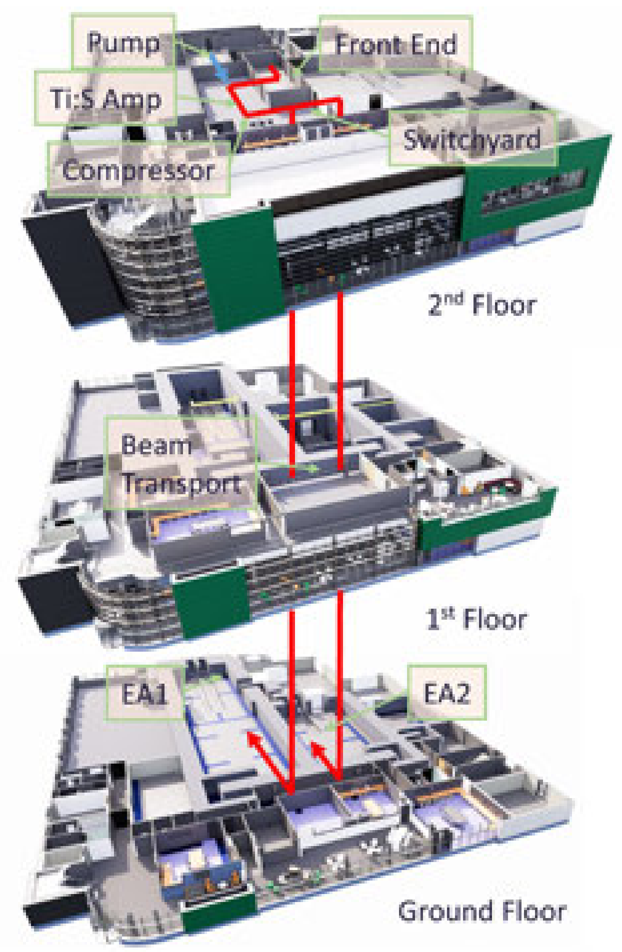
Advancing towards EPAC –

a new national facility to support UK science, technology, innovation and industry

The building construction phase of the Extreme Photonics Applications Centre (EPAC) is nearing completion, with the building scheduled to be handed over to the CLF in May 2022.

EPAC will bring together academic, industrial, defence and security communities in a diverse programme of fundamental and applied research, industrial metrology and qualification, materials processing, and advanced imaging.

As a facility asset for the UK, EPAC will combine unique capabilities and will serve broad communities. It will enable novel applications leading to scientific breakthroughs and new solutions to challenging problems that will advance UK science and technology, helping to keep us safer, improve our healthcare and support a cleaner, more productive economy.



The EPAC building in April 2022

EPAC will house a state-of-the-art 10 Hz, 1 PW laser, with two independent experimental areas. It will constitute a new capability for studies of fundamental science using laser-driven secondary sources, and will focus much of its research on developing laser plasma accelerators for a range of applications in industry, medicine, defence and security.

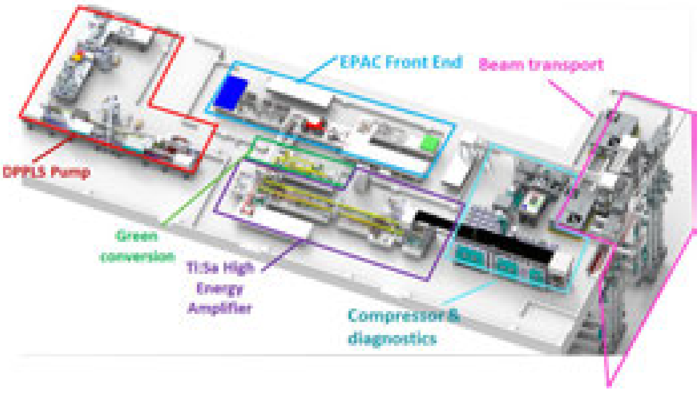
The ground floor of the building houses three double-height radiologically-shielded experimental areas, where the laser-driven sources are created and used, plus support laboratories.

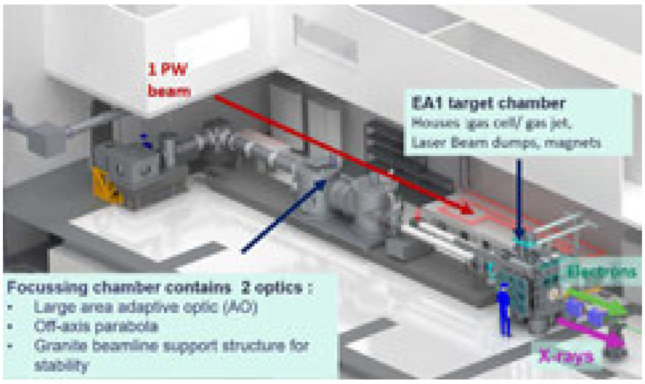
The parts of the first floor not occupied by the double height experimental areas will house services and offices.

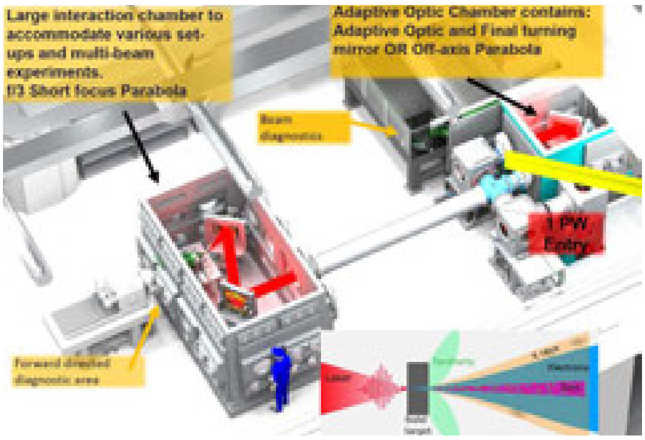
The second floor will house the highly advanced laser technology, with a beam transport propagating the beam to the experimental areas on the ground floor.

The new facility will initially deliver a PW-class laser operating at 10 Hz. In order to achieve this high peak power and repetition rate, the CLF's DiPOLE technology will be used to pump a high energy Titanium Sapphire amplifier.

Detailed descriptions of the laser sub-systems can be found in P.D. Mason, P.J. Phillips, N.H. Stuart *et al.*, EPAC Laser Systems, in the online version of this report on the CLF website.







The versatile experimental areas (EAs) in EPAC can drive bright, beam-like high-energy x-ray beams and beams of high-energy electrons, protons, ions, neutrons and muons by merely changing the target geometry, enabling multi-modal imaging and probing capabilities for fundamental science and applications.

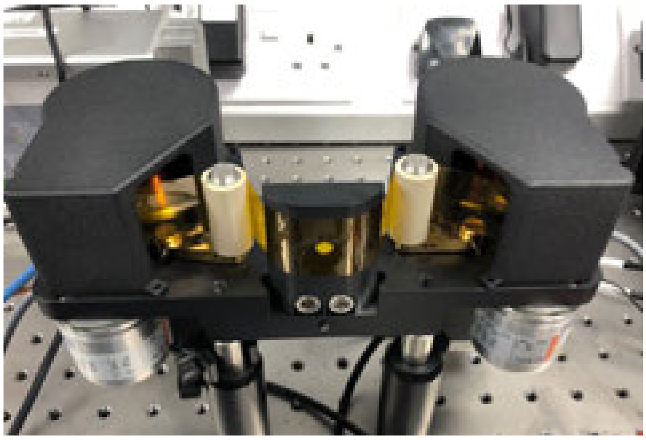
EA1 (top) has a fixed configuration, delivering a long-focus laser beamline predominantly for driving a laser-wakefield accelerator.

EA2 (bottom) contains a large vacuum chamber that can be configured in a flexible way with short, medium, and long-focus beamline options. The primary aim of EA2 will be to deliver high intensity solid target interactions; however; it will be possible to also deliver liquid and gas targetry, depending on the science or application driver.

Detailed descriptions of the experimental areas can be found in DR Symes, JS Green, *et al.*, EPAC Experimental Areas and Targetry Developments, in the online version of this report on the CLF website

Several targetry technologies remain under development for EPAC to be able to supply well-characterised targets at up to 10 Hz once user operations begin. There are many areas that need to be progressed to fully exploit the capabilities of EPAC, including rapid batch fabrication (sometimes in situ), accurate alignment, characterisation, and issues of survivability in such extreme environments. Several R&D projects are underway for both solid and liquid targetry, including several larger collaborative efforts with a number of international institutions.

Detailed descriptions of EPAC targetry can be found in W. Robins, C. Spindloe, *et al.*, EPAC High repetition-rate targetry developments, in the online version of this report on the CLF website



The CLF has made significant progress in the build and testing of an ultra-stable tape delivery system for targets