Artemis Operational Statistics

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During the reporting year April 2009 - April 2010 a total of 5 experiments were delivered in the Artemis facility, which is under development, as shown in Table 1. At the user request the experiments were scheduled in recurring short, ~2 week slots. In total 21 experimental weeks were delivered to users excluding set-up weeks. 18 development weeks were allocated for the Artemis project. 3 weeks were allocated for the installation and commissioning of new equipment. 4 weeks were allocated to laser-services. Artemis facility overall availability was 142% when including the out of normal hours operations. Laser reliability was 88%.

Table 1. Artemis schedule 2009/10

Artemis	2009-2010	
	30-Mar-09	05-Apr-09
Marangos HHG with 2-colour laser Rapid Access	06-Apr-09	12-Apr-09
	13-Apr-09	19-Apr-09
	20-Apr-09	26-Apr-09
Artemis engineering XUV beamline	27-Apr-09	03-May-09
	04-May-09	10-May-09
	11-May-09	17-May-09
	18-May-09	24-May-09
	25-May-09	31-May-09
	01-Jun-09	07-Jun-09
	08-Jun-09	14-Jun-09
	15-Jun-09	21-Jun-09
	22-Jun-09	28-Jun-09
	29-Jun-09	05-Jul-09
Set-up week	06-Jul-09	12-Jul-09
Poletto - 90000 XUV beamline commissioning	13-Jul-09	19-Jul-09
	20-Jul-09	26-Jul-09
Mat Sci acceptance tests	27-Jul-09	02-Aug-09
Poletto - 90000 XUV beamline commissioning	03-Aug-09	09-Aug-09
	10-Aug-09	16-Aug-09
PI laser Service	17-Aug-09	23-Aug-09
Artemis engineering	24-Aug-09	30-Aug-09
	31-Aug-09	06-Sep-09
	07-Sep-09	13-Sep-09
Cavalleri – 90001 Material Science end station commissioning	14-Sep-09	20-Sep-09
	21-Sep-09	27-Sep-09
Artemis engineering	28-Sep-09	04-Oct-09
Red Dragon Laser Service	05-Oct-09	11-Oct-09
Artemis engineering	12-Oct-09	18-Oct-09
Cavalleri – 90001 Material Science end station commissioning	19-Oct-09	25-Oct-09
	26-Oct-09	01-Nov-09
Artemis engineering	02-Nov-09	08-Nov-09
	09-Nov-09	15-Nov-09
TOPAS laser installation: UV/Vis	16-Nov-09	22-Nov-09
Set-up week	23-Nov-09	29-Nov-09
Underwood 81003 Ultrafast dynamics of molecules	30-Nov-09	06-Dec-09
Red Dragon laser repair	07-Dec-09	13-Dec-09
	14-Dec-09	20-Dec-09
	21-Dec-09	27-Dec-09
Christmas and New Year	28-Dec-09	03-Jan-10
Red Dragon laser repair	04-Jan-10	10-Jan-10
	11-Jan-10	17-Jan-10
Red Dragon laser service	18-Jan-10	24-Jan-10
Artemis engineering	25-Jan-10	31-Jan-10
Cavalleri – 90001 Mat Science end station commissioning	01-Feb-10	07-Feb-10
Topas laser service	08-Feb-10	14-Feb-10
Petersen - 92000 EU Ultrafast dynamics in complex materials	15-Feb-10	21-Feb-10
Underwood 81003 Ultrafast dynamics of molecules	22-Feb-10	28-Feb-10
	01-Mar-10	07-Mar-10
	08-Mar-10	14-Mar-10
Petersen - 92000 EU Ultrafast dynamics in complex materials	15-Mar-10	21-Mar-10
	22-Mar-10	28-Mar-10
Hollow-fibre installation	29-Mar-10	04-Apr-10
Artemis engineering – vacuum system	05-Apr-10	11-Apr-10
Underwood 81003 Ultrafast dynamics of molecules	12-Apr-10	18-Apr-10

Table 2 and Figure 1 are an experiment by experiment break down of the Artemis facility performance for the reporting year and show a very good availability and reliability. The Artemis laser-beams were used for many long hours every day – while observing the standing orders for late-night working. 5 weeks around the end of 2009 were necessary for repairing the Red Dragon laser after one of the cryostats developed a vacuum leak: these weeks were also used for Artemis engineering in parallel to repairing the laser. This experimental time (Underwood experiment) was rescheduled in the New Year 2010 as shown in Table 1. The last week of this experiment was scheduled in April at the request of the user.

	Availability in normal hours (%)	Overall Availability (%)	Reliability (%)
Marangos	78	133	86
Poletto	81	142	88
Cavalleri	81	126	87
Underwood	75	141	85
Petersen	84	169	92

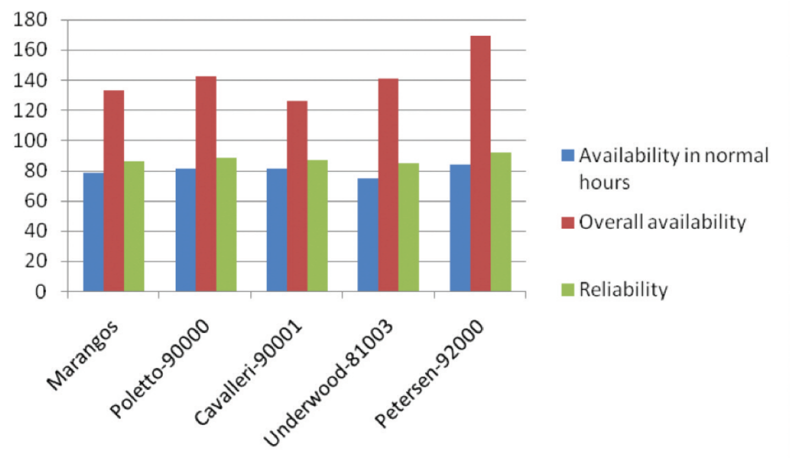

Figure 1. Artemis availability and reliability in 2009-10

Artemis proved very flexible in providing many combinations of fs pump-probe beamlines: Red Dragon, Topas (1300nm and UV), XUV beamlines (broadband and monochromatic), into end-stations: Materials Science end two visiting end-stations.

Astra Operational Statistics

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During the reporting year April 09 – April 10 a total of 3 complete experiments were delivered to the Astra-Gemini Target Area. In total 23 high power laser experimental weeks were delivered the Gemini target. The delivered schedule is presented below in figure 1.

The availability of the Gemini laser system (delivery to the Gemini Target Area) was 63% during normal working hours, rising to 104% with time made up from running out of normal working hours. The reliability of the Gemini laser was 73%. (represented in figure 3).

		Gemini
06-Apr-09	12-Apr-09	M Borghesi (LIBRA) 81025
13-Apr-09	19-Apr-09	
20-Apr-09	26-Apr-09	
27-Apr-09	03-May-09	
04-May-09	10-May-09	
11-May-09	17-May-09	
18-May-09	24-May-09	
25-May-09	31-May-09	
01-Jun-09	07-Jun-09	
08-Jun-09	14-Jun-09	
15-Jun-09	21-Jun-09	Contrast enhancement
22-Jun-09	28-Jun-09	
29-Jun-09	05-Jul-09	
06-Jul-09	12-Jul-09	
13-Jul-09	19-Jul-09	
20-Jul-09	26-Jul-09	Macholite replacement and Amp 3 re-build
27-Jul-09	02-Aug-09	
03-Aug-09	09-Aug-09	
10-Aug-09	16-Aug-09	Construaction works
17-Aug-09	23-Aug-09	Macholite replacement and Amp 3 re-build
24-Aug-09	30-Aug-09	
31-Aug-09	06-Sep-09	
07-Sep-09	13-Sep-09	
14-Sep-09	20-Sep-09	
21-Sep-09	27-Sep-09	Set up
28-Sep-09	04-Oct-09	
05-Oct-09	11-Oct-09	M Zepf 91009
12-Oct-09	18-Oct-09	
19-Oct-09	25-Oct-09	
26-Oct-09	01-Nov-09	
02-Nov-09	08-Nov-09	
09-Nov-09	15-Nov-09	Jade 2 installation and contrast enhancement
16-Nov-09	22-Nov-09	
23-Nov-09	29-Nov-09	
30-Nov-09	06-Dec-09	
07-Dec-09	13-Dec-09	
14-Dec-09	20-Dec-09	Coseners meeting
21-Dec-09	27-Dec-09	Christmas
28-Dec-09	03-Jan-10	
04-Jan-10	10-Jan-10	Set up
11-Jan-10	17-Jan-10	
18-Jan-10	24-Jan-10	D Jarozynski 91032
25-Jan-10	31-Jan-10	
01-Feb-10	07-Feb-10	
08-Feb-10	14-Feb-10	
15-Feb-10	21-Feb-10	
22-Feb-10	28-Feb-10	Contrast investigation and improvement
01-Mar-10	07-Mar-10	
08-Mar-10	14-Mar-10	
15-Mar-10	21-Mar-10	
22-Mar-10	28-Mar-10	Dual beam commisioning
29-Mar-10	04-Apr-10	

Figure 1. Experiment by experiment breakdown of statistics

Following the Zepf experiment a number of changes were made to the Gemini operational model. Firstly the role of the designated Astra and Gemini operators were changed. The Astra operator now starts the Astra system up early, at 08:00 and brings up the Astra optical chain. The Gemini operator, as previously, brings up the Gemini systems, both operators then bring up full system shots. The Gemini operator now takes over sole responsibility for the system. The Gemini operator also maintains a presence at all times possible in the Gemini control room, such that there is a single local point of contact during the day. The presence of an operator at all time in control room means that system problems can be actively maintained and adjusted during the day rather than in a reactionary way to failures. There has also been an introduction of late operations cover 3 nights of the week, this allows the system to be maintained after 17:00 (a time identified when laser issues are more likely to occur) and into the early evening (as represented in figure 2 below). In order to improve communications the Astra operator for the following day meets briefly with the users at ~16:30 to discuss requirement for the next day.

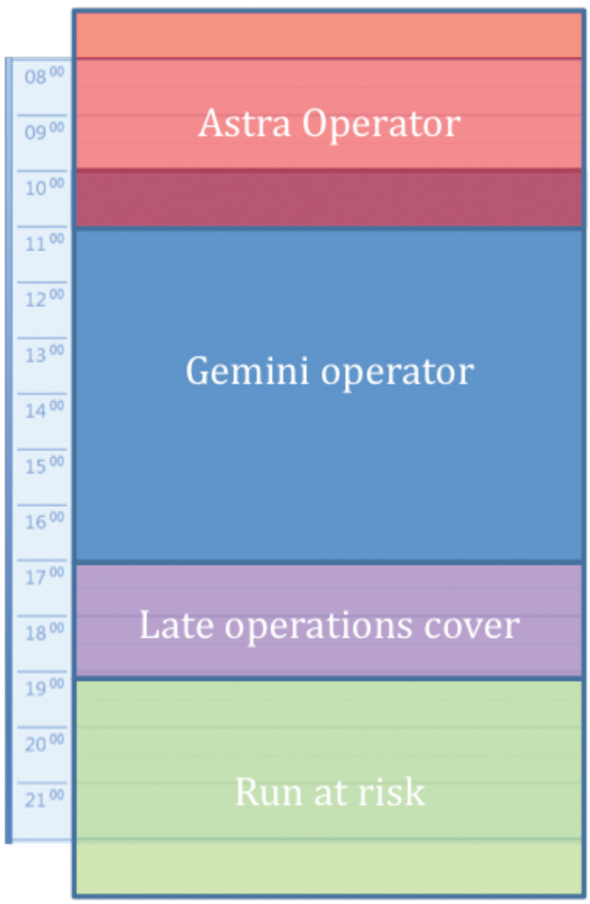

Figure 2. Revised Gemini operational model

During the reporting year a number of changes were made to the Astra systems in order to improve the system reliability. The major project during the year was to replace the macholite pump laser for the third Astra amplifier with 4 new Quanta Ray lasers. This project also involved a complete re-build of the amplifier. Previously the third amplifier straddled 2 optical tables, resulting in beam alignment stability issues. Additional optical tables were installed to accommodate the new pump lasers so the additional space created by the Macholite removal allowed the amplifier to be rebuilt on a single optical table. The beam expansion pipes for Gemini and ATA2 were lowered to bench height to improve access for optical alignment and to remove the need for periscopes, improving safety aspects of the amplifier.

The JADE pump laser for the KHz front was replaced with a more reliable JADE2. At the same time the Femtopower front end was reconfigured to give improved ASE contrast. A large number of aging optical components in the Astra chain were replaced with new optics with improved V-coatings. This removed a number of discreet picoseconds pre-pulses.

The Verdi pump laser for the Gemini oscillator was replaced with a new Verdi system; the replaced system had run for ~9000 hours without failure.

A number of periods of contrast characterization and improvement work were undertaken during the reporting year, the results of which are describe elsewhere in the annual report.

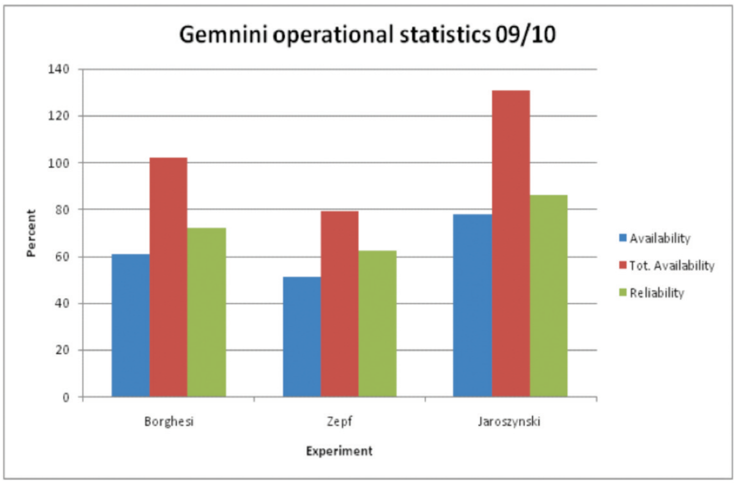

Figure 3. Experiment by experiment breakdown of statistics

Lasers for Science Facility Operational Statistics

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RAL-based experiments

The reorganisation of the LSF has been completed with scheduling lines organised across the Functional Biological Imaging (FBI) and the Molecular Structural Dynamics (MSD). In response to requirements of the LSF to support cross Harwell Campus activity a line of resource has been put in place to reflect this and one can be confident that this section of the LSF will grow in the coming years as the LSF joins the Research Complex at Harwell. Both the MSD and FBI have made major new additions to their operational strengths. MSD turned on the BBSRC/STFC funded ULTRA laser system seeing its first User activity in July 2009, and following relocation of the single-molecule imaging capability from Daresbury to support the FBI biological applications of the LSF a new set of Users was welcomed in July. The year has also seen an enormous level of activity with the division moving the suite of LSF laser systems into the Research Complex, the operation will be completed in Sepetember 2010. In the reporting period (April 2009 to March 2010), 21 different User groups performed a total of 23 experiments in the LSF laboratories at RAL. A total of 3110 hours laser time was delivered to the UK User community and European Users throughout the year, with only 46 hours downtime. The majority subject group scheduled was biological related science, see figure 1. A full breakdown by subject number of weeks applications versus weeks scheduled is shown in figure 2 showing a 2 - 3 times level of oversubscription. The RAL-Based schedule is shown in table 1. The average User satisfaction marks obtained from the scheduled Users are shown in figure 3. There were a total of 20 formal reviewed publications produced from the years efforts, with the LSF programme supporting 4 students working towards a PhD in the reporting year.

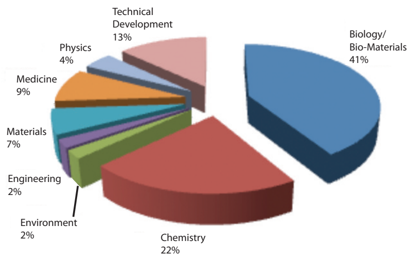

Figure 1. RAL-based bids by subject group

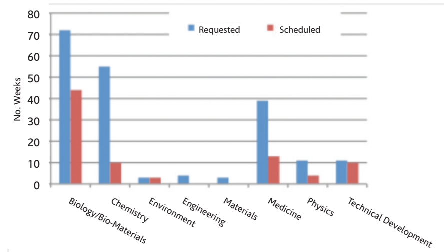

Figure 2. RAL-based experiments by subject

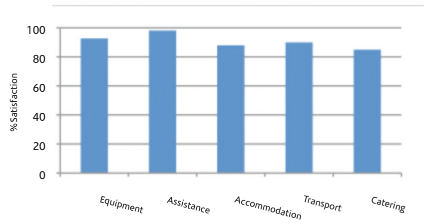

Figure 3. RAL-based average User satisfaction scores

Loan Pool

In March 2009 the new EPSRC Loan Pool grant commenced, this is for £2.6m over 5 years and will see the replacement of many of the laser systems within the facility. This year saw the introduction of a Steering Committe to the Loan Pool which will meet annually to provide advice on direction and purchases for the facility. Following the first meeting a number of purchases are in progress many of which will enable the facility to target a broader community. The delivery of the first system a quasi-cw supercontinuum source is expected in summer 2010. Further details on the developments can be found in the article "Developments within the EPSRC Laser Loan Pool".
The Loan Pool delivered 324 weeks of laser time in the reporting period with a ratio of weeks applied for to weeks scheduled of 1.33:1. Downtime was 32 weeks which is unusually high; the vast majority of this was for a fault with the UFL2 system which required two factory repairs before the fault was rectified, losing an entire loan period. The year's activity saw 4 new research groups use the Loan Pool. The chemistry community was once again the biggest User with 33% of allocated time. The breakdown is shown in figure 4. The Loan Pool schedule is shown in table 2. There were a total of 8 publications.

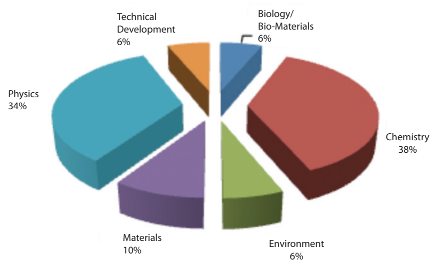

Figure 4. Loan Pool bids by subject group

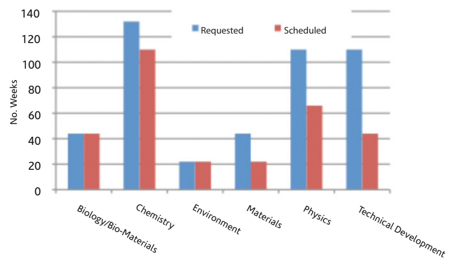

Figure 5. Loan Pool experiments by subject

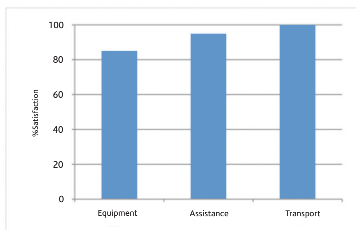

Figure 6. Loan Pool average User satisfaction scores

Table 1. Lasers for Science Facility RAL-based Schedule 2009/10

	Date	Functional Biosystems Imaging	Molecular Structural Dynamics	Cross Department Research
2009	6 Apr			
	13 Apr			
	20 Apr			
	27 Apr			
	4 May			
	11 May			
	18 May		**ULTRA SETUP AND DEVELOPMENT**	
	25 May	**RELOCATION OF ASMID TO RAL**		
	1 Jun			
	8 Jun			
	15 Jun			
	22 Jun			
	29 Jun			
	06 Jul		**M SEARLE** (University of Nottingham) **DNA Hairpin Folding by 2DIR** **91033** Proof of concept proposal for ULTRA	
	13 Jul		**N SCRUTTON** (University of Manchester) **Dynamics of Light Activated Enzyme POR** **91033** Proof of concept proposal for ULTRA	*Currel/Botchway DLS-MT106*
	20 Jul			
	27 Jul	**M MARTIN-FERNANDEZ** (STFC) **91,011** Supra-molecular rules in signalling networks	**M SEARLE** (University of Nottingham) **DNA Hairpin Folding by 2DIR** **91033** Proof of concept proposal for ULTRA	
	03 Aug		**M GEORGE** (University of Nottingham) **Infrared Coherent Control** **91033** Proof of concept proposal for ULTRA	
	10 Aug	**A W PARKER** (STFC) **91,032** Studies to unravel the specific protein signalling pathways	**SETUP AND MAINTENANCE**	**A D WARD** (STFC) **91,038** X-ray diffraction studies from microcrystals
	17 Aug		**C JOHNSON** (MRC-LMB Cambridge) **Protein Folding of BBL** **91033** Proof of concept proposal for ULTRA	
	24 Aug	**M MARTIN-FERNANDEZ** (STFC) **91,011**		
	31 Aug		**M GEORGE** (University of Nottingham) **Non-statistical Dynamics** **91033** Proof of concept proposal for ULTRA	**A D WARD** (STFC) **91,034** Target delivery using optical levitation
	07 Sept	**A W PARKER** (STFC) **91,032**	**A J ORR-EWING** (University of Bristol) **91,004** Dynamics of chemical and photochemical reactions in solution	
	14 Sept			
	21 Sept	**M MARTIN-FERNANDEZ** (STFC) **91,011**	**A W PARKER** (STFC) **91,031** Investigating the role of secondary and tertiary structure on DNA photostabilty	

	28 Sept	**C HAWES** (Oxford Brookes University) **91,014** The plant secretoryome	**A W PARKER** (STFC) **91,031** Investigating the role of secondary and tertiary structure on DNA photostabilty	
	05 Oct			
	12 Oct	**M MARTIN-FERNANDEZ** (STFC) **91,011**		
	19 Oct	**A JESHTADI** (Oxford Brookes University) **91,025** Autographa californica multinucleopolyhedrovirus Capsid protein	**MAINTENANCE**	
	26 Oct	**A W PARKER** (STFC) **91,032**	**M TOWRIE** (STFC) **91,022** A novel hybrid Raman-IR technique	
	02 Nov			**J C HILLER** (DLS) **91,015** A ground-breaking dual beam laser trap for X-ray experimental facilities
	09 Nov	**J R DILWORTH** (Oxford University) **91,009** Evaluating the intracellular stability of complexes of metallic radionuclides		
	16 Nov	**M MARTIN-FERNANDEZ** (STFC) **91,011**		
	23 Nov		**MAINTENANCE**	**A D WARD** (STFC) **91,034**
	30 Nov	**P O'NEILL** (Oxford University) **91,035** Dynamics of genomic DNA damage repair proteins	**S R MEECH** (University of East Anglia) **91,005** Protein photosensors: The blue light using Flavin domain	
	07 Dec	**MAINTENANCE**		
	14 Dec	**M MARTIN-FERNANDEZ** (STFC) **91,011**!		
	21 Dec	**CHRISTMAS AND NEW YEAR**		
	28 Dec			
2010	4 Jan	**MAINTENANCE**	**MAINTENANCE**	**A D WARD** (STFC) **91,034**
	11 Jan		**P PORTIUS** (University of Sheffield) **91,036** Real-time structural dynamics of molecular systems for energy generation and storage	
	18 Jan	**J R DILWORTH** (Oxford University) **91,009**		
	25 Jan	**A JESHTADI** (Oxford Brookes University) **91,025**	**N T HUNT** (University of Strathclyde) **91,003** Dynamics and reactivity of the FeFe[Hydrogenase] enzyme system	*Currel/Botchway DLS-EE106*
	01 Feb	**J R DILWORTH** (Oxford University) **91,009**		
	08 Feb	**C HAWES** (Oxford Brookes University) **91,014**		
	15 Feb	**A JESHTADI** (Oxford Brookes University) **91,025**		
	22 Feb	**M MARTIN-FERNANDEZ** (STFC) **91,011**	**J M KELLY** (University of Dublin) **92,005**	
	01 Mar	**P O'NEILL** (Oxford University) **91,035**	**M T PRYCE** (Dublin City University) **92,004**	
	08 Mar	**MAINTENANCE**		
	15 Mar	**S J QUINN** (University College Dublin) **101,002** **I CASIMIRO** (Universidad de Extremadura) **101,000**	**P PORTIUS** (University of Sheffield) **91,036**	
	22 Mar	**P O'NEILL** (Oxford University) **91,035**		
	29 Mar	**S J QUINN** (University College Dublin) **101,002**	**MAINTENANCE**	

Table 2. Lasers for Science Facility Loan Pool Schedule 2009/10

<table>
<tr><th></th><th>Date</th><th>NSL1</th><th>NSL2</th><th>NSL3</th><th>NSL4</th><th>NSL5</th><th>UFL1</th><th>UFL2</th><th>CWL1</th></tr>
<tr><td rowspan="39">2009</td><td>Apr 6</td><td rowspan="41">HIPPLER
(Sheffield)
High-resolution stimulated Raman spectroscopy with photo-acoustic detection (PARS)
82,008</td><td rowspan="13">SIMONS
(Oxford)
Carbohydrate molecular recognition: Probing CH-pi interactions
82,007</td><td rowspan="17">RUDDOCK
(Strathclyde)
Nonlinear spectroscopy of doped glass and crystal for applications in distributed fibre sensing
82,005</td><td rowspan="11">SNOEK
(Oxford)
Studying the influence of metal cation binding on zinc finger moldel peptide folding behaviour
82,004</td><td rowspan="45">CARTY
(Durham)
A radical beam source for an experiment to magnetically trap cold NH(X) at high densities
82,000</td><td rowspan="17">JONES
(Edinburgh)
2-photon excitation microscopy and confocal FLIM
81,011</td><td rowspan="12">BENNINGTON
(STFC)
Using tip enhanced femtosecond lasers to create graphite nano-structures on diamond
82,010</td><td rowspan="13">DUTTON
(STFC)
Surface Raman spectroscopy of photo-catalytic hydrogen production processes
82,001</td></tr>
<tr><td>Apr 13</td></tr>
<tr><td>Apr 20</td></tr>
<tr><td>Apr 27</td></tr>
<tr><td>May 4</td></tr>
<tr><td>May 11</td></tr>
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<tr><td>May 25</td></tr>
<tr><td>Jun 01</td></tr>
<tr><td>Jun 08</td></tr>
<tr><td>Jun 15</td></tr>
<tr><td>Jun 22</td><td rowspan="2"></td></tr>
<tr><td>Jun 29</td><td rowspan="2"></td></tr>
<tr><td>Jul 06</td><td rowspan="2"></td><td rowspan="29">Repair</td><td rowspan="2"></td></tr>
<tr><td>Jul 13</td><td rowspan="38">WU
(York)
Effect of laser pulse width/energy on optically-induced magnetisation reversal
91,007</td></tr>
<tr><td>Jul 20</td><td rowspan="36">SIMONS
(Oxford)
Antigens laid bare: the intrinsic conformations of free & hydrated lewis antigens
91,010</td><td rowspan="37">VOLK
(Liverpool)
Polymer coil-globule transition dynamics on the ms-time scale
91,024</td></tr>
<tr><td>Jul 27</td></tr>
<tr><td>Aug 03</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Aug 10</td></tr>
<tr><td>Aug 17</td><td rowspan="33">RUDDOCK
(Strathclyde)
Distributed sensing by time-correlated two-photon excited fluorescence in rare earth doped optical fibres
92,001</td><td rowspan="33">CLAEYSSENS
(Sheffield)
2-photon 3D structuring of photo-curable biopolymers
91,027</td></tr>
<tr><td>Aug 24</td></tr>
<tr><td>Aug 31</td></tr>
<tr><td>Sep 07</td></tr>
<tr><td>Sep 14</td></tr>
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<tr><td>Sep 28</td></tr>
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<tr><td>Dec 21</td></tr>
<tr><td>Dec 28</td></tr>
<tr><td>Dec 28</td></tr>
<tr><td rowspan="13">2010</td><td>Jan 04</td></tr>
<tr><td>Jan 11</td></tr>
<tr><td>Jan 18</td><td rowspan="2"></td></tr>
<tr><td>Jan 25</td><td rowspan="2"></td></tr>
<tr><td>Feb 01</td><td rowspan="9">RITCHIE
(Oxford)
Measurement of fragment polarization from photolysis of vibrationally state prepared molecules
92,000</td></tr>
<tr><td>Feb 08</td><td rowspan="8">BLITZ
(Leeds)
Generation and photo-dissociation of the HO_3 radical
92,003</td></tr>
<tr><td>Feb 15</td><td rowspan="2"></td></tr>
<tr><td>Feb 22</td></tr>
<tr><td>Mar 01</td><td rowspan="5">HIPPLER
(Sheffield)
92,002</td></tr>
<tr><td>Mar 08</td></tr>
<tr><td>Mar 15</td></tr>
<tr><td>Mar 22</td></tr>
<tr><td>Mar 29</td><td></td></tr>
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Target Fabrication Operational Statistics

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RAL Experiments

A total of one Astra Gemini and eight Vulcan experiments were supported by Target Fabrication in the reporting period April 2009 to April 2010. All these experiments were 'solid target' experiments. Target Fabrication provided a total of 49 weeks of experimental support for Vulcan and 4 weeks for Astra Gemini on solid target experiments. The report does not include the extensive amount of filter and pinhole support provided from Target Fabrication for some gas jet experiments.

1) Target Numbers

For the reporting year, the total target numbers produced are shown in Table 1. The table is broken down into separate experiments and gives data on total target numbers produced and the subset consisting of high specification complex 3D targets that have been produced. High specification 3D targets are defined as targets that have taken significant highly skilled microassembly or micromachining to be produced over and above standard target manufacture. The total number of targets for use at RAL produced by the group in 2009-2010 was 1,424 compared to 1,023 in 2008-2009[1]. During 2009-2010, the number of high specification targets produced was 379 accounting for 27% of the total targets made which is consistent with the figure of 29% for 2008-2009[1].

Experiment	Targets Produced	High Specification Targets
May 2009 TAP	143	2
May 2009 TAW	116	48
July 2009 TAP	101	53
July 2009 TAW	197	82
Oct 2009 GTA	97	0
Nov 2009 TAP	60	43
Nov 2009 TAW	153	56
Jan 2010 TAW	274	95
Mar 2010 TAW	283	0
TOTAL	1424	379

Table 1: Target production summary for 2009-2010.

2) Target Types

The high specification targets can be separated into 6 main types as shown in Table 2 and Figure 1. Most notably, 53 multilayered microsquare targets were delivered to the July 2009 TAP experiment and 95 thin wire targets were delivered to the January 2010 TAW experiment requiring extensive highly skilled microassembly.

Target Type	Targets Produced
Multilayered Microsquares (100um x 100um)	53
XRTS	41
Multilayered Opacity Targets	28
Thin Wires	95
Ultra Thin DLC	35
Other	0

Table 2: High Specification Target Delivery Summary.

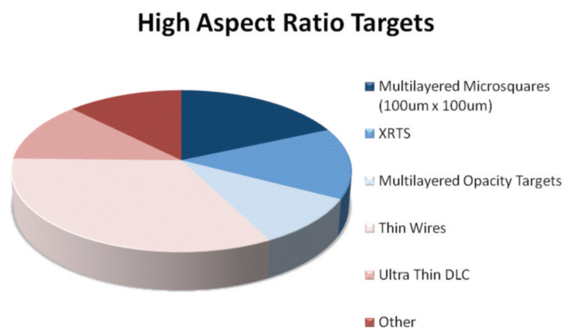

Figure 1: High Specification Target Delivery Summary.

3) Experimental Response

It is seen as a significant strength of Target Fabrication to be rapidly responsive to experimental results and conditions by working collaboratively with experimental groups. The Target Fabrication group responds to experimental changes during a run and often implements a number of modifications or redesigns to the original requests. The number of modifications and variations usually fluctuates widely across a year and is dependent on the type of experiment and also on experimental conditions such as diagnostic and laser performance. On average, during experiments in the reporting period, 42% of the targets that were shot were modified or redesigned from the planned target specifications. This is higher that the figures for the previous 2 years, which were 30% in 2008-2009[1] and 32% in 2007-2008[2]. Figure 2 shows the proportion of targets that were redesigned or modified during the experiments supported in 2009-2010.

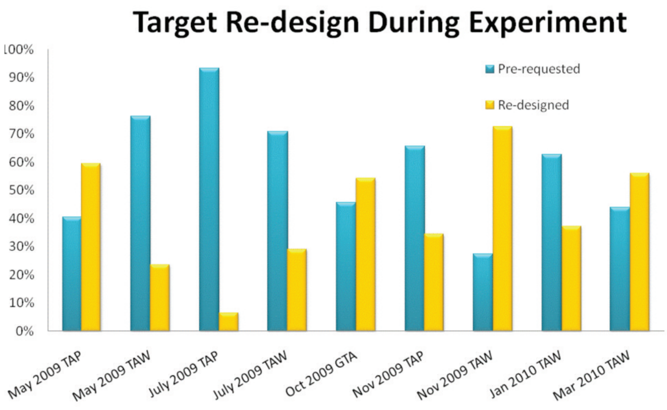

Figure 2: The percentage of pre-requested targets compared to redesigned targets fabricated throughout the year for each experiment.

The redesign of targets during experiments means that there are often a number of targets that have been fabricated but that are not shot by the end of experimental campaigns. As shown in Figure 3, throughout the year an average of 39% of targets that were fabricated were either returned un-shot to Target Fabrication or were unused having been made in preparation for the experiment but not required due to changes. This is slightly higher than the figures of 35% for 2008-2009[1] 36% for 2007-2008[2].

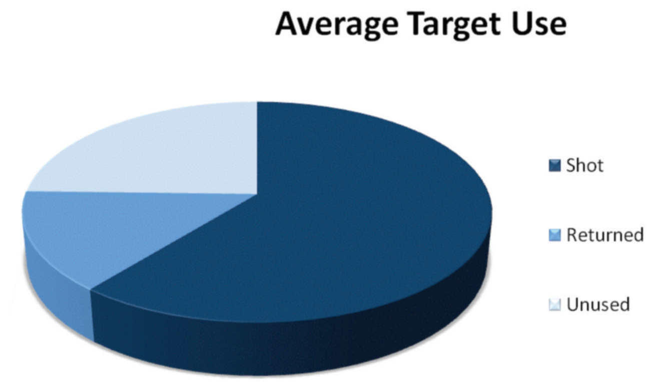

Figure 3: The average proportion of targets shot, returned and unused during solid target experiments on Vulcan in 2009-2010.

External Contracts

Scitech Precision Ltd, a spinout company from Target Fabrication, also supplied microtargets, specialist coatings and consultancy to a number of external contracts. A total of ten experiments were supported at external facilities including LULI, PALS, GEKKO and GSI.

Summary

Target Fabrication has supported nine internal and ten external experimental groups in the last year as well as providing an increasing amount of characterisation services and acting as a knowledge base for Target Fabrication activities throughout Europe. There was an increase in the number of targets delivered to experiments on Vulcan compared to 2008-2009 even though the number of experiments scheduled was the same.

References

1. *H. F. Lowe, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2008-2009, p326-327*
2. *H. F. Lowe, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2007-2008, p306-307.*

Vulcan Operational Statistics

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Introduction

Vulcan has completed an active experimental year, with 48 full experimental weeks allocated to target areas TAW and TAP between April 2009 and March 2010. This figure is down on previous years for two reasons :

1) The Vulcan laser was shut down for three months from August to November 2009 for the rod amplifier upgrade and recommissioning[1].

2) Single area operations were adopted in January 2010 to enable front end tests to be undertaken.

Table 1 below shows the operational schedule for the year, and illustrates the shot rate statistics for each experiment. Numbers in parentheses indicate the total number of full energy laser shots delivered to target, followed by the number of these that failed.

PERIOD	TAW	TAP
4 May – 14 Jun	G Tallents EUV probing of solar opacity (41, 5) (87.8%)	M Borghesi Plasma jets driven by petawatt pulses (48, 7) (85.4%)
29 Jun – 9 Aug	J Fuchs Influence of overlapping high-intensity laser beams on electron and ion generation and transport (83, 10) (88.0%)	M Zepf Measurement of enhanced coupling in counter-propagating fast electron beams interaction in high-intensity laser-plasma experiments (42, 12) (71.4%)
10 Aug – 8 Nov	Rod amplifier upgrade	
9 Nov – 20 Dec	D Riley Short range screening in warm dense matter (51, 5) (90.2%)	Z Najmudin Ion acceleration from ultra-thin targets and near critical density targets (43, 8) (81.4%)
11 Jan – 21 Feb	Hoarty (AWE) A proposal to use laser produced proton beams to isochorically heat materials for warm dense matter studies (75, 10) (86.7%)	
8 Mar – 18 Apr	M Borghesi Laser-driven ion-acoustic solitons in tenuous plasmas (62,8) (87.1%)	

Table 1. Experimental schedule for the period April 2009 – March 2010

(Shots fired, failed shots)
(Reliability)

The total number of full disc amplifier shots that have been fired to target this year is 445. This is a decrease compared with recent years (Table 2) for the reasons given above. 65 shots failed to meet user requirements. The overall shot success rate to target for the year is 85%, compared to 91%, 90%, 85%, 86% in the previous four years. Figure 1 shows the reliability of the Vulcan laser to all target areas over the past five years.

The shot reliability to TAW has remained roughly constant compared with 2008-2009 at 88%. This is encouraging considering that all of the experiments in TAW in this reporting year were carried out after the upgrade. The shot rate in Vulcan has dropped this year due to the shutdown for the rod amplifier upgrade. Again following this upgrade the overall reliability of Vulcan has remained unaffected. The shot reliability to TAP is around 80% and efforts in the coming year will be focused on increasing the number of good shots to TAP.

Analysis of the failure modes reveals that, as in recent years, the two overriding causes of failed shots are alignment and front end related issues. It is difficult to distinguish these two causes and in the coming year we will be commissioning further diagnostics on the rod amplifier chain (energy monitors and beam profiling after each amplifier). Issues with the front end system over the past year have included timing issues with the shaped long pulse oscillator, the spectrum of the silicate / phosphate chain and the opcpa pump laser.

There is a requirement which was originally instigated for the EPSRC FAA that the laser system be available, during the four week periods of experimental data collection, from 09:00 to 17:00 hours, Monday to Thursday, and from 09:00 to 16:00 hours on Fridays (a total of 156 hours over the four week experimental period). The laser has not always met the startup target of 9:00 am but it has been common practice to operate the laser well beyond the standard contracted finish time on several days during the week. In addition, the introduction of early start times on some experiments continues to lead to improvements in availability.

On average, Vulcan has been available for each experiment to target areas for 76.4% of the time during contracted hours and 105.6% overall. These figures compare with 78.8% and 108.2% in 2008-2009 to all target areas. The time that the laser is unavailable to users is primarily the time taken for beam alignment at the start of the day. Over the past twelve months, each experiment has also experienced an average of 5.7 hours during the standard working week when the laser has been unavailable, or just over one hour per day.

Reference

1. *A K Kidd et al, "Vulcan rod amplifier upgrade", CLF Annual Report 2009-2010.*

	No of shots	Failed shots	Reliability
05 - 06	672	93	86%
06 - 07	1043	149	85%
07 - 08	977	98	90%
08 - 09	646	61	91%
09 - 10	445	65	85%

Table 2. Shot totals and proportion of failed shots for the past five years

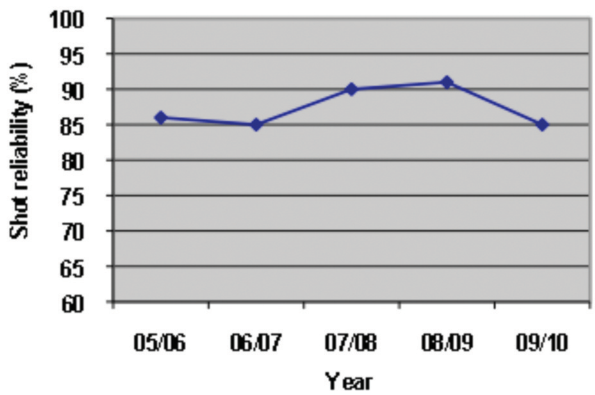

Figure 1. All areas shot reliability for each year 2005-6 to 2009-10

Journal Papers

ASTRA & ARTEMIS

T. Siegel, R. Torres, D.J. Hoffmann, L. Brugnera, I. Procino, A. Zair, J.G. Underwood, E. Springate, I.C.E. Turcu, L.E. Chipperfield and J.P. Marangos,
High harmonic emission from a superposition of multiple unrelated frequency fields
Optics Express **18** (7) 6853-6862(2010)

T.P.A. Ibbotson, N. Bourgeois, T.P. Rowlands-Rees, L.S. Caballero, S.I. Bajlekov, P.A. Walker, S. Kneip, S.P.D. Mangles, S.R. Nagel, C.A.J. Palmer, N. Delerue, G. Doucas, D. Urner, O. Chekhlov, R.J. Clarke, E. Divall, K. Ertel, P.S. Foster, S.J. Hawkes, C.J. Hooker, B. Parry, P.P. Rajeev, M.J.V. Streeter and S.M. Hooker,
Laser-wakefield acceleration of electron beams in a low density plasma channel
Physical Review Special Topics-Accelerators and Beams
13 (3) 31301, 2010

A.D. Debus, M. Bussmann, U. Schramm, R. Sauerbrey, C.D. Murphy, Z. Major, R. Horlein, L. Veisz, K. Schmid, J. Schreiber, K. Witte, S.P. Jamison, J.G. Gallacher, D.A. Jaroszynski, M.C. Kaluza, B. Hidding, S. Kiselev, R. Heathcote, P.S. Foster, D. Neely, E.J. Divall, C.J. Hooker, J.M. Smith, K. Ertel, A.J. Langley, P. Norreys, J.L. Collier and S. Karsch,
Electron Bunch Length Measurements from Laser-Accelerated Electrons Using Single-Shot THz Time-Domain Interferometry
Physical Review Letters **104** (8), 84802 (2010)

R. Torres, T. Siegel, L. Brugnera, I. Procino, J.G. Underwood, C. Altucci, R. Velotta, E. Springate, C. Froud, I.C.E. Turcu, M.Y. Ivanov, O. Smirnova and J.P. Marangos,
Extension of high harmonic spectroscopy in molecules by a 1300 nm laser field
Optics Express **18** (3), 3174-3180(2010)

D.R. Symes, U. Wegner, H.C. Ahlswede, M.J.V. Streeter, P.L. Gallegos, E.J. Divall, R.A. Smith, P.P. Rajeev and D. Neely,
Ultrafast gated imaging of laser produced plasmas using the optical Kerr effect
Applied Physics Letters **96**, 111109 (2010)

M. Siebold, M. Loeser, U. Schramm, J. Koerner, M. Wolf, M. Hellwing, J. Hein and K. Ertel,
High-efficiency, room-temperature nanosecond Yb:YAG laser
Optics Express **17** (22),19887-19893 (2009)

Z.M. Sheng, W.M. Wang, R. Trines, P. Norreys, M. Chen and J. Zhang,
Mechanisms of electron injection into laser wakefields by a weak counter-propagating pulse
European Physical Journal-Special Topics **175** 49-55(2009)

B. Dromey, D. Adams, S. Kar, C. Bellei, D.C. Carroll, R.J. Clarke, J.S. Green, S. Kneip, K. Markey, S.R. Nagel, P.T. Simpson, L. Willingale, P. McKenna, D. Neely, Z. Najmudin, K. Krushelnick, P.A. Norreys and M. Zepf,
High brightness keV harmonics from relativistically oscillating plasma surfaces
European Physical Journal-Special Topics **175** 57-60 (2009)

N. Booth, M.H. Edwards, Z. Zhai, G.J. Tallents, T. Dzelzainis, C.L.S. Lewis, A. Behjat, Q. Dong, S.J. Wang, D. Neely, P. Foster and M. Streeter,
Grazing incidence pumping of an 18.9 nm Ni-like Mo X-ray laser
European Physical Journal-Special Topics **175** 153-158(2009)

P.A. Norreys,
Laser-driven particle acceleration
Nature Photonics **3** (8) 423-425 (2009)

S. Kneip, S.R. Nagel, S.F. Martins, S.P.D. Mangles, C. Bellei, O. Chekhlov, R.J. Clarke, N. Delerue, E.J. Divall, G. Doucas, K. Ertel, F. Fiuza, R. Fonseca, P. Foster, S.J. Hawkes, C.J. Hooker, K. Krushelnick, W.B. Mori, C.A.J. Palmer, K.T. Phuoc, P.P. Rajeev, J. Schreiber, M.J.V. Streeter, D. Urner, J. Vieira, L.O. Silva and Z. Najmudin,
Near-GeV Acceleration of Electrons by a Nonlinear Plasma Wave Driven by a Self-Guided Laser Pulse
Physical Review Letters **103** (3), 35002 (2009)

J.D. Alexander, C.R. Calvert, R.B. King, O. Kelly, W.A. Bryan, G.R.A.J. Nemeth, W.R. Newell, C.A. Froud, I.C.E. Turcu, E. Springate, P.A. Orr, J. Pedregosa-Gutierrez, C.W. Walter, R.A. Williams, I.D. Williams and J.B. Greenwood,
Short pulse laser-induced dissociation of vibrationally cold, trapped molecular ions
Journal of Physics B-Atomic Molecular and Optical Physics
42 (15), 154027 (2009)

J.D. Alexander, C.R. Calvert, R.B. King, O. Kelly, L. Graham, W.A. Bryan, G.R.A.J. Nemeth, W.R. Newell, C.A. Froud, I.C.E. Turcu, E. Springate, I.D. Williams and J.B. Greenwood,
Photodissociation of D-3(+) in an intense, femtosecond laser field
Journal of Physics B-Atomic Molecular and Optical Physics
42 (14), 141004 (2009)

B. Dromey, S.G. Rykovanov, D. Adams, R. Horlein, Y. Nomura, D.C. Carroll, P.S. Foster, S. Kar, K. Markey, P. McKenna, D. Neely, M. Geissler, G.D. Tsakiris and M. Zepf,
Tunable Enhancement of High Harmonic Emission from Laser Solid Interactions
Physical Review Letters **102** (22), 225002 (2009)

A.S. Pirozhkov, I.W. Choi, J.H. Sung, S.K. Lee, T.J. Yu, T.M. Jeong, I.J. Kim, N. Hafz, C.M. Kim, K.H. Pae, Y.C. Noh, D.K. Ko, J. Lee, A.P.L. Robinson, P. Foster, S. Hawkes, M. Streeter, C. Spindloe, P. McKenna, D.C. Carroll, C.G. Wahlstrom, M. Zepf, D. Adams, B. Dromey, K. Markey, S. Kar, Y.T. Li, M.H. Xu, H. Nagatomo, M. Mori, A. Yogo, H. Kiriyama, K. Ogura, A. Sagisaka, S. Orimo, M. Nishiuchi, H. Sugiyama, T.Z. Esirkepov, H. Okada, S. Kondo, S. Kanazawa, Y. Nakai, A. Akutsu, T. Motomura, M. Tanoue, T. Shimomura, M. Ikegami, I. Daito, M. Kando, T. Kameshima, P. Bolton, S.V. Bulanov, H. Daido and D. Neely,
Diagnostic of laser contrast using target reflectivity
Applied Physics Letters **94** (24) , 241102 (2009)

B. Dromey, C. Bellei, D.C. Carroll, R.J. Clarke, J.S. Green, S. Kar, S. Kneip, K. Markey, S.R. Nagel, L. Willingale, P. McKenna, D. Neely, Z. Najmudin, K. Krushelnick, P.A. Norreys and M. Zepf,
Third harmonic order imaging as a focal spot diagnostic for high intensity laser-solid interactions
Laser and Particle Beams **27** (2) 243-248 (2009)

J.G. Underwood,
Molecules standing to attention
Nature Physics **5** (4) 253-254 (2009)

C.A. Froud, R.T. Chapman, E.T.F. Rogers, M. Praeger, B. Mills, J.Grant-Jacob, T.J. Butcher, S.L. Stebbings, A.M. de Paula, J.G. Frey and W.S. Brocklesby,
Spatially resolved Ar* and Ar+* imaging as a diagnostic for capillary-based high harmonic generation
Journal of Optics A-Pure and Applied Optics **11** (5), 54011 (2009)

VULCAN

R.R Faustlin, T. Bornath, T. Doppner, S.Dusterer, E. Forster, C. Fortmann, S.H. Glenzer, S. Gode, G. Gregori, R. Irsig, T. Laarmann, H.J. Lee, B. Li, K.H. Meiwes-Broer, J. Mithen, B. Nagler, A. Przystawik, H. Redlin, R. Redmer, H. Reinholz, G. Ropke, F. Tavella, R. Thiele, J. Tiggesbaumker, S. Toleikis, I. Uschmann, S.M. Vinko, T. Whitcher, U. Zastrau, B. Ziaja and T. Tschentscher,
Observation of Ultrafast Nonequilibrium Collective Dynamics in Warm Dense Hydrogen
Physical Review Letters **104** (12) 125002 (2010)

P.A. Norreys,
Controlling Implosion Symmetry Around a Deuterium-Tritium Target
Science **327** (5970) 1208 -1210 (2010)

K. Quinn, P.A. Wilson, B. Ramakrishna, L. Romagnani, G. Sarri, C.A. Cecchetti, L. Lancia, J. Fuchs, A. Pipahl, T. Toncian, O. Willi, R.J. Clarke, D. Neely, M. Notley, P. Gallegos, D.C. Carroll, M.N. Quinn, X.H. Yuan, P. McKenna and M. Borghesi,
Modified proton radiography arrangement for the detection of ultrafast field fronts
Review of Scientific Instruments **80** (11), 113506 (2009)

A. Morace, A. Magunov, D. Batani, R. Redaelli, C. Fourment, J.J. Santos, G. Malka, A. Boscheron, A. Casner, W. Nazarov, T. Vinci, Y. Okano, Y. Inubushi, H. Nishimura, A. Flacco, C. Spindloe and M. Tolley,
Study of plasma heating induced by fast electrons
Physics of Plasmas **16** (12), 122701 (2009)
T. Ma, M.H. Key, R.J. Mason, K.U. Akli, R.L. Daskalova, R.P. Freeman, J.S. Green, K. Highbarger, P.A. Jaanimagi, J.A. King, K.L. Lancaster, S.P. Hatchett, A.J. Mackinnon, A.G. MacPhee, P.A. Norreys, P.K. Patel, R.B. Stephens, W. Theobald, L.D. Van Woerkom, M.S. Wei, S.C. Wilks and F.N. Beg,
Transport of energy by ultraintense laser-generated electrons in nail-wire targets
Physics of Plasmas **16** (11), 112702 (2009)

F. Perez, M. Koenig, D. Batani, S.D. Baton, F.N. Beg, C. Benedetti, E. Brambrink, S. Chawla, F. Dorchies, C. Fourment, M. Galimberti, L.A. Gizzi, R. Heathcote, D.P. Higginson, S. Hulin, R. Jafer, P. Koester, L. Labate, K. Lancaster, A.J. MacKinnon, A.G. McPhee, W. Nazarov, P. Nicolai, J. Pasley, A. Ravasio, M. Richetta, J.J. Santos, A. Sgattoni, C. Spindloe, B. Vauzour and L. Volpe,
Fast-electron transport in cylindrically laser-compressed matter
Plasma Physics and Controlled Fusion **51** (12), 124035 (2009)

D. Riley, J.J.A. Gareta, E.G. Saiz, F.Y. Khattak, J. Kohanoff, S. Sahoo, G.S. Naz, S.F.C. Shearer, K.A. Thornton, C. Gregory, N.C. Woolsey, M. Notley and D. Neely,
Structure of warm dense matter via angularly resolved x-ray scatter
Plasma Physics and Controlled Fusion **51** (12), 124036 (2009)

W. Theobald, K.S. Anderson, R. Betti, R.S. Craxton, J.A. Delettrez, J.A. Frenje, V.Y. Glebov, O.V. Gotchev, J.H. Kelly, C.K. Li, A.J. Mackinnon, F.J. Marshall, R.L. McCrory, D.D. Meyerhofer, J.F. Myatt, P.A. Norreys, P.M. Nilson, P.K. Patel, R.D. Petrasso, P.B. Radha, C. Ren, T.C. Sangster, W. Seka, V.A. Smalyuk, A.A. Solodov, R.B. tephens, C. Stoeckl and B. aakobi,
Advanced-ignition-concept exploration on OMEGA
Plasma Physics and Controlled Fusion **51** (12),124052 (2009)

K.L. Lancaster, M. Sherlock, J.S. Green, C.D. Gregory, P. Hakel, K.U. Akli, F.N. Beg, S.N. Chen, R.R. Freeman, H. Habara, R. Heathcote, D.S. Hey, K. Highbarger, M.H. Key, R. Kodama, K. Krushelnick, H. Nakamura, M. Nakatsutsumi, J. Pasley, R.B. Stephens, M. Storm, M. Tampo, W. Theobald, L. Van Woerkom, R.L. Weber, M.S. Wei, N.C. Woolsey, T. Yabuuchi and P.A. Norreys,
Effect of reentrant cone geometry on energy transport in intense laser-plasma interactions
Physical Review E **80** (4) 45401 (2009)

K. Quinn, P.A. Wilson, B. Ramakrishna, G. Sarri, L. Romagnani, A. Pipahl, O. Willi, L. Lancia, J. Fuchs, D.C. Carroll, M.N. Quinn, P. Gallegos, X.H. Yuan, P. McKenna, R.J. Clarke, D. Neely, M. Notley, A. Macchi and M. Borghesi,
Observation of the transient charging of a laser-irradiated solid
European Physical Journal D **55** (2) 293-297(2009)

P.A. Norreys, R.H.H. Scott, K.L. Lancaster, J.S. Green, A.P.L. Robinson, M. Sherlock, R.G. Evans, M.G. Haines, S. Kar, M. Zepf, M.H. Key, J. King, T. Ma, T. Yabuuchi, M.S. Wei, F.N. Beg, P. Nilson, W. Theobald, R.B. Stephens, J. Valente, J.R. Davies, K. Takeda, H. Azechi, M. Nakatsutsumi, T. Tanimoto, R. Kodama and K.A. Tanaka,
Recent fast electron energy transport experiments relevant to fast ignition inertial fusion
Nuclear Fusion **49** (10), 104023(2009)

T. Yabuuchi, A. Das, G.R. Kumar, H. Habara, P.K. Kaw, R. Kodama, K. Mima, P.A. Norreys, S. Sengupta and K.A. Tanaka,
Evidence of anomalous resistivity for hot electron propagation through a dense fusion core in fast ignition experiments
New Journal of Physics **11**, 93031(2009)

W. Theobald, C. Stoeckl, P.A. Jaanimagi, P.M. Nilson, M. Storm, D.D. Meyerhofer, T.C. Sangster, D. Hey, A.J. MacKinnon, H.S. Park, P.K. Patel, R. Shepherd, R.A. Snavely, M.H. Key, J.A. King, B. Zhang, R.B. Stephens, K.U. Akli, K. Highbarger, R.L. Daskalova, L. Van Woerkom, R.R. Freeman, J.S. Green, G. Gregori, K. Lancaster and P.A. Norreys,
A dual-channel, curved-crystal spectrograph for petawatt laser, x-ray backlighter source studies
Review of Scientific Instruments **80** (8), 83501 (2009)

A.P.L. Robinson, D.H. Kwon and K. Lancaster,
Hole-boring radiation pressure acceleration with two ion species
Plasma Physics and controlled Fusion **51** (9), 95006 (2009)

M. Borghesi, T. Toncian, J. Fuchs, C.A. Cecchetti, L. Romagnani, S. Kar, K. Quinn, B. Ramakrishna, P.A. Wilson, P. Antici, P. Audebert, E. Brambrink, A. Pipahl, R. Jung, M. Amin, O. Willi, R.J. Clarke, M. Notley, P. Mora, T.D. Grismayer, E. Humieres and Y. Sentoku,
Laser-driven proton acceleration and applications: Recent results
European Physical Journal-Special Topics **175**, 105-110 (2009)

A.P.L. Robinson, P. Foster, D. Adams, D.C. Carroll, B. Dromey, S. Hawkes, S. Kar, Y.T. Li, K. Markey, P. McKenna, C. Spindloe, M. Streeter, C.G. Wahlstrom, M.H. Xu, M. Zepf and D. Neely,
Spectral modification of laser-accelerated proton beams by self-generated magnetic fields
New Journal of Physics **11**, 83018 (2009)

J.G. Kirk, A.R. Bell and I. Arka,
Pair production in counter-propagating laser beams
Plasma Physics and Controlled Fusion **51** (8), 85008 (2009)

T. Tanimoto, H. Habara, R. Kodama, M. Nakatsutsumi, K.A. Tanaka, K.L. Lancaster, J.S. Green, R.H.H. Scott, M. Sherlock, P.A. Norreys, R.G. Evans, M.G. Haines, S. Kar, M. Zepf, J. King, T. Ma, M.S. Wei, T. Yabuuchi, F.N. Beg, M.H. Key, P, Nilson, R.B. Stephens, H. Azechi, K. Nagai, T. Norimatsu, K. Takeda, J. Valente and J.R. Davies,
Measurements of fast electron scaling generated by petawatt laser systems
Physics of Plasmas **16** (6), 62703 (2009)

J.P. Perin, M. Perlado and M. Tolley,
Development of a Cryogenic Target Delivery System for HiPER
Fusion Science and Technology **56** (1), 405 -408 (2009)

C.D. Gregory, J. Howe, B. Loupias, S. Myers, M.M. Notley, Y. Sakawa, A. Oya, R. Kodama, M. Koenig, E. Falize, S. Bouquet, C. Michaut and N.C. Woolsey,
Colliding plasma experiments to study astrophysical-jet relevant physics
Astrophysics and Space Science **322**, 41(2009)

B. Ramakrishna, P.A. Wilson, K. Quinn, L. Romagnani, M. Borghesi, A. Pipahl, O. Willi, L. Lancia, J. Fuchs, R.J. Clarke, M. Notley and W. Nazarov,
Propagation of relativistic electrons in low density foam targets
Astrophysics and Space Science **322**, 165 (2009)

C.A. Cecchetti, M. Borghesi, J. Fuchs, G. Schurtz, S. Kar, A. Macchi, L. Romagnani, P.A. Wilson, P. Antici, R. Jung, J. Osterholtz, C.A. Pipahl, O. Willi, A. Schiavi, M. Notley and D. Neely,
Magnetic field measurements in laser-produced plasmas via proton deflectometry
Physics of Plasmas **16** (4) , 43102 (2009)

K.L. Lancaster, J. Pasley, J.S. Green, D. Batani, S. Baton, R.G. Evans, L. Gizzi, R. Heathcote, C.H. Gomez, M. Koenig, P. Koester, A. Morace, I. Musgrave, P.A. Norreys, F. Perez, J.N. Waugh and N.C. Woolsey,
Temperature profiles derived from transverse optical shadowgraphy in ultraintense laser plasma interactions at $6x10^{20}$ W cm^{-2}
Physics of Plasmas **16** (5), 56707 (2009)

K. Quinn, P.A. Wilson, C.A. Cecchetti, B. Ramakrishna, L. Romagnani, G. Sarri, L. Lancia, J. Fuchs, A. Pipahl, T. Toncian, O. Willi, R.J. Clarke, D. Neely, M. Notley, P. Gallegos, D.C. Carroll, M.N. Quinn, X.H. Yuan, P. McKenna, T.V. Liseykina, A. Macchi and M. Borghesi,
Laser-Driven Ultrafast Field Propagation on Solid Surfaces
Physical Review Letters **102** (19), 194801 (2009)

R.M.G.M. Trines,
Wave-breaking limits for nonquasistatic oscillations in a warm one-dimensional electron plasma
Physical Review E **79** (5), 56406 (2009)

P.A. Norreys,
Progress in Fast Ignition
Laser-Plasma Interactions **361**, 375 (2009)

K. Wunsch, J. Vorberger, G. Gregori and D.O. Gericke,
Ion structure in dense plasmas: MSA versus HNC
Journal of Physics A-Mathematical and Theoretical **42** (21), 14053 (2009)

D.R. Symes, M. Hohenberger, J. Lazarus, J. Osterhoff, A.S. Moore, R.R. Fäustlin, 2, A.D. Edens, H.W. Doyle, R.E. Carley, A. Marocchino, J.P. Chittenden, A.C. Bernstein, E.T. Gumbrell, Mike Dunne, R.A. Smith and T. Ditmire
Investigations of laser-driven radiative blast waves in clustered gases
High Energy Density Physics **6** (2) 274-279 (2009)

P.M. Nilson, S.P.D. Mangles, L. Willingale, M.C. Kaluza, A.G.R. Thomas, M. Tatarakis, Z. Najmudin, R.J. Clarke, K.L. Lancaster, S. Karsch, J. Schreiber, R.G. Evans, A.E. Dangor and K. Krushelnick
Generation of Ultrahigh-Velocity Ionizing Shocks with Petawatt-Class Laser Pulses
Phys. Rev. Lett. **103**, 255001 (2009)

N.L. Kugland, G. Gregori, S. Bandyopadhyay, C.M. Brenner, C.R.D. Brown, C. Constantin, S.H. Glenzer, F.Y. Khattak, A.L. Kritcher, C.Niemann, A. Otten, J. Pasley, A. Pelka, M. Roth, C. Spindloe and D. Riley
Evolution of elastic x-ray scattering in laser-shocked warm dense lithium
Phys. Rev. E **80**, 066406 (2009)

P.A. Norreys, F.N. Beg, Y. Sentoku, L.O. Silva, R.A. Smith and R.M.G.M. Trines
Intense laser-plasma interactions: New frontiers in high energy density physics
Phys. Plasmas **16**, 041002 (2009);

LASER FOR SCIENCE FACILITY

M. Towrie, G.W. Doorley, M.W. George, A.W. Parker, S.J. Quinn and J.M. Kelly
ps-TRIR covers all the bases - recent advances in the use of transient IR for the detection of short-lived species in nucleic acids
Analyst **134**, 1265-1273 (2009)

M. Towrie, S.W. Botchway, A. Clark, E. Freeman, R. Halsall, A.W. Parker, M. Prydderch, R. Turchetta, A.D. Ward and M.R. Pollard,
Dynamic position and force measurement for multiple optically trapped particles using a high-speed active pixel sensor
Rev. Sci. Instrum. **80** (2009)

A. Osterrieder, C.M. Carvalho, M. Latijnhouwers, J.N. Johansen, C. Stubbs S.W. Botchway and C. Hawes
Fluorescence Lifetime Imaging of Interactions between Golgi TetheringFactors and Small GTPases in Plants
Traffic **10**, 1398-9219 (2009)

R. Kania, A.I. Stewart, I.P. Clark, G.M. Greetham, A.W. Parker, M. Towrie and N.T. Hunt
Investigating the vibrational dynamics of a 17e(-) metallocarbonyl intermediate using ultrafast two dimensional infrared spectroscopy
Phys Chem Chem Phys **12**, 1051-1063 (2010)

A.W. Parker, C.Y. Lin, M.W. George, M. Towrie and M.K. Kuimova
Infrared Characterization of the Guanine Radical Cation: Finger Printing DNA Damage
J. Phys. Chem. B **114**, 3660-3667 (2010)

J.A. Askari, C.J. Tynan, S.E.D. Webb, M.L. Martin-Fernandez, C. Ballestrem and M.J. Humphries
Focal adhesions are sites of integrin extension
J. Cell. Biol. **188**, 891-903 (2010)

T.M. Ismail, S. Zhang, D.G. Fernig, S. Gross, M.L. Martin-Fernandez, V. See, K. Tozawa, C.J. Tynan, G.Z. Wang, M.C. Wilkinson, P.S. Rudland and R. Barraclough
Self-association of Calcium-binding Protein S100A4 and Metastasis
J. Biol. Chem **285**, 914-922 (2010)

S.R. Meech
Excited state reactions in fluorescent proteins
Chem. Soc. Rev. **38**, 2922-2934 (2009)

M.A.H. Alamiry, N.M. Boyle, C.M. Brookes, M.W. George, C. Long, P. Portius, M.T. Pryce, K.L. Ronayne, X.Z. Sun, M.Towrie and K.Q. Vuong
Unusually Slow Photodissociation of CO from (eta^6-C_6H_6)Cr(CO)$_3$(M =Cr or Mo): A Time-Resolved Infrared, Matrix Isolation, and DFT Investigation

Organometallics **28**, 1461-1468 (2009)

T.L. Easun, W. Z. Alsindi, N. Deppermann, M. Towrie, K.L. Ronayne, X.Z. Sun, M.D. Ward and M.W. George
Luminescence and Time-Resolved Infrared Study of Dyads Containing (Diimine)Ru(4,4 '-diethylamido-2,2 '-bipyridine)(2) and (Diimine)Ru(CN)(4) Moieties: Solvent-Induced Reversal of the Direction of Photoinduced Energy-Transfer
Inorg. Chem. **48**, 8759-8770 (2009)

A. Vlcek
Ultrafast Excited-State Processes in Re(I) Carbonyl-Diimine
Complexes:From Excitation to Photochemistry

Photophys. Organometallics **29**, 73-114 (2010)

M.D. Hargreaves, N.A. Macleod, V.L. Brewster, T. Munshi, H.G.M. Edwards and P. Matousek
Application of portable Raman spectroscopy and benchtop spatially offset Raman spectroscopy to interrogate concealed biomaterials
J. Raman. Spectrosc. **40**, 1875-1880 (2009)

N. Everall, P. Matousek, N. MacLeod, K.L. Ronayne and I.P. Clark
Temporal and Spatial Resolution in Transmission Raman Spectroscopy
Appl. Spectrosc. **64**, 52-60 (2010)

R.H. Bisby, S.W. Botchway, A.G Crisostomo, J. Karolin, A.W. Parker and L. Schroder
Interactions of the beta-blocker drug, propranolol, with detergents, beta-cyclodextrin and living cells studied using fluorescence spectroscopy and imaging
Spectrosc-Int. J. **24**, 137-142 (2010)

N.T. Hunt
2D-IR spectroscopy: ultrafast insights into biomolecule structure and function
Chem. Soc. Rev. **38**, 1825-2148 (2009)

M.A. Elbagerma, H.G.M. Edwards, T.Munshi, M.D. Hargreaves, P. Matousek and I.J. Scowen
Characterization of New Cocrystals by Raman Spectroscopy, Powder X-ray Diffraction, Differential Scanning Calorimetry, and Transmission Raman Spectroscopy
Cryst. Growth Des.**10**, 2360-2371 (2010)

Conference Proceedings

ASTRA

B. Li, P.P. Rajeev, G. Gregori, M. Benetou, B. Dobson, A. Cavalleri, L. Pickworth, P. Lau, P. Jaanimagi, F. Read, J. Lynn and D. Neely,
Design of a sub 100-femtosecond X-ray Streak Camera
Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference
(CLEO/QELS 2009), VOLS **1-5**,2456-2457 (2009)

B. Dromey, D. Adams, R. Hoerlein, Y. Nomura, D. Neely, G. Tsakiris and M. Zepf
Diffraction Limited Harmonic Emission from Laser Produced Plasmas
X-Ray Lasers 2008, Proceedings **130** 323-328 (2009)

LASERS FOR SCIENCE FACILITY

M.D. Hargreaves and P. Matousek
Threat detection of liquid explosive precursor mixtures by Spatially Offset Raman Spectroscopy (SORS), "Optics and Photonics for Counterterrorism and Crime Fighting V"
Proceeding Spie **7486** (1): 74860B - 74860B-7 (2009)

VULCAN

P.A. Norreys, A.P.L. Robinson and R.M.G.M. Trines,
Laser Particle Acceleration
Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference (CLEO/QELS 2009), VOLS **1-5**, 51 (2009)

N. Booth, M. H. Edwards, Z. Zhai, G. J. Tallents, T. Dzelzainis, R. Ferrari, C.L.S. Lewis, G. Gregori and D. Neely
Ablation Measurements Using Ni-Like Ag X-Ray Laser Transmission
X-Ray Lasers 2008, Proceedings **130** 366-372 (2009)

M.M. Notley, N.B. Alexander, R. Heathcote, S. Blake, R.J. Clarke, J.L. Collier, P. Foster, S.J. Hawkes, C. Hernandez-Gomez, C.J. Hooker, D. Pepler, I.N. Ross, M. Streeter, G. Tallents, M. Tolley, T. Winstone, B. Wyborn and D. Neely,
Central Laser Facility High Power Laser Capabilities Applied to X-Ray Laser Science
X-Ray Lasers 2008, Proceedings **130**, 59-63 (2009)

Thesis

HIGH POWER LASER FACILITY – ASTRA & VULCAN

B. Ramakrishna
Production and transport of energetic particles in ultra-intense laser matter interaction
PhD Thesis, Queens University, Belfast. 2010

P. Wilson
Studies of laser generated relativistic electron dynamics using proton probing
PhD Thesis, Queens University, Belfast 2009

D. Carroll
Laser-driven ion acceleration : source optimisation and optical control
PhD Thesis, University of Strathclyde, 2009

S. Nagel
Studies of Electron Acceleration Mechanisms in Relativistic Laser-Plasma Interactions
PhD Thesis, Imperial College, London (2009)

C. Bellei
Measurements of Optical Radiation from High-Intensity Laser-Plasma Interactions
PhD Thesis, Imperial College, London (2009)

C. Kamperidis
Investigation of Electron Laser Wakefield Acceleration in Novel Plasma Structures
PhD Thesis, Imperial College, London (2009)

Rashida Jafer
Laser Based proton generation and proton radiography of laser driven cylindrical implosion
PhD Thesis, University of Milano Bicocca, Milan, Italy (2009)

K. Quinn
Plasma dynamics following ultraintense laser-solid interactions
PhD Thesis, Queens University, Belfast 2010

LASERS FOR SCIENCE FACILITY

P. Reynolds
Investigation of cellular DNA damage induced by multiphoton laser light absorption of near infrared femtosecond laser pulses
PhD Thesis, Reading University (2009)

Panel membership and CLF structure

Laser for Science Facility Access Panel 2009/10

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