EPICS control systems at the Central Laser Facility

India EPICS collaboration meeting Nov '24

Chris Gregory

The CLF

The CLF

Octopus

Advanced laser-based imaging and laser trapping capabilities
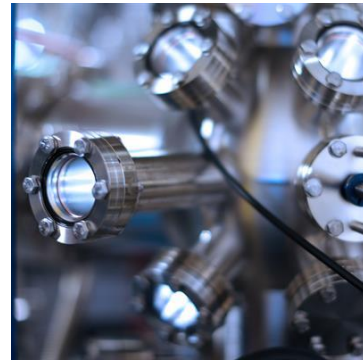
Super-resolution microscopy

Multidimensional single molecule imaging and tracking

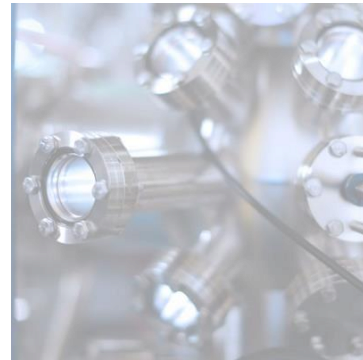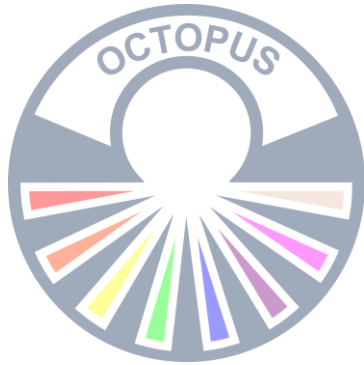Confocal microscopy

Light microscopy

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Artemis

Few optical cycle and widely tuneable laser sources, and ultrafast XUV (10-100 eV) pulses produced through high harmonic generation

Ultrafast dynamics in experiments on gas, liquid and solid materials
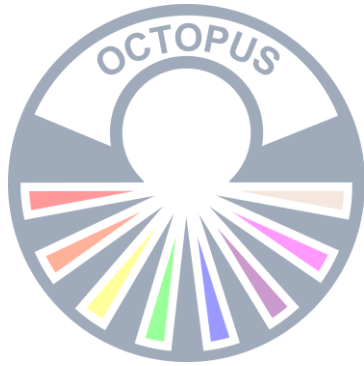
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Ultra

Time-resolved (pump-probe) spectroscopy facility

Ultra-fast molecular dynamics for applications in physical and life sciences

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Vulcan

High-energy laser facility for fundamental science. In transition to new phase.

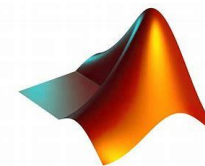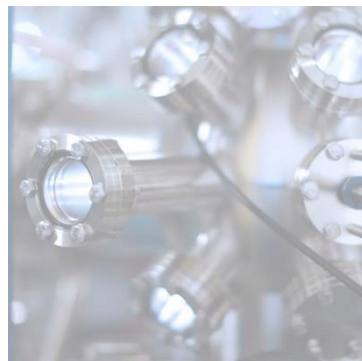Will be the highest intensity laser in the world.

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Gemini
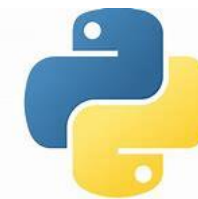
Petawatt class laser with short (40fs) pulses

Two configurable beams for flexible configuration and wide range of experiments

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Transition to EPICS

Around 10 years ago moved to develop new laser control systems in EPICS

The first project was D100X – a laser delivered to the European XFEL

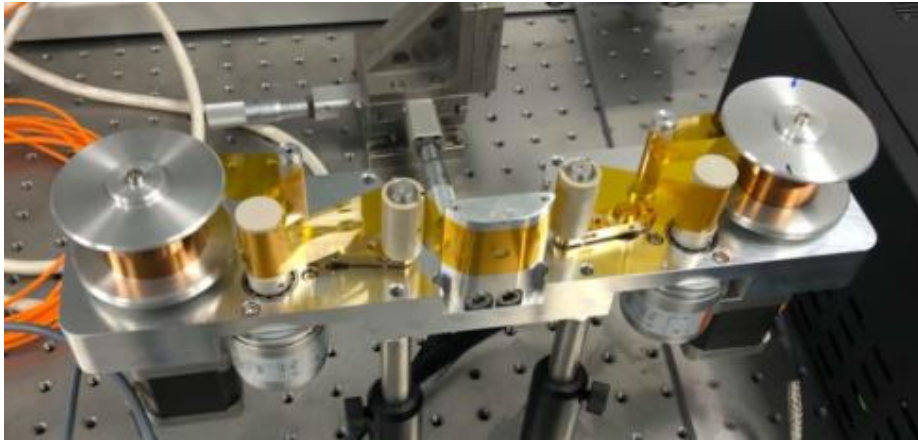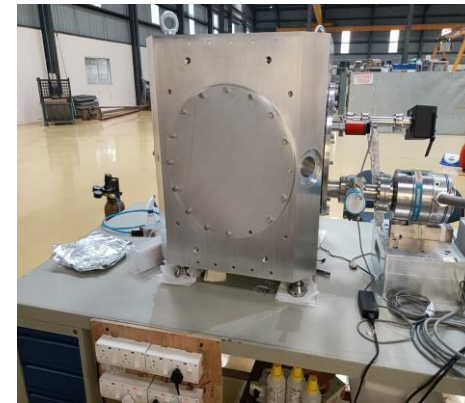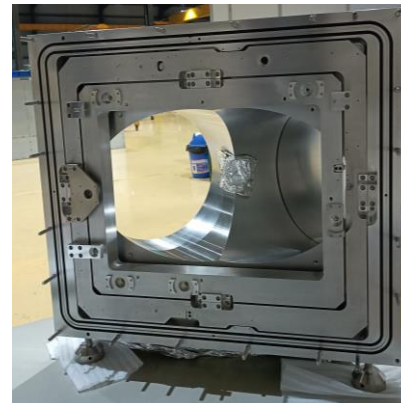Next EPAC, Vulcan20-20, and upgrades to Ultra and Artemis

EPIC collaboration

The Extreme Photonics Innovation Centre (EPIC) is a joint venture between UKRI and TIFR, based at TIFR.

Control software, AI/ML, target fabrication, mechanical engineering, plasma science, advanced detectors, and biological imaging.

https://epic-innovation.org/

Extreme photonics application centre (EPAC)

Petawatt laser at 10Hz for fundamental research and industrial applications.
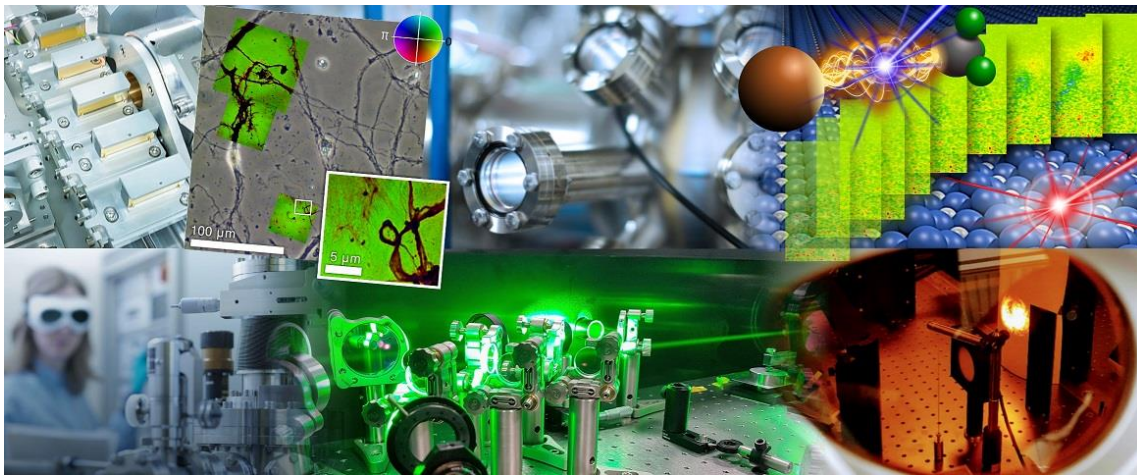
Scheduled to complete early 2026

Approximately 200 IOCs currently deployed and commissioned. Expected to double in the next year.

Hilux

Upgrade to Artemis and Ultra. Multi-kHz lasers, detectors, sample handling technologies, and data.

New challenges in repetition rate, new detectors for the IR range, lots of Labview code to migrate/integrate.
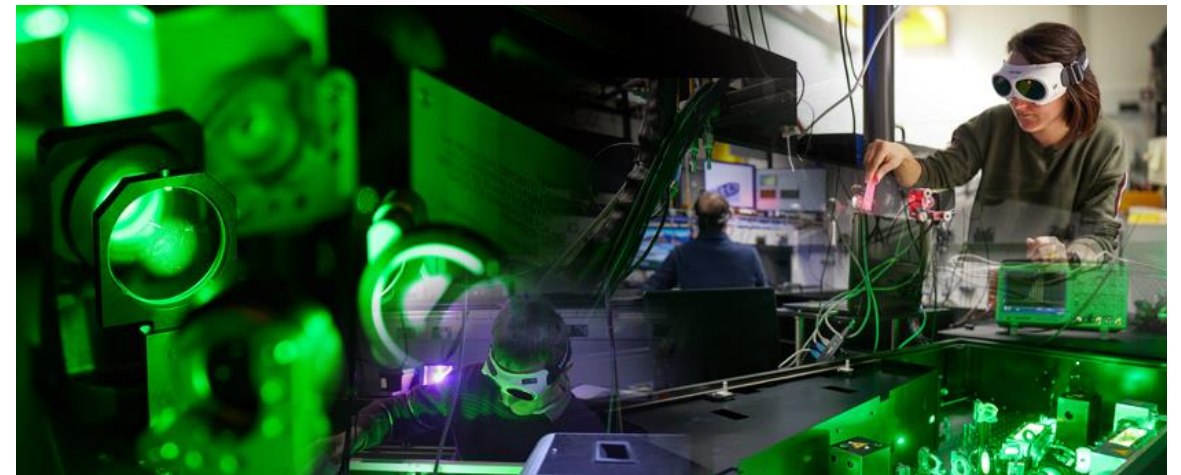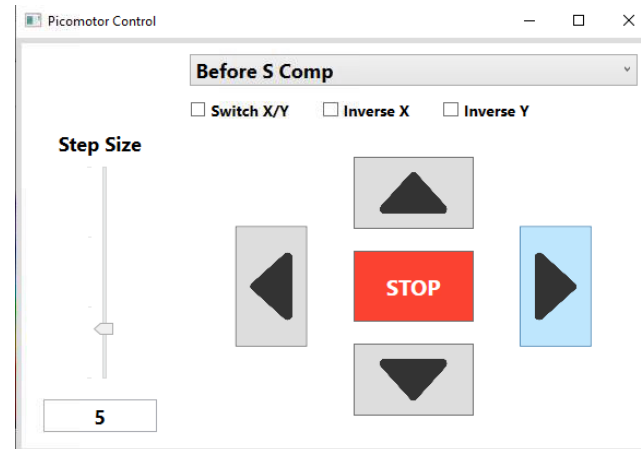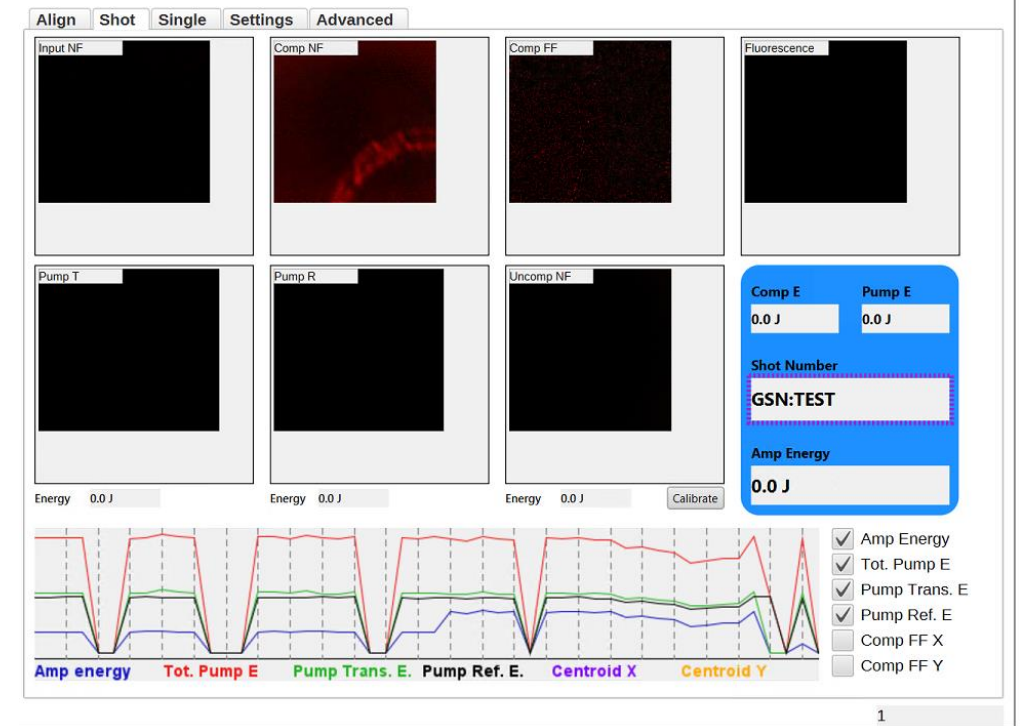
Upgrade existing machines

New EPICS developments are prototyped or back-ported to existing facilities where possible.

In Gemini, we have several IOCs interacting with the .NET control system and python applications around the lab.

What else?

Improve user experience with better interfaces and smart logging and reporting.

Help developers with hardware simulation and deployment pipelines.

Handle large data volumes – from 2D detectors and other sources – and transport and store them efficiently.

Design and build new lasers. Ensure smooth operations with machine protection systems.