Overview of the Central Laser Facility

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Facilities for Users

The Central Laser Facility (CLF) is a world leading centre for research using lasers. This has been a year of real growth – in terms of our staff, in new development projects for our facilities, and in the breadth of science undertaken.

I am pleased to say we have been successful in attracting some exceptional new scientists and engineers. We have seen a good number of our staff take up visiting fellowships in academia, and we have instigated new joint appointments with some of our key user groups. This is part of a drive to increase the level of collaboration and coordination within our community to ensure best use is made of the facilities. Alongside this we have developed closer ties with our international counterparts and users to create new scientific and facility opportunities.

At the European level there are new initiatives in laser fusion energy (www.hiper-laser.eu) and in the development of laser plasma sources of GeV energy electron beams (EuroLEAP). Research on our high power laser facilities Vulcan and Astra will be central to the advancement of these concepts.

Another key strategic theme for the CLF is in the application of laser and imaging technology to the biosciences. We have now installed a biological support laboratory and are running an active biomedical network. Future plans are to integrate the LSF into a new Research Complex, bringing together the physical and bio- sciences, with a particular focus on applications on Diamond and the CLF.

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. A range of pulse durations are available from 100 ps to 20 ns, with flexible focusing and harmonic conversion options. Short pulse (<500 fs), high irradiance (up to 10^{21} Wcm^{-2}) chirped pulse amplification (CPA) capability is available on the Petawatt and 100TW beams, with an evolving capability to link these to long pulse beams. A broad suite of laser and plasma diagnostics is under constant development, tailored for each experiment.

Astra

The Astra Ti:Sapphire laser facility currently delivers to two target areas. Target Area 1 is an ultrafast area for atomic and molecular physics studies, combining pulses at 1kHz or 10Hz in 30-50fs duration and energy up to 10 mJ with a 10fs, 0.5mJ beam. Target Area 2 delivers 500 mJ in <40fs with flexible target irradiance options up to 10^{19} Wcm^{-2} and various probe beam configurations. This year a new oscillator operating at 30fs with 10^{10}:1 contrast ratio has been introduced. In 2007 this will also offer CEP stabilised beams to TA1.

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 up to three times per minute, enabling interaction studies at 10^{22} Wcm^{-2} in a dedicated interaction area, due to come online to users in August 2007.

Lasers for Science Facility (LSF)

The LSF operates a suite of state-of-the-art table top laser systems, 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 scientific and industrial applications across chemistry, physics, biology, medical and material sciences.

The time resolved resonance Raman (TR^3) facility enables highly fluorescent samples to be studied using a 4ps optical Kerr shutter in combination with a fully tunable kHz femtosecond synchronised pump-probe capability. 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. A "laser tweezers" laboratory is used to study Raman spectra and pico-Newton forces between particles in solution (such as living cells and aerosol droplets) for bioscience and environmental research.

This year saw the instigation of a new project, Ultra, which will significantly enhance our Raman and IR spectroscopy. Operating at 10kHz with spectral coverage from 200-16000 nm and temporal resolution down to 50fs, this will provide unsurpassed sensitivity, with 60 fold faster data acquisition than the current state of the art.

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. 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 high quality 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, SEM, AFM, surface profiling and a plasma etch facility. Many targets are produced in collaboration with CCLRC micromachining and lithographic services. 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, with applications peer reviewed by external Facility Access Panels. For information please visit: www.cclrc.ac.uk/activity/facilityaccess or contact me at the above email address.

Access to CLF facilities is awarded to European researchers under the auspices of the LASERLAB integrated infrastructure initiative (www.laserlab-europe.net). Hiring of the facilities and access to CLF expertise is also available on a commercial basis for industrial research and development.

See our website for more details on all aspects of the CLF.