Industrial Impact and Innovation

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This article highlights the economic impact, industrial user engagement, and innovation activities of the CLF for the reporting period April 2017 to March 2018.

Economic impact

The CLF spinout company Cobalt Light Systems Ltd, which develops and markets disruptive technology using Spatially Offset Raman Spectroscopy (SORS), has been acquired by Agilent Technologies, a US company, for £40M. SORS is an exclusive CLF technique, which differs from traditional Raman spectroscopy in that it can identify materials through opaque containers deeper beneath the surface than with previous methods. The SORS technique was originally developed using the CLF's cutting edge ultra-fast laser, Ultra. Cobalt was formed in 2008 and attracted numerous awards including RAEng's prestigious 2014 MacRobert Award and the 2015 Queen's Award for Enterprise. The company developed a number of SORS products, including table-top devices to identify liquid explosives concealed within bottles that are currently in operation at over 75 airports worldwide. Using the same technique, hand-held instruments have also been developed by Cobalt to quickly and efficiently test the contents of bottles and jars for explosives, narcotics and hazardous substances. The company will be located at the Harwell Campus next to STFC RAL and will become Agilent's global centre for Raman spectroscopy.

Industrial users and engagement

Six paid-for access projects with industrial users were completed this year, delivering experimental access to Gemini, Ultra, and Octopus. The CLF's expertise, in combination with its world-class capabilities and laser-based techniques, continues to make an impact on a wide variety of industrial science themes and R&D areas, including fluorescence microscopy for studying catalytic materials, laser-driven accelerators for defence sector technologies development, and 2DIR spectroscopy supporting pharmaceutical research.

The Coconut Collaborative Ltd (CCL) and UK National Measurement Laboratory LGC Ltd collaborated with the CLF under the new Analysis for Innovators (A4I) scheme, to access CLF's Raman spectroscopy and multispectral imaging capability and assess whether this is a basis for an enhanced level of quality control and screening in CCL's manufacturing plants. This screening approach could avoid annual costs in excess of £500k through reduced production and material charges. James Averdieck, Managing Director of CCL, said, "*It has enabled us, at a time when our core staff are stretched in supporting our strong organic growth, to work in a time efficient way with world class institutions and scientists to develop and prove a principle for solving a very unique but real rancidity measurement problem. We are impressed with the encouraging results.*"

The A4I scheme is funded by Innovate UK to help companies to gain access to world-leading expertise, cutting-edge facilities, techniques and technologies to solve existing analysis or measurement problems facing businesses. UK businesses can apply for a share of up to £4 million to work with scientists and research facilities to resolve productivity and competitiveness issues.

The CLF has received funding from another scheme recently introduced to boost industrial collaboration with national facilities. Bridging for Innovators (B4I) is an Industrial Strategy Challenge Fund (ISCF) programme run by STFC to help UK industry overcome product, manufacturing or process performance issues and boost productivity.

The CLF hosted an industry engagement workshop that focused on laser-driven sources of x-rays and particles, and their application to many high value sectors, including advanced imaging and inspection for aerospace, nuclear and new materials. Over 30 people attended, including university users, companies and organisations such as Rolls Royce, National Composites Centre, TWI Ltd, and Stirling Dynamics. By connecting world-leading research with business, this event has helped set an example for the future, namely that strong relations between academia and industry increase the feasibility of tackling some of the greatest challenges of the twenty-first century.

The CLF developed an industrial capability portfolio for laser-driven x-rays by engaging a number of companies and organisations who use x-ray imaging for product quality control. A range of samples were loaned by High Value Manufacturing Catapult centres (Manufacturing Technology Centre, National Composites Centre, Warwick Manufacturing Centre), Rolls Royce, and Southampton μ-vis X-ray Imaging Centre. Phase contrast x-ray radiographs and MeV energy absorption radiographs generated at CLF demonstrated high resolution imaging capability through a range of materials and a range of thicknesses, indicating the strong potential impact of laser-driven x-rays for industrial non-destructive testing and advanced imaging.

Industry Partnership

The CLF's partnership with Johnson Matthey (JM) continues, with a JM research fellow joint appointment at the CLF to solve industrial challenges and add insight into fundamental R&D through the application of advanced laser spectroscopy and laser microscopy techniques on Ultra and Octopus. Regions of scientific interest for JM include next-generation battery technology, fuel cell characterisation, and catalytic science of zeolites for clean air applications.

The CLF continues to collaborate with the Defence Science and Technology Laboratory (Dstl) novel detectors group to deliver a programme of R&D focusing on advanced inspection and disruption technologies for defence applications based on laser-driven secondary sources. Dstl fund an applications development scientist appointment at CLF and at least one experimental access time on either Gemini or Vulcan each year.

The collaboration between the CLF, the University of Bristol, and Queen's University Belfast under an industrial partnership with Sellafield Ltd continues the development of laser-driven x-rays and neutron sources for inspection and waste assay applications. The Pulsed Laser Accelerators for The Inspection of NUclear Materials (PLATINUM) project is of three-year duration, funded by the STFC Innovation Partnership Scheme. This year the team completed an experiment using the Vulcan laser to demonstrate that laser-driven x-rays have the source qualities to resolve corrosion-induced cracking in grout surrounding uranium, and imaged through at least 400 mm of grout in a single pulse exposure. The CLF-led experiment was delivered in collaboration with the University of Strathclyde, Queen's University Belfast and the University of Bristol.

International Impact

A pilot innovation project between the CLF and India's Tata Institute of Fundamental Research was announced which will focus on skills enhancement, with engineers from India receiving training in next-generation laser technology during their time at the CLF. The CLF's Dr Rajeev Pattathil stated, "*There is now a strong demand from academic communities on both sides for establishing a joint innovation centre in order to translate the research we do into societal applications that will benefit the people in both countries.*"

Build and delivery of the DiPOLE D100X system, 100 J at 10 Hz, to the high-energy density end station of the European XFEL Facility continues to be on track. This is the second build contract for the CLF's world leading 100 J level high peak power and high average power laser system and paves the way for more interest from international facilities for this innovative technology.

Innovation

We constantly scan for innovation and technology transfer opportunities across the whole of the CLF, with a view to capturing and driving forward the most high impact ideas and inventions.

During this year, two proof-of-concept projects remained active – one based on the development of an advanced Raman spectroscopy readout system, and one based on the application of laser microscopy for targeted therapeutics. One project came to a close, based on the development of the DiPOLE10 laser for laser peening applications. The laser peening laboratory is now equipped with robotic handling capability for sample materials to be peened and a water flow system for surface cooling. A series of experiments and demonstrations have taken place. A university group is scheduled to access this capability for materials science experiments.

A new project for the development of an advanced capability for the CLF's DiPOLE laser has commenced, aiming to increase the repetition rate by a factor of ten.

In this year two new patents were filed, five new patents were granted related to the patent families, and thirteen invention disclosure forms were submitted for consideration that may lead to future patents.