8

Vulcan operational statistics 08/09

Contact andy.kidd@stfc.ac.uk

A. K. Kidd and T. Winstone

Central Laser Facility, STFC, Rutherford Appleton Laboratory, HSIC, Didcot, Oxon OX11 0QX, UK

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.

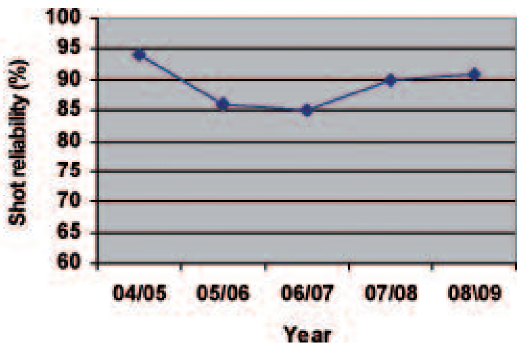

Figure 1. All areas shot reliability for each year 2004-5 to 2008-9.

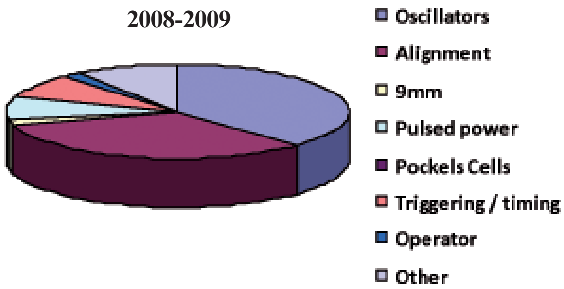

Figure 2. Total numbers of failed shots and their causes 2008-2009. The most significant contributions come from oscillators and alignment.

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).