Artemis operational statistics

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During the reporting year April 2012 - April 2013 a total of 10 experiments were delivered in the Artemis facility, as shown in Table 1. Artemis had planned 28 and delivered 29 operational weeks including a one week extension which was granted to experiment 12120006. Seven weeks were dedicated to experiment set-up, with grouped set-up weeks for sets of similar experiments.

Table 1. Artemis schedule for FY 2012/2013

02/04/2012	06/04/2012	Holidays and Engineering
09/04/2012	13/04/2012	
16/04/2012	20/04/2012	XUV Beamline characterisation, Cacho
23/04/2012	27/04/2012	111003 EU, Crepaldi, Topological Insulators
30/04/2012	04/05/2012	Engineering: MatSci Chamber
07/05/2012	11/05/2012	111003 EU, Crepaldi, Topological Insulators
14/05/2012	18/05/2012	
21/05/2012	25/05/2012	111008, Kaiser, Complex insulators
28/05/2012	01/06/2012	101007, Petersen, Structural dynamics in insulators
04/06/2012	08/06/2012	Engineering: Vac control.
11/06/2012	15/06/2012	101007, Petersen, Structural dynamics in insulators
18/06/2012	22/06/2012	
25/06/2012	29/06/2012	Development: HHG high flux short wavelength
02/07/2012	06/07/2012	
09/07/2012	13/07/2012	Development/Set-up AMO chamber
16/07/2012	20/07/2012	111010, Minns/Fielding, Dissociation in model systems
23/07/2012	27/07/2012	
30/07/2012	03/08/2012	
06/08/2012	10/08/2012	Experiment Set-up, Autoionization
13/08/2012	17/08/2012	KML Red Dragon Laser service
20/08/2012	24/08/2012	111012, Bryan, Autoionisation dynamics
27/08/2012	31/08/2012	KML Red Dragon Laser service
03/09/2012	07/09/2012	111012, Bryan, Autoionisation dynamics,
10/09/2012	14/09/2012	
17/09/2012	21/09/2012	
24/09/2012	28/09/2012	Engineering: Mat Sci Chamber
01/10/2012	05/10/2012	Development: XUV Beamline
08/10/2012	12/10/2012	TOPAS laser service
15/10/2012	19/10/2012	Engineering: MatSci Chamber
22/10/2012	26/10/2012	111009, Petersen, Charge-density-wave insulators
29/10/2012	02/11/2012	
05/11/2012	09/11/2012	Development, Phillips, Coherent beam-combining
12/11/2012	16/11/2012	12120002 EU, Gierz , Coherent control in Graphene
19/11/2012	23/11/2012	
26/11/2012	30/11/2012	Engineering
03/12/2012	07/12/2012	12120005 EU, Johanssen, Electron-phonon coupling in Graphene
10/12/2012	14/12/2012	
17/12/2012	21/12/2012	Engineering: Remove MatSci/ Install Liquid jet
24/12/2012	28/12/2012	Holidays and Engineering
31/12/2012	04/01/2013	
07/01/2013	11/01/2013	KMLabs Red Dragon Laser service
14/01/2013	18/01/2013	12120006 EU, Chergui, Solvated electron dynamics
21/01/2013	25/01/2013	
28/01/2013	01/02/2013	
04/02/2013	08/02/2013	
11/02/2013	15/02/2013	12120006 EU, Extension: Chergui, Solvated electron dynamics
18/02/2013	22/02/2013	Topas Laser service
25/02/2013	01/03/2013	12120001, Weber, Control of orbital interplay in HHG
04/03/2013	08/03/2013	
11/03/2013	15/03/2013	
18/03/2013	22/03/2013	
25/03/2013	29/03/2013	Engineering

Three weeks were allocated for development work: one week for in-house development of coherent beam combining, to support Gemini high power laser development, and two weeks for HHG optimisation. Three weeks were dedicated to engineering, with additional engineering access for laboratory maintenance in holiday periods. Laser operations were supported by two Red Dragon laser services by KMLabs (three weeks), two Topas laser services by Light Conversion (two weeks) and four short (few hours) pump laser services by Laser Lines.
We completed the upgrade of the three Photonics Industries pump lasers to the new model, resulting in a clear improvement of the long term laser beam power stability.

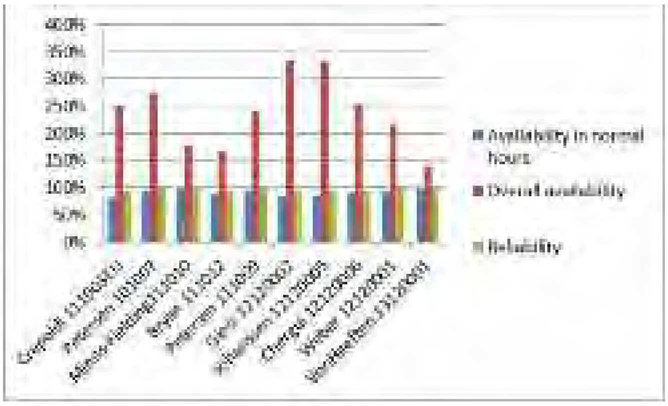
Table 2 and Figure 1 are experiment by experiment breakdowns of Artemis facility performance for the reporting year and show the availability and reliability. The overall availability of the Artemis facility, when including operations out of normal hours, was 238%, dramatically up from 172% last year. The laser facility is scheduled for eight-hour operation during weekdays (9am to 5pm) which corresponds to 100% availability. We now run the laser continuously from Monday to Friday as standard.

Table 2. Artemis facility statistics 2012/13

	Availability in normal hours (%)	Overall availability (%)	Reliability (%)
Crepaldi 111003	82	249	93
Petersen 101007	93	274	98
Minns-Fielding111010	97	176	98
Bryan 111012	88	166	93
Petersen 111009	95	242	98
Gierz 12120002	83	334	95
Johannsen 12120005	85	333	96
Chergui 12120006	91	253	96
Weber 12120001	93	217	97
von Haeften 13120001	98	140	98
Average of all expts.	91	238	96

Figure 1. Artemis availability and reliability in 2012/13

The experiments of Gierz (12120002) and Johannsen (12120005) took data through the weekends, and so achieved overall availabilities of 333% and 334%.



Laser reliability was 96% (up from 92% last year). The down-time was mainly due to air-conditioning failure, external water-chiller failure, interlock failures and pump-laser emergency service visits. All these were fixed very quickly, in hours, due to the efficiency of service contracts as well as our very skilled engineers. On Monday mornings we needed to clean the oscillator crystal which introduced a 0.5-1 hour downtime.

These statistics show the level of availability and reliability of the Artemis laser and XUV beamlines due to diode-pumping and cryogenic technology as well as the extremely stable laboratory environment and the user-friendly laser-interlock system introduced late last year. One could contemplate scheduling the facility for 24/7 operations provided the manpower and running costs are increased accordingly.

Gemini operational statistics

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During the reporting year, April 12 – April 13, a total of 5 complete experiments were delivered to the Astra-Gemini Target Area. In total 31 high power laser experimental weeks were delivered to the Gemini Target Area. The delivered schedule is presented in figure 2.

The availability of the Gemini laser system (delivery to the Gemini Target Area) was 80% during normal working hours, rising to 148% with time made up from running out of normal working hours. The reliability of the Gemini laser was 88%. An individual breakdown of the availability and reliability for the 5 experiments conducted is presented in figure 1.

The high levels of total availability were made possible by the unique operational model employed on Gemini, which involves running the laser late into the evening. In addition, during the 12/13 operating period frequent weekend operations were made available.

In order to address reliability issues the femtolasers oscillator crystal was replaced at the start of the year, which resulted in an improvement in the front end stability during evening operations. The other main issue which stops evening operations is the Quantel pump laser tripping out, this is to be ultimately addressed with a software upgrade. In the mean time this is being addressed by increasing the user familiarity with the Quantel laser allowing them to re-start the system.

During the year the pulse compression grating in the North compressor was replaced, resulting in the compressor throughput increasing to 74%. Consequently the Gemini North beam has been delivering close to the energy design specification of 15J routinely.

There were 3 system access campaigns during the year, two of which were used to test beam stabilization techniques in LA3 and transmission gratings in the front end. The third was an internal experiment to demonstrate coherent combination of the 2 Gemini beams, for results of this see annual report article by Jonathan Phillips.

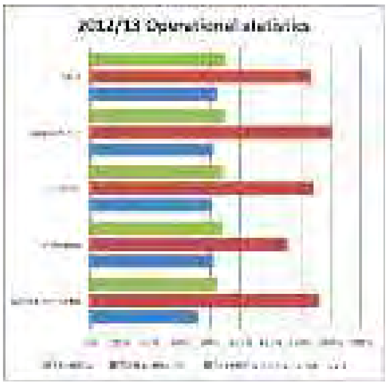

Figure 1. 2012/20013 operational statistics

Figure 2. 2012/2013 Gemini operational schedule

Lasers for Science Facility Operational Statistics

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RAL-based experiments

In the reporting period (April 2012 to March 2013), 49 different User groups performed a total of 65 experiments in the LSF laboratories at RAL. A total of 3584 hours laser time was delivered to the UK User community and European Users throughout the year, with 57 hours downtime. Chemistry formed the majority of the applications, see figure 1.

A full breakdown of number of weeks applied for versus number of weeks scheduled is shown in figure 2 indicating an oversubscription ratio of 1.73:1. The RAL-Based schedule is shown in table 1. The average User satisfaction marks obtained from the scheduled Users are shown in figure 3, with an average satisfaction of 93% across the categories.

There were a total of 36 formal reviewed publications produced from the year's efforts.

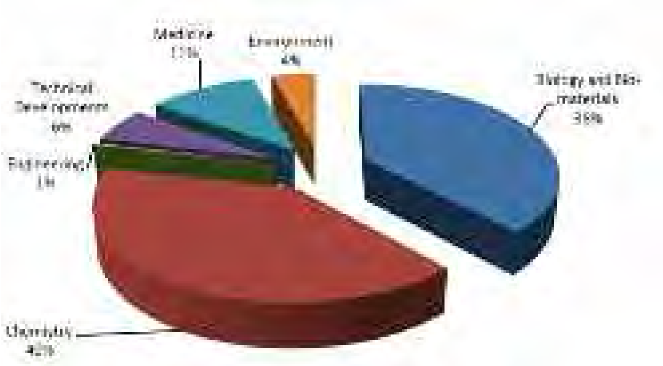

Figure 1. RAL-based bids by subject group

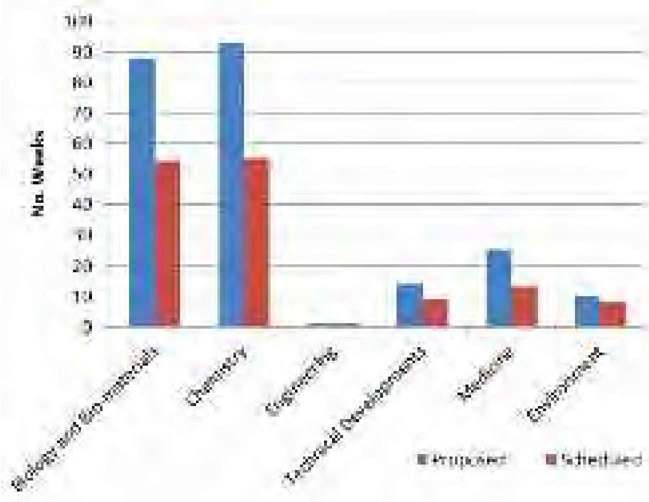

Figure 2. RAL-based experiments by subject

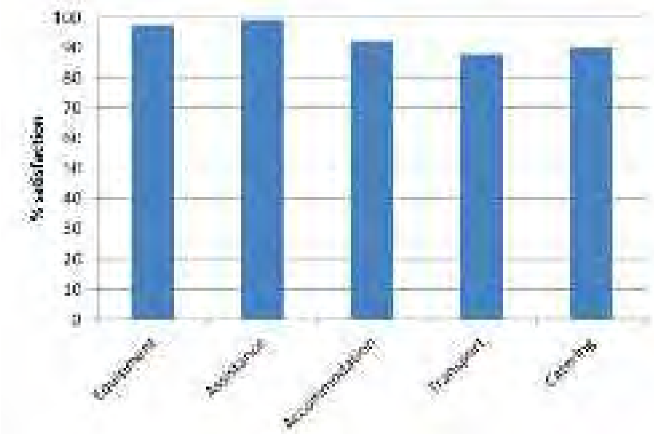

Figure 3. RAL-based average User satisfaction scores

Loan Pool

Throughout 2012/13 the Laser Loan Pool continued to provide laser loans to the UK research community. The facility delivered 330 weeks of laser time in the reporting period, supporting 13 research groups through 15 laser loans, and its work lead to the publication of 14 articles in peer reviewed journals. The ratio of weeks applied for versus weeks scheduled was 1.625:1 and the downtime was approximately 10 %.

The Light Conversion Pharos/Orpheus laser system introduced last year proved to be popular and is currently on loan to Dr Greenwood (Queen's University Belfast) who is using the laser's tuneable capabilities for Laser Induced Acoustic Desorption (LIAD) aiming to improve target plume density of biological molecules at kilohertz frequencies in an experiment designed to directly observe coherent, intra-molecular electron motion. The facility also supported the Diamond Light Source through the provision of a laser system to Dr Winter (Aberystwyth University) who performed X-ray measurements to study strain propagation in laser-shocked granular ceramics.

The Loan Pool ordered a new laser system this year which is due to arrive in early 2014. This system, which is aimed at the engineering community, is a high power Nd:YAG laser with 10 Joules in the fundamental and is ideal for peening and machining applications. This system will be equipped with second, third and fourth harmonics and available for loan in spring 2014.

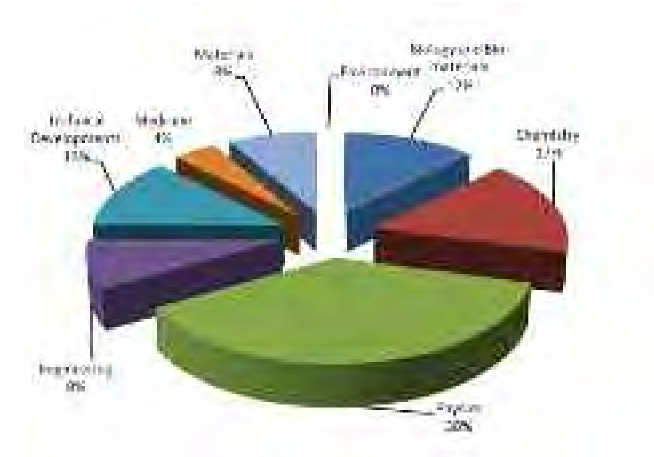

Figure 4. Loan Pool bids by subject group

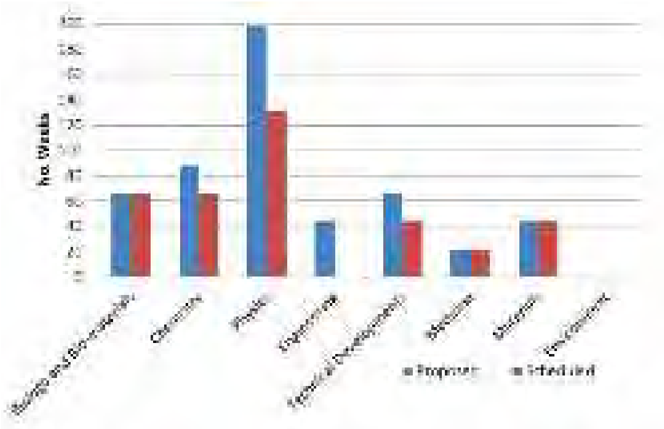

Figure 5. Loan Pool experiments by subject

Table 1: Lasers for Science Facility RAL-based Global Schedule 2012 Period 1

	Date	Functional Biosystems Imaging	Molecular Structure and Dynamics	Cross Department Research
2012	2 Apr	**J WEINSTEIN** (Uni. of Sheffield) **1120017**	MAINTENANCE	
	9 Apr	MAINTENANCE	**G GREETHAM** (STFC) **12130018**	
	16 Apr	**R FREEDMAN (Uni. Warwick)** **12130011**		
	23 Apr	LSF USER MEETING		
	30 Apr	**N KAD** (University of Essex) **12130020**	**G GREETHAM** (STFC) **12130018**	**N KAD** (University of Essex) **12130020**
	7 May	**S L IRONS** (Oxford Brookes) **12130010**	**A ORR-EWING** (University of Bristol) **12130000**	
	14 May	**N KAD** **12130020** / **R FREEDMAN** **12130011**		**N KAD** (University of Essex) **12130020**
	21 May	MAINTENANCE		**M WATSON** (University of Bristol) EPSRC/NERC SPICE PROGRAMME
	28 May	**S PASCU** (Uni. Bath) **12130013**	**S MEECH** (UEA) **12130003**	
	4 Jun	MAINTENANCE	MAINTENANCE	MAINTENANCE
	11 Jun	**S L IRONS** (Oxford Brookes) **12130010**	**R BISBY** (University of Salford) **12130008**	
	18 Jun	**M MARTIN-FERNANDEZ** (STFC) **12130007**	**A VLCEK** (Queen Mary Uni. London) **12130005**	MAINTENANCE
	25 Jun	**M AMELOOT** (Hasselt University) **12140002 – EU ACCESS**	**M GEORGE** (University of Nottingham) **12130019**	**A ALEXANDER** (Uni. Edinburgh) **12130012**
	2 July	MAINTENANCE		
	9 July	**M MARTIN-FERNANDEZ** (STFC) **12130007**	MAINTENANCE	
	16 July	**S PASCU** (Uni. Bath) **12130013**	**N HUNT** (University of Strathclyde) **12130001**	**M KING** (Royal Holloway) **12130016**
	23 July	**M MARTIN-FERNANDEZ** (STFC) **12130007**		**C PFRANG** (University of Reading) **12130021**
	30 July	**C STUBBS** (STFC) **12130002**		
	6 Aug	**S CARTMELL** (University of Manchester) **12130015**	**HEYES** (University of Manchester) **12130004**	
	13 Aug	**M AMELOOT** (Hasselt University) **12140002 – EU ACCESS**	**M GEORGE** (University of Nottingham) **12130019**	MAINTENANCE
	20 Aug	MAINTENANCE		
	27 Aug	**C HAWES** (Oxford Brookes) **12130006**	**S MEECH** (UEA) **12130003**	
	3 Sep			
	10 Sep	**F CURRELL** (QUB) **DLS MT7648**		**M KING** (Royal Holloway) **12130016**
	17 Sep	**S PASCU** (Uni. Bath) **12130013**	**S QUINN** (University College Dublin) **12140003 – EU Access**	**C PFRANG** (University of Reading) **12130021**
	24 Sep	**C HAWES** (Oxford Brookes) **12130006**		
	1 Oct	**S CARTMELL** (University of Manchester) **12130015**		

Table 1 continued: Lasers for Science Facility RAL-based Global Schedule 2012 Period 2

<table>
<tr><th></th><th>Date</th><th colspan="2">Functional Biosystems Imaging</th><th colspan="2">Molecular Structure and Dynamics</th><th>Cross Department Research</th></tr>
<tr><td rowspan="14">2012</td><td>1 Oct</td><td colspan="2">S CARTMELL(University of Manchester)
12,130,015</td><td colspan="2">S QUINN (University College Dublin)
12,140,003 – EU ACCESS</td><td>M WATSON (University of Bristol)
EPSRC/NERC/STFC SPICE PROG</td></tr>
<tr><td>8 Oct</td><td colspan="2">MAINTENANCE</td><td colspan="2" rowspan="2">MAINTENANCE</td><td>MAINTENANCE</td></tr>
<tr><td>15 Oct</td><td colspan="2"></td><td></td></tr>
<tr><td>22 Oct</td><td colspan="2"></td><td colspan="2">M GEORGE (University of Nottingham)
12,230,025</td><td></td></tr>
<tr><td>29 Oct</td><td colspan="2">R FREEDMAN
12130011</td><td colspan="2">H L ANDERSON (University of Oxford)
12,230,011</td><td>MAINTENANCE</td></tr>
<tr><td>5 Nov</td><td colspan="2">MAINTENANCE</td><td colspan="2" rowspan="3">A ORR-EWING (University of Bristol)
12,230,000</td><td></td></tr>
<tr><td>12 Nov</td><td colspan="2">I ROBINSON/J WEINSTEIN
12,230,009</td><td></td></tr>
<tr><td>19 Nov</td><td colspan="2">M MARTIN-FERNANDEZ (STFC)
12,230,029</td><td></td></tr>
<tr><td>26 Nov</td><td colspan="2">C HAWES (Oxford Brookes University)
12,230,010</td><td colspan="2">MAINTENANCE</td><td>See Functional Biosystems Imaging</td></tr>
<tr><td>3 Dec</td><td colspan="2">R FREEDMAN (University of Warwick)
12,230,007</td><td colspan="2" rowspan="3">P PORTIUS (University of Sheffield)
12,230,022</td><td>A ALEXANDER (Uni. Edinburgh)
12,130,012</td></tr>
<tr><td>10 Dec</td><td colspan="2" rowspan="2">M MARTIN-FERNANDEZ (STFC)
12,230,029</td><td></td></tr>
<tr><td>17 Dec</td><td></td></tr>
<tr><td>24 Dec</td><td colspan="5">CHRISTMAS HOLIDAYS</td></tr>
<tr><td>31 Dec</td><td colspan="5">MAINTENANCE</td></tr>
<tr><td rowspan="12">2013</td><td>7 Jan</td><td colspan="2">D BARLOW (King's College London)
12,230,005</td><td colspan="2">N SCRUTTON (University of Manchester)
12,230,002</td><td>M KING (Royal Holloway)
12,230,019</td></tr>
<tr><td>14 Jan</td><td colspan="2">J WEINSTEIN (University of Sheffield)
12,230,009</td><td colspan="2" rowspan="2">M GEORGE (University of Nottingham)
12,230,025</td><td></td></tr>
<tr><td>21 Jan</td><td colspan="2">A SCHNEIDER
12,230,015</td><td></td></tr>
<tr><td>28 Jan</td><td colspan="2">C HAWES (Oxford Brookes University)
12,230,010</td><td colspan="2" rowspan="3">S MEECH (University of East Anglia)
12,230,006</td><td>See Functional Biosystems Imaging</td></tr>
<tr><td>4 Feb</td><td colspan="2">F CURRELL (Queen's University of Belfast)
12,230,001</td><td></td></tr>
<tr><td>11 Feb</td><td colspan="2">C HAWES (Oxford Brookes University)
12,230,010</td><td>See Functional Biosystems Imaging</td></tr>
<tr><td>18 Feb</td><td colspan="2">D BARLOW (King's College London)
12,230,005</td><td colspan="2">N SCRUTTON (University of Manchester)
12,230,002</td><td></td></tr>
<tr><td>25 Feb</td><td colspan="2" rowspan="3">See Cross Department Research</td><td colspan="2">M GEORGE (University of Nottingham)
12,230,025</td><td rowspan="3">F POPE (University of Birmingham)
12,230,017</td></tr>
<tr><td>4 Mar</td><td colspan="2">MAINTENANCE</td></tr>
<tr><td>11 Mar</td><td rowspan="3">S C CHARALAMBOUS HAYES
(University of Cyprus)
12,240,003 – EU ACCESS (1 week)</td><td rowspan="3">N STINGELIN
(Imperial College London)
12,230,024 (2 weeks)</td></tr>
<tr><td>18 Mar</td><td>J WEINSTEIN
12,230,009</td><td rowspan="2">M AMELOOT
12,240,004 (EU)</td><td>M KING (Royal Holloway)
12,230,019</td></tr>
<tr><td>25 Mar</td><td>C STUBBS
12,130,002</td><td></td></tr>
<tr><td rowspan="2"></td><td>1 Apr</td><td colspan="2"></td><td colspan="2" rowspan="2">D C WILLIAMS (Trinity College Dublin)
12,240,002 – EU ACCESS
PROVISIONAL DATE</td><td></td></tr>
<tr><td>8 Apr</td><td colspan="2">F CURRELL (Queen's University of Belfast)
12,230,001</td><td>F CURRELL (Queen's Uni. Belfast)
12,230,001</td></tr>
</table>

Table 2: Lasers for Science Facility Loan Pool Schedule 2012 Period 1

	Date	NSL1	NSL2	NSL3	NSL4	UFL1	UFL2	UFL3	CWL1	Date
		Powerlite Nd:YAG + Sirah Dye + SHG + DFG	Powerlite Nd:YAG + Sirah Dye + SHG + MAD	Powerlite Nd:YAG + Panther Mid-band OPO + SHG	Powerlite Nd:YAG + Sirah Dye + SHG + DFG	Light Conversion Pharos + Orpheus + SHG	Coherent Libra OPerA Ultrafast Amp + OPA	Coherent Chameleon Ultra II + OPO Compact + SHG	NKT SuperK G2 Extreme + AOTF	
	Mar 26									Mar 26
	Apr 02									Apr 02
	Apr 09									Apr 09
	Apr 16									Apr 16
	Apr 23							**Cataluna** (Dundee) New degrees of freedom for terahertz generation from quantum-dot materials **1,152,005**		Apr 23
	Apr 30									Apr 30
	May 07									May 07
	May 14	**SERVICE & REPAIR**								May 14
	May 21									May 21
	May 28									May 28
	Jun 04									Jun 04
	Jun 11									Jun 11
	Jun 18									Jun 18
	Jun 25			**ULBRICHT** (S'hampton) Optical manipulation of complex molecules **12,150,002**						Jun 25
	Jul 02									Jul 02
	Jul 09						**MINNS** (S'hampton) High harmonic spectroscopy A new technique for the study of photo-chemical reactivity **121,50,008**			Jul 09
2012	Jul 16					**UNALLOCATED**				Jul 16
	Jul 23									Jul 23
	Jul 30									Jul 30
	Aug 06									Aug 06
	Aug 13									Aug 13
	Aug 20								**KUKURA** **(Oxford)** Single molecule absorption spectroscopy **12,150,009**	Aug 20
	Aug 27	**SHAH** (ICR) Purification of gold nanorods using a tunable laser for photo-acoustic imaging **1,152,007**								Aug 27
	Sep 03									Sep 03
	Sep 10							**MAHAJAN** (Cambridge) Label-free chemical imaging system for cancer detection **12,150,003**		Sep 10
	Sep 17									Sep 17
	Sep 24		**BROWN** (UCL) Photo-catalysis on carbon-aceous surfaces **12,150,005**							Sep 24
	Oct 01									Oct 01
	Oct 08									Oct 08
	Oct 15									Oct 15
	Oct 22									Oct 22
	Oct 29									Oct 29

Table 2 continued: Lasers for Science Facility Loan Pool Schedule 2012 Period 2

	Nov 05									**Nov 05**
	Nov 12									**Nov 12**
	Nov 19									**Nov 19**
	Nov 26									**Nov 26**
	Dec 03									**Dec 03**
	Dec 10						**BRYAN** (Swansea) Pondero-motive compression and metrology of femtosecond electron pulses **12,250,005**			**Dec 10**
	Dec 17			**WINTER** (Aberystwyth) Strain propagation in laser-shocked granular ceramics **12,250,006**						**Dec 17**
	Dec 24									**Dec 24**
	Dec 31									**Dec 31**
	Jan 07									**Jan 07**
	Jan 14									**Jan 14**
	Jan 21					**MUSKENS** (S'hampton) Ultrafast all-optical nano-plasmonic modulator **12,250,002**				**Jan 21**
	Jan 28									**Jan 28**
	Feb 04									**Feb 04**
	Feb 11									**Feb 11**
2013	**Feb 18**									**Feb 18**
	Feb 25				**LEVY** (Northumbria) Preliminary studies of chemi-luminescence in $Ni + RO \rightarrow NiO^{*} + R$ (R = O, NO, N_2, O_2) **12,250,003**					**Feb 25**
	Mar 04							**CATALUNA** (Dundee) Ultrafast characterization of carbon-based nano-materials **12,250,008**		**Mar 04**
	Mar 11									**Mar 11**
	Mar 18									**Mar 18**
	Mar 25									**Mar 25**

Target Fabrication operational statistics

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RAL Experiments

A total of four Astra Gemini and eight Vulcan experiments were supported by Target Fabrication in the reporting period April 2012 to April 2013, four more than the last reporting year. For solid target experiments the Target Fabrication Group provided a total of 36 weeks of experimental support for Vulcan and 21 weeks for Astra Gemini. However this report does not include the extensive amount of filter and pinhole support provided from Target Fabrication for gas jet experiments and also does not include support for other areas of the CLF such as Artemis and the LSF. The total number of weeks of target support rose from 46 to 51 from last year compared to this year.

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 targets are defined as targets that have taken significant highly skilled micro assembly 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 2012-2013 was 1801 compared to 1080 in 2011–2012 and 1532 in 2010-2011. During 2012-2013 the number of high specification targets increased from 355 in the last reporting year to 549, accounting for 30% of the total targets produced, around the same proportion as the last year of 33%.

Experiment	Targets Produced	High Specification Targets
0512 GTA	217	8
0512 TAW	278	93
0612 TAW	108	0
0812 TAP	219	19
0812 GTA	68	22
0912 TAW	237	0
0912 TAP	176	160
0113 TAP	49	0
0113 TAW	164	96
0113 GTA	51	0
0313 GTA	58	38
0414 TAP	176	113
TOTAL	1801	549

Table 1: Target production summary for 2012-2013. High specification targets include 3D micro-structures, low density targets and mass limited targets.

2) Target Categories

The targets can be separated into 7 main categories as shown in Figure 1 and Table 2. It is worth noting that, although single target foils were sent to Gemini, these targets were mounted onto an array of numerous single target positions. The Gemini set up takes multiple shots on each array with up to 25 shots available per single target array. One array foil accounts for one mass produced foil in Table 2 below, and 47 mass produced foils give a total of over 1000 possible shots.

Target Category	Targets Produced
Mass Produced Foils	58
Ultra-Thin Foil	302
Thick Foils	717
Multi-layered foils (>2 layers)	132
Alignment	147
3D Micro-structures	427
Foams	20

Table 2: Target category summary, Ultra-thin foils consist of foils of 500nm and below and mass produced are specially mounted for high repetition rate Gemini experiments.

Table 2 is not a reflection of time spent on each target type as some targets require a significant amount of R&D to achieve. For example each one of the 20 foam targets shot required considerably more staff time and resource to produce than a single foil target.

Figure 1: 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, 33% of the targets that were shot were modified or redesigned from the planned target specifications. This is similar to the figures for recent years which were 30% in 2011-2012 and 34% in 2008-2009. However it is somewhat lower than the figure for 2009-2010 which was 42%. There were approximately 300 different target variants with 15 of the variants comprising approximately 50% in quantity of the total targets made all of which were pre-planned targets. The rest of the pre-planned targets (20%) and all the modified targets (30%) comprised the 285 other target variants and were in quantities of less than 30. This shows that the majority of the target variants were unplanned and required Target Fabrication's unique adaptability to produce a large variety of unplanned targets.

4) Adapting to Demand

The Target Fabrication Group endeavors to be adaptable to the changing demands of the user community as experiments develop because each experiment that is carried out often has widely varying target demands; the group is required to be constantly developing its capabilities. Ultra-thin foils have continued to be popular from last year to this year increasing from 202 to 302 targets produced. As well as foil targets, 3D assemblies, mass limited and foam targets were fielded by 5 experiments in both Gemini and Vulcan and the combined quantity produced increased significantly from 246 in 2011-2012 to 457 2012-2013. It can be seen from figure 2 that requirements for all targets types have increased by approximately 60% since the last reporting year.

Figure 2: Target Delivery Summary

5) Waste Reduction

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. It is worth noting that most of the experiments had no returned targets at all in this reporting period with the maximum being 13% in 0912 TAP. 13% 'not shot' rate is consistent with last year's (10% average) which was a dramatic reduction from previous years. In 2010-2011 23% of targets that were fabricated were either returned un-shot to Target Fabrication or were unused and the figures for 2009-2010 and 2008-2009 were 43% and 34% respectively.
This reduction can be accounted for by the continued implementation of the ISO9001 Quality Management System which has allowed the Target Fabrication Group to plan experimental delivery of targets in a more structured way. Improved planning processes enable long term delivery projects to be managed effectively but has not led to less flexibility as the percentage of re-designed and additional targets is in line with the figures for 2008-2009 and 2007-2008.
It is worth noting that any unissued or returned targets are carefully sorted and high aspect ratio targets are stored under closely controlled conditions for potential use on future experiments. Where possible all spare target components and mounts are also stored for future use. The variety of mounts and components held in stock by the Target Fabrication Group contribute to their ability to adapt target designs quickly in response to experimental changes.

External Contracts

Scitech Precision Ltd, (a spinout company from CLF Target Fabrication) also supplied microtargets, specialist coatings and consultancy to a number of external contracts. In the year 2012-2013 a total of thirty-six contracts were completed for coatings, characterisation and also full target design and assembly. These contracts were delivered to external facilities in countries including France, Germany, Italy, India and the US.

Summary

Target Fabrication has supported twelve internal and thirteen other UK and international 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 compared to 2011-2012 with four more target experiments running compared to the previous period.

References

1. *D.Haddock, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2011-2012, p71-72*
2. *H. F. Lowe, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2010-2011, p76-77.*
3. *H. F. Lowe, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2009-2010, p55-56.*
4. *H. F. Lowe, C. Spindloe & M. Tolley, Target Fabrication Operational Statistics, CLF Annual Report 2008-2009, p326-327.*

Vulcan operational statistics

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Introduction

Vulcan has completed an active experimental year, with 36 full experimental weeks allocated to target areas TAW and TAP between April 2012 and March 2013. This figure is down on previous years due to Vulcan being inaccessible to users between October 2012 and January 2013 in order to install new beamlines between the front end and laser areas.

PERIOD	TAW	TAP
2012		
30 Apr – 03 Jun	G Gregori Turbulent amplification of cosmological magnetic fields in laboratory experiments (198, 12, 93.9%) (89.3%, 111.7%)	
18 Jun – 22 Jul	P Norreys Control and application of parametric processes for channel formation, over-dense propagation and energy transfer (66, 7, 89.4%) (84.5%, 98.7%)	
30 Jul – 02 Sep		S Kar Fusion – Neutron source employing radiation pressure driven ions (151, 31, 79.5%) (81.4%, 110.4%)
17 Sep – 21 Oct	M Borghesi Collisionless shock waves in rarefied, magnetized media (115, 19, 83.5%) (90.7%, 117.8%)	D Carroll Measurement of magnetic fields generated by hot electrons within glass targets (73, 2, 97.3%) (83.7%, 110.8%)
Installation of New Beamlines		
2013		
28 Jan – 03 Mar		D Neely Innovations (91, 4, 95.6%) (87.8%, 110.0%)
04 Feb – 10 Mar	M Roth Characterization of the melting of graphite under shock compression using X-ray scattering (140, 16, 88.6%) (94.7%, 120.8%)	
14 Mar – 20 Mar	K Spohr Production and decay of radioactive 26-Al in laser induced plasma, pump priming an astrophysical laboratory (26, 2, 92.3%) (91.5%, 121.3%)	

Table 1. Experimental schedule for the period April 2012 – March 2013

(Total shots fired, failed shots, reliability)
(Availability normal, additional hours

Table 1 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 and the percentage of successful shots. The second set of numbers are the availability of the laser to target areas during normal operating hours and including outside hours operations.

The total number of full disc amplifier shots that have been fired to target this year is 860. Table 2 shows that this figure compares favourably with recent years. 93 shots failed to meet user requirements. The overall shot success rate to target for the year is 89%, compared to 91%, 85%, 89% and 92% in the previous four years. Figure 1 shows the reliability of the Vulcan laser to all target areas over the past five years.

	No of shots	Failed shots	Reliability
08 - 09	646	61	91%
09 – 10	445	65	85%
10 – 11	764	87	89%
11 - 12	641	54	92%
12 - 13	860	93	89%

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

The shot reliability to TAW has remained consistent at around 90% compared with 2011-2012, which is particularly encouraging as this follows the installation of the new beamlines[1] The shot reliability to TAP is around 88% - down slightly from 92% in 2011-12.

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 we are in the process of commissioning high repetition rate camera-based energy monitors in the front end and throughout the laser area to identify and resolve specific sources of instability.

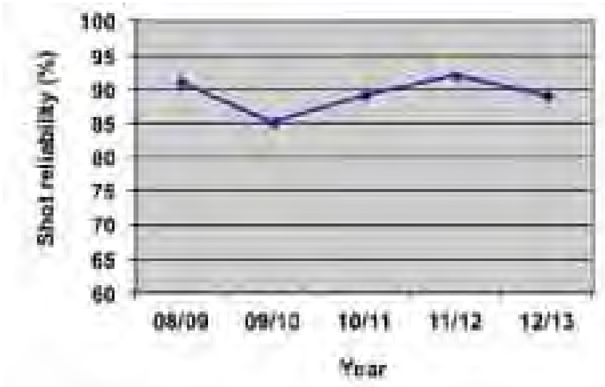

Figure 1. All areas shot reliability for each year 2008-9 to 2012-13

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). This figure is now 195 hours for five week experiments. 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 87.5% of the time during contracted hours and 111.8% overall. These figures compare with 74.2% and 111.2% in 2011-2012 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.

Reference

1. B Parry, report on installation of beamlines on Vulcan, CLF Annual Report 2012-2013.