CLF Economic Impact and Outreach Facilities

P. Matousek
Central Laser Facility, STFC, Rutherford Appleton Laboratory, HSIC, Didcot, Oxon OX11 0QX, UK

In addition to the vibrant scientific and R&D programmes reported in this Annual Report, the CLF also strongly focuses on the delivery of high return on investment into science to the wider benefit of our society and economy. It is recognised that the effective and sustained delivery of Economic Impact (EI) requires the presence of a vibrant world-leading scientific environment which provides fertile foundations on which new ideas and concepts can be effectively generated and developed. In this context, we strive to foster EI activities in harmony with our core science programmes. Specific delivery mechanisms are as follows:

- Fostering of internationally leading scientific programmes providing long-term high-impact benefits to the society
- Provision of facility beamtime and expertise to academic and commercial users
- Formation of new spin-out companies
- Generating intellectual property and its licensing
- Attracting global inward investment
- Marketing niche equipment developed through our advanced R&D programmes
- Training of the next generation of scientists
- Participating in the development of Harwell & Daresbury Science and Innovation Campuses and working in partnership with its residents
- Addressing societal priorities

Below are several examples of activities in this sphere we have engaged in this year.

Spinouts

The generation and nurturing of new spinouts represents an effective mechanism for producing high value EI with a long lasting impact on the local and national economies. This activity is closely linked with a prior generation of know-how and patents as these are key prerequisite for establishing successful and stable enterprises. In this area, we emphasise the particular importance of the early identification of new platform technologies and new phenomena with a long term EI potential and nurturing them in a timely and continuous manner throughout their entire EI lifetime to maximise their overall impact.

The CLF has a sound track record in this area. For example, the Facility made a major contribution to the formation of LaserThor, a company developing new technology for cleaning railway tracks using high power lasers and it also operates an internal company, Rutherford Optics, to market its specialised equipment developed throughout the past extensive R&D programmes and capitalising on the expert technology and know-how present at the CLF.

cobalt LIGHT SYSTEMS

This year was particularly fruitful with a launch of new spinout Cobalt Light Systems Ltd (formerly LiteThru Ltd) which in June 2008 successfully secured £750k of venture capitalist funding enabling the company to commercialise a new spectroscopic technique (Spatially Offset Raman Spectroscopy – SORS). SORS enables non-invasive probing of biological tissue and non-see through objects such as capsules and plastic bottles. The technology was developed at CLF's Lasers for Science Facility gaining readiness for full commercial exploitation maturity in several application areas including the quality control of pharmaceutical and security screening. The commercialisation was carried out in close partnership with CLIK (STFC's technology transfer arm) in a timely manner ensuring continuity of the programme and maximising the benefits captured for UK's economy. The Cobalt currently receives expert support from the CLF on commercial basis through subcontracting CLF's facilities and expertise.

The preceding translational research carried out at the CLF which led to the formation of Cobalt was crucial and facilitated the transformation of the first concept from its original large scale facility form to a portable tool applicable in practical settings. This activity yielded 7 patent filings along with attracting major international scientific acclaim. The research has also seeded topical research programmes in numerous HEI's. This mode of commercialisation of science permits the EI to be delivered hand in hand with internationally leading scientific research and as such it represents one of the most optimum and effective ways of delivering our strategic objectives.

Intellectual Property

The generation of intellectual property represents another fertile EI area for the CLF. New ideas and inventions are nurtured in partnership with CLIK (STFC's technology transfer arm) utilising its proof-of-concept funds as appropriate. It is recognised that licensing opportunities can deliver particularly deep and lasting impact; outside immediate cash income from royalties, far larger impact is often generated externally through the development of new technologies and subsequent further increase in the competitiveness of beneficiary organisations as well as through the boost provided to the local and national economies. Currently, the CLF has 16 live patent families generated through its sciences and R&D activities. One new patent was filed this year in the area of novel platinum complexes. This is a result of IP created jointly with collaborators from the University of Sheffield and the Durham University.

Attracting Inward Investment and Addressing Societal Priorities

In this area the most notable activity is undoubtedly the HiPER (High Power Laser Energy Research Facility) initiative led by the CLF aiming at providing the Laser driven fusion as a source of future inexhaustible carbon-free energy on a global scale. A preparatory phase of the European HiPER project was launched this year with the European community defining by this step a strategic way forward in the fusion research and its exploitation. The multi-national project aims at demonstrating a credible path to laser driven fusion as a commercial energy production source offering also a broad based science research facility. The European collaboration of leading physicists and government officials representing 10 countries, and supported by science partners from fusion research establishments worldwide, formally signed an agreement to coordinate a three-year preparatory phase to establish the planning and design for the full HiPER facility.

The HiPER facility is also anticipated to have a major impact on a wide range of fundamental science topics – enabling researchers to study here on Earth some of the most extreme conditions in the Universe. Reaching temperatures and pressures only otherwise found at the centre of the sun, or in an exploding supernova. The benefits of fusion energy cannot be overstated in a global settings where climate change, pollution, energy security and the ever increasing demand for energy consumption represent the principal challenge facing humankind. HiPER represents a very significant step on that journey.

The future location of HiPER is being explored over the next few years, with the UK being a prime candidate.

New Light Source Project

The New Light Source (NLS) project is a large scale facility aiming for unique studies of microscopic motions in matter of all kinds. The NLS builds on the very latest photon source technology and will allow to conduct unique studies of the microscopic motions that occur within matter of all kinds. The exceptional brightness and coherence of the light will permit other unprecedented research that will have the potential for revolutionary advances in science and technology. The CLF plays a significant role in the project contributing to the development of a science case. The NLS Facility is envisaged to be based on advanced conventional and free electron lasers, with unique and world leading capabilities. A review took place in 2008 of the underpinning science case for next generation light sources of this kind via a consultation with a broad community of scientists and technologists. The key science drivers defined through the consultation process were:

Imaging Nanoscale Structures

Instantaneous images of nanoscale objects can be recorded at any desired instant allowing, for example, nanometer scale resolution of sub-cellular structures in living systems.

Capturing Fluctuating and Rapidly Evolving Systems

Rapid intrinsic evolution and fluctuations in the positions of the constituents within matter can be characterized.

Structural Dynamics Underlying Physical and Chemical Changes

The structural dynamics governing physical, chemical and biochemical processes can be followed by using laser pump- X-ray probe techniques.

Ultrafast Dynamics in Mutli-Electron Systems

New approaches to measuring the multi-electron quantum dynamics, that are present in all complex matter, will become possible.

To address these sciences concrete baseline specifications for the facility were also developed this year.

International Launch of the Extreme Light Infrastructure Preparatory Phase

Several members of the CLF also attended the formal launch of the Extreme Light Infrastructure (ELI) Preparatory Phase project (known as ELI-PP). The launch was held in Paris in February 2009. ELI is a proposed laser infrastructure dedicated to explore laser-matter interactions in the ultra-relativistic regime and to develop intense ultra-short radiation sources for fundamental science. The CLF have a leading role in developing the safety case and radiation protection for the proposed facility.

150 Years of Anglo-Japanese Scientific Exchange

The second UK-Japan Workshop on High Energy Density Science was held at the Royal Society London in December 2008. This followed on from the first meeting that was held in Tokyo in September 2007 at the British Embassy. The Workshop, attended by over 70 eminent scientists from the EU and Japan, was held in celebration of 150 years of Anglo-Japanese scientific exchange and friendship. The event was co-sponsored by the STFC and the Japan Society for the Promotion of Science. Topics covered included joint work on fusion energy, particle accelerators, laboratory astrophysics, warm dense matter physics and atomic physics of dense plasmas. During the event, a Memorandum of Understanding was signed between Professor Richard Wade (Chief Operating Officer, STFC) and Professor Motoyuki Ono (President, JSPS) to strengthen the foundations laid down at the Workshops held in the two capital cities. Professor Yuko Furukawa (Director, JSPS London) witnessed the signing ceremony.

Training and Inspiring

Training of the next generation of scientists in expert areas pertinent to underpinning future technologies and sciences represents an integral component of the delivery of effective EI on national and international scale. The CLF is engaged in training programmes at several levels. Below are some examples from this area.

This year, the CLF hosted 4 sandwich students and 6 are expected to start in the year 2009-10. In summer 2008, 4 vacation students worked at the CLF. The CLF mechanical and electrical workshops also trained 3 apprentices in 2008-09.

The CLF staff are also effectively engaged in PhD programmes co-supervising in partnership with UK's universities PhD students (this year, 13 PhD students benefitted from this activity). This area is actively supported at STFC level through network programmes and represents a long term sustained commitment to the engagement in this type of high level expert training. Numerous PhD's and post-doctoral research associates are also trained through association with our user facility programmes and R&D projects. The close interaction with higher education institutions is also reflected in the number of visiting professorships held at the CLF - currently standing at 6.

A parallel training activity in which the CLF also actively engages is running specialist courses. This year, the CLF hosted a two week training course to prepare new PhD students and Post Doctoral researchers for working at the facility in the coming year. During the two weeks the participants attended theoretical and practical sessions hosted by members of staff on subjects ranging from parabola optimisation to vacuum pumping. The sessions were designed to give students a broad introduction to the workings of the facility during an experiment; not just from the perspective of the users, but also encompassing techniques in target fabrication, design engineering, mechanical engineering and experimental planning.

The main advantage of the Training Weeks initiative is that students then come to use the facility with a working knowledge of how it is run. This leads to an increase in the efficiency of the experimental runs as well as giving the participants hands-on training that will benefit them throughout their time spent at the CLF as well as in their future career.

Inspiring a Younger Generation

Further high impact activity includes hosting regular school visits aiming at inspiring the next generation of scientist and increasing uptake of natural sciences by pupils.

In February 2009, six schools from around Oxfordshire got together at the Rutherford Appleton Laboratory to present their projects on the topic of "Water and your School". The project was run by Go4Set, a new Engineering Development Trust (EDT) initiative involving students, engineers and companies to stimulate the interest of young people in Science, Engineering, Technology and Maths. Go4Set links teams of Year Nine pupils (13/14 year olds) with companies and universities to offer a 10 week Science, Engineering and Technology experience. STFC sponsored one team and the Oxfordshire Independent State School Partnership sponsored the other five teams. Two mentors from STFC supported two local school teams, providing technical knowledge, engineering advice and support for their teams throughout the 10 week project on water recycling at their schools.

The pupils were asked to identify a suitable building or part of the site at their school to work out how rain water could be collected and used instead of mains water. Their project findings were presented and assessed at the Rutherford Appleton Laboratory by a team of independent assessors and the winners presented with £250 for their school's science department. Darren Neville from the CLF was placed with the winning team from Didcot Girl's School.