

Industry Engagement and Innovation

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Introduction

This article highlights the industrial user engagement, industry partnerships, and innovation activities of the Central Laser Facility for the reporting period April 2021 to March 2022.

Industrial users and engagement

During this past year, the facilities concentrated on recovery of the academic programme due to the impact of the COVID-19 pandemic. This had a knock-on effect on capacity to deliver industrial use of the facilities. Whilst the CLF delivered an increase of industry access this year compared to year 2020-21, the industry user programme is still in recovery and aims to reach the allocated 10% industry access rates by year 2023-24.

The CLF delivered 19 facility access weeks with industrial users this year, delivering experimental access to Gemini, Octopus and Ultra facilities and access to CLF scientific expertise. The CLF continues to drive impact across a wide variety of industrial sectors and to contribute advanced characterisation in industrial R&D despite the reduced operational delivery.

Over the past year CLF's Industry Partnerships and Innovation (IPI) group has also delivered multiple expertise consultations with industry partners. In 2021-22 we consulted on 14 different projects with 14 different industry partners. The industry sectors engaged with through the CLF's industry user programme include advanced manufacturing, formulation and chemical, defence and security, space, food and agritech, and biotechnology (healthcare, medical, bio-pharmaceuticals).

SME LightOx Ltd, a spin-out success from Durham University, focuses on developing light activated chemotherapy for treatment of early-stage mouth cancers. LightOx and the CLF were awarded funding through Innovate UK's Analysis for Innovators (A4I) grant to study the two-photon absorption cross-section and cellular-behaviour of their light activated probes. LightOx scientists were seconded to our facilities to learn our advanced fluorescence microscopy

techniques. The experiments carried out at the CLF are helping LightOx in developing new therapeutic solutions to improve patient function and long-term outcomes.

The IPI group has also performed a number of pump-prime applications with industry and academic partners, and a number of commercial access experiments that prime future return or provide current return of investment for the facilities. We have carried out experiments for a PepsiCo sponsored PhD studentship in collaboration with Leeds University, applied advanced spectroscopy with Oxford Nanopore Technologies, and imaging and spectroscopy for the CLF's strategic partner Johnson Matthey.

Industry Partnerships

This year our Gemini facility carried out exploratory application of laser plasma acceleration to penetrative x-ray imaging for our industry partner Rolls Royce. This work is crucial to understanding how our new Extreme Photonics Applications Centre (EPAC) will be used by industry and help us to develop our technology to suit the requirements of business.

The experiment looked towards laser-produced highly penetrative x-rays used to image the rotor found in Rolls Royce's new electric engine for aerospace. Large, metallic items like Rolls Royce's rotor are difficult to image due to their size, high density and magnetic materials. EPAC will revolutionise x-ray imaging of these type of objects non-destructively, which will have applications in engineering and manufacturing industries from across the UK and internationally.

In partnership with both academia and industry, a CLF collaboration has been awarded funding through the Innovation Partnership Scheme to develop the novel application of two-dimensional IR spectroscopy as a liquid-biopsy diagnostic technique. This project will run for next three years and includes funding for regular access to our 2DIR system. Our lead academic partners at York University are developing a rapid multi-sample holder to be optimised at our Ultra facilities, and our industrial partner UCB Pharma will utilise the new technique for realising business benefits.

The CLF's long-standing laser fellowship programme with Johnson Matthey continued once more this year, successfully delivering industrial access to both the Ultra and the Octopus facilities. The fellowship highlights the importance of the work that the CLF does for knowledge transfer between large-scale facilities and industry.

Innovation

The CLF's IPI group continues to scan for innovative concepts and technology transfer opportunities, to capture and drive forward the most impactful ideas and inventions.

This year the CLF filed a new patent family, giving a current total of 25 active patent families, and 11 invention disclosure forms were submitted for consideration for future patent filing. Additionally, three proof-of-concept projects were funded or ongoing, and a new Knowledge Assets Grant Fund was awarded.

A new area of innovation for the CLF is the development of a novel VUV Light source for gas and water treatment. This project was supported this year by the governments Knowledge Assets Grant Fund. This project proposes the development of a microwave plasma to produce VUV ($UV \lambda < 200 \text{ nm}$). Currently, the main source of VUV commercially is from excimer lamps. The proposed microwave-sustained plasma system will push beyond current systems, remove the need for environmentally harmful mercury, and provide advantageous rates of photochemical reactions and conversion compared to other systems.

In this reporting period the CLF's spin-out company Scitech Precision Limited benefited from the recovery from the COVID-19 pandemic. Experimental campaigns restarted across the world and company sales began to recover to pre-pandemic levels. The company carried out 98 individual contracts across 32 institutions across the world, with a turnover of £239k.

Scitech sold its first target delivery system, supplying a tape drive to the SCAPA facility at the University of Strathclyde. This sale was part of the licencing agreement between SPL and the CLF that allows the CLF to support, participate and supply external facilities. The company also supplied its first targets direct to LLNL in the US, as well as continuing to support experiments at the LCLS. Scitech also supported the local scientific campus by providing services to Diamond Light Source, and other spin-out companies on the Harwell campus, as well as companies requiring micro-fabrication across the UK.

International Impact

Horizon 2020's IMPULSE programme, with participation of representatives from 15 Consortium partners from the UK and nine other European countries, continued throughout 2021-22. The project is using the IPI group's expertise to help develop and implement new industry liaison offices, processes and policy, to obtain a strong understanding and learning of how to grow and improve collaborations with industry partnerships and commercial customers to large-scale laser-based facilities.

The Extreme Photonics Innovation Centre (EPIC), a partnership between the CLF and the Tata Institute of Fundamental Research (TIFR), is proving beneficial to the CLF and TIFR alike. EPIC is developing a critical mass of skilled people in India in the technologies associated with novel accelerators, and is proving to be essential for the CLF's ongoing facility development projects, such as EPAC and Vulcan 20-20.