Overview of the Central Laser Facility

M Dunne

Central Laser Facility, CCLRC Rutherford Appleton Laboratory, Chilton, Didcot, Oxon., OX11 0QX, UK

Email address: *m.dunne@rl.ac.uk*

Facilities for Users

The Central Laser Facility (CLF) is a world leading centre for research using lasers. Over the past year there has been significant investment in the facility infrastructure to improve reliability and ensure sustainable operations into the future. To enhance the CLF's contribution to the science programme we have started to recruit more experimental scientists and have taken the initiative to form a new theory team that will offer a variety of modelling and theory services to our users.

To ensure that our facilities continue to be scientifically leading, flexible and effective, the CLF is committed to driving the analysis of long-term requirements in our field and working with our user communities to prioritise developments based on this strategic view.

Vulcan

Vulcan is a highly versatile Nd:glass laser with three independent target areas. A maximum of 2.5 kJ can be delivered in its six 10 cm and two 15 cm beamlines, with frequency conversion optics to enable 1μm and 0.5μm operation. A range of pulse durations are available from 100 ps to 20 ns, with very flexible focusing options. In addition, short pulse (<700 fs) high irradiance (10^{20}-10^{21} Wcm^{-2}) chirped pulse amplification (CPA) capability is available on the Petawatt and 100TW beamlines.

This reporting period saw many successful experiments, achievement of 1 PW operation, and installation of a set of dedicated diagnostics to monitor the phase front quality, spectrum, pulselength, near field and equivalent far field profile of this beam.

Astra

The Astra Titanium: Sapphire laser facility provides users with access to high intensity laser pulses at 10 Hz repetition rate, simultaneously to two target areas. Target Area I provides pulses of 50fs duration with energy of 10 mJ for atomic and molecular physics studies. Target Area II delivers 500 mJ in 40fs with flexible target irradiance options up to 10^{19} W cm^{-2}. This year, a state-of-the-art pulse compressor has been added to Target Area I to provide a 10 fs, 0.5 mJ probe capability.

In July 2004 the Astra facility started a 3-year upgrade project called "Gemini" to raise its output power by a factor of 40. Two beams will each deliver 0.5 PW once per minute, enabling interaction studies at 10^{22} Wcm^{-2} in a dedicated interaction area.

Lasers *for* Science Facility (LSF)

The LSF operates a suite of state-of-the-art table top laser systems and associated instrumentation giving users access to highly tunable (VUV to IR) and variable pulse width (ns to fs) laser radiation. The extremely versatile lasers are applied to a wide range of applications across chemistry, physics, biology, medical and material sciences. In particular, there are specialist facilities for time-resolved vibrational spectroscopy in the femtosecond and picosecond time domain.

The time resolved resonance Raman (TR3) facility provides unique capabilities to enable highly fluorescent samples to be studied using a 4 ps optical Kerr shutter in combination with a fully tunable kHz femtosecond synchronised pump-probe apparatus based on OPA technology. The same laser source also drives the high brightness PIRATE facility (Picosecond InfraRed Absorption and Transient Excitation) giving two independently tunable beams across the mid infrared region of the spectrum for pump/probe experiments. The Laser Microscope Laboratory is actively developing the use of lasers for imaging and spectroscopic characterisation of biological materials at the cellular level. This technology includes the use of lasers to provide optical traps ("laser tweezers") for investigating Raman spectra and pico-Newton forces between particles in solution (such as living cells and aerosol droplets).

Laser Loan Pool

Commercial laser systems are available from the Laser Loan Pool for periods of up to 6 months at the user's home laboratory. Systems available include nanosecond tunable YAG pumped dye lasers (with frequency up-conversion and down-conversion covering the spectral region from 205 nm to 4500 nm), an excimer laser operating down to 157 nm, a CW frequency doubled argon ion laser and an all solid-state femtosecond Titanium Sapphire laser tunable between 680 nm and 1020 nm, as well as a 1 kHz ultrafast regenerative amplifier and OPA system. A wide range of ancillary and diagnostic equipment is also available to support user experiments.

Laser Research

In addition to the research associated with developing the major facilities, the CLF is engaged in developing attosecond laser technology (as part of a Basic Technology consortium); and high average power photo-injectors for CERN and future Free Electron Laser based systems.

Engineering Services

Mechanical, electrical and computing support is provided for the operation of the laser facilities at the CLF, for the experimental programmes on these facilities and for the CLF's research and development activities. Access to mechanical and electrical CAD tools and workshop facilities enable a rapid response to be provided to users.

Target Preparation

A target fabrication facility is operated within the CLF. It is equipped with a wide range of target production and characterisation equipment, including evaporation and sputter coating plants, interference microscopes and a plasma etch facility. A rapid turnaround service responds quickly to the developing demands for targets, essential for maintaining the scientific productivity of the programme.

Access to Facilities

Calls for access are made twice annually at defined dates, with applications peer reviewed by external Facility Access Panels. For information please visit the CCLRC Web site at: http://www.cclrc.ac.uk/Activity/FacilityAccess or contact me at the above email address.

During the period covered by this report, beamtime at CLF facilities was awarded to European researchers through the EU Access to Large Scale Infrastructure programme under the auspices of the LASERLAB integrated infrastructure initiative. For information please contact Mr Colin Danson (c.danson@rl.ac.uk).

Hiring of the facilities and access to CLF expertise is also available on a commercial basis for industrial research and development. Please contact Mrs Alison Brown for further information (a.j.brown@rl.ac.uk).

CLF Web Site

Further information on the CLF, its facilities and the scientific programmes is available on the CLF Web site at http://www.clf.rl.ac.uk.