Development

Laser beam collimation effects on large CPA compressors

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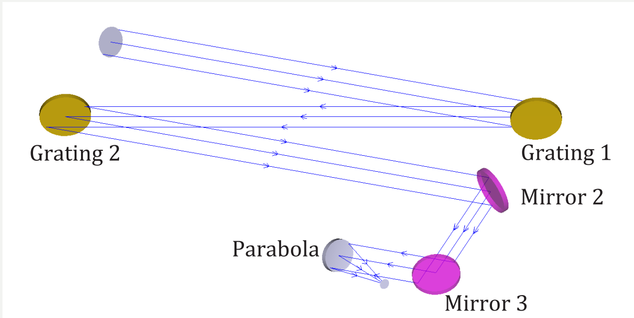
Modelling and analysis have been performed to show a link between laser collimation tolerances and dispersion effects in chirped pulse amplification (CPA) compressors. These show that an uncollimated beam can present itself as residual dispersion in a CPA system, which will have adverse effects on laser power and intensity if uncorrected.

The techniques of shearing interferometry and beam propagation over large distances for setting beam collimation have been assessed for their limitations in measuring wavefront radii. An analysis of the sensitivity of CPA systems to non-collimated beams has been studied. This effect has been practically demonstrated for a high-power Nd:glass laser and the best techniques for alignment are discussed.



Zemax models of the Petawatt beamline

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Laser shock peening of Si_3N_4 ceramics: experimental set-up and general effects

P. Shukla, J. Lawrence *(Laser Engineering & Manufacturing Research Group, University of Chester, UK)*

For over two decades, laser shock peening (LSP) or laser peening has been an established technique for the surface treatment of metals and alloys, due to the known benefits offered by the process. In particular, the technique offers: increased compressive residual stress; reduction in friction and wear; surface topography changes; and an increase in hardness.

LSP of advance ceramics is, however, unreported and requires much development. Physical characteristics prevent ceramics from behaving in the same way as metals when exposed to short pulses of laser energy, such that mechanical yielding and plastics deformation is difficult to introduce. As a result, the benefits from LSP found with metals/alloys are not common with hard brittle materials, such as ceramics. It is, therefore, of great interest to investigate LSP of ceramics, to understand the short pulse laser-material interaction, and the surface and bulk property modification.

Our work is a first step towards developing a laser peening technique for ceramics, intended to provide greater understanding of the science behind the technique, particularly for ceramics, by analysing mechanical, physical, and internal aspects of the material. Our goal is to apply the successful technique to engineer (strengthen) components from range of industrial sectors. We present details of the experimental set-up of our research using the EPSRC-funded ultra-high power (10 J) Nd:YAG laser (NSL4) system.

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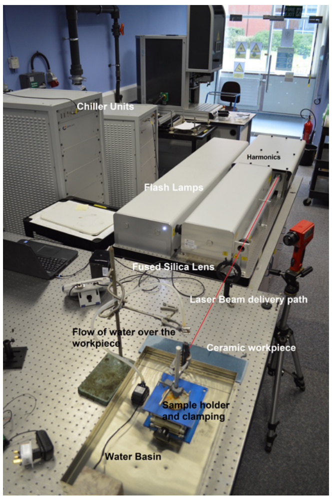
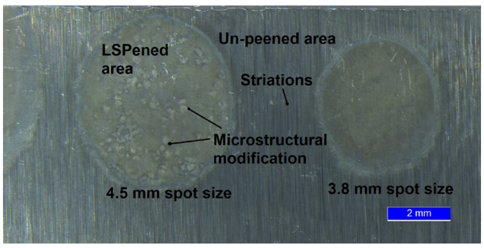




Left: Set-up of LSP experiments.
Right: Optical image of two different regions post-LSP, with an indication of a microstructural modification. As-received surface (left) and post-LSP surface (right) of Si_3N_4 advanced ceramic.

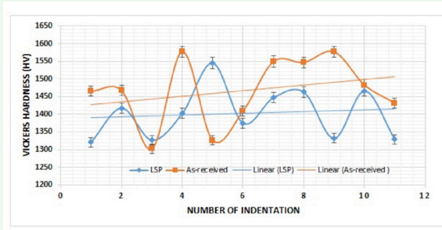
Alteration of fracture toughness (K_{Ic}) of Si_3N_4 advanced ceramics by laser shock peening

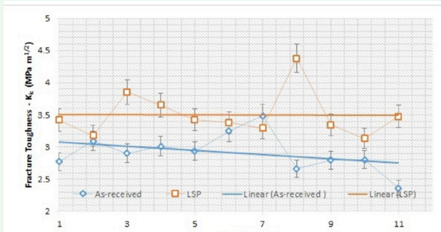
P. Shukla, J. Lawrence *(Laser Engineering & Manufacturing Research Group, University of Chester, UK)*

Lasers are known to influence the surface properties of ceramics materials in general. This study is a continuation of our work in laser shock peening (LSP) of Si_3N_4, initiated to study the effects on the surface hardness and the surface fracture toughness (K_{Ic}).

For a number of years, LSP has been an established technique for the surface treatment of metals in particular. However, LSP of advanced ceramics remains an under-developed process for a number of reasons, including brittleness and the ceramic being prone to cracking. It is, therefore, of great interest to study the effects of laser LSP of advanced ceramics, to gain a better understanding of the short pulse laser-material interaction and the changes in physical and internal properties.

Silicon nitride (Si_3N_4) ceramics are some of the most widely used advanced ceramic materials in industry, with diverse applications across many sectors including automotive, motorsports, military, aerospace and space. For many of these high demand industrial applications, fracture toughness is an essential property, and ceramics in general have a low fracture toughness compared with that of metals and alloys. Crack sensitivity and low K_{Ic} could limit the use of Si_3N_4; however, its applications have gradually increased as a result of the desirable physical properties and longer functional life which gives it a commercial advantage over the conventional materials in use. With that said, an increase in the K_{Ic} would lead to an enhancement in the functional life and performance of Si_3N_4 components. Our work with the LSP technique aims to result in increased K_{Ic}.





Surface hardness (top) and K_{Ic} (bottom) of the Si_3N_4 advanced ceramic after LSP

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Progress on positioning of solid targets for Gemini

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(CLF, STFC Rutherford Appleton Laboratory, Didcot, UK)

Experiments on Gemini require target positioning with micron accuracy to achieve the highest intensity. Our standard method is to backlight the rear surface of the target with an LED through the microscope objective used to image the focal spot. We demonstrate some enhancements to this alignment technique ensuring that we can achieve accurate positioning, even using challenging materials such as ultrathin 10 nm carbon foils and polished silicon wafers. The focal spot camera has been modified to include a lower magnification (10x) mode, and a laser focusing onto the rear surface of the target to complement our standard LED backlighting. We also discuss characterisation of the motorised stages commonly used in the CLF, which we have measured using a confocal sensor capable of detecting sub-micron motion. Each stage has advantages and drawbacks, and we point out some improvements that are needed to the drive system to optimise the positioning performance.

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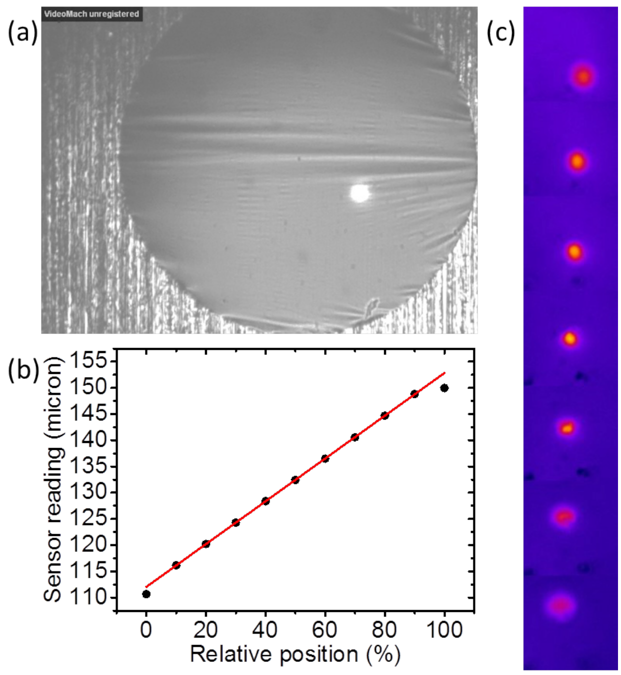

(a) Image of a 10 nm carbon foil backlit with an LED at 10x magnification.
(b) A focusing laser has been added to the camera arrangement and can be used for micron-accurate positioning.
(c) A closed loop piezoelectric motor can be used for extremely accurate motion over a range of 25 microns.

Increased radiation shielding in Gemini Target Area 3

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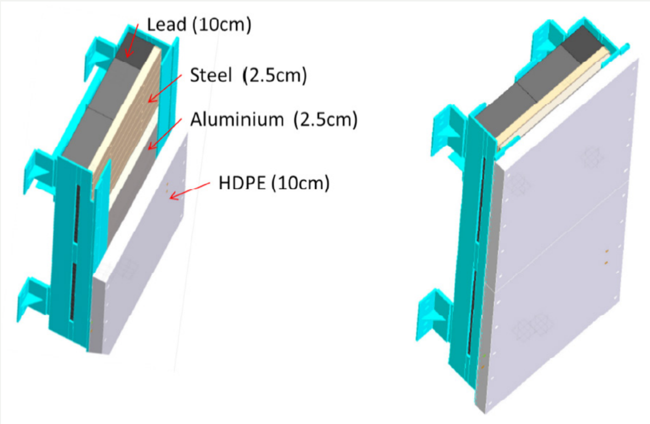
K. Poder, N. C. Lopes *(The John Adams Institute for Accelerator Science, Blackett Laboratory, Imperial College London, UK)*

The success of laser wakefield acceleration on Gemini has led to a steady increase in electron energies over recent years. Experiments are now routinely generating GeV electron beams with a high repetition rate (1 shot / 20 seconds) for many hours continuously. In order to resolve the highest energies of over 1 GeV, a strong magnetic field is required, which sweeps some of the electrons above the original lead shielding wall on the North side of TA3. These advances have necessitated a review of the radiological shielding in the bunker.

Here we report the calculations carried out to determine the required shielding enhancement, and how these enhancements have been carried out. First, we added extra layers to the main shielding wall in the forward beam path; second, we installed a permanent lead wall inside TA3, covering the area directly above the beam path. This shielding is sufficient for current experimental demands.



Engineering drawing of the frame that has been installed in Gemini TA3 to hold extra lead shielding vertically above the electron beamline.

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Optimisation of the *f*/2 Gemini focal spot using full beam adaptive optics

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A new optimisation method for the Gemini *f*/2 parabola has been adopted. The standard focal spot camera has been modified in order to both image the focus of the laser, and measure the wavefront quality with a HASO sensor (a commercial Shack-Hartmann sensor from Imagine Optic). These measurements are made simultaneously and in real-time, whilst adjusting a full-aperture adaptive optic in either closed- or open-loop correction mode. In addition, an ImageJ macro has been written that allows rapid, quantitative characterisation of the focal spot using a number of standard metrics. In a recent experiment using this optimisation scheme, a wavefront flatness of < $\lambda/20$ was achieved, with the corresponding focal spot containing > 58% energy in its $1/e^2$ radius of 1.6 µm.

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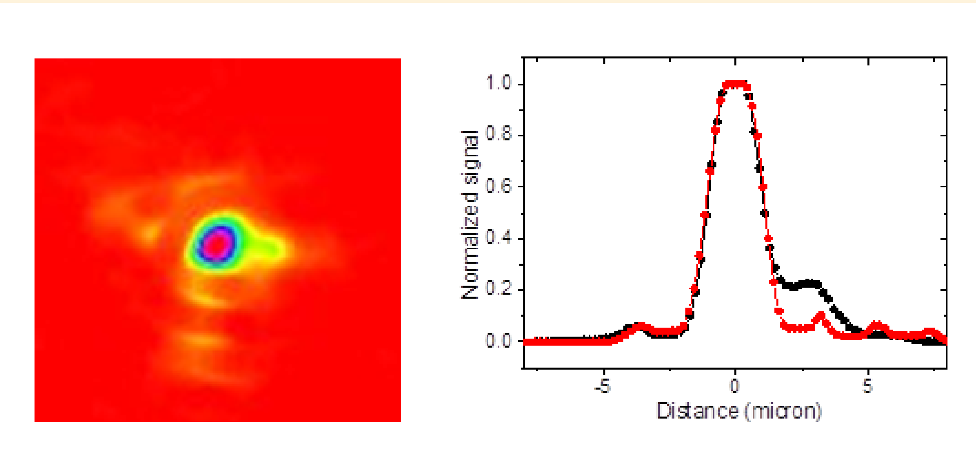

Focal spot of the pulsed beam using an adaptive optic and f/2 parabola.

An adaptive optic in the Astra laser

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An adaptive optic (AO) has been installed at the output of Amplifier 3 in the Astra laser, to control the wavefront before the beam is split to ATA2 and Gemini. The AO is a dielectric-coated, bimorph-type deformable mirror, coated on both sides to maintain an acceptable level of flatness. It has 31 actuators in a circular pattern, 19 of which are inside the area of the beam. The wavefront is measured in the beam transmitted through a good-quality turning mirror after the AO, using a HASO wavefront sensor from Imagine Optic in a plane conjugate to the AO. The dominant error in the beam is astigmatism due to the four oblique passes of the 800 nm beam through the Ti:sapphire crystal. The AO has been able to reduce the wavefront error from typically 0.6 wave to better than 0.06 wave P-V and 13 nm RMS.

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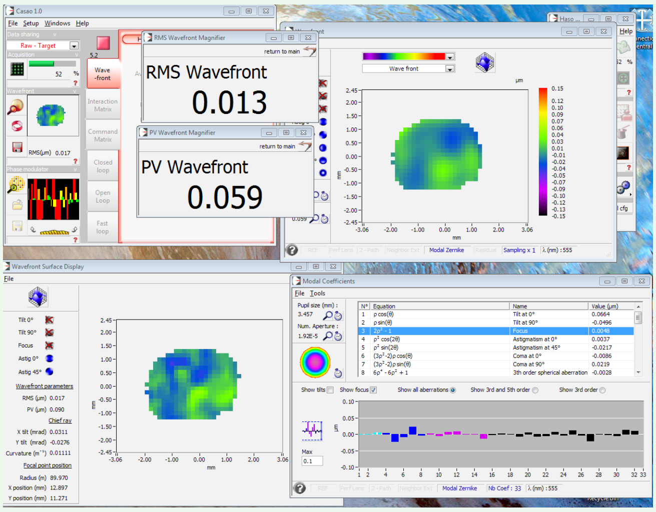

Screenshot from the AO control program, showing a well-corrected beam from Amplifier 3.

A transmission grating pulse stretcher for contrast enhancement of Gemini

Y. Tang, O. Chekhlov, S.J. Hawkes, C.J. Hooker, J.L. Collier, P.P. Rajeev *(CLF, STFC Rutherford Appleton Laboratory, Didcot, UK)*

Studies of contrast on the Gemini laser showed that a contrast feature around the main pulse (the pedestal) originates in the pulse stretcher. Use of transmission gratings in a test set-up reduced the pedestal by a factor of almost 100 compared to reflection gratings. We therefore built a new stretcher for the Gemini laser using two transmission gratings, and took advantage of the change to design better mountings for all the optics in the stretcher, to improve stability and ease of alignment.

The stretcher was commissioned in September 2014. For reasons we have not yet discovered, the expected improvement in contrast did not materialise, and we are planning further studies to understand this. However, the transmitted spectrum of the new stretcher is wider by around 8 nm, and this has led to compressed pulses as short as 35 fs for the first time on Gemini.

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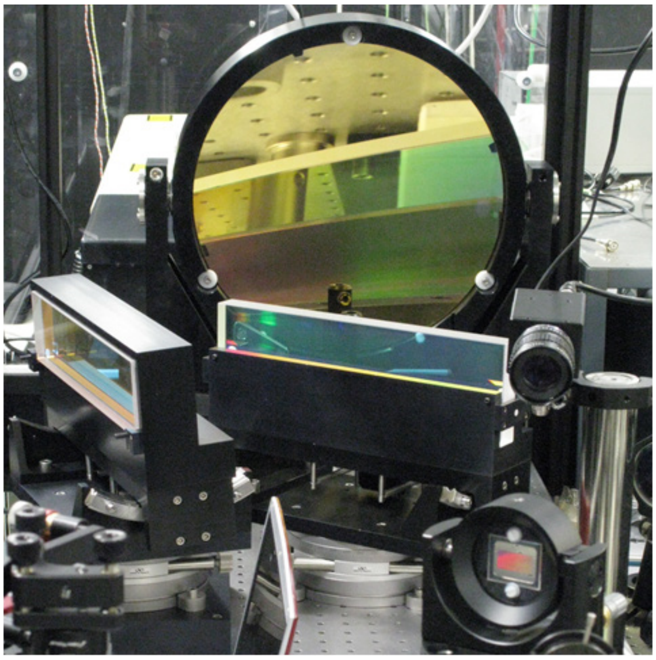

The new Gemini stretcher. The small first grating is in the foreground. Behind are the second grating and the spherical mirror, with the flat rear mirror on the left.

Facility development update: The Kerr-gated Raman/ ultrafast time-resolved fluorescence instrument

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The Kerr-gating beamline has been developed for 10 kHz repetition rate and implemented in the Ultra facility. The instrument provides efficient rejection of the emission background in Raman experiments, and offers a capability to carry out broad-band TRF experiments with ultrafast temporal resolution. The upgraded set-up demonstrates 40% gate opening efficiency and ~ 4 ps gate width when CS_2 is used as Kerr medium, and covers > 3000 cm^{-1} in one frame with ~ 15 cm^{-1} spectral resolution in the Raman experiments, with the dark noise of ~ 6 counts rms in 10 s acquisition.

The top figure shows the Kerr-gate schematic. The bottom figure demonstrates the power of the Kerr-gate, showing the spectrum of Fluorescein dye in ethanol with and without the gate. Without the gate (blue line), emission completely obscures the Raman signatures, but with the gate (red line), the Raman lines of the solvent are easily observed.

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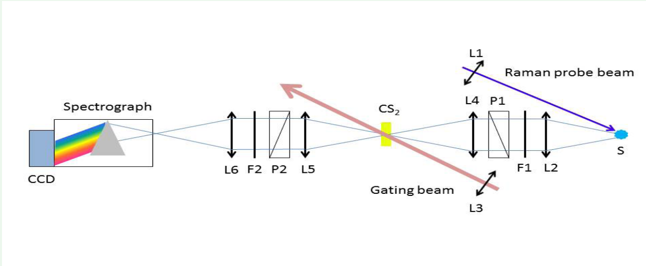

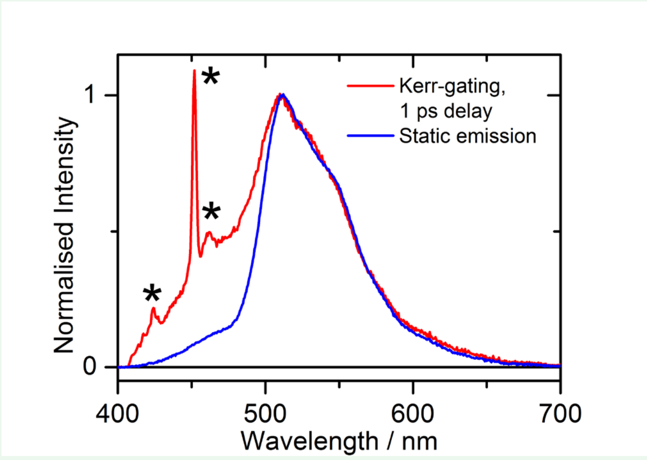

Top: Schematic diagram of the Kerr-gate, where: S is the sample; L1 – L6 are lenses; F1, F2 are cut-off filters; P1, P2 are polarisers; and CS_2 is the Kerr cell filled with carbon disulfide.
Bottom: Comparison of the Kerr-gated spectrum taken at 1 ps time delay (red line) from Fluorescein in ethanol, with the reconstructed steady-state spectrum from the same sample (blue line). Both spectra have been normalized to the peak intensity of fluorescence.

Time-resolved multiple-probing experiments on Ultra

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Early experiments on the new BBSRC- and STFC-funded Ultra-LIFEtime system are presented. The dual ytterbium-based amplifier laser's application to time-resolved multiple-probing experiments is described. These measurements show IR spectral changes from chemical and biological molecular dynamics over more than 10 orders of magnitude in time, from femtoseconds to seconds.

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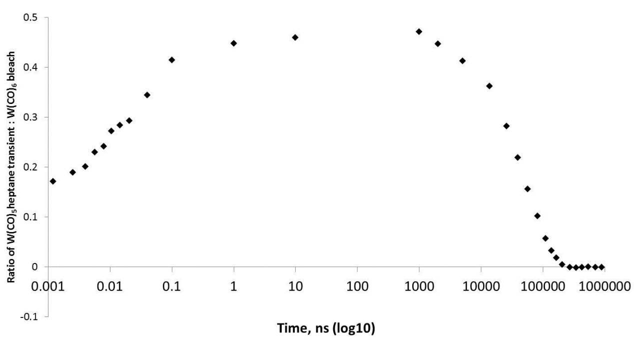

Orders of magnitude in time

Surface specific IR-Visible sum frequency generation on Ultra

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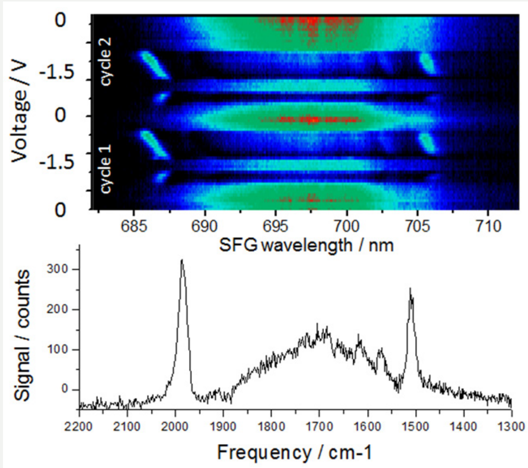
A.J. Cowan, G. Neri, J.J. Walsh *(Dept of Chemistry, University of Liverpool, UK)*

Infrared-Visible surface specific sum frequency generation (IR-Vis SFG) measurements were made available to users on Ultra for the first time. The method's unique advantage is that it gives vibrational spectra of molecules at interfaces with incredible sensitivity and selectivity. The broad infrared bandwidth, flexible femtosecond-picosecond synchronised amplifiers, and high repetition rate of ULTRA, were used to give a sensitive IR-Vis SFG platform.

The Cowan Group from the University of Liverpool applied IR-Vis SFG on Ultra to study electrochemical catalyst reactions at metal electrodes. In particular, the Group is interested in catalysts that enhance carbon dioxide reduction to carbon monoxide; a process with important industrial applications. By controlling the voltage applied to the electrodes, IR-Vis SFG was used to observe the arrival of the catalysts on the electrode surface and the subsequent chemical changes with applied voltage.



Voltage-cycled electrochemical interface IR-Vis SFG signal from a Mn(bpy)(CO)₃(Br) solution

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Performance of the rod amplifier chain for the 20 PW Component Test Lab

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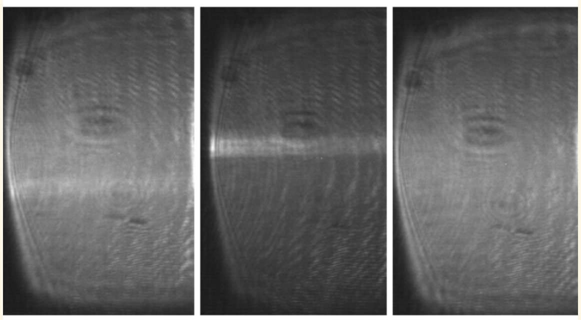
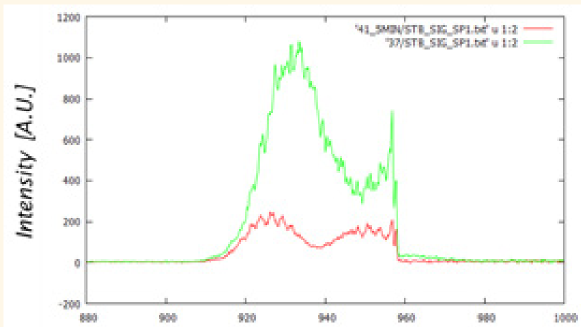
OPCPA-based laser systems are capable of producing high contrast, high peak power amplification whilst maintaining the large bandwidth required for short pulses of a few tens of femtoseconds. This makes the technology the ideal candidate for future multi-petawatt facilities, such as the proposed Vulcan 20 PW upgrade.

The 20 PW Component Test Lab (CTL) OPCPA pump laser was fired and 20 J of green, 527 nm, was achieved at 59% conversion efficiency. Initially this was used to find the phase matching angle of 80% deuterated DKDP (left-hand figure). OPCPA was then demonstrated using a seed beam, 40 nm bandwidth centred at 940 nm, in collinear alignment to achieve OPCPA. The seed beam was amplified from 40 mJ to 0.9 J and the full bandwidth was sustained (right-hand figure).





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Left: Three NF images showing the phase matching scan. The left-hand and middle images show a narrow stripe corresponding to 0.01 degree acceptance angle; the right-hand image shows the NF after precise tuning.
Right: Seed beam from 20 PW front end (red). Amplified seed using OPCPA in 80% DKDP (green).

Development of the laser diagnostics for Vulcan

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At the Vulcan facility, users are continually requesting improvements to the laser diagnostic systems. The main requests are to:

- implement a view tools to the users and operators of all the diagnostics data;
- improve reliability of the diagnostics;
- implement automatic data;
- concentrate all the important information on one screen;
- implement loop stabilization;
- provide after shot data analysis; and
- record more metadata related to the shot.

To address these issues, a new diagnostic architecture was required (left-hand figure) with an upgrade of the software. This architecture includes automatic alignment and loop stabilization, automatics saving and data analysis, centralized error reporting, and 'out of window' parameter checking. It also integrates the capability to catalogue the data using an ICAT system, and then to make it accessible via eCat, which enables the data to be displayed, searched and downloaded (right-hand figure).

The new system is currently under test and will be released next year.

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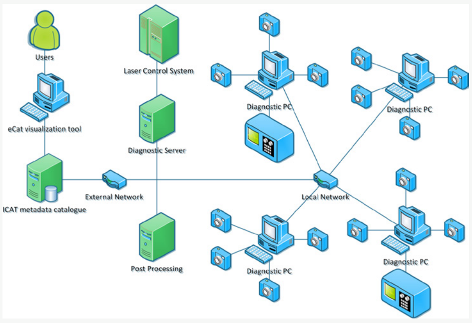
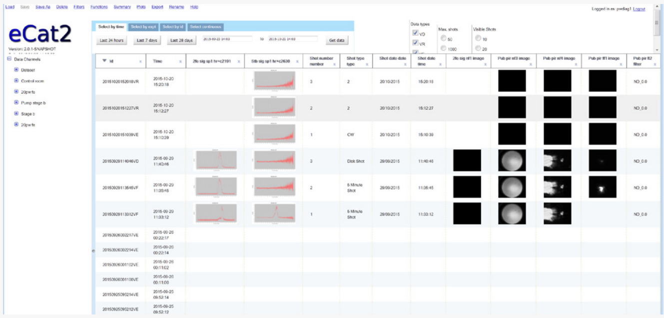


Diagnostic architecture



Screenshot of eCat web page

Development of GRENOUILLE analysis tools

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D. Giulietti *(Physics Department of the University and INFN, Pisa, Italy)*

The characterization of ultra-short high-power laser pulses has always been a challenge. One of the most promising techniques is GRENOUILLE, which is considerably more sensitive and extremely easy to set-up and align than previous techniques. Here we present the development of the analysis software for GRENOUILLE data.

This innovative analysis program is based on the acquisition of an experimental image, which will be cleaned up and calibrated before being used.

Starting from an arbitrary pulse, we create a simulated image and compare it to the experimental data. By using a minimisation algorithm to change the arbitrary pulse, we minimise the distance between the two images, obtaining the laser pulse shape.

The software has been tested on experimental images acquired in the Target Area Petawatt at the Vulcan Facility at STFC RAL (see figures).

The results have been compared to those for a standard single-shot autocorrelator, showing good agreement. The new software will be integrated into the diagnostic system at Vulcan.

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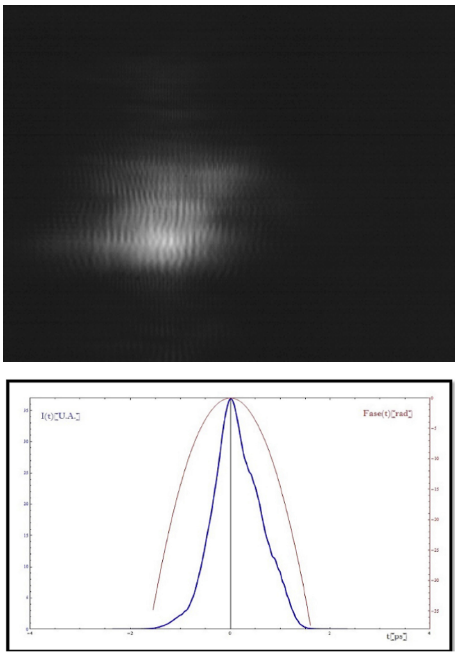

Top: GRENOUILLE image. Bottom: Reconstructed pulse

Image Plate scanner calibrations

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The FUJI Image Plate and associated scanning machine FLA5000 are regularly used at the Central Laser Facility to record and read data from high power laser interaction experiments. The image plates (IP) available (MS, SR, and TR types) are all sensitive in varying degrees to ionising radiation (for example, x-rays, electrons and protons) and are used to detect and record information, while the scanner is used to read and digitize it.

Investigations have taken place using an Fe55 source and test objects (pinhole arrays and a test grid) to verify the linearity of response, noise levels and resolution limits of the FLA5000 scanner in combination with MS, SR and TR-type IPs. The full report details the specific tests carried out and the results.

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Characterization of x-ray lens for use in probing high energy density states of matter

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H. W. Doyle *(First Light Fusion, Yarnton, UK)*
D. C. Carroll, C. Spindloe *(CLF, STFC Rutherford Appleton Laboratory, Didcot, UK)*
M. Calvert, D. Riley *(School of Mathematics and Physics, Queen's University Belfast, UK)*
I. J. Kim, C. H. Nam *(Centre for Relativistic Laser Science, Institute for Basic Science, Gwangju, Korea)*

We outline the use of an x-ray polycapillary lens to focus divergent laser-produced x-ray sources to high intensities, thus achieving an improvement in signal-to-noise ratio compared to conventional backlighter techniques.

In the experiment, line emission produced by driving a titanium backlighter target is focused by the lens and the output characterized. We find that our setup is equivalent to placing the backlighter target 3 mm from the sample with a 600 µm diameter pinhole.

The lens therefore enables the placement of the backlighter target at a much larger distance from the sample to be studied and, therefore, has the ability to greatly improve the signal-to-noise ratio on detectors in high energy density physics experiments. We demonstrate this with two simple diffraction experiments using pyrolytic graphite and polycrystalline aluminium.

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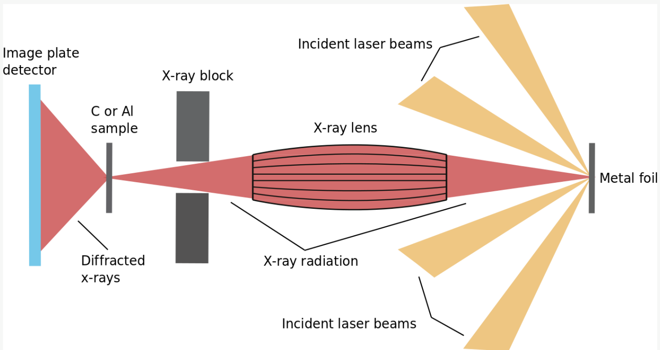

Top-down view of the experimental setup. The incident laser beams drive the He-α transition in the titanium foil on the right hand side of the diagram. The resulting line radiation is focused by the x-ray lens onto the target. The x-rays are diffracted according to Bragg's law and are detected by the image plate. The distance between the titanium target and the sample is 242.3 mm.

DARB: An automated system for diagnostic handling, analysis, review and backup of laser plasma experimental data

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R.J. Clarke *(CLF, STFC Rutherford Appleton Laboratory, Didcot, UK)*

Through a collaboration between the University of Strathclyde and the CLF, an automated system called DARB has been developed for storing, analyzing, visualizing and backing up data produced during laser-plasma experiments.
This current version is able to operate in a fully hands-off mode, enabling researchers to transfer effort from labour-intensive data registration to data analysis, ideally improving scientific outcomes for laser-plasma experiments. Close integration with the RAL based ECAT data system will be added in the future.

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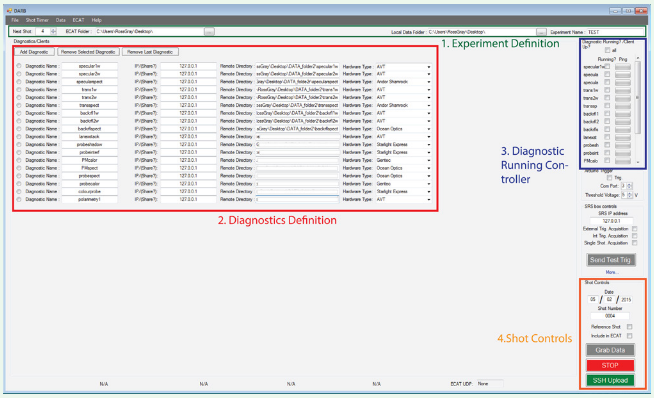

Graphical user interface for DARB software package:
(1) Definition of the experiment name and data folder
(2) Definition of diagnostic name, client IP address, and remote data directory
(3) Activation of diagnostic and ping of remote client
(4) Grab data command.

Validity of the analysis of radiochromic film using MATLAB Code

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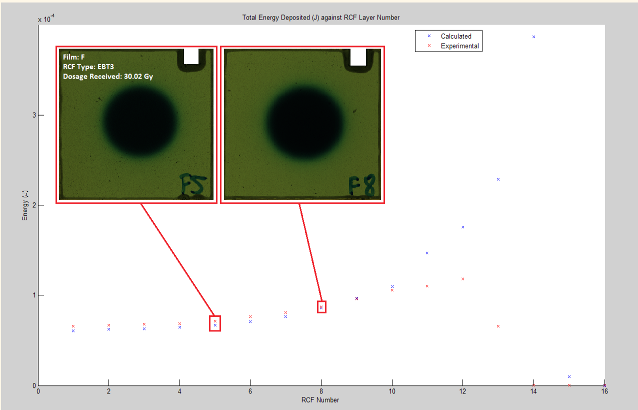
A series of MATLAB (MATrix Laboratory) code has been written, to create and use calibration files to extract data from radiochromic film (RCF) when used as a diagnostic in laser target interactions. Two types of RCF – HDV2 and EBT3 – were given known dosages of protons at the Birmingham cyclotron, and the data was extracted using the MATLAB code before being compared to data calculated by SRIM (Stopping Ranges in Ions and Matter) software to determine the validity of the code.

The code was tested against single proton energy stacks, as well as a range of proton energies provided by the use of a modulation wheel. The energy deposited, as calculated by the MATLAB code, fit the SRIM calculations more accurately for EBT3 than for HDV2. It was concluded that the test did not provide a fair assessment of the code's ability to generate proton spectra, as the calibration tests did not fit the assumptions made by the code.



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Total energy deposited in active layer (J) against RCF active layer number.
The red displays the experimental data output by the Matlab code, and the blue displays the calculated data output from SRIM software. Overlaid are two pieces of RCF used in the calibration tests, linked to their corresponding data points. Both pieces have been exposed to 30.02 Grays.

Comparison of Cameras: Dynamic Ranges and Sensitivities of optical CCDs.

P. Oliver, A. Horn, R.J. Clarke, D. R. Rusby, G. Scott, L. A. Wilson, D. Neely
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Cameras are used for collecting light and imaging in a wide range of diagnostics. This report details properties and characteristic features of a range of different cameras used in experiments, including charge coupled devices (CCD), electron multiplying charged coupled devices (EMCCD), and complementary metal–oxide–semiconductor (CMOS). The dynamic range and linearity of the cameras are compared, and the different components of noise and their levels for each camera are studied.

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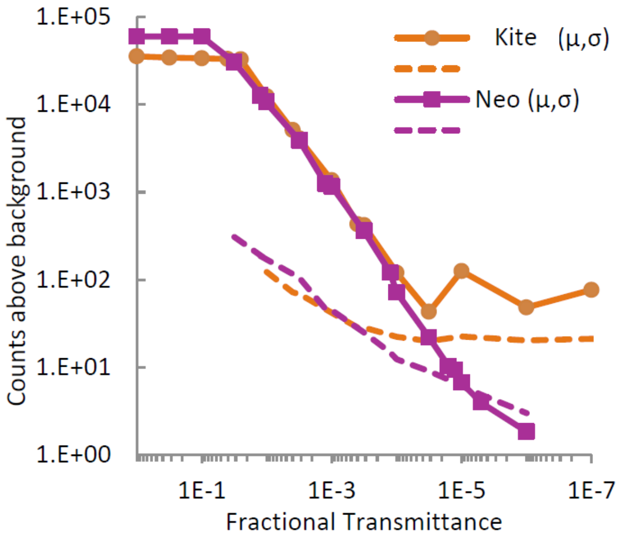

Linearity curve for Raptor kite EMCCD and Andor Neo CMOS cameras.

Camera operational characterisation: Stingray F-033 and Imaging Source USB DFK 23U274

I. Arteaga, L. A. Wilson, R. J. Clarke, G. Scott, P. Oliver, D. Neely
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Two CCD cameras were characterised to test linear response, dynamic range and background counts. The cameras studied were a monochrome Stingray F-033 and a colour Imaging Source (IS) DFK 23U274.

Uniform green light was shone onto the CCDs, and the fractional transmittance was varied by placing different ND filters in front of the chip. Several pictures were taken for each optical density, and mean counts and standard deviation were recorded for each picture.

It was found that the Stingray had a better linear response to incident light as well as larger dynamic range.

The IS camera was found to have a large increase in background counts due to warming of the camera over use, generating random counts within the CCD chip.

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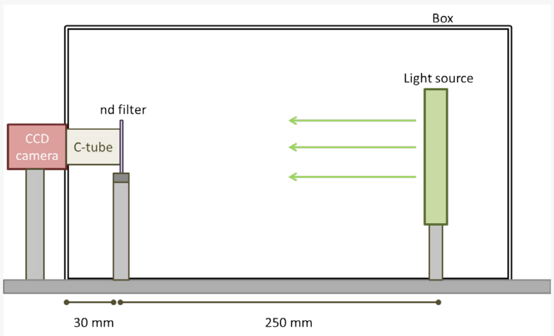

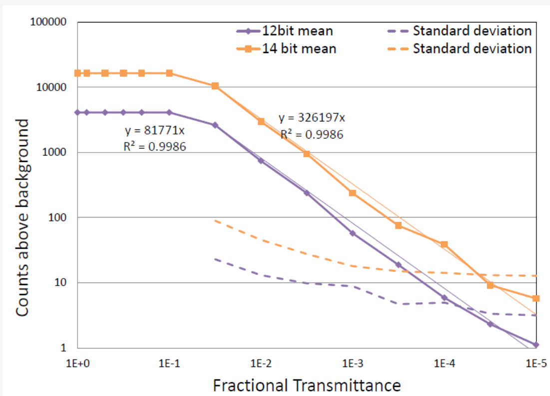

Top: Diagram of the experimental set up.
Bottom: Linearity plot of mean counts and standard deviation vs fractional transmittance of Stingray F-033 at 12 bit and 14 bit

Tip Enhanced Raman Spectroscopy for high power laser target applications

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The Target Fabrication Group at the Central Laser Facility, in collaboration with Professor Tony Parker, has developed Tip Enhanced Raman Spectroscopy (TERS). TERS is a new characterisation technique that combines the molecular bonding information provided by Raman Spectroscopy with the high spatial resolution offered by Atomic Force Microscopy (AFM). Combining the two techniques allows users to gain information on the chemical bonding nature of a material on the scale of tens of nanometers.

When laser light is incident on a gold-coated AFM tip, there is a large enhancement of the signal from the molecules touching the tip. This signal can be detected by the Raman Spectrometer, providing chemical bonding information for a very small area, just a few tens of nanometers in size. This TERS technique is being developed to provide advanced characterisation information to support the Target Fabrication Group's production of Diamond-Like Carbon and similar materials.

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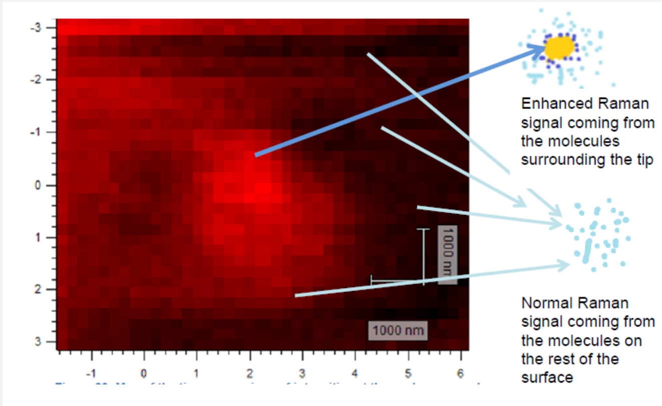
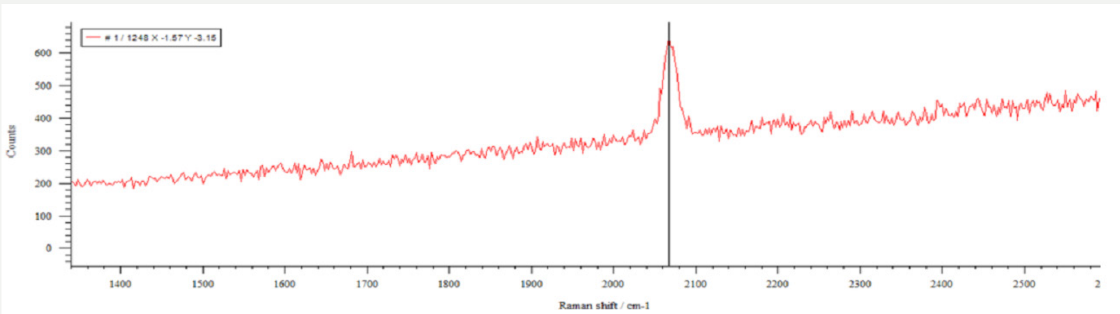


Above: Each pixel represents the intensity of the Raman Spectroscopy signal at the point shown in the spectrum below. Below: The map is the area around a gold coated AFM tip in contact with HCM Rotaxane. The centre of the image clearly shows enhancement of the Raman signal in close proximity to the tip.



Delivery of targets to the 2015 Orion academic access campaign

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E. Tubman, N. Woolsey *(York Plasma Institute, University of York, UK)*

This paper describes the range of targets that have been produced by the Target Fabrication Group in the CLF, for the academic access experiments on the Orion laser facility at AWE during 2015.

The experiments were carried out by academic groups from the University of York and Imperial College London, with different target designs required for each campaign. During the reporting period, a large number of high specification targets and backlighters have been delivered, and a number of new technologies have been developed to support the programme. This paper reviews the assembly processes, thin film requirements and micro-machining processes needed to produce the targets. Also discussed is the implementation of a gas fill system to produce targets that have an internal fill of gas from 0.3 bar to 1 bar, and the challenges that are posed by such a targets.

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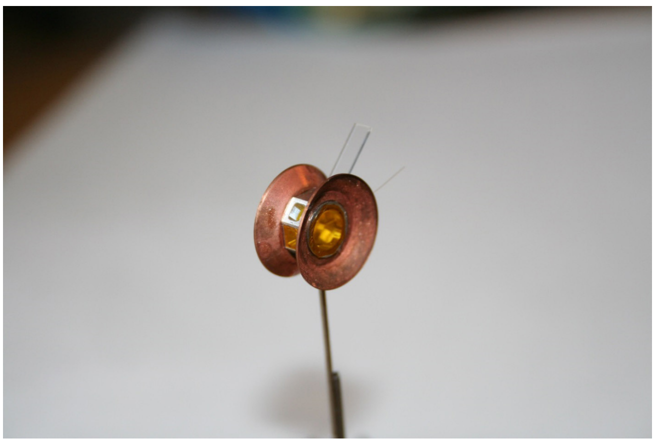

The gas filled target for the Imperial College London experiment in 2015.

Recent developments in the manufacture of cryogenic deuterium target

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Targets made of cryogenic deuterium/hydrogen ice films are currently of significant interest for high power laser experiments. The CLF has been researching and developing a target system to produce thin films of hydrogen and deuterium ice to deliver such targets.

This paper describes developments in the cryogenic target system design including radiation shielding, coldhead and growth chamber redesigns. Operating methodology issues are also discussed. Refinements of the system resulted in the ability to grow deuterium ice films of the order of several hundred microns thick, with survivability in excess of 14 hours.

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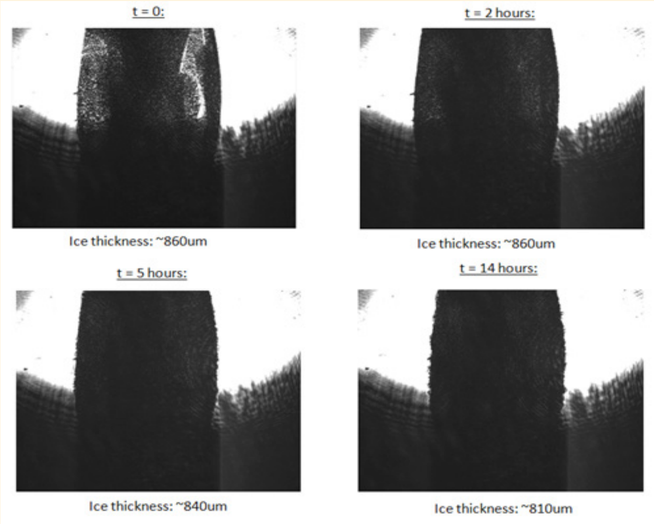

Time-lapse sequence of deuterium ice over 14 hours

The problem with silicon

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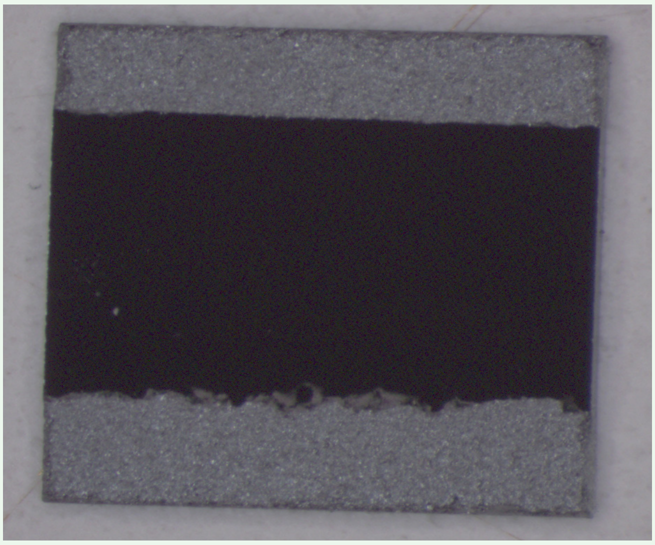
Precise alignment of laser targets, to within Rayleigh range of experiment focusing optics, can usually be achieved by retro imaging[1]. This involves collecting light that scatters off a target from an alignment beam, re-imaging it, and setting the image to be at its smallest size when the target is at the focus of the alignment beam. This has become the standard way to make sure that targets are at focus on experiments using the Vulcan High Power Laser Facility, and is relied upon to guarantee the highest intensity is present on the target. The precision needs to be within the Rayleigh range (30 μm) for the F#3 focusing optics that are used.

Silicon targets are now regularly used in plasma interactions for their lattice structure and resistivity properties[2]. Silicon, however, presents alignment procedure issues with retro-imaging, due to highly polished, flat surfaces and high transmission to the laser light employed (1053 nm) at alignment beam intensities (mW). This polished surface means that silicon targets do not diffusely reflect, giving a very low scatter signal, and rendering retro imaging very difficult to achieve.

This report presents a method and results to mitigate these issues.

References

[1] D. Carroll CLF annual report 2011-2012, 'An imaging system for accurate target positioning for fast focusing geometries'
[2] D.McLellan et al PRL 113 185001 (2014)



Silicon target after solution applied.

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A dedicated target fabrication laboratory for low density materials, polymers and novel materials

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This paper describes the capabilities of the recently opened, fully-refurbished chemistry laboratory in the Central Laser Facility within the Target Fabrication Group. The laboratory is dedicated to the production of low density materials, polymer thin films and other novel chemistry-based target components, including electroplating, to deliver to the high power laser programs that are run by STFC.

For a number of years, there has been an increasing demand for low density materials as target components, with foams being the most requested type. A dedicated laboratory for the production of such targets will enable target quality to be increased, and also allow the development of new and more complex materials. This article presents the current capabilities of the laboratory, together with the initial results of the production and characterisation of low density polymeric foams and thin polymer films.

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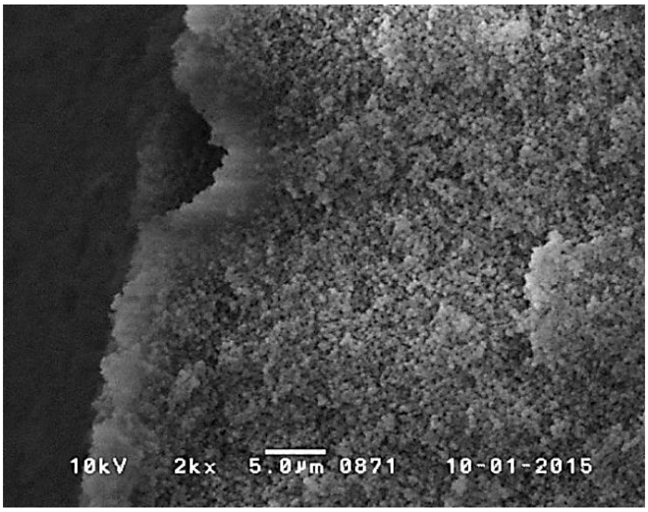

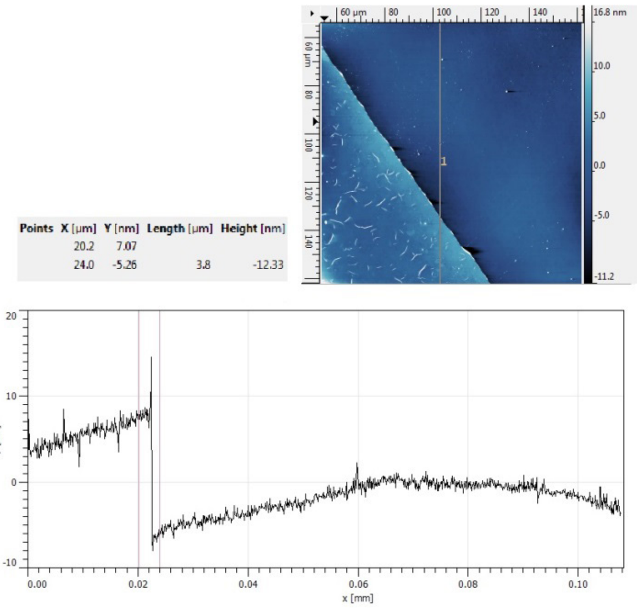

Top: 100mg/cc foam, Au coated, x2000 mag. Image used to characterise pore size used.
Bottom: An AFM scan of a 12 nm thick Formvar film mounted on a silicon wafer.