Innovation Campuses, Sci-Tech Daresbury and Harwell Oxford, to promote collaboration and economic growth.

Our role within the research councils is thus uniquely broad; we commission and deliver our own scientific programme, and through our facilities and Campuses we enable our strategic partners to deliver their programmes. Strong relationships are core to these two facets of our role and many of our impacts are generated in collaboration with others.

Impacts are realised on differing timescales and levels:

- **Direct** – relatively easy to quantify, attribute and predict, these outputs are short- to medium-term in nature.
- **Indirect** – may only be predictable in general terms. These impacts often occur when original research is used in a novel, manner and normally materialise over the medium term.
- **Global** – significant international impact, which has an effect on people's daily lives. This kind of impact arises infrequently and generally happens over the long term.

This report is structured around our three strategic goals of research, innovation and skills and illustrates how our different delivery functions generate a range of impacts on varying timescales. We also review the improvements we are making in our evaluation efforts and methodologies.



36 inch telescope at the Royal Observatory Edinburgh, home of STFC's UK Astronomy Technology Centre. The UKATC builds instruments for many of the world's major telescopes, and leads activities that inspire the public to get involved with astronomy.

World Class Research

Our ambition is to sustain the UK's position as one of the world's leading research nations and support the growth of a high-technology UK economy. This section demonstrates our progress towards this goal, starting with **research statistics** to give scale and context. STFC creates direct impact by **generating new knowledge** from fundamental research through our grant-funded programmes and at our facilities. That new knowledge can then **create long term impact** and benefits for society and the economy via the development of enabling technologies, for example our Futures programme uses our strengths and capabilities to find **solutions for global challenges**.

- **£98.7m** amount invested in research grant funding to UK institutions
- **26m** number of people reached by TV and radio coverage of announcement of discovery of new Higgs-like particle
- **£3bn** cost of decommissioning and replacing two nuclear power stations, deferred after research at ISIS supported the case for 5-year life extensions

Research statistics

In 2011/12:

- STFC invested £98.7 million in grant funding, supporting 266 Principal Investigators.
- Over 3,600 users accessed STFC's UK large facilities, carrying out over 2,000 experiments and generating around 900 publications.
- Around 1,000 UK researchers accessed the facilities funded by STFC at the ESRF and ILL.
- Diamond Light Source recorded 319 new depositions in the Worldwide Protein Databank², up from 282 in 2010, and ESRF recorded 881.

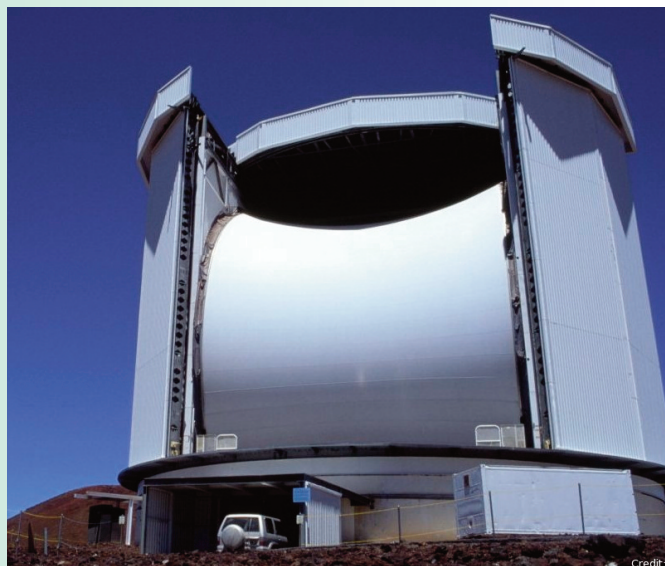


Scientists at the Large Hadron Collider at CERN this year announced the discovery of a new particle. Credit: CERN

This single archive of the world's protein structure data leads to a greater understanding of processes in the human body, for example how to lessen the impact of diseases.

- Around 650 UK particle physicists carried out research at CERN, and around 400 astronomers carried out research using the telescopes operated by ESO. These facilities are provided by STFC through international subscriptions.
- Publication records were broken at the JAC (Joint Astronomy Centre), with both telescopes UKIRT and JCMT producing their highest ever numbers of peer-reviewed papers.

The most recent bibliometric data confirms that in terms of research quality, the UK was first in the world in citation impact in astronomy and particle physics, and second in nuclear physics. An updated report will be available by March 2013; the change in the timing of the reporting has been made to ensure that we have the most robust data available. Further statistics can be found in Appendices 1 and 2.

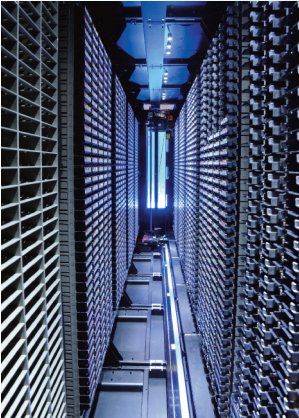


The Joint Astronomy Centre produced its highest ever numbers of peer reviewed publications. Credit: Joint Astronomy Centre

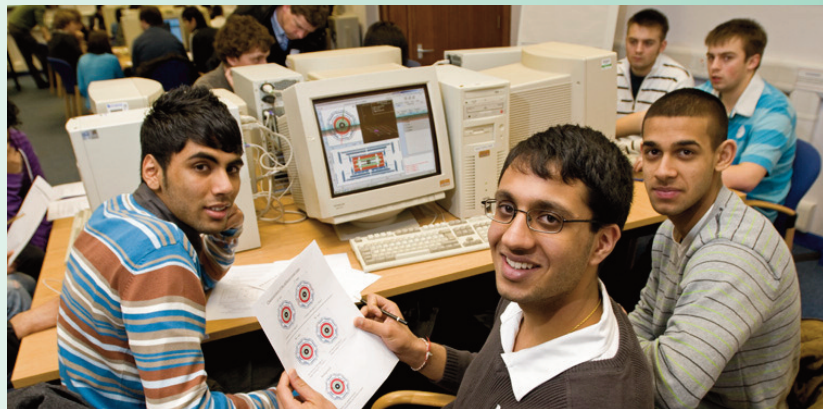
² http://biosync.sbk.org/stats.do?stats_sec=RGNL&stats_focus_lvl=RGNL&stats_region=European

Generating new knowledge

STFC funds curiosity-driven research that is seeking to answer some of the most fundamental questions about the Universe. We also provide access to world-leading facilities for multi-disciplinary research, which allows researchers to understand the structure of materials from the atomic to the cellular scale. The outputs of these endeavours create impact by advancing human knowledge, by pushing the boundaries of technology and by inspiring the next generation of scientists and innovators. Here we highlight two of the major advances made in 2011/12.



Super-fast computing capability enables the UK to remain at the forefront of research.



Cutting-edge research in fundamental physics inspires future generations to study STEM subjects.

It's a boson!

Particle physics entered a new era of discovery with the announcement from CERN that a new particle had been observed, with properties consistent with that of the elusive Higgs Boson. The UK played a central role in this discovery, from Peter Higgs and other theorists who formulated the model, to the engineers and scientists who designed, built and exploited the Large Hadron Collider (LHC).

The global scale of the media coverage demonstrates how fundamental physics excites and inspires the general public. Twelve million people watched the UK television coverage and a further 14 million heard it on local and national radio. The Higgs was mentioned every 1.1 seconds on Twitter at the peak of the excitement with eight of the ten 'trending' topics being Higgs-related.



The Higgs was mentioned every 1.1 seconds on Twitter highlighting the huge public interest in the announcement.

The discovery represents a significant breakthrough in our understanding of the basic forces that shaped our Universe but is just the start of the LHC's scientific mission. Scientists will continue to probe the data to seek answers to 'big' questions such as 'what is our Universe made of?'

ALMA reveals its first image

A new telescope is offering exciting new scientific opportunities to UK astronomers and its construction has strengthened the capabilities of UK high-tech businesses. ALMA, the most complex ground-based telescope in existence, opened in October 2011 and produced its first image.

UK astronomers will now be able to study stars and galaxies from the very early Universe using ALMA through STFC's membership of the European

Southern Observatory (ESO). The telescope took over a decade to design and construct, involving collaborators from four continents and with STFC's laboratories and funded university groups contributing key areas of technology. The return to UK industry during the construction phase was in excess of £5 million, benefitting companies such as Dorset company NTE Vacuum Technology Ltd and engineering services firm Brixworth Engineering Co Ltd.



ALMA's fifty-four telescopes are located 5000m above sea level and will provide an unprecedented view of the earliest and most distant galaxies. Credit: ESO

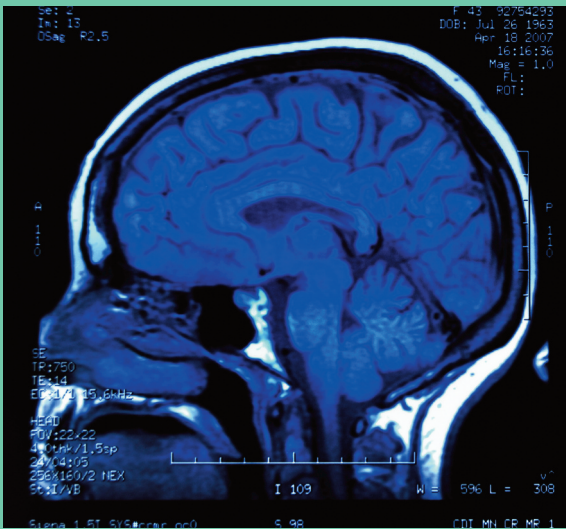
Creating long term impact

Impact arises from fundamental research in ways that are not always foreseen at the time, and can take years to materialise, but can bring significant improvements to our lives and wellbeing. For instance, the techniques used at our facilities for neutron and muon scattering, lasers, and synchrotron light are all based on decades-old

fundamental physics principles, but are now being used daily as tools to generate some very immediate benefits to the economy and society. By supporting curiosity-led research, we create the capability and skills-base that will lead to future economic and social impact. Here we give examples of how long term impact has been generated through fundamental physics discoveries and through research at our facilities.

Celebrating Centenaries

In the past year we celebrated three significant centenaries of discoveries in fundamental physics which have gone on to shape our everyday lives. These applications were not foreseen at the time, which illustrates that whilst the value of current research can be difficult to predict, its impact on the future can be world-changing.



THE MRI industry contributed £111 million to the UK economy in 2010. Credit: Dreamstime

Superconductivity was discovered in 1911, and has enabled a major advance in healthcare through Magnetic Resonance Imaging (MRI). A key advance which made superconducting magnets practically feasible was achieved at STFC's Rutherford Appleton Laboratory in the 1970s, enabling the MRI technique to go on to become a powerful diagnostic tool. Conservative estimates show that in 2010, the MRI systems industry's total value-added contribution to UK GDP was £111 million, supporting around 2,200 jobs. MRI has led to improved healthcare through its special capabilities in imaging soft tissue, particularly important for the diagnosis and treatment of conditions such as cancer and dementia. Over 2.5 million MRI scans are performed in the UK each year. The economic impact of the availability of MRI for just one common condition (surgical treatment of prolapsed discs) was estimated to be around £166 million each year³.

Also in 1911, Ernest Rutherford discovered the nucleus of the atom, and his insight changed our world forever. The study of nuclei has led to the development of nuclear energy generation and methods to treat cancer. The civil nuclear energy industry in the UK generates around 16.5% of the UK's energy, and supports around 80,000 UK jobs⁴. STFC supports continuing research into fundamental nuclear physics, which has led to new medical imaging and security scanning techniques.

Cosmic rays were discovered in 1912, giving rise to a new field of study, particle astrophysics. Interfaces have been developed with a remarkable variety of fields, including atmospheric physics, climatology, geology, seismology and volcanology. A multi-disciplinary project at the STFC-funded Boulby Underground Laboratory is using cosmic rays to perform 3-D geological surveys, with applications in mining and potential future Carbon Capture and Storage (CCS) technology⁵.

Through marking these significant anniversaries, we can recognise the major contributions to society and the economy made through advances in fundamental physics.



2012 marks the 100th anniversary of the discovery of cosmic rays.

³ The economic impact of physics research in the UK: Magnetic Resonance Imaging (MRI) Scanners Case Study, Oxford Economics, 2012

⁴ <http://www.niauk.org/facts-and-figures>

⁵ http://www.aspera-eu.org/images/stories/files/GEOSPHERETOCOSMOS_5MB.pdf

Supporting the integrity of the UK's power supply

Research at STFC's ISIS facility supported five-year life extensions to two UK nuclear power stations, enabling uninterrupted energy generation, and deferring the need for decommissioning and replacement at a cost of around £3 billion. EDF Energy worked with the Open University Materials Engineering group to satisfy safety regulators of the integrity of repair welds in four reactors, using the powerful Engin-X instrument.

Engin-X was built using £2.5 million capital investment from EPSRC, and is a dedicated engineering instrument which can precisely and non-destructively map stress distributions within materials. Frequent users of this instrument include 22 UK universities, international researchers from 24 countries, numerous multinational companies such as Airbus, Rolls-Royce, Qinetiq, the Natural History Museum, and Government agencies from the UK and abroad.



Research at ISIS has supported 5-year life extensions to two UK nuclear power stations. Credit: British Energy

Solutions for Global Challenges

STFC undertakes a wide range of activities that address the global challenges in energy, the environment, security and healthcare. It is our ambition to ensure that our science, skills and facilities are at the heart of the research effort to develop innovative solutions to the Global Challenges. Some examples of STFC's impact in these areas include:

- Signal processing techniques from particle physics are being used to analyse biomolecules and medicines by Imperial College spin-out deltaDOT Ltd. The UK firm has been selected to form part of the US's \$285m programme for biosecurity preparedness.
- Instrumentation developed for an STFC-funded space mission is being used to develop a rapid and accurate test for tuberculosis – a disease which kills around 2 million people every year.
- A team of nuclear physicists is applying radiation detection techniques to develop a portable gamma ray detector, which can be used to examine radioactive material in remote and hostile environments.

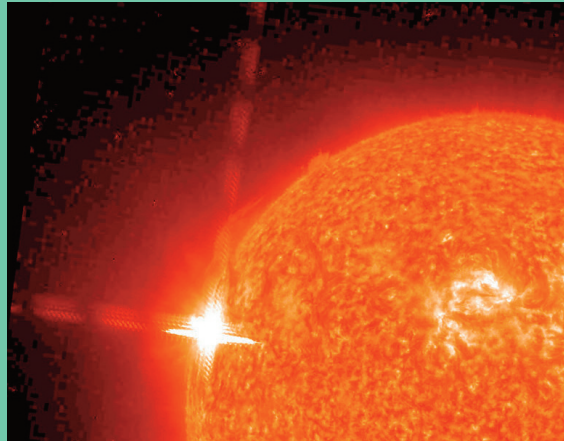
- Technology originally developed by STFC for use on satellites is being redeployed by Radius Diagnostics Ltd to create portable X-ray scanners that could, for example, be taken to the scene of an accident. Potentially, this will benefit patients and medical professionals, saving time and optimising emergency care.
- Research performed at STFC's Central Laser Facility has led to a new insight into how plants fight disease, which will help to improve crop resilience to diseases, pests, and the challenges of drought and a warming climate.

Cheaper, more efficient solar cells

Research at ISIS and Diamond has shown that efficient solar cells can be made from very thin films, with a flexibility like cling-film. These can be manufactured in high volumes, using very simple and inexpensive methods. The combined use of neutron scattering at ISIS and bright X-rays at Diamond enabled scientists from the universities of Sheffield and Cambridge to understand how different processing steps change the overall efficiency and performance of the solar cells.

Space Weather

The Futures Programme, together with NERC, is supporting a coordinated UK approach to the understanding and forecasting of space weather events. Space weather refers to the conditions in outer space created by solar activity, such as flares and coronal mass ejections. Extreme space weather can cause severe disruption to communications, electronic circuits and power grids, and is included in the Government's National Risk Register⁶. Of the non-malicious risks identified, space weather is second only to pandemic influenza when likelihood and impact are taken into account. STFC provides critical space weather expertise and monitoring services, and by bringing together researchers, industry and government, will be instrumental in developing a UK space weather strategy.

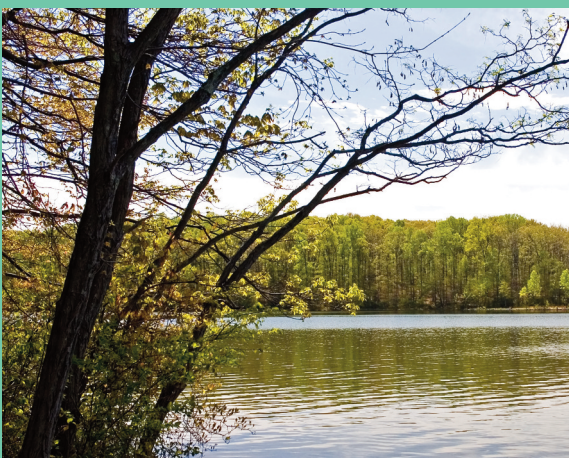


Understanding Space Weather is crucial to protecting the UK's communications infrastructure. Credit: STEREO (NASA)

STFC's research facilities and energy challenges

Research at STFC's large facilities addresses the Global Challenge areas in a variety of ways. Energy-related research is a particular strength and ranges from studies on hydrogen storage materials, battery technology, materials for new forms of solar cells,

green catalyst systems, nuclear power plant engineering and lifetime studies, through to technology development for a new laser energy facility (HiPER). We now estimate that we spend £11 million out of £70 million on facility time at ISIS, Diamond and the Central Laser Facility addressing this key global challenge. drought and a warming climate.



Monitoring lake environments allows practical management of UK lake systems. Credit: Dreamstime

Lake observing network

STFC, working with NERC, is aiding government policy implementation by developing the UK's first coordinated, high-intensity lake monitoring network. Lake systems play a fundamental role in storing and providing fresh water and food, supporting recreation and protecting species diversity, and are coming under increasing pressure from the demands of society and the changing climate. This project will have immediate practical benefits for the management of the lakes included in the study and will aid in managing all UK lake systems. Beneficiaries include the statutory bodies with responsibility for protecting the freshwaters of the UK⁷.

⁶http://www.cabinetoffice.gov.uk/sites/default/files/resources/CO_NationalRiskRegister_2012_acc.pdf

⁷www.ecn.ac.uk/what-we-do/science/projects/ukleon

World Class Innovation

Our ambition is to realise the innovative capacity of STFC's science and research facilities to support the growth of a high-technology UK economy. To achieve this, we are taking a number of steps from supporting **innovation from our grant-funded programmes** through a range of schemes and industrial collaborations, supporting the **commercialisation of STFC intellectual property (IP)**, through to **helping UK businesses to take advantage of our facilities and subscriptions** by enabling industrial access. We also help UK companies win contracts from UK and international facilities and deliver considerable impact through our **National Science and Innovation Campuses** which offer a dynamic environment for innovation and the opportunity to reap significant economic benefit from the successful exploitation of the Government's new **investment in e-infrastructure**.

- **£500-£700m** estimated economic benefit realised by Oxford Instruments and e2v through long-standing of collaboration and engagement with STFC and its university research communities
- **\$1m** investment from Space Florida in STFC spin-out Cella Energy
- **£25bn** forecast annual revenue generated through successful exploitation of high performance computing
- **.90** new jobs created at Sci-Tech Daresbury and Harwell Oxford Campuses

Innovation from grant-funded programmes

STFC operates a number of schemes to support the commercialisation and exploitation of technology emerging from our grant-funded research programmes, investing almost £3.5 million in 2011/12. STFC's e-Val data from 2011 indicates that since 2006, 10 spin-outs have arisen from our university research base, employing up to 66 people. Axomic Ltd⁸, a London-based company, is an excellent example - using know-how from CERN, they have created data management software that helps architects, civil engineers and construction companies store and search for images. Set up in 2002 by two UK CERN researchers, the company is already a keen exporter with a client base that includes 250 of the world's leading architectural practices including Foster & Partners.

Mutual benefits of collaborating with industry

Through long-standing collaboration with STFC and its university research communities, Oxford Instruments and e2v have been able to commercially exploit technology advances made through fundamental physics research and gain access to new markets. Without the inputs from STFC, these two major high-technology companies would have had markedly different product portfolios. The economic benefit for the two companies is estimated to be in excess of £500 million, and could be as high as £700 million.⁹

Group Chief Technology Officer of e2v, Trevor Cross, said, "The catalytic effect of contracts in science facilities enable early entry into commercial markets, usually resulting in a higher market share and an enhanced reputation for innovation and quality. This effect has been replicated a number of times." John Burgoyne of Oxford Instruments described interactions with STFC in the provision of new technology to the ISIS facility as follows: "...we start to understand the science that they are trying to achieve... that enables us to continually innovate, continually develop our technologies... we see ourselves working hand in hand with the scientists: they define the needs of their experiments: we define the innovations, the technologies that are available to them, and by bringing those two together, obviously with the funding provided by STFC and other bodies, then we get the results that take science forward here in the UK and abroad."

⁸ <http://www.axomic.com>

⁹ 'The economic and societal impact of STFC support: case studies on e2v and Oxford Instruments', The Galbraith Muir Consultancy Ltd, 2012

Space technology revolutionises graphics industry

Support from STFC and the Royal Society of Edinburgh has helped commercialise a software product, IKinema, which is revolutionising the games and animation industries. Developed at the University of Surrey, the software was originally intended to assist control systems for spacecraft. IKinema and world-leading UK special effects company Framestore together produced the animation for the Hollywood movie 'Wrath of the Titans' which took £8 million at the UK Box Office. Framestore employs over 600 staff, and has an annual turnover of £48.5 million. A spokesperson said, "IKinema is really unique in what it does and how it does it – it's like something we've always been missing without knowing it..."

The UK film and gaming industries are growing and significant. The film industry contributes around £4.5 billion to the UK economy and while gaming only contributes £1 billion from global revenues of £2.8 billion, it is growing by 25% per year. Within both industries visual effects are the fastest growing component, with the film industry recording 16.8% growth between 2006 and 2008.

Commercialisation of STFC IP

STFC has a dedicated technology transfer office, STFC Innovations Ltd, which has the exclusive rights to the commercial exploitation of STFC's intellectual property (IP). They identify and broker deals that exploit STFC's IP through spin-outs, patents and licence agreements. STFC only owns the IP arising from our own facility development and laboratory activities, which is less than 10% of our total investment and similar in scale to a university physics department. We do not own IP arising from grants to universities, experiments carried out at our facilities, or the work carried out by our international partners such as CERN.

Commercialisation statistics:

- 15 spin-outs created since 2002, employing 121 people, of whom 28% hold a PhD and 95% are educated to at least bachelor degree level.
- Filed four new patent families in 2011/12, and created two new royalty bearing licences.

Our portfolio currently contains 54 patent families, with 189 separate filings across many countries (of which 76 granted, 113 pending). In 2011/12, 20 new Proof of Concept projects were funded, bringing the total to 118 since 2004.



The INSIGHT100 bottle scanner enables accurate detection of liquid explosives and is being trialled at European airports.

News from STFC spin-outs:

- One of STFC's earliest spin-outs, Nominet, manages the '.co.uk' domain, one of the world's largest Internet registries, that underpins the UK digital economy; Nominet manages 10 million UK business domain names, employs over 100 staff with an annual turnover of £27 million.
- Cella Energy attracted \$1 million investment from Space Florida, which will enable it to set up research facilities at NASA and at STFC's Rutherford Appleton Laboratory, and to double its employee numbers. The company has developed an innovative, safe, low-cost solution to hydrogen storage, which could provide an alternative to petrol fuelled vehicles.
- Cobalt Light Systems Ltd secured approval for use of its INSIGHT100 bottle scanner at European airports and is now deployed in trials at several major airports. The device uses lasers to rapidly detect the presence of a dangerous liquid in a closed bottle. It is anticipated that this will enable a relaxation of the liquids ban in air passengers' hand luggage.
- Microvisk Technologies won the Healthcare Project of the Year Award at the 2011 Bionow Awards. Based on STFC technology developed for planetary exploration, Microvisk's blood coagulation monitor allows patients that are at risk from potentially fatal blood clots to monitor their status with immediate results. The system

is simpler, quicker and more precise than the alternative - a visit to a surgery and a 24-hour wait for results. A study in 'The Lancet' found there were 12% fewer major haemorrhagic events and 18% fewer deaths in those who self-monitor compared to those in the 'usual care' regime.

Supporting UK businesses to take advantage of our facilities and subscriptions

In 2011/12, over 60 commercial organisations from a variety of sectors accessed STFC's UK facilities, and around 50 UK companies accessed the ESRF and ILL. To give an example of the way that STFC's facilities are helping to maintain the vibrancy and innovative capacity of key industries, we highlight some of the contributions made to the automotive sector in 2011/12:

- Lightweight alloys are being studied at ISIS by Magnesium Elektron, which can be used to make lighter vehicles and therefore improve fuel efficiency.
- Infineum, a joint venture of ExxonMobil and Shell, is using our facilities to study additives for lubricants and fuels which will allow better control of vehicle emissions.
- Toyota has been optimising electrode materials for lithium-ion batteries used in electric cars.

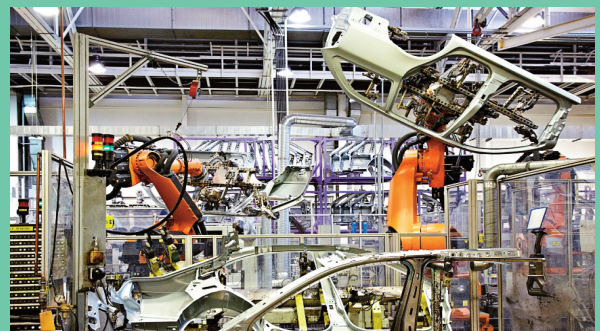
Last year we launched a pilot Innovation Vouchers Scheme to enable small- and medium-sized enterprises (SMEs) to access STFC's facilities, helping them build their innovation and research capabilities, and profit from our expertise. To date, four SMEs have benefitted, undertaking training in various R&D techniques, and enabling them to improve their products.

Industrial access to ISIS Neutron and Muon Source

A scheme launched in 2011 is helping more companies to access ISIS. The Collaborative R&D Scheme provides a fast-track, low-risk route to large facility access, for companies that wish to explore solutions to specific technical, often near market, problems. It has been enthusiastically received, with 52 days of beamtime allocated at a value of just over £1 million. The aggregated forecast of the value of the research to the companies over 10 years is £160 million. Acknowledging that these figures are estimates, they nevertheless demonstrate the significant value of our facilities to UK businesses. Usage by sector is approximately 50% chemical and catalyst industry, with the remainder evenly split between aerospace engineering, energy engineering and innovation, and petrochemicals, fuels and lubricants.

This scheme complements the main mode of access through university/industry partnerships.

In 2011/12 over 280 days of beam-time were allocated via this route¹⁰. This research contributes to key UK sectors such as chemical and catalyst (40%), energy engineering and innovation (25%) and pharmaceuticals and healthcare (11%), with the remainder in automotive, aerospace, manufacturing and petrochemicals.



STFC's facilities have been widely used by the automotive industry to research more efficient fuels, batteries and lightweight materials for vehicle construction. Credit: Dreamstime

¹⁰ In 2011/12, ISIS operated for a total of 140 days. Multiple experiments can run concurrently on different instruments and beam lines; ISIS delivered over 730 experiments in 2011/12, with each experiment lasting on average 5 days.

Molecular makeover

Research at ISIS has enabled a UK company to improve one of its processes, making it greener, cleaner, more energy-efficient and cheaper. Ineos ChlorVinyls is Europe's largest PVC manufacturer, producing over 100,000 tonnes of methyl chloride every year, which is used in a wide range of everyday products from plastics to pharmaceuticals. They found that their process produced a wasteful side product that was expensive to recycle back into the process.

A collaboration between Ineos ChlorVinyls and the University of Glasgow used neutron scattering to understand what was happening at a molecular scale, enabling them to modify the process. This significantly reduced costs by almost eliminating the unwanted side product, thereby avoiding construction of a new waste handling plant. This insight, gained in just 12 days of experiments, could not have been achieved using any other technique. The new process has now been operating continuously at the company's chemical reactors for several years.

Creating new business opportunities

STFC helps UK companies take advantage of ongoing opportunities to supply products and services to our national and international facilities, ensuring that our membership of organisations such as CERN brings direct benefits to the UK. We provide advance notice of upcoming tenders, and give support and advice through the tender processes. Targeted events link potential suppliers with facility procurement specialists, and promote collaboration between business and academia.

In 2011:

- £14.5 million contracts from CERN were placed with UK companies, up 30% on 2010, and bringing the total since 2008 to £38.0 million;
- £8.3 million contracts were awarded to UK firms from ESO, bringing the total since 2005 to £53.1 million;
- £1.5 million UK contracts came from the ESRF;
- £911,000 of orders were placed with UK companies by the ILL facility.

Like our partner facilities, STFC also has ongoing procurement requirements and in 2011/12 we placed £111 million in contracts with UK companies, just under half of which went to SMEs.



STFC's membership of organisations such as ESRF, ILL, ESO and CERN brings direct benefits to UK companies. Credit: VISTA, ESO

Delivering impact through the Science and Innovation Campuses

STFC is a major partner in delivering the two National Science and Innovation Campuses, Sci-Tech Daresbury in Cheshire and Harwell Oxford. In August 2011, Prime Minister David Cameron announced that both Campuses were to become Enterprise Zones. Companies within the Enterprise Zones enjoy lower taxes, less stringent planning restrictions and access to superfast broadband. Both Campuses are world-class hubs for science, technology and business, providing a unique environment for innovation and business growth. The proximity to STFC's facilities and expertise, together with the provision of first-rate accommodation and business support services, has proved to be a compelling combination, attracting spin-outs, SMEs, and large blue chip industries alike.

UK company wins major CERN contract

In February 2012, Midlands-based company Brandauer won a major contract from CERN worth £3.5 million, to supply parts for the Large Hadron Collider. The family-owned precision pressing and stamping firm employs 50



Many UK companies have secured contracts from CERN to supply parts for the LHC. Credit: CERN

people, and has been in business for 150 years. This new contract follows an earlier deal from CERN worth £350,000. Brandauer's managing director said, "Simply working on this contract has pushed our technical capability to the best in the world. Working with CERN has been such a boost – it only deals with excellence." The company also supplies the automotive, aerospace, electronics, medical and alternative energy sectors.

- Created a net increase of 62 jobs, up from 45 in 2010. 71% of companies are forecasting further recruitment in 2012 for 182 new jobs, in roles such as software development, specialist IT, and business development;
- Delivered £28.3 million in sales, 24% of which were exports. Nearly two-thirds of companies saw sales growth. The average sales growth over the past 4 years has been 37% per year;
- Attracted £75 million investment;
- Developed 125 new products, with a quarter of companies filing patents.

In nearly seven years, only nine companies have gone into administration, of which six have phoenixed and one was acquired by another Campus company.



Vanguard House opened in June 2011 to accommodate the growing businesses at Sci-Tech Daresbury.



Sci-Tech Daresbury companies secured £75 million in investment in the last financial year.

Sci-Tech Daresbury

Sci-Tech Daresbury has been in operation since 2006 and now some 100 companies are based there, employing 437 people, of which 72% are educated to bachelor degree or above.¹¹ The success of the venture has led to the construction of a new building, Vanguard House, which opened in June 2011 and now houses many of the companies that outgrew their original Campus accommodation. The 2011 company survey showed the continuing success of the Campus in challenging economic circumstances, with low failure rates, strong growth, high-value job creation, high levels of collaboration and strong innovation performance:

The Campus also supports a highly networked business environment:

- 48% of companies are actively collaborating with another Campus company, generating a value in terms of new sales or cost savings of over £1 million (£845k in 2010);
- 71% reported that they had a collaboration with either a university or STFC (65% in 2010);
- 40% are using services and/or expertise from STFC (34% in 2010).

The Campus management team are exploring opportunities to build on these successes. These include the development of collaboration programmes with blue chip companies such as IBM and Siemens, and further work with UKTI to boost export sales.

¹¹ The UK average for similar companies is 13%. 'UK Innovation Survey 2009', Department for Business, Innovation and Skills, December 2010.

Harwell Oxford Campus



The Harwell Oxford Campus supports a highly collaborative and networked business environment.

Harwell Oxford is at the heart of the Science Vale UK Enterprise Zone. Around 150 organisations, employing approximately 4,500 people, are located there. A survey of the Campus companies was undertaken by the Goodman management team in 2011. The survey, the first undertaken at Harwell Oxford, revealed the highly collaborative and networked nature of the Campus. Of the 54 companies that responded:

- 42% were collaborating with another Campus company;
- 53% were using another Campus company as a supplier or service provider;
- 44% reported that their customer base included other Campus companies;
- 50% were using equipment or facilities provided by another Campus resident.

In assessing what most attracted companies to remain on Campus, 40% cited opportunities to collaborate with STFC, other public sector

organisations, or other Campus-based companies as being a key factor.

Campus companies are also collaborating with STFC in a variety of ways, from engaging our technical expertise (15%) through to using our lab/office space (20%) or equipment (20%). Other business relationships have been developed through the use of STFC as a supplier (15%) and as a customer (15%), indicating the mutual benefit of the co-location of the Campus with the laboratory.

The Campus supports a significant number of high-value jobs: 55% of companies reported that over 50% of their staff hold at least a bachelor degree, and 30% reported that over 91% of their staff are educated to this level. In 2011/12 the 54 companies surveyed created 30 new jobs on Campus and 30% had identified a need to recruit for 40 new jobs over the next year.

Some 20% of companies reported sales growth in excess of £100k in the past year with many reporting this growth to be export driven. Sales were reported across all regions of the globe. The most significant export market was Europe, followed by North America. Asia Pacific, the Middle East and South America and Africa featured to a lesser extent, but sales to all regions were reported. The majority of supplies were sourced within the UK.

The survey will be repeated annually to monitor the success of the Campus. A number of improvements have been identified and will be implemented for the 2012 survey.

Attracting international investment

In May 2012 Element Six, world-leaders in synthetic diamond supermaterials, selected the Harwell Oxford Campus as the best place in the world to locate their new innovation centre. A division of De Beers, Element Six are investing £20 million to create the world's largest and most sophisticated synthetic supermaterials R&D facility. Construction is due to complete in spring 2013, and will create employment for over 100 scientists, engineers and technicians. Cyrus Jilla, Element Six CEO, said: "I am proud we selected the UK as the best location globally for our

Innovation Centre. I am positive it will deliver higher performance products for our customers, disruptive technologies for new applications and markets, inspire and spur new related businesses in the UK, and provide an extremely rewarding environment for our scientists who are at the forefront of their field." Element Six synthetic diamond materials are used in a broad range of sectors from aerospace to healthcare with innovative uses including optics in lasers for automotive engineering, detectors in medical radiotherapy, and drill bits for oil and gas drilling.

Business Incubator Centres – helping high-tech start-ups

The European Space Agency's Business Incubation Centre at Harwell Oxford offers a unique and intensive package of technical expertise and business support for up to ten start-up businesses a year, to commercialise technology originally developed for space. This centre is now fully operational, having welcomed its first tenant in May 2011.

Following this success, and in collaboration with CERN, we launched this year the first ever CERN Business Incubation Centre at our Sci-Tech Daresbury Campus, which will nurture small businesses to develop marketable services and products based on CERN technologies. The main areas of focus will include accelerators, detectors, cryogenics, magnets, superconductors, materials science and high performance computing.

A hub for space innovation

The Harwell Oxford Space Cluster is fast becoming the national innovation hub for space technology and new satellite applications and services. It supports the UK's ambition to grow our 6% share of the £160 billion world space market to 10%, predicted to be worth £400 billion by 2030, and create at least 100,000 high value jobs. The hub was founded on STFC's capabilities in its RAL Space department and now includes the International Space Innovation Centre, the European Space Agency's UK office, their Business Incubation Centre, and is soon to be the location of the newly announced TSB-supported Satellite Applications Catapult Centre.

STFC's RAL Space department, with support from NERC, plays an underpinning role in satellite navigation technology through the monitoring of space weather and the

evaluation of signals from Galileo, the European global navigation system. The GPS-sensitive proportion of UK GDP is around 7% with GPS delivering substantial business efficiencies including a £1.6 billion annual saving by the aviation industry due to reduced delays and lower emissions. The satellite navigation industry is expected to generate a value-added contribution of £1.45 billion to the UK economy between 2011 and 2020¹².



The Harwell Oxford Space Cluster supports the UK's ambition to create 100,000 jobs in the industry by 2030. Credit: ESA

Innovation Technology Access Centres

STFC has developed Innovation Technology Access Centres (I-TACs) at both its Campuses which offer easy, affordable access to advanced laboratory facilities, technology and expertise that can give start-ups and established businesses a competitive edge. The Daresbury I-TAC opened in February 2010, with the Harwell Oxford I-TAC following in 2012. Between February 2010 and September 2011, the Daresbury I-TAC supported 26 companies and created 34 new jobs. Notable successes include:

- I-TAC Daresbury won 'Best Service Provider' at the 2011 UK Energy Innovation Awards, and 'Service Provider of the Year' at the 2012 Chemicals Northwest Awards;
- I-TAC tenant Atmos Technologies Ltd is developing economic, non-toxic ways of obtaining hydrogen from sea water using solar energy, and won the 'New Energy Generation' prize at the 2011 UK Energy Innovation Awards;
- I-TAC tenant and hygiene technology innovator Byotrol launched a new cleaning spray for Tesco and signed a seven-year licencing deal with global brand Kimberly-Clark. Byotrol is highly effective in combating antibiotic-resistant

¹² The economic impact of physics research in the UK: Satellite Navigation Case Study', Oxford Economics, 2012.

superbugs such as MRSA: a study at Manchester Royal Infirmary showed that Byotrol outperformed bleach by 33% when controlling MRSA growth.

Investment in e-infrastructure



Investments in High Performance Computing will create accessible and invaluable tools for UK industry. Credit: Alec Finch / STFC

A major collaboration between STFC and IBM has established one of the world's foremost centres in high performance computing and software development at Daresbury Laboratory. Following a £37.5 million e-infrastructure investment from BIS, the IBM 'Blue Joule' machine installed at our Daresbury laboratory is the UK's most powerful supercomputer and the 13th most powerful globally, and provides the ability to simulate extremely complex systems, such as the Earth's climate.

The facility will establish high performance computing as a highly accessible and invaluable tool to UK industry, speeding up the innovation cycle and accelerating economic growth. Already, Unilever is working with STFC to speed up the development of more efficient and more environmentally friendly personal care products. It is estimated that the successful exploitation of high performance computing could increase European GDP by 2-3% within ten years¹³. For the UK, this translates into around £25 billion per year in revenue and more than half a million UK-based, high-value jobs.

¹³ International Data Corporation, 2010, <http://www.hpcuserforum.com/EU/downloads/SR03S10.15.2010.pdf>

World Class Skills

STFC's ambition is to deliver the scientific and technically skilled workforce that will sustain the UK as one of the world's leading research nations and support the growth of a high-tech economy, and we contribute to the UK skills base in many ways. We provide **highly skilled people** for the UK through post-graduate training and by developing our own staff. We **inspire and involve** young people and the general public, to encourage a greater take-up of STEM subjects and to increase awareness of the benefits of science. We deliver our programme through **collaborations** with strategic partners, capitalising on an enhanced joint capacity to deliver shared goals.

- **912** rolling cohort of STFC-supported PhD students
- **93%** percentage of STFC PhD graduates in employment
- **8.3%** increase in applications to physics degree courses
- **46.5m** estimated total audience reached by STFC Public Engagement schemes since 2006

- Provided over 12,000 training days to postgraduate students, funded by other research councils, at our facilities and departments across a range of disciplines. Just under 1,500 PhD students used our UK facilities, around 40% of the total number of users.

In 2011, STFC updated its PhD career paths survey¹⁴, last performed in 2009, by surveying students whose funding ended between 2004 and 2009. The results showed that STFC PhD graduates enjoy near-complete employment, typically earning more than the average professional worker in the UK. The survey also indicated the value of PhD training in building capability, and in developing the high-level skills needed to drive a high-value, innovative economy. The results are summarised below:

- 93% of respondents were in employment;
- 48% were employed in universities, 27% in the private sector and 22% in the public sector;
- 69% were still engaged in scientific research;
- Of those employed in the private sector, 71% work in financial or business services - this reflects the strong demand from these sectors for the high-level computing, modelling, quantitative and transferable skills that are developed through a STFC PhD;
- 41% were earning a salary similar to, or greater than, the £35,000 UK average for professional occupations;
- The five skills considered most useful in subsequent careers were problem solving, programming, knowledge of their subject area, data analysis and written communication.



STFC provided over 12,000 training days to PhD students at our facilities and departments. Credit Diamond Light Source

Highly skilled people

Postgraduate training

In 2011/12 STFC:

- Invested £23.9 million in postgraduate training and fellowships in particle physics, nuclear physics and astronomy, including 220 new PhD studentships, bringing the rolling cohort to 912;

¹⁴ <http://www.stfc.ac.uk/resources/PDF/PhDcareerpathsummaryreport.pdf>

Developing our people

STFC employs nearly 1,700 people, many of whom are highly skilled scientists, technicians and engineers. STFC is a focal point for the UK's national capability in a number of areas, such as microelectronics, high performance computing and research techniques such as neutron and X-ray scattering. STFC also supports skills development through apprenticeships, following a nationally recognised programme to provide academic and skills-based training in a range of disciplines. In October 2011, STFC's commitment to professional development was recognised with the achievement of the Investors in People (IiP) Silver Award - a national benchmark of good practice.

For the first time in 2011, STFC took part in the 'Sunday Times Best Companies Survey' to gauge employee engagement, and benchmark our progress in key areas such as leadership, management and team working. STFC achieved 'One to Watch' status, with a Best Companies Index of 606.3 out of 1,000. We are currently undertaking a series of actions to better understand these initial results and to identify areas for improvement. We are also repeating the survey in 2012 to monitor our progress.

Research leadership

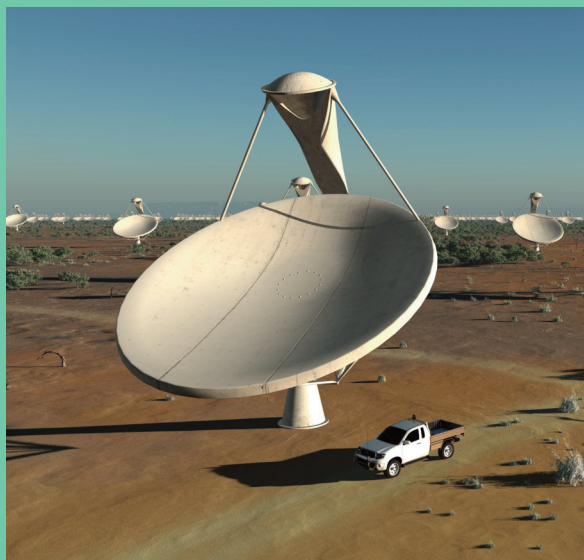
Amongst STFC's staff, and the academics we support in universities, are many individuals considered to be world-leaders in their respective fields. Around 100 staff members hold honorary academic positions and joint appointments with universities or companies, both within the UK and internationally. Some 250 staff received significant awards or recognition in 2011/12, such as research prizes, representation on international scientific committees and membership of journal editorial boards.

Collaborative project celebrates over 30 years of excellence

A project located at the Research Complex at Harwell, supported by BBSRC and MRC, and coordinated by STFC's Scientific Computing department, has been recognised for its importance as a resource worldwide and for its exemplary team ethos. The prestigious award from the Royal Society of Chemistry acknowledged the achievement of the project, established over 30 years ago to support a world-leading suite of software programs for the analysis of X-ray crystallography and other biophysical techniques.

Leadership of the SKA project

The UK is taking a pivotal role in the leadership, organisation and management, as well as in the technical and scientific challenges, of the Square Kilometre Array (SKA) project. The SKA is an international project to design and build the world's largest radio telescope, and STFC coordinated the UK's successful bid to lead the SKA Organisation and has now established its headquarters in Manchester. The UK headquarters, established in December 2011, will formalise the relationships between the partners and centralise the leadership of the project.



The UK is playing a key role in the ground-breaking SKA project which will create the world's largest radio telescope. Credit: SKA Organisation/TDP/DRAO/Swinburne Astronomy Productions



Thousands of people are engaging with astronomy through Dark Sky Discovery events.

Inspiring and involving

STFC makes a distinctive contribution to the UK skills base by inspiring future generations to study STEM subjects. In February 2012 the Institute of Physics reported an increase in applications to university physics courses of 8.3% for the second year running (around 2,000 extra applications compared to the previous year), despite an overall decline in university applications of 8.7%¹⁵. This is widely attributed to the high profile of astronomy, physicists such as Professor Brian Cox, and the prominence of CERN in the media. Some highlights from 2011/12 include:

- The 'LHC on tour' exhibition showcasing the LHC has visited venues as diverse as the UK Parliament and the Jodrell Bank music festival, and features a life-sized replica of a section of the LHC tunnel. It is estimated that over 70,000 people will have visited the exhibition by the end of its tour;

- STFC sponsored the online competition, 'I'm a scientist, get me out of here!', and its sister event, 'I'm an engineer...'. Students aged 11-18 were given the opportunity to engage directly with scientists and engineers by asking questions and through instant messaging conversations. Responding with huge enthusiasm, the 1,300 participating students asked 1,400 questions, generating 3,500 answers from the scientists, and over 22,000 lines of live chat.
- The STFC-led Dark Sky Discovery initiative is sparking interest in science and technology by inspiring thousands of people to get involved in astronomy. Launched in 2011, it is encouraging the public to nominate the best stargazing spot in their area. Over 20 sites have been pinpointed, and in January 2012 over 15,000 people took part in events linked with the BBC's 'Stargazing LIVE'. The first night of 'Stargazing LIVE', with Professor Brian Cox and comedian Dara O'Briain, attracted 3.8 million viewers. In the hours after the broadcast, web retailer Amazon.co.uk reported an increase in telescope sales of nearly 500%, with total sales at over three times 2011 levels.

¹⁵ http://www.iop.org/news/12/feb/page_53743.html

Public engagement programme

STFC supports public engagement through a range of schemes. Since 2006, it is estimated that the total audience reached by just two schemes totals 46.5 million people, illustrating the high level of public interest in STFC science. This figure is dominated by one particular project, the UK Herschel Outreach Programme, which reached 38 million people through numerous features in the media and large public events. Even without this major contribution, the programme has achieved great success in disseminating STFC science.

In 2011/12:

- STFC invested in 47 public engagement awards, including three new Fellowships - the current cohort of fellows has, to date, reached an estimated audience of 570,000 people;
- Our moon rock samples were loaned out 127 times to schools, universities, science centres and astronomical societies;
- STFC welcomed over 20,000 visitors to our sites, from schools, industry and the general public - included in this number are over 1200 teachers from over 850 schools;
- Nearly 250 UK schools visited CERN, and nearly 200 teachers attended the CERN teacher programme, which aims to promote the teaching of particle physics in schools, to expose teachers to the world of research, and to help stimulate the popularisation of physics.



Our public engagement programme aims to inspire the next generation of scientists.

Collaboration activities

By their very nature, science and technology are highly collaborative endeavours that exchange knowledge and build skills. The delivery of STFC's programme is underpinned by successful collaborations with a wide range of strategic partners, including universities, other research councils, the Technology Strategy Board, our Campus partners and tenants, and industry. There are many mechanisms through which we collaborate and provide a fertile environment across organisational boundaries. In 2011/12, some examples of our formal collaborations included:

- STFC is working with Siemens Healthcare to develop a compact accelerator which is cheaper to build and operate than those currently available;
- A five year Memorandum of Understanding with China's Guanghai Science and Technology Foundation pledges to jointly promote the development and exploitation of science and technology;
- Working with US laboratory Fermilab to transfer technology developed for particle physics accelerators into other applications;
- Agreement with AWE and the Lawrence Livermore National Laboratory to increase collaboration on developments towards the demonstration of the technical and economic viability of laser fusion as a source of energy;
- Agreement with the National Physical Laboratory to target closer business and research links on commercial offerings for the healthcare industry.

A collaborative approach leads to cancer breakthrough

The Research Complex at Harwell (RCaH) is providing the right environment and facilities for truly multi-disciplinary research collaborations to flourish. For example, a collaboration between biologists, laser scientists and computational modellers has achieved a new understanding of a biological process that causes many common cancers, paving the way for new drug treatments.

Methodological developments and future challenges

In 2011/12 we advanced our evaluation methodologies through the adoption of an evaluation framework and strategy, and by improving STFC e-Val our outputs data gathering system. We also piloted an evaluation of the quality of 'Pathways to Impact' documents.

Impact evaluation strategy and framework

In 2011/12, STFC adopted an impact evaluation strategy and framework. The strategy sets out our approach to impact evaluation and demonstrates STFC's commitment to developing this area as a core competence. Our framework helps us to articulate and evaluate STFC's wide range of impacts. It is based upon our three strategic goals of world class research, innovation and skills, and spans our various delivery functions including universities, facilities and Campuses. By populating the matrix with our evidence, we have identified gaps in our knowledge and prioritised our future efforts. The strategy also helps us evaluate our policies and programmes, generating lessons or models of best practice that are transferable to other projects. We are raising awareness within the organisation of this approach. Our summary impact evaluation programme is given at the end of this section.

STFC e-Val

We completed analysis of the first data collection in late 2011, gathering much useful and valuable information that we are now using to enhance our reports and case studies. The level of reporting will continue to improve as we gather more information in future years. In response to feedback received during the data collection, we convened a panel to review the performance of STFC e-Val and improve the system for users whilst fulfilling STFC's data collection requirements. The panel comprised academics from across STFC's research areas, plus a representative of university Research Managers. Of the many recommendations made on the system and on broader issues such as communication, some were acted on immediately and some needed further discussion with the STFC e-Val developers. We have now implemented the majority of the recommendations and will run our next data collection exercise in spring 2013 using a thoroughly tested revised system.

Pathways to Impact evaluation - monitoring culture change

STFC has undertaken a pilot project to evaluate the quality of the 'Pathways to Impact' documents. Introduced in 2009, and now a requirement for the majority of grant schemes, these documents are intended to help grant holders consider and realise the impact from their research. The study has shown a good level of researcher engagement and indicates an improvement over time. This pilot evaluation project has focussed on the knowledge exchange activities. The same methodology could also be applied to public engagement and we are looking to extend the study to this area.

'Pathways to Impact' has raised the profile of impact consideration. Professor Alan Smith of UCL's Mullard Space Science Laboratory, said, "Pathways to Impact has manifested change in people's attitudes to engaging with the outside world." His group is exploring the potential to transfer astronomical data analysis techniques to medical applications.

STFC is taking a number of steps to support applicants in their exploration of 'Pathways to Impact'. A series of university visits is helping us gain a better understanding of university mechanisms for exploring and reporting impact, which will enable us to offer more focussed support, including pro-active use of university technology transfer offices and STFC Innovation Partnership Scheme Fellows as institution-based focal points for sharing best practices. A follow-up study is planned for 2014.

Future challenges

The highly networked and collaborative nature of STFC's activities enables us to maximise our impact, but also presents a challenge in its evaluation and demonstration. STFC's role within the Research Councils is uniquely broad; not only do we deliver our own scientific programme, but through our facilities and Campuses we also enable other Councils and strategic partners to deliver theirs. We are therefore looking at cross-Research Council approaches to evaluating impact, such as joint analysis of facility usage data, and joint case studies where work has been supported by at least one other RC. One ongoing project in this area is gathering information on the views of our facility users, who are typically supported by other RCs, on the benefits that STFC facilities bring to their research.

STFC impact evaluation programme

Project	What	Date	Progress
Policy/strategy work			
STFC Impact Evaluation Strategy & Framework	<ul style="list-style-type: none"> Develop a framework which describes and helps assess the outcomes and impacts across the STFC's key strategic themes of research, innovation and skills Form a plan to communicate this framework and strategy internally to STFC and externally to our key stakeholders 	2011/12 2012/13	Complete - signed off by Council 29th May 2012. Internally to be done as part of Impact Plans project. Plan to be formed for external stakeholders.
Metric development			
STFC e-Val	Commission the STFC e-Val on-line system to collect outcomes and impact data from our university research. <ul style="list-style-type: none"> Evaluate the outputs from phase 1 of the project Second data collection to be completed Explore how e-Val can be adapted to UK facilities and international subscriptions 	2011/12 2012/13 2013/14	Pilot run in 2010 & Phase 1 data collection and analysis complete with completed first report available. System improvements undertaken in response to science community feedback. Second data collection scheduled to start January 2013 and run until end March 2013. Initial scoping underway.
Organisational KPIs	Develop a set of organisational KPIs to show progress to BIS using dashboard to reflect balanced scorecard.	2013/14	Pilot and beta testing of Action Plan collection tool has been completed, full roll out expected for January 2013. Structure of dashboard under development draft proposals to be considered by STFC senior management by year end.
STFC corporate strategy success measures	Long term, high level metrics to measure direction of travel across key strategic themes in STFC corporate strategy. <ul style="list-style-type: none"> Agree approach to each measure Implement each measure 	2011/12 2013/14	15 projects each with separate plan. Approach signed off by Council. Started implementation.
Innovation index	Develop a set of metrics for each of STFC's innovation areas which will show progress for each area <ul style="list-style-type: none"> Innovation Business Development Campuses Centres 	2013/14	Approach agreed. Gathering data for some areas and exploring options for others.

Project	What	Date	Progress
Science and Innovation Campus metrics	<p>Development of improved metrics to illustrate the broad spectrum of impacts that arise from DSIC and HSIC.</p> <ul style="list-style-type: none"> • Work with BIS to modify company survey at DSIC and improve reporting • Develop a company survey at the HSIC • Develop additional impact metrics for DSIC beyond those contained in the DIC company survey 	<p>2011/12</p> <p>2011/12</p> <p>2012/13</p>	<p>Phases 1 and 2 complete.</p> <p>Suggestions made to improve HSIC pilot.</p> <p>Phase 3 to be captured under innovation index.</p>
STFC impact plans	Develop plans for each STFC department which capture impacts measures and examples and outline how impact is being improved.	2012/13 – 2014/15	Approach being developed.
Impact studies			
Case studies	Case studies to be written over the SR period which highlight different aspects of STFC's impact.	Ongoing	30 complete to go on new website. Several underway and carrying out joint case studies with IoP.
Oxford Economics studies on MRI & GPS	Modify original unpublished report into long case studies and publish.	2012/13	Complete, to be published in 2013.
Neutrons impact report	Undertake a study to highlight the range of impacts from the ISIS and ILL neutron facilities	2012/13	Complete, to be published in 2013.
Long term relationship with UK industry	<ul style="list-style-type: none"> • Deliver studies on impact of relationship with e2v and Oxford Instruments • Explore additional companies to study (eg. IBM) 	<p>2012/13</p> <p>2013/14</p>	<p>Complete. To be published in 2013.</p> <p>Scoping stage of additional studies.</p>

Appendices

Appendix 1: STFC publication statistics

* Bibliometric data for 2011 will be available in March 2013. The change in the timing of the reporting has been made to ensure that we have the most robust data available.

Astronomy

Year	No of publications & world ranking	Citation impact & world ranking
2008	2075, 2nd	10.06, 2nd
2009	2256, 2nd	11.37, 1st
2010	2411, 2nd	11.79, 1st
2011	*	*

Particle physics

Year	No of publications & world ranking	Citation impact & world ranking
2008	1127, 4th	8.35, 1st
2009	1047, 3rd	8.99, 1st
2010	1030, 4th	9.23, 1st
2011	*	*

Nuclear physics

Year	No of publications & world ranking	Citation impact & world ranking
2008	372, 7th	6.47, 2nd
2009	347, 7th	6.99, 2nd
2010	347, 7th	6.74, 2nd
2011	*	*

Appendix 2: STFC Statistics

	UNITS	2008/09	2009/10	2010/11	2011/12
Total Funds Available	£mil	691	705	639	601
Budget Allocation	£mil	603	607	583	536
Leverage	£mil	59	60	61	65
of which Private	£mil	12	10	7	6
of which from Other Research Councils	£mil	14	14	11	14
of which from Other Sources*	£mil	34	36	43	45
of which Private	%	2%	2%	1%	1%
of which Other Research Councils	%	2%	2%	2%	3%
of which Other	%	6%	6%	7%	8%
Total Expenditure	£mil	691	657	639	601
of which Responsive Mode Grant	£mil	116	120	90	99
of which Postgraduate Awards	£mil	23	25	26	24
of which Other Components	£mil	552	512	523	478
of which Responsive Mode Grant	%	17%	18%	14%	16%
of which Postgraduate Awards	%	3%	4%	4%	4%
of which Other Components	%	80%	78%	82%	80%
Human Capital					
Principal Investigators	#	365	345	360	266
Research Leaders in Sponsored Institutes	#	NA	NA	NA	NA
Research Fellowships	#	19	12	11	13
Knowledge Generation					
Number of Grants Assessed for Reporting	#	294	189	280	229
Refereed Publications	#	4281	4438	4654	**
Human Capital	#				
Number of PhD Students Supported	#	258	235	235	220
Finishing Rates	%	95%	85%	91%	92%
Commercialisation Activities					
New Patent Family Applications Filed***	#	7	4	4	4
Total Number of Patents Granted Worldwide ****	#		15	12	26
Spinouts/New Businesses Created	#	6	3	2	0
Licences	#	3	1	3	2
Income from Royalty Bearing Licences	£mil	0.23	0.11	0.09	0.104
Human Capital					
First destinations after PhD					
of which University	%	50%	52%	45%	47%
of which Wider Public Sector	%	15%	6%	7%	5%
of which Third Sector	%	9%	7%	13%	15%
of which Private Sector	%	26%	35%	35%	33%
of which Unknown or Other	%	0	0	0	0
of which Unemployed	%	0	0	0	0
Facility usage					
Station Days	#	X	X	9297	11349
Unique Users	#	X	X	2803	3675
Experiments	#	X	X	1584	2072

*Govt organisations, HEIs, EC.

** Bibliometric data for 2011 will be available in March 2013. The change in the timing of the reporting has been made to ensure that we have the most robust data available.

*** A patent family is a set of patents taken in various countries to protect a single invention. It can take a number of years from first filing to the patent being granted.

**** Patents can be awarded in different countries; this number does not represent the number of inventions, but the number of patents held across all countries and across all inventions.

X Historical data unavailable due to changes in method of data collection.

Appendix 3: Glossary

ALMA	Atacama Large Millimetre/sub-millimetre Array
AWE	Atomic Weapons Establishment
BBSRC	Biotechnology and Biological Sciences Research Council
BIC	Business Incubation Centre
EPSRC	Engineering and Physical Sciences Research Council
ESA	European Space Agency
ESO	European Southern Observatory
ESRF	European Synchrotron Radiation Facility
ILL	Institut Laue-Langevin
I-TAC	Innovation Technology Access Centre
JAC	Joint Astronomy Centre
JCMT	James Clerk Maxwell Telescope
LHC	Large Hadron Collider
MRC	Medical Research Council
MRI	Magnetic Resonance Imaging
NERC	Natural Environment Research Council
RCaH	Research Complex at Harwell
SKA	Square Kilometre Array
STFC	Science and Technology Facilities Council
UKIRT	United Kingdom Infrared Telescope

RCUK Impact Report

Research Councils UK (RCUK) is a strategic partnership of the UK Research Councils which enables the Research Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities. The RCUK Impact Report reports on activities that Council are doing together, both how cross-council working is being delivered and the added value and impact that is being achieved as a result. The RCUK Impact Report can be found at:
<http://www.rcuk.ac.uk/Publications/reports/Pages/impact2012.aspx>

Science and Technology Facilities Council
Polaris House, North Star Avenue, Swindon, SN2 1SZ, UK
T: +44(0)1793 442000 F: +44(0)1793 442002 E: publications@stfc.ac.uk

www.stfc.ac.uk

Head office Science and Technology Facilities Council, Polaris House, North Star Avenue, Swindon SN2 1SZ, UK
Establishments at Rutherford Appleton Laboratory, Oxfordshire; Daresbury Laboratory, Cheshire;
UK Astronomy Technology Centre, Edinburgh; Chilbolton Observatory, Hampshire; Isaac Newton Group, La Palma;
Joint Astronomy Centre, Hawaii.



Science & Technology
Facilities Council