Schedules and operational statistics

8

Astra

Artemis

Lasers for Science Facility

Vulcan

Target Fabrication

Astra operational statistics 08/09

Contact **S.J.Hawkes@stfc.ac.uk**

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During the reporting year April 08 – March 09 a total of 4 complete experiments were delivered to the two Astra Target Areas. 3 experiments were delivered to the Gemini Target Area and 1 experiment in Astra Target Area 2. In total 20 high power laser experimental weeks were delivered to the Gemini Target Area, in addition to 3 set up weeks. In total 6 weeks were delivered to Target Area 2. The delivered schedule is presented below in figure 1.

The availability of the Gemini laser system (delivery to the Gemini Target Area) was 75% during normal working hours, rising to 113% with time made up from running out of normal working hours. The reliability of the Gemini laser was 82%. The availability of the Astra laser (delivery to ATA2) was 73% during normal working hours, rising to 101% with time made up from running out of normal working hours. The reliability of the Astra laser was 79%.

		Gemini	ATA2
07-Apr-08	13-Apr-08	Z. Najmudin Extension	
14-Apr-08	20-Apr-08		
21-Apr-08	27-Apr-08	Maintenance	
28-Apr-08	04-May-08		
05-May-08	11-May-08		
12-May-08	18-May-08		
19-May-08	25-May-08	S. Hooker	
26-May-08	01-June-08	G307-08P2	
02-June-08	08-June-08		
09-June-08	15-June-08		
16-June-08	22-June-08		
23-June-08	29-June-08	S. Hooker Extension	
30-June-08	06-July-08		
07-July-08	13-July-08	Quantel service	
14-July-08	20-July-08	Setup	D. Symes
21-July-08	27-July-08		81022
28-July-08	03-Aug-08	D. Jaroszynski	
04-Aug-08	10-Aug-08	81030	
11-Aug-08	17-Aug-08		
18-Aug-08	24-Aug-08		
25-Aug-08	31-Aug-08		
01-Sep-08	07-Sep-08	South beam optimisation	
08-Sep-08	14-Sep-08		
15-Sep-08	21-Sep-08		
22-Sep-08	28-Sep-08		
29-Sep-08	05-Oct-08		
06-Oct-08	12-Oct-08		
13-Oct-08	19-Oct-08		
20-Oct-08	26-Oct-08	Target area preparation	
27-Oct-08	02-Nov-08	South beam optimisation	D. Symes extension
03-Nov-08	09-Nov-08		
10-Nov-08	16-Nov-08		
17-Nov-08	23-Nov-08		
24-Nov-08	30-Nov-08		
01-Dec-08	07-Dec-08	J. Wark	
08-Dec-08	14-Dec-08	81007	
15-Dec-08	21-Dec-08	Coseners meeting	
22-Dec-08	28-Dec-08	Christmas	
29-Dec-08	04-Jan-08		
05-Jan-09	11-Jan-09		
12-Jan-09	18-Jan-09		
19-Jan-09	25-Jan-09	Target area preparation	
26-Jan-09	01-Feb-09	South beam optimisation	
02-Feb-09	08-Feb-09		
09-Feb-09	15-Feb-09		
16-Feb-09	22-Feb-09		
23-Feb-09	01-Mar-09	Maintenance	
02-Mar-09	08-Mar-09	Setup	
09-Mar-09	15-Mar-09		
16-Mar-09	22-Mar-09		
23-Mar-09	29-Mar-09	M. Borghesi (LIBRA)	
30-Mar-09	05-Apr-09	81025	

Figure 1. Astra experimental schedule.

The experiment by experiment availability and reliability of the Gemini laser system is presented below (fig 2). It is clear from the data that this has improved from the Najmudin experiment in the previous year as staff gained a better understanding of the laser's workings and its performance capabilities.

Extensive de-bugging of the laser during the Najmudin experiment in the period 07-08 had identified a number of areas that needed to be addressed in order to improve the operational statistics. This included the use of 2 operators, one being the Astra operator as previously, the other a dedicated Gemini operator who is responsible for aligning the Gemini amplifiers and the Quantel pump lasers in parallel with Astra operations. This allowed the Gemini laser to come online sooner during the day. Issues with reliability of the Quantel pump laser were addressed with a new software control system and replacement of damaged components.

Areas identified for improvement are the replacement of the macholite pump laser, which provides the pump source for the 3rd Astra amplifier. An extensive re-build of the 3rd Astra amplifier including 4 new pump lasers, automated alignment systems and new infrastructure is planned for the summer of 09. A replacement for the Jade laser which provides the pump source for the front end systems is planned for the period 09/10, this is to be replaced with a more reliable JADE2 system, already bought for this purpose. A campaign of contrast improvement is also planned for the summer and autumn, with investigation into double CPA schemes and cross polarize wave concepts planned. Investment has been made in a spatial light modulator to replace the Dazzler, this will give greater control over the shape of the spectrum and spectral phase.

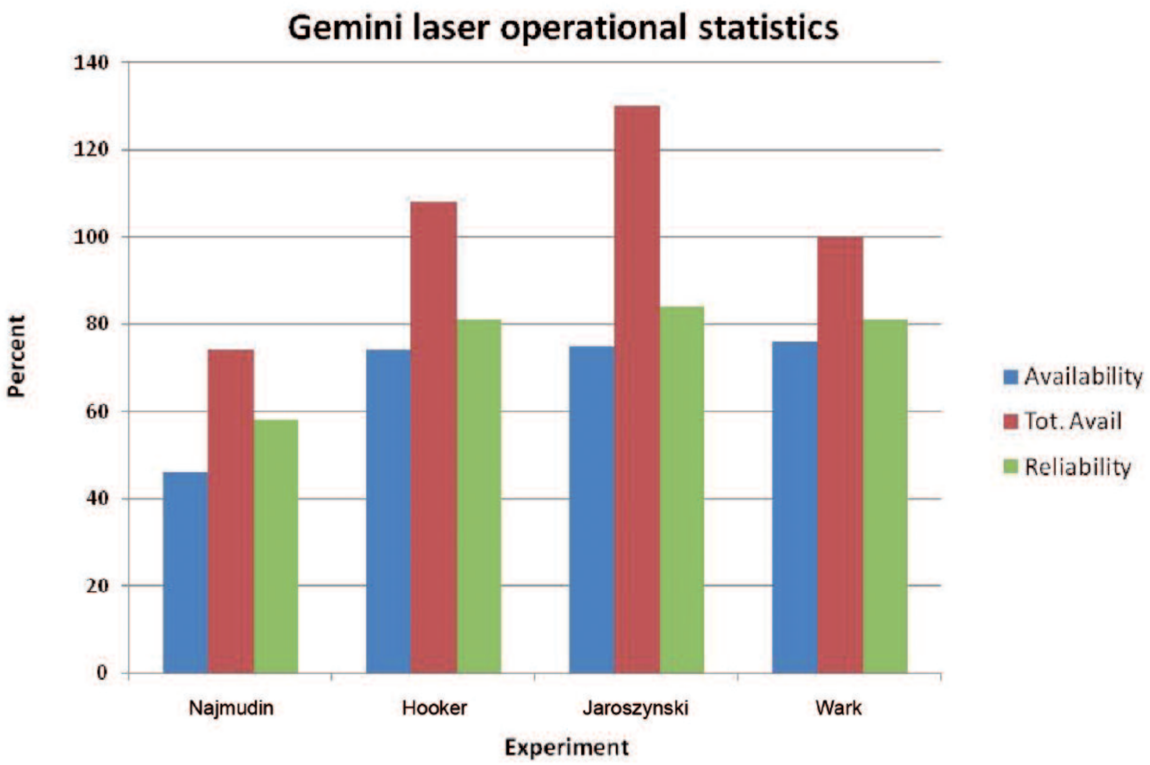

Figure 2. Gemini operational statistics 2008/9.

Artemis operational statistics 08/09

Contact **Edmond.Turcu@stfc.ac.uk**

E. Turcu

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During the reporting year April 08-March 09 a total of 3 experiments were delivered in the new Artemis laboratory, which is under development, as shown in Table 1. In total 16 experimental weeks were delivered to users and 34 development weeks were allocated for the Artemis project development.

Artemis	2008-2009	
	Start	End
	31-Mar-08	06-Apr-08
	07-Apr-08	13-Apr-08
	14-Apr-08	20-Apr-08
	21-Apr-08	27-Apr-08
	28-Apr-08	04-May-08
Laboratory	05-May-08	11-May-08
Re-commissioning	12-May-08	18-May-08
and	19-May-08	25-May-08
Artemis	26-May-08	01-June-08
Development	02-June-08	08-June-08
	09-June-08	15-June-08
	16-June-08	22-June-08
	23-June-08	29-June-08
	30-June-08	06-July-08
	07-July-08	13-July-08
	14-July-08	20-July-08
	21-July-08	27-July-08
	28-July-08	03-Aug-08
Greenwood	04-Aug-08	10-Aug-08
Cold Molecular Ions	11-Aug-08	17-Aug-08
	18-Aug-08	24-Aug-08
	25-Aug-08	31-Aug-08
	01-Sep-08	07-Sep-08
	08-Sep-08	14-Sep-08
	15-Sep-08	21-Sep-08
Artemis	22-Sep-08	28-Sep-08
Development	29-Sep-08	05-Oct-08
	06-Oct-08	12-Oct-08
	13-Oct-08	19-Oct-08
	20-Oct-08	26-Oct-08
	27-Oct-08	02-Nov-08
	03-Nov-08	09-Nov-08
	10-Nov-08	16-Nov-08
EU-Poletto	17-Nov-08	23-Nov-08
Monochromatic XUV	24-Nov-08	30-Nov-08
Beamline	01-Dec-08	07-Dec-08
	08-Dec-08	14-Dec-08
	15-Dec-08	21-Dec-08
Christmas	22-Dec-08	28-Dec-08
and New Year	29-Dec-08	04-Jan-08
	05-Jan-09	11-Jan-09
	12-Jan-09	18-Jan-09
	19-Jan-09	25-Jan-09
Artemis	26-Jan-09	01-Feb-09
Development	02-Feb-09	08-Feb-09
	09-Feb-09	15-Feb-09
	16-Feb-09	22-Feb-09
	23-Feb-09	01-Mar-09
Marangos	02-Mar-09	08-Mar-09
1300nm HHG from	09-Mar-09	15-Mar-09
Aligned Molecules	16-Mar-09	22-Mar-09
	23-Mar-09	29-Mar-09

Table 1. Artemis schedule 2008-09

The overall availability of Artemis was 73% rising to 118% with additional time from out of normal hours operations. Laser reliability was 82%.

Investigator	Availability in normal hours	Overall availability	Reliability
Greenwood	50	109	69
Poletto	85	106	88
Marangos	84	140	90

Table 2. Artemis statistics 2008-09

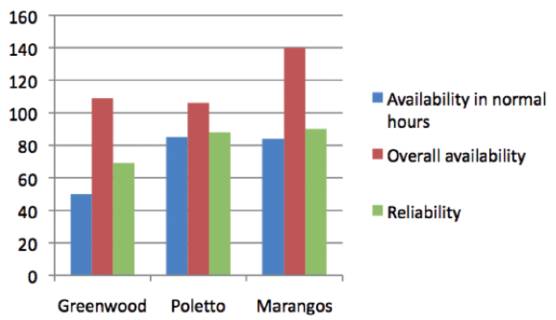

Figure 1. Artemis availability and reliability 2008-09.

During the reporting year Artemis underwent the most sustained period of development in the project. The new Red Dragon and HE-Topas lasers were installed and were used in experiments. New X-ray beam-lines were installed. The new XUV high-harmonic-generation chamber with kHz HHG gas jet and flat-field spectrometer were installed and used in experiments. The new monochromatic beamline, time-preserving-XUV-monochromator and toroidal mirror chamber are fully operational and being used in experiments.

Table 2 and Figure 1 are an experiment by experiment break down of the Artemis facility performance for the reporting year. The first experiment was the first to use the newly installed Red Dragon laser coupled into the hollow fibre compressor and teething problems with the new laser system resulted in a lower availability and reliability. The facility performance improved to the excellent availability and reliability demonstrated in the Marangos experiment which used the Red Dragon and HE-Topas converter from 780 nm to 1300 nm wavelength.

8

Lasers for Science Facility operational statistics 08/09

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RAL-based experiments

Within the reporting period the LSF welcomed the arrival of the Advanced Single Molecule Imaging and Dynamics (ASMID) group from Daresbury adding new capability to LSF's biological science programmes. The year also saw the LSF beginning to restructure itself in readiness to moving into the new Reseaerch Complex at Harwell presently under construction as well as adapting its structure following the previous year's reviews. In the reporting period (April 2008 to March 2009), 29 different User groups performed a total of 35 experiments in the LSF laboratories at RAL. A total of 2785 hours laser time was delivered to the User community and European Users throughout the year, with only 89 hours downtime. The majority subject group scheduled was biological related science, see figure 1. A full breakdown by subject number of weeks applications verses weeks scheduled is shown in figure 2 showing between a 2-3 times 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 51 formal reviewed publications produced from the years efforts, with the LSF programme supporting 11 students working towards a PhD in the reporting year.

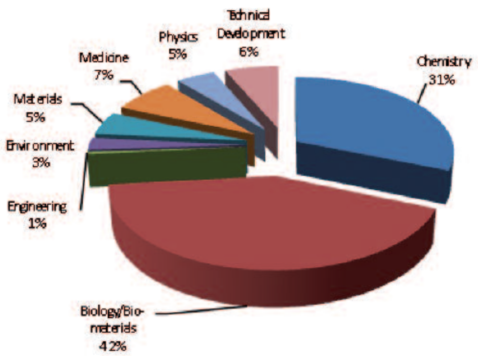

Figure 1. RAL-based bids by subject group.

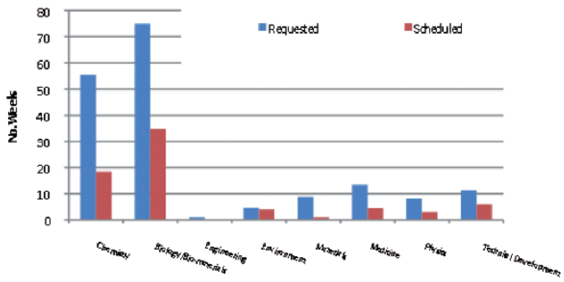

Figure 2. RAL-based experiments by subject.

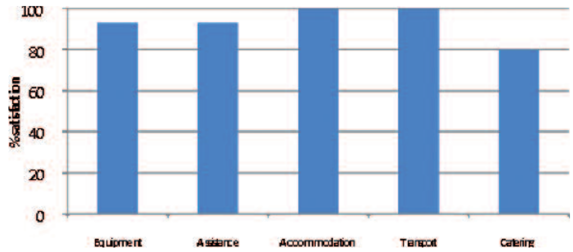

Figure 3. RAL-based average user satisfaction scores.

Loan Pool

During this reporting period the LSF was successful in obtaining a new 5 year grant worth £2.6M from EPSRC (EP/G03088X/1) to continue operation of the Loan Pool, which had for some time been operating on the remaining funds from the previous grant. These funds will see 6 of the pool's 8 lasers replaced with the old systems retired to the user community. The LSF is at present in the process of establishing a steering committee for the Loan Pool to advise on development strategies for the Laser Loan Pool facility, helping to assess potential purchases to ensure continued popularity amongst the UK research community by operating lasers suited to its requirements and thus maintaining the standard of the facilities internationally leading research.

The Loan Pool delivered 484 weeks of laser time in the reporting period with a ratio of weeks applied versus scheduled of 1.59:1. Downtime was only 9 weeks and was due to minor breakdowns throughout the year. The years activity saw 8 new research groups use the Loan Pool. The chemistry community was once again the biggest user with 50% of allocated time, however there has been an increase in applications and usage of the pool for bioscience. The breakdown is shown in figure 4. The Loan Pool schedule is shown in table 2. There were a total of 10 publications, 3 conference presentations including posters and 4 PhD thesis published during the reporting year.

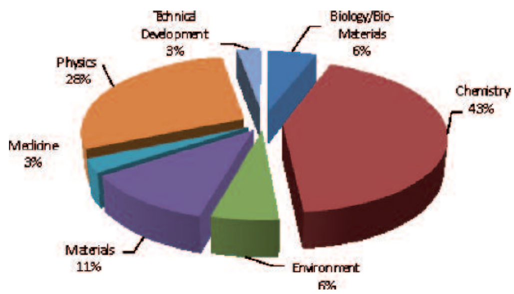

Figure 4. Loan Pool bids by subject group.

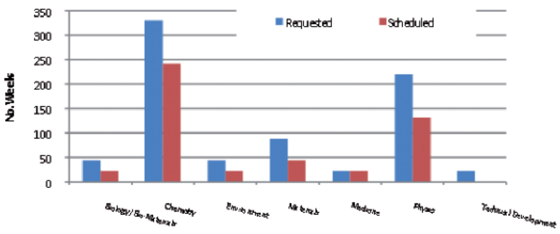

Figure 5. Loan Pool experiments by subject.

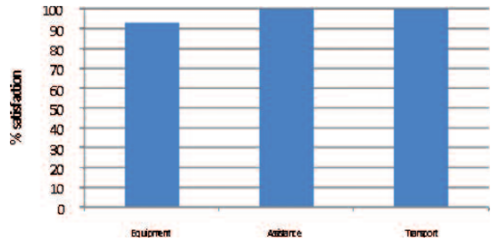

Figure 6. Loan Pool average user satisfaction scores.

Date	Confocal Microscopy Laboratory	Raman Tweezers Laboratory	ASMID	Ultrafast Spectroscopy Laboratory
Mar 31		MAINTENANCE		**A. VLCEK** 81,005 (QMUL)
April 07	**P. O'NEILL** 81,048 (MRC)	**A. WAGNER** 81,057 (Diamond)		MAINTENANCE/ TOPAS INSTALLATION
April 14		**P. GARDNER** 81,035 (MIB) *Optical tweezers Raman spectroscopy of cell lines*		
April 21	**C. STUBBS** 81,033 (Brookes)			LABORATORY SETUP AND TRAINING
April 28	**A. JESHTADI** 81,007 (Brookes) *Fowlpox virus putative structural protein interactions*			**A. WARD** 81,064 (CLF) *White-light whispering gallery modes*
May 05				
May 12			**C. BALLESTREM** 81,051 (Manchester)	
May 19	MAINTENANCE			**T. WELLER** 81,065 (ISIS) *Graphitisation of diamond using ultrafast lasers*
May 26	**P. O'NEILL** 81,048 (MRC)			
June 02				
June 09				TRIR TESTS
June 16				ULTRA IMPLEMENTATION
June 23			**J. SANDERSON** 81,052 (Durham)	**S. MEECH** 72,022 (UEA)
June 30	**C. BALLESTREM** 81,051 (Manchester)			ULTRA IMPLEMENTATION
July 07		**P. O'NEILL** 81,048 (MRC)	**A. WARD** (STFC/MSF) *Cloud chamber*	
July 14			TWEEZERS NANOPROBE DEVELOPMENT	**P. PORTIUS** 81,066 (Sheffield) *TRIR study of the photochemistry of energetic compounds*
July 21		**R. BISBY** 81,037 (Salford)		
July 28				
Aug 04	MAINTENANCE			
Aug 11			**A. WARD** (STFC/MSF) *Cloud chamber*	**S. QUINN** 81,030 (Trinity College Dublin) *Unravelling the photodynamics of nucleic acid base systems*
Aug 18			**M. KING** 81,069 (Royal Holloway)	
Aug 25	**T. NG** 81,009 (King's College London) *Unravelling supra-molecular rules in signal receptor networks*		**A. WARD** (STFC/MSF) *Cloud chamber*	2D-IR PREPARATION
Sept 01	**K. SADER** 81,018 (SuperSTEM)		**M. KING** 81,069 (Royal Holloway)	**S. QUINN** 81,030 (Trinity College Dublin)
Sept 08	**A. JACKSON** 81,026 (Cambridge)			2D-IR PREPARATION
Sept 15				**N. HUNT** 81,020 (Strathclyde) *Transient 2D-IR spectroscopy – real time absorption of chemical reactions*
Sept 22	**A. SHRIVE** 81,039 (Keele)			

Table 1. Lasers for Science Facility RAL-based schedule period 1 and 2 (2008/09).

<table>
<tr><th>Date</th><th>Confocal Microscopy Laboratory</th><th>Raman Tweezers Laboratory</th><th>ASMID</th><th colspan="2">Ultrafast Spectroscopy Laboratory</th></tr>
<tr><td>Sept 29</td><td></td><td>**R. BISBY**
81,037 (Salford)</td><td></td><td colspan="2" rowspan="3">**N. HUNT**
81,020
(Strathclyde)</td></tr>
<tr><td>Oct 06</td><td>**A. SHRIVE**
81,039 (Keele)</td><td></td><td></td></tr>
<tr><td>Oct 13</td><td>**T. NG** 81,039
(King's College London)</td><td>**I. MUELLER-HARVEY**
81,072 (Reading)</td><td></td></tr>
<tr><td>Oct 20</td><td>**K. SADER**
81,018 (SuperSTEM)</td><td></td><td></td><td colspan="2" rowspan="2">ULTRA DEVELOPMENT</td></tr>
<tr><td>Oct 27</td><td>**C. BALLESTREM**
81,051 (Manchester)</td><td></td><td></td></tr>
<tr><td>Nov 03</td><td>**K. SADER**
81,018 (SuperSTEM)</td><td></td><td>**J. SANDERSON**
81,052 (Durham)</td><td colspan="2" rowspan="2">**A. PARKER**
81,043 (CLF)
Characterisation of intermediates in serotonin and 5-hydroxytryptophan</td></tr>
<tr><td>Nov 10</td><td rowspan="2">**A. SHRIVE**
81,039 (Keele)
Structural studies of human CRP interaction with C-polysaccharide</td><td>**A. JESHTADI**
81,007 (Brookes)</td><td></td></tr>
<tr><td>Nov 17</td><td>**C. STUBBS**
81,033 (Brookes)</td><td rowspan="2">**C. NEYLON**
81,070 (ISIS)
Single molecule studies of the Tus-Ter protein DNA interaction</td><td colspan="2" rowspan="2">**A. VLCEK**
81,005 (QMUL)
Electron hopping in proteins</td></tr>
<tr><td>Nov 24</td><td></td><td>TRAINING</td></tr>
<tr><td>Dec 01</td><td>**K. SADER**
81,018 (SuperSTEM)</td><td></td><td></td><td colspan="2" rowspan="3">**I. CLARK**
81,061 (STFC)
Temperature and time resolved spectroscopy on the ultrafast timescale</td></tr>
<tr><td>Dec 08</td><td>**A. SHRIVE**
81,039 (Keele)</td><td></td><td>**A. WAGNER**
81,057 (Diamond)</td></tr>
<tr><td>Dec 15</td><td></td><td></td><td></td></tr>
<tr><td>Dec 22</td><td colspan="5" rowspan="2">CHRISTMAS AND NEW YEAR</td></tr>
<tr><td>Dec 29</td></tr>
<tr><td>Jan 05</td><td rowspan="13">RELOCATION OF ASMID</td><td></td><td rowspan="5">BT-LIBRA DEVELOPMENT</td><td>**I. CLARK**
81,061
(STFC)</td><td rowspan="3">**M. KUIMOVA**
81,071
(Imperial)
Electron and energy transfer from 2-aminopurine to guanine</td></tr>
<tr><td>Jan 12</td><td></td><td rowspan="2">ULTRA DEV.</td></tr>
<tr><td>Jan 19</td><td></td></tr>
<tr><td>Jan 26</td><td>**C. STUBBS**
81,033 (Brookes)</td><td colspan="2" rowspan="3">ULTRA DEVELOPMENT</td></tr>
<tr><td>Feb 02</td><td>**A. JESHTADI**
81,007 (Brookes)</td></tr>
<tr><td>Feb 09</td><td></td><td rowspan="2">**C. PFRANG**
81,025 (Reading)
Exploring NO_x chemistry in levitated aqueous aerosol droplets</td></tr>
<tr><td>Feb 16</td><td rowspan="2">**C. STUBBS**
81,033 (Brookes)
Protein signalling pathways involving P13K, mTOR and MEK</td><td colspan="2">**J. KELLY** 81,028 (TCD)
TR^3 spectroscopy of quantum dots</td></tr>
<tr><td>Feb 23</td><td rowspan="6">CALL FOR ACCESS AUTUMN 2008</td><td>ULTRA DEV.</td><td>**S. ELLIOTT**
81,015
(Cambridge)</td></tr>
<tr><td>Mar 02</td><td></td><td colspan="2" rowspan="2">ULTRA DEVELOPMENT</td></tr>
<tr><td>Mar 09</td><td></td></tr>
<tr><td>Mar 16</td><td></td><td rowspan="3">ULTRA DEV.</td><td rowspan="3">**P. MATOUSEK**
81,063
(STFC)
NIR Kerr Gate</td></tr>
<tr><td>Mar 23</td><td></td></tr>
<tr><td>Mar 30</td><td></td></tr>
</table>

Table 1. Lasers for Science Facility RAL-based schedule period 1 and 2 (2008/09) *(continued)*

Date	NSL1 YAG/Dye Powerlite + Sirah + SHG + DFG	NSL2 YAG/Dye Powerlite + Sirah + SHG + MAD	NSL3 YAG/ Mid-band OPO + SHG	NSL4 YAG/Dye Powerlite + Sirah + SHG	NSL5 YAG/Dye Spectra Pro + Sirah + SHG	UFL1 Coherent Verdi/Mira + SHG + THG	UFL2 Coherent Libra OPerA Ultrafast Amp + OPA	CWL1 Frequency Doubled Argon Ion
Feb 25			S. Elliott (Cambridge) 72,006	S. Hochgreb				J. Weinstein
Mar 03	I. Walmsley	L. Snoek		(Cambridge)		J. Wu	A. Hodgson	(Sheffield)
Mar 10	(Oxford)	(Oxford)		*CO/NO laser*		(York)	(Liverpool)	*Resonance Raman insight*
Mar 17	72,024	72,003		*induced*		*Ultrafast spin*	*Surface*	*into electronic*
Mar 24				*fluorescence*		*dynamics in*	*dynamics*	*structure of photo-,*
Mar 31				72,005		*heat-assisted*	*initiated by*	*solvato- and*
April 07						*magnetic*	*hot electrons*	*electrochromic*
April 14						*recording*	72,012	*metal-based molecular*
April 21						72,043		*systems*
April 28								72,045
May 05								
May 12								
May 19								
May 26								
June 02								
June 09								
June 16								
June 23								
June 30	I. Walmsley							
July 07	(Oxford)	Simons		L. Snoek				
July 14	*Attosecond*	(Oxford)		(Oxford)				
July 21	*pulse*	*Hydrophilic and*	S. Elliott	*IR-MPD of*	G. Hancock		J. Wu	M. Brust
July 28	*generation*	*hydrophobic*	(Cambridge)	*small histidine-*	(Oxford)		(York)	(Liverpool)
Aug 04	*by molecular*	*carbo-hydrate*	*Stimulated*	*containing*	*Vibrational*		*Ultrafast*	*Laser photo-*
Aug 11	*modulation in*	*interactions*	*Raman and*	*antioxidant*	*emission from*		*angular*	*thermal*
Aug 18	*hollow-core*	80,001	*rare-earth-ion*	*peptides in a*	*electronic*		*momentum –*	*cancer*
Aug 25	*photonic*		*mid-IR*	*quadrupole*	*quenching*		*energy transfer*	*therapy*
Sep 01	*crystal fibres*		*emission*	81,049	81,049		*between*	*using metal*
Sep 08	81,062		*spectroscopies*				*photons and*	*nanoparticles*
Sep 15			81,024				*spins in CoPt*	81,004
Sep 22							*TbFe*	
Sep 28							81,053	
Oct 06								
Oct 12								
Oct 20						A. Jones		
Oct 27						(Edinburgh)		
Nov 03						*2-photon*		
Nov 10						*excitation*		
Nov 17						*microscopy*		
Nov 24						*and confocal*		
Dec 01						*FLIM*		
Dec 08						81,011		
Dec 15								
Dec 22								
Dec 29								
Jan 05								
Jan 12				L. Snoek				
Jan 19	Hippler			(Oxford)				Dutton
Jan 26	(Sheffield)	Simons		*Studying the*				(STFC)
Feb 02	*High-*	(Oxford)		*influence of*			Bennington	*Surface*
Feb 09	*resolution*	*Carbo-hydrate*		*metal carbon*	Carty		(STFC)	*Raman*
Feb 16	*stimulated*	*molecular*		*binding on*	(Durham)		*Using tip*	*spectroscopy*
Feb 23	*Raman*	*recognition:*	Ruddock	*zinc finger*	*A radical*		*enhanced*	*of photo-*
Mar 02	*spectroscopy*	*probing CH-pi*	(Strathclyde)	*moldel*	*beam source*		*femtosecond*	*catalytic*
Mar 09	*with photo-*	*interactions*	*Nonlinear*	*peptide*	*for an*		*lasers to*	*hydrogen*
Mar 16	*acoustic*	82,007	*spectroscopy*	*folding*	*experiment to*		*create graphite*	*production*
Mar 23	*detection*		*of doped glass*	82,004	*magnetically*		*nanostructures*	*processes*
Mar 30	*(PARS)*		*and crystal for*		*trap cold*		*on diamond*	82,001
Apr 06	82,008		*applications in*		*(NH(X) at high*		82,010	
Apr 13			*distributed*		*densities*			
Apr 20			*fibre sensing*		82,004			
Apr 27			82,005					
May 04								
May 18								

Table 2. Lasers for Science Facility Loan Pool schedule period 1 and 2 (2008/09).

Vulcan operational statistics 08/09

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Vulcan has completed an active experimental year, with 54 full experimental weeks allocated to target areas TAE, TAW and TAP between April 2008 and March 2009. This figure is down on 2007-08 due to the five month shutdown for the TAW upgrade and recommissioning.

Table 2 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. The total number of full disc amplifier shots that have been fired to target this year is 646 with only 61 of these failing to meet user requirements. The overall shot success rate to target for the year is 91%, compared to 90%, 85%, 86%, 94% in the previous four years. Figure 1 shows the reliability of the Vulcan laser to all target areas over the past five years.

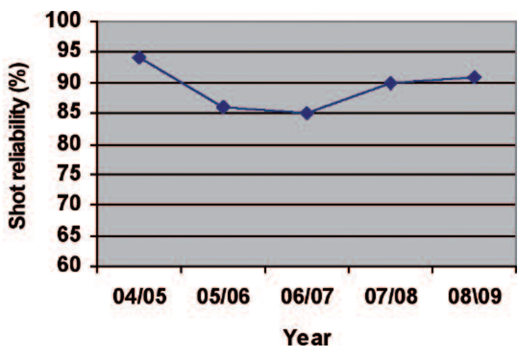

Figure 1. All areas shot reliability for each year 2004-5 to 2008-9.

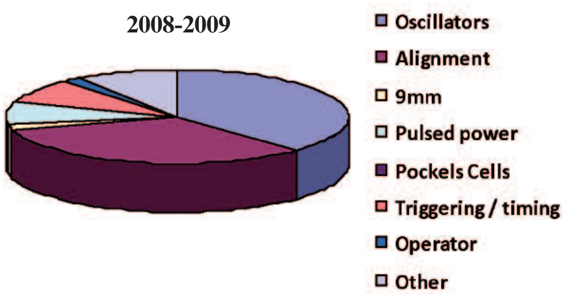

Figure 2. Total numbers of failed shots and their causes 2008-2009. The most significant contributions come from oscillators and alignment.

The overall shot success rate to TAP for the period has significantly increased from 89.2% last year to 93.9%, which is almost the highest figure since TAP was commissioned. The shot reliability to TAW has dropped slightly from 90.6% to 89.8%. Nevertheless, this is encouraging considering that all of the experiments in TAW in this reporting year were carried out after the upgrade. The reliability of Vulcan has increased over the past three years (Table 1), although the shot rate has dropped this year due to the shutdown for the TAW upgrade.

	No of shots	Failed shots	Reliability
04 - 05	878	52	94%
05 - 06	672	93	86%
06 - 07	1043	149	85%
07 - 08	977	98	90%
08 - 09	646	61	91%

Table 1. Shot totals and proportion of failed shots for the past five years

Analysis of the reasons for failure of the individual shots enables a breakdown of these causes into specific categories. Figure 2 shows the combined failure rates for the identified failure modes. For the past 12 months, the most serious causes of failed shots to target areas are the oscillators and alignment of the beam through the rod chain (72% of all failed shots). About half of this is due to issues with the OPCPA pump laser – a replacement OPCPA pump has been ordered and this will be addressed in the coming year. In 2007-2008, oscillators and alignment accounted for 69% of all failed shots. The other significant factor this year is triggering (8%), initially following the installation of a new triggering system for the Vulcan 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 78.8% of the time during contracted hours and 108.2% overall. These figures compare with 81.9% and 120.2% in 2007-2008 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 8.3 hours during the standard working week when the laser has been unavailable, or just over one and a half hours per day.

PERIOD	TAE	TAW	TAP
7 April – 1 June	D. Riley *X-ray scatter from from warm dense matter* (98,18) (81.6%)		P. McKenna *Investigation of electron transport instabilities in dense plasma* (96,8) (91.7%)
4 August – 14 September			M. Zepf *Control of fast electron propagation in ultraintense laser interactions* (38,4) (89.5%)
20 October – 30 November		M. Koenig *Fast electron transport in cylindrically compressed matter – Phase 1: Cylindrical compression study* (58,8) (86.2%)	
3 November – 14 December			J. Pasley *Effects of prepulse driven hydrodynamics on the interaction of a high power picoseconds laser with a gold cone* (77,3) (96.1%)
1 December – 21 December		D. Batani *Fast electron transport in cylindrically compressed matter – Phase 2: Cylindrical compression study* (62,2) (90.3%)	
12 January – 22 February		M. Roth *X-ray Thomson scattering on laser-accelerated proton heated warm dense matter* (74,4) (94.6%)	J. Schreiber (54,2) (96.3%)
2 March – 12 April		P. Norreys *HiPER* (42,6) (85.7%)	N. Woolsey (47,2) (95.7%)

(Shots fired, failed shots)
(Reliability)

Table 2. Experimental schedule for the period April 2008 – March 2009 (Experiments had staggered finish dates).

8

Target Fabrication operational statistics 08/09

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RAL experiments

A total of 3 Astra Gemini and 8 Vulcan experiments were supported by Target Fabrication in the reporting period April 2008 to March 2009. Of these 2 of the Astra Gemini experiments and 6 Vulcan experiments were 'solid target' experiments and 2 Vulcan experiments were a combination of gas jet shots and solid target shots. Target Fabrication provided a total of 46 weeks of experimental support for Vulcan and 16 weeks for Astra Gemini on solid target experiments. This report shows target numbers from the 8 Vulcan experiments. Statistics for high rep rate targetry for experiments in Astra Gemini will be dealt with in a separate report [2]. 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 2008-2009 was 1,023 compared to 2,223 in 2007-2008 [1]. Due to the upgrade in TAW, Target Fabrication supported fewer experiments in Vulcan during 2008-2009 which accounts for the reduction in target numbers. However, during 2008-2009, the number of high specification targets produced was 298 accounting for 29% of the total targets made compared to 19% in 2007-2008 [1].

Experiment	Targets Produced	High Specification Targets
Aug 2008 TAP	205	33
Oct 2008 TAW	215	80
Nov 2008 TAP	137	65
Jan 2009 TAP	100	38
Jan 2009 TAW	82	38
March 2009 TAP	114	36
March 2009 TAW	170	8
TOTAL	**1023**	**298**

Table 1. Target production summary for 2008-2009.

2) Target types

The high specification targets can be separated into 6 main types as shown in Table 2 and Figure 1. Most notably, 80 cylindrical compression targets were delivered to the October 2008 TAW experiment and 65 cone targets were delivered to the December 2008 TAP experiment requiring extensive highly skilled micromachining and microassembly.

Target Type	Targets Produced
Cones	67
Multilayered Microsquares (100µm × 100µm)	34
XRTS	39
Cylindrical 'HiPER'	80
Embedded/Coated Microdots	35
Other	43

Table 2. High specification target delivery summary.

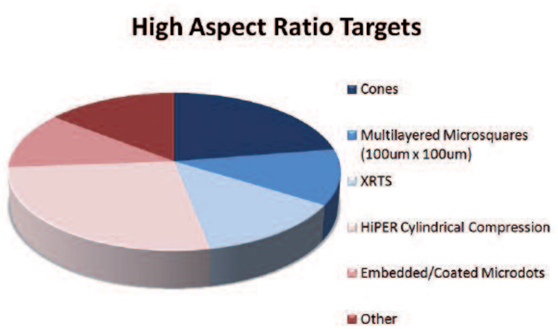

Figure 1. High specification target delivery summary.

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 experimentalists. 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, 30% of the targets that were shot were modified or redesigned from the planned target specifications. This is consistent with the figure of 32% for target production in 2007-2008 [1]. Figure 2 shows the proportion of targets that were redesigned or modified during the experiments supported in 2008-2009.

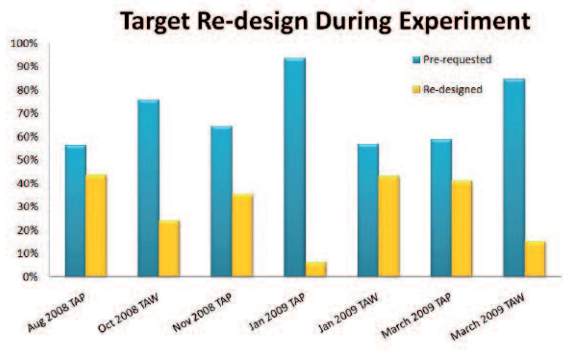

Figure 2. The percentage of pre-requested targets compared to redesigned targets fabricated throughout the year for each experiment.

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 35% 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 consistent with the figure of 36% for 2007-2008.

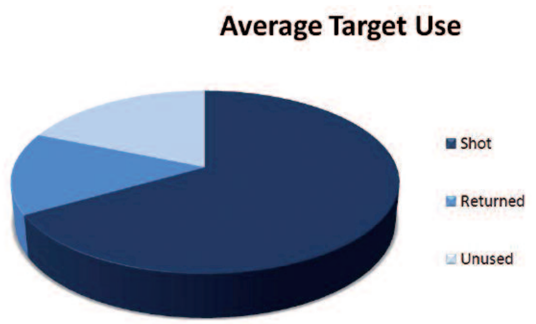

Figure 3. The average proportion of targets shot, returned and unused during solid target experiments on Vulcan in 2008-2009.

External contracts

Target Fabrication also supplied microtargets, specialist coatings and expertise to groups for use at external facilities during the reporting period. This activity included the production of AFI cone targets delivered to LLE, foam washer targets delivered to the University of Michigan & targets delivered to a number of HiPER WP10 experiments at other facilities. All of the work required to supply targets to external groups was carried out in addition to experimental support for the CLF.

Summary

Target Fabrication has supported 11 internal and 8 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. Although there was a reduction in the number of targets delivered to experiments on Vulcan compared to previous years, due to the commencement of solid target experiments on Astra Gemini, there was an overall two-fold increase [2] in solid target delivery in 2008-2009 compared to 2007-2008.

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8

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Panel Membership and CLF Structure

LSF/Astra TA1 Facility Access Panel 2008/09

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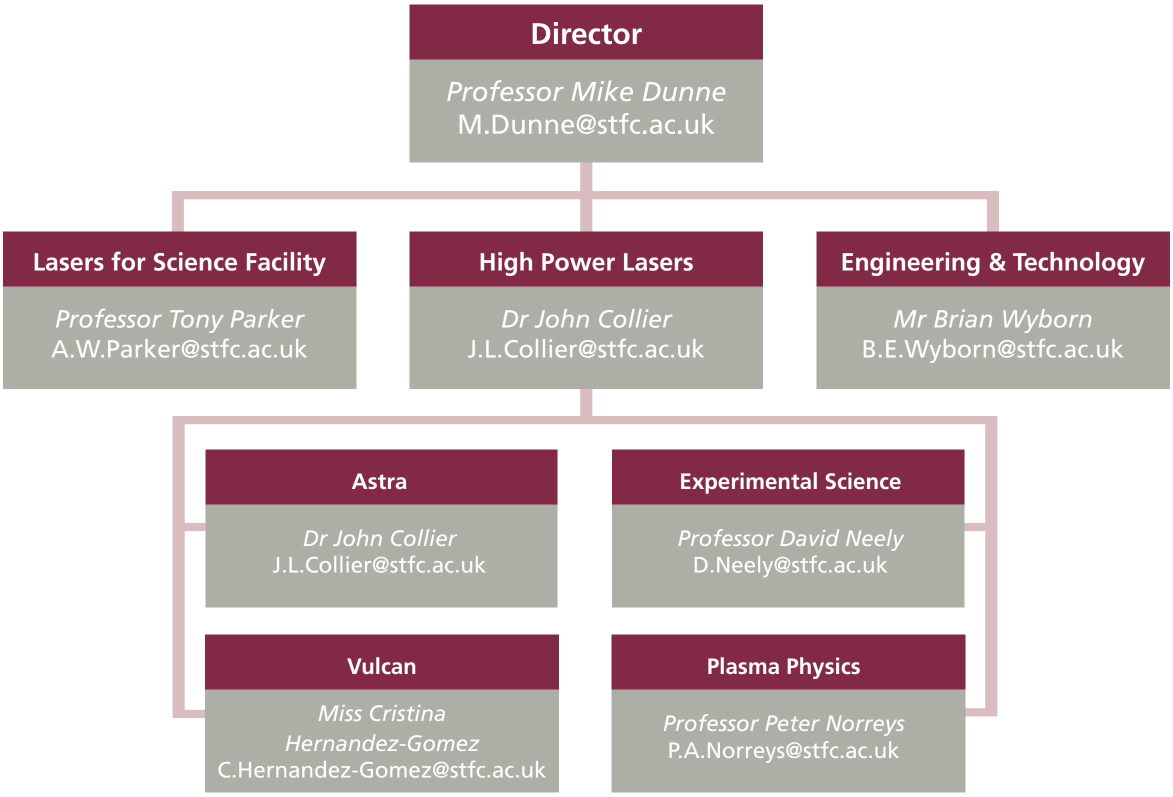
8

Central Laser Facility Structure 2008/09



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S

T

U

V

W

X

Y

Z