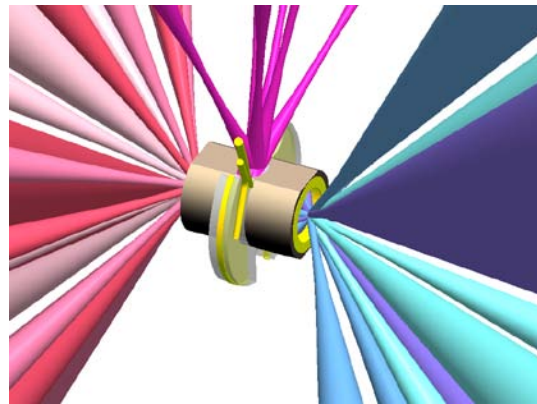
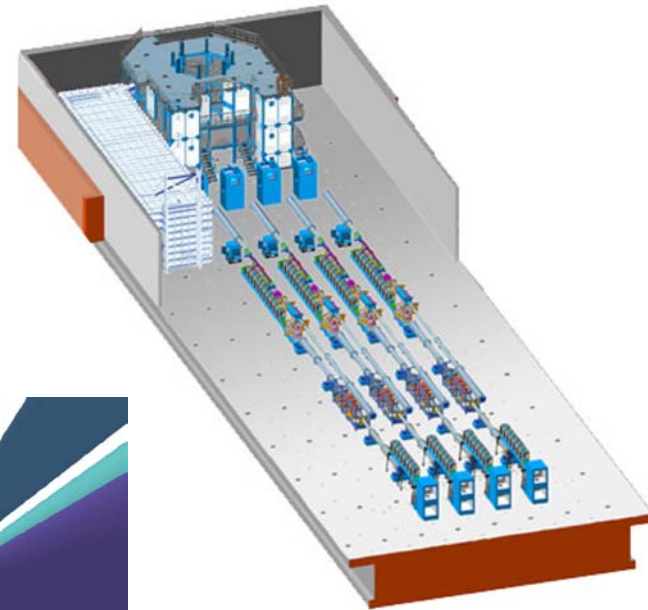
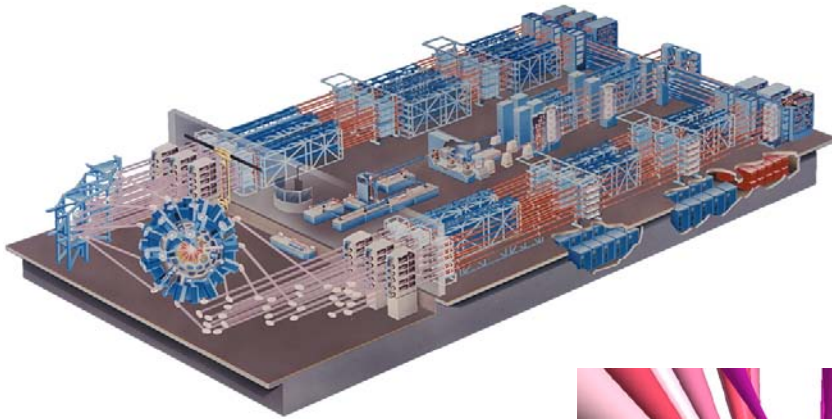


Omega Facility Status and Performance Update



K. A. Thorp
Omega Laser Facility Manager
University of Rochester
Laboratory for Laser Energetics

Omega Laser Facility
Users' Group Workshop
Rochester, NY
28–30 April 2010

Summary

Omega Facility operations are conducted using both lasers at ~80% of full capacity



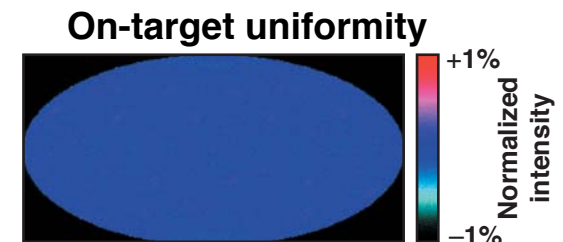
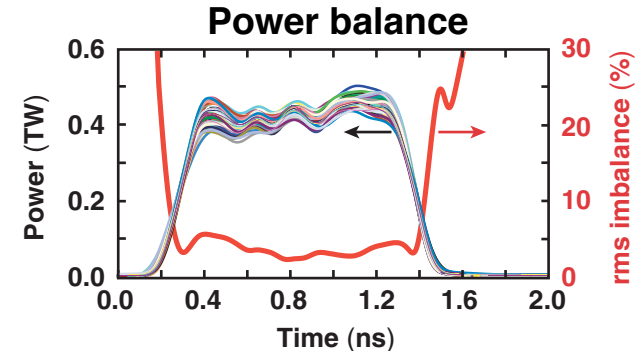
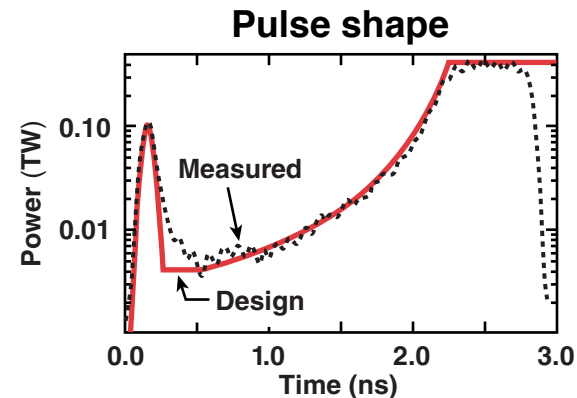
- OMEGA continues to have high demand from the user community
- Availability and Effectiveness remain high
- OMEGA EP capability continues to improve
- OMEGA and OMEGA EP are operated independently and simultaneously for joint shots

High availability and proven platform effectiveness are keys to remaining competitive in the changing environment.

OMEGA is a high-performance, high-uniformity world class laser facility and is better than ever

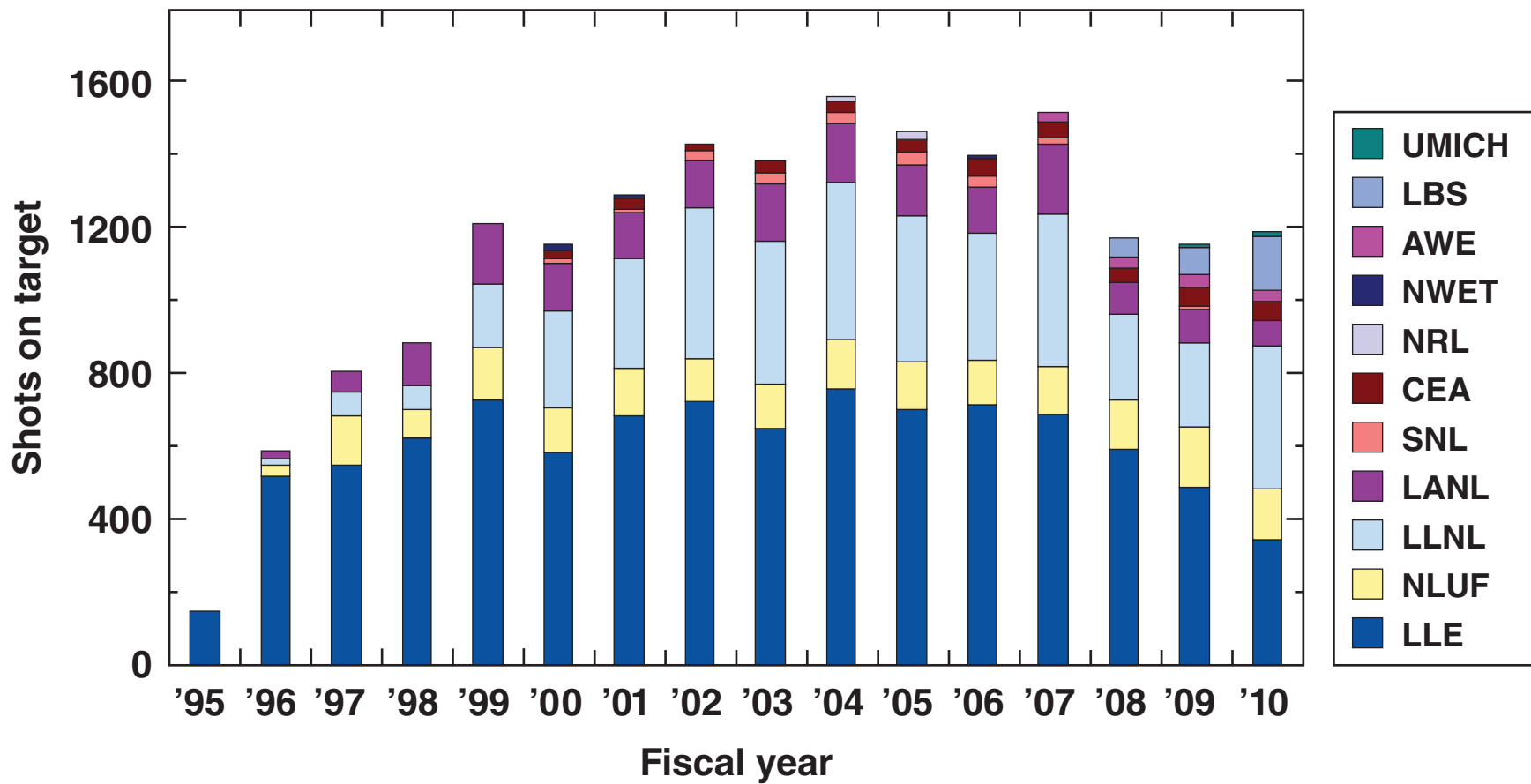


- 30-kJ energy on target continues to have strong demand from user community
- OMEGA provides flexible pulse shaping, drive/backlighting capabilities
- UV energy balance on target is typically less than 3% rms, and power balance can exceed 5% rms
- On-target irradiation uniformity exceeds 1% with SG4 DPP's and 10- μm -rms pointing
- Beam-pointing accuracy of 16- μm rms is routine and 10- μm -rms precision is available upon demand



OMEGA has met or exceeded all performance requirements.

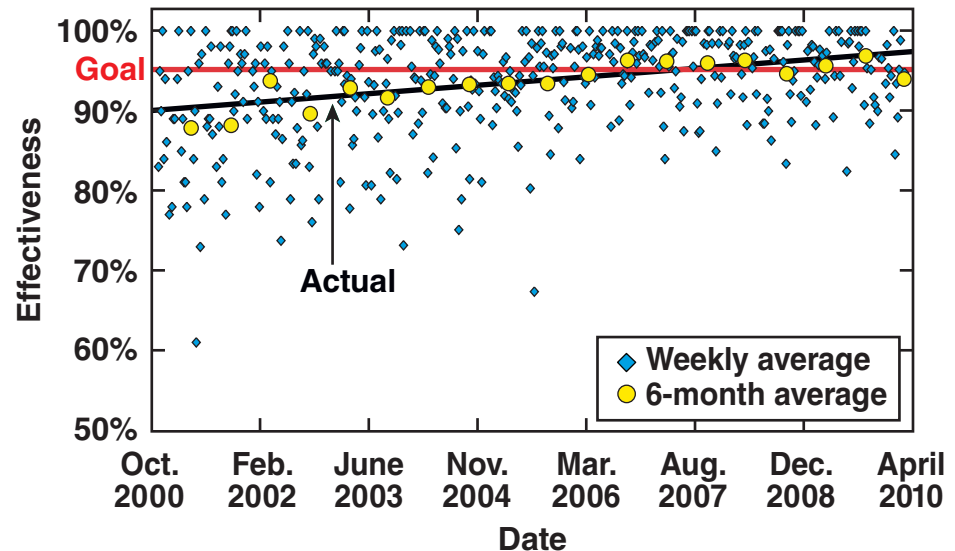
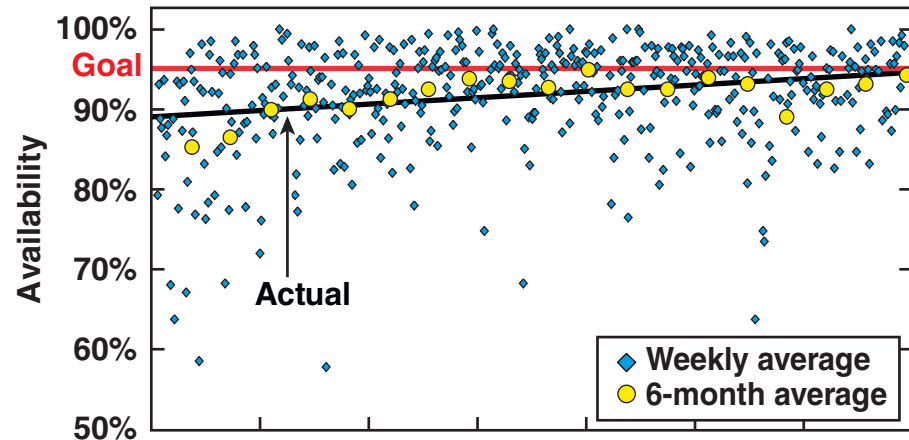
As of 4/1/10, OMEGA has conducted 17,789 target shots for a variety of users



The 60-beam OMEGA Laser System achieves high Availability and Effectiveness



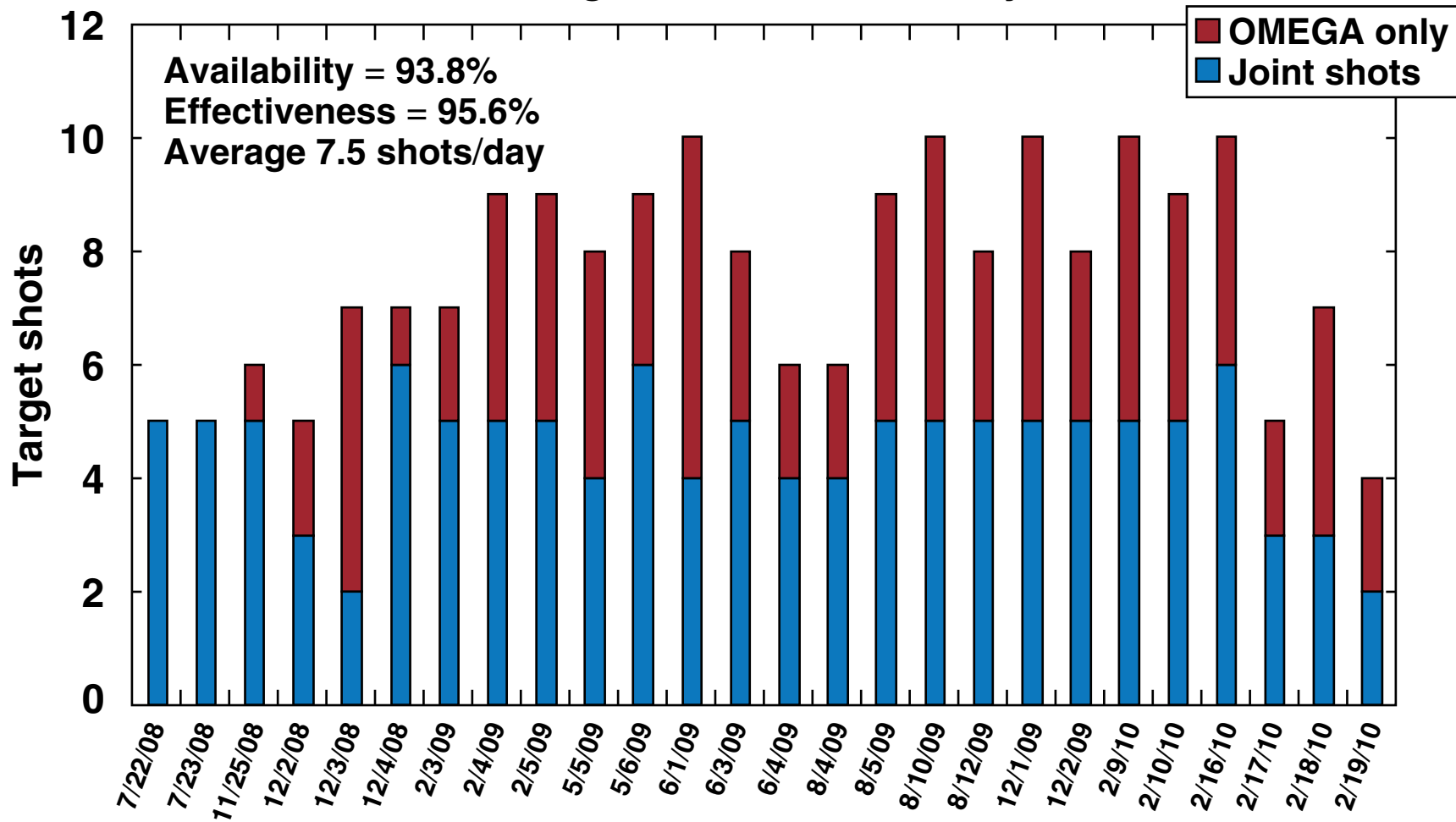
- **Availability:**
Quantitative schedule performance metric for Laser and Experimental operations
- **Effectiveness:**
Initial response of the PI to whether the shot produced good data quality



The number of target shots on Joint Shot days has increased by interleaving OMEGA only shots



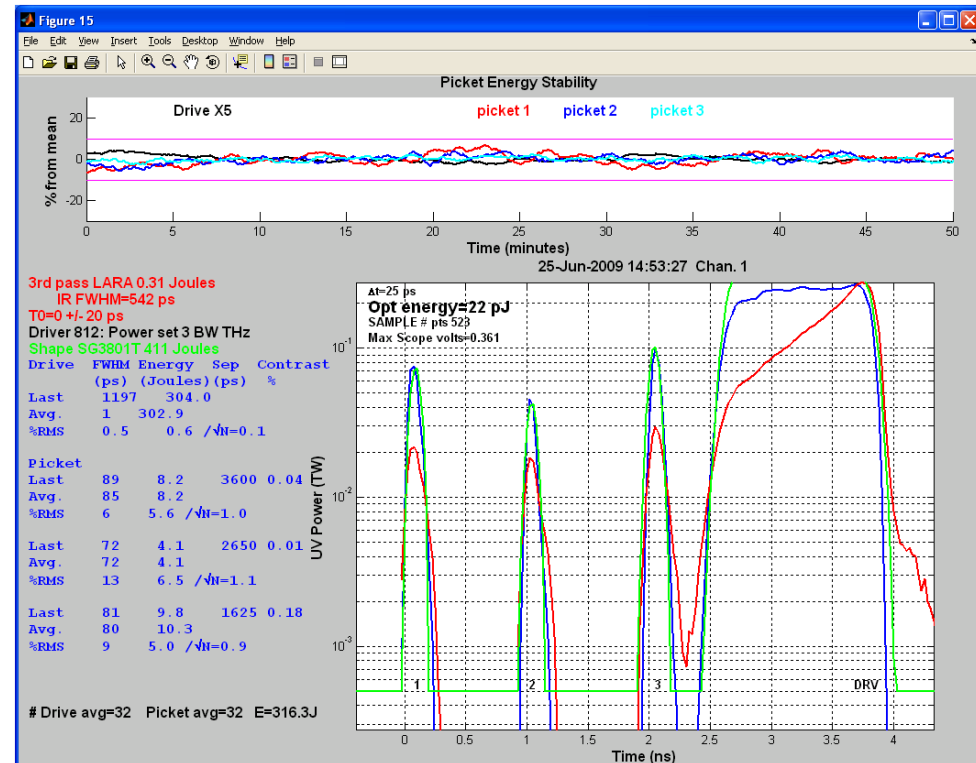
Histogram of Joint Shot Days



Pulse-shaping system upgrades have significantly improved stability and control of picket pulses



- New hardware provides capability to adjust picket amplitudes independently
- Higher-resolution electronics improve picket energy control
- Thermally stabilized IFES hardware improves picket energy stability



OMEGA capability enhancements benefit the user community



- **Three-color-cycle SSD optimizes target irradiation for triple-picket pulse shapes and increases the available energy**
- **The precision UV-pulse-shape diagnostic (PUVP) enhances pulse-shape-measurement capabilities**
- **Triple-picket pulse-shape-analysis capability improvements**
- **Full SSD modulator synchronization improves pulse-shape repeatability and is planned for deployment in June**
- **Designs to drive only one leg with SSD are in development—deployment of this capability may be possible in late FY11**

OMEGA capabilities are increasing to improve the user experience.

Principal investigator indoctrination (qualification) is required to ensure safety and effectiveness



Principal investigators (PI's) must complete the following prior to leading experiments on OMEGA:

- **Briefing on laser and experimental system capabilities**
- **Facility tour**
- **Review of responsibilities including Shot Request Form preparation and target metrology and positioning requirements**
- **Observation of operations, preferably with an experimental PI**
- **Briefing on diagnostic qualification procedures**

The Proposal Template is reviewed and approved two months prior to the planned shot date



- Initiates the preparation phase at least two months prior to the date of the experiment.
- The proposal is reviewed by the Scheduling Committee to ensure that the experiment's requirements are consistent with the capabilities of the Omega Laser Facility.
- The Committee reviews safety of specified experiments: targets, materials, special pointing or laser conditions.
- The Committee reviews progress of the preparation for and execution of approved experiments.

Experiment requirements, system safety, campaign compatibility, and intra-shot delays are carefully evaluated.

Shot Request Forms (SRF's) are required for shot specification



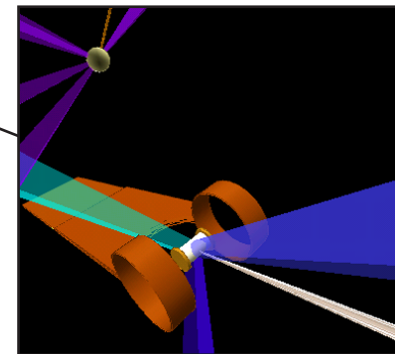
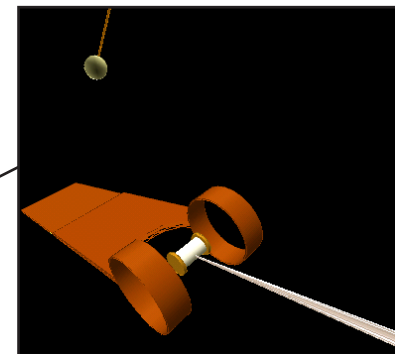
- **SRF's capture a detailed record of the laser and diagnostic configurations for each shot**
- **The SRF's are “differenced” to identify changes to the configuration during the shot day and aid development of the shot plan**
- **Effectiveness is optimized by capturing expert information centrally, controlling it carefully, and incorporating the process into planning tools**
- **On shot day the SRF functions to synchronize the shot crew to a common objective and ensures that the configurations are implemented correctly**

Proposals must be submitted two months prior to the experiment

Detailed experimental configurations allow optimized facility planning and improved compatibility verification between adjacent experiments

Target Request Forms improve target tracking and specification

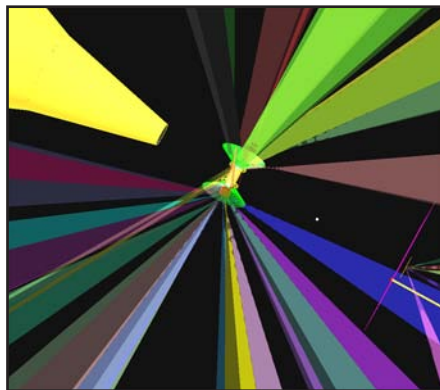
Experimental Configuration Name	4.2.1.3 Example RID #	4.2.1.4 Targets			4.2.1.5 VISRAD Filename (RID-PI Name.vrw) (Submit files with proposal)	4.2.1.6 # of Target Shots
		TRF #	Complex Yes No			
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
4.2.1.7 Identify all diagnostics required that are not available						



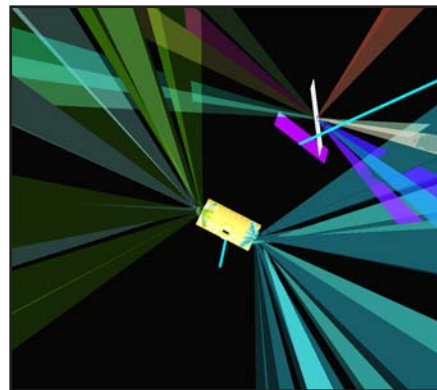
OMEGA proposal analysis for week of 16 February 2010



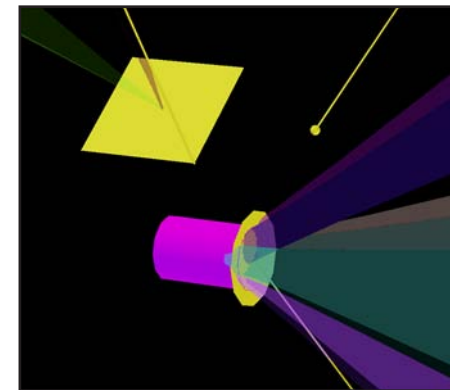
Date	Campaign	PI	Targets	Configuration	Overnight Reconfiguration	Mid-Day Reconfig.	Comments
2/17/10	AGEX EOS	Lanier	Hohlraums + foils (PABL)	9 beams ~8 mm off-axis w/SG8 DPP's 24 beams ~8 mm off-axis w/no DPP's	Point 33 beams to 18 locations	—	Dual drivers. Max energy on BL driver: SG0301 105 J, SG1014 425 J. Composite pulser shape reduction required
2/18/10	NIF 5	Keiter	Hohlraums and foils (PABL)	30 beams ptd along P6/P7 w/no DPP's 12 beams to 6.15/39/141 w/no DPP's	5 DPP operations point 42 beams to 5 locations	—	—
2/19/10	Proton radiography	Li/ Petrasso	Small spheres + foils + halfraums	10 beams to TCC w/SG8s 18 beams 9 mm/P6 no DPP's 2 beams 9 mm/H3 no DPP's	10 DPP operations point 30 beams to 3 locations	—	Dual Drivers Drive Advanced 125 ns



Lanier – AGEX EOS



Keiter – NIF 5



Li/Petrasso – proton radiography

A thorough review of the shot plan begins at the first PI brief two weeks before shot day



- **The first PI brief is held to review the planned experiment in detail, identify issues, and optimize the shot plan**
- **The PI presents experimental objectives and gives detailed specifications for laser and experimental conditions**
- **Sample SRF's for each unique configuration are reviewed in detail and inconsistencies are identified**
- **Models of beams and targets are carefully reviewed**

The shot plan is finalized at the one-week PI brief



- **Final SRF's for all planned shots are due Monday, one week before the planned shot week**
- **The one-week brief is the final opportunity to interface with the PI directly to resolve outstanding issues prior to shot day**
- **System experts ensure that the PI's made changes to the SRF's based on recommendations provided at the two-week brief**
- **All details must be finalized at the end of the meeting and the SRF's are locked at midnight on Thursday**
- **All subsequent changes MUST go through the Laser Facility Manager or Experimental Operations group leader**

Significant changes to the shot plan after the one-week PI brief requires explicit approval.

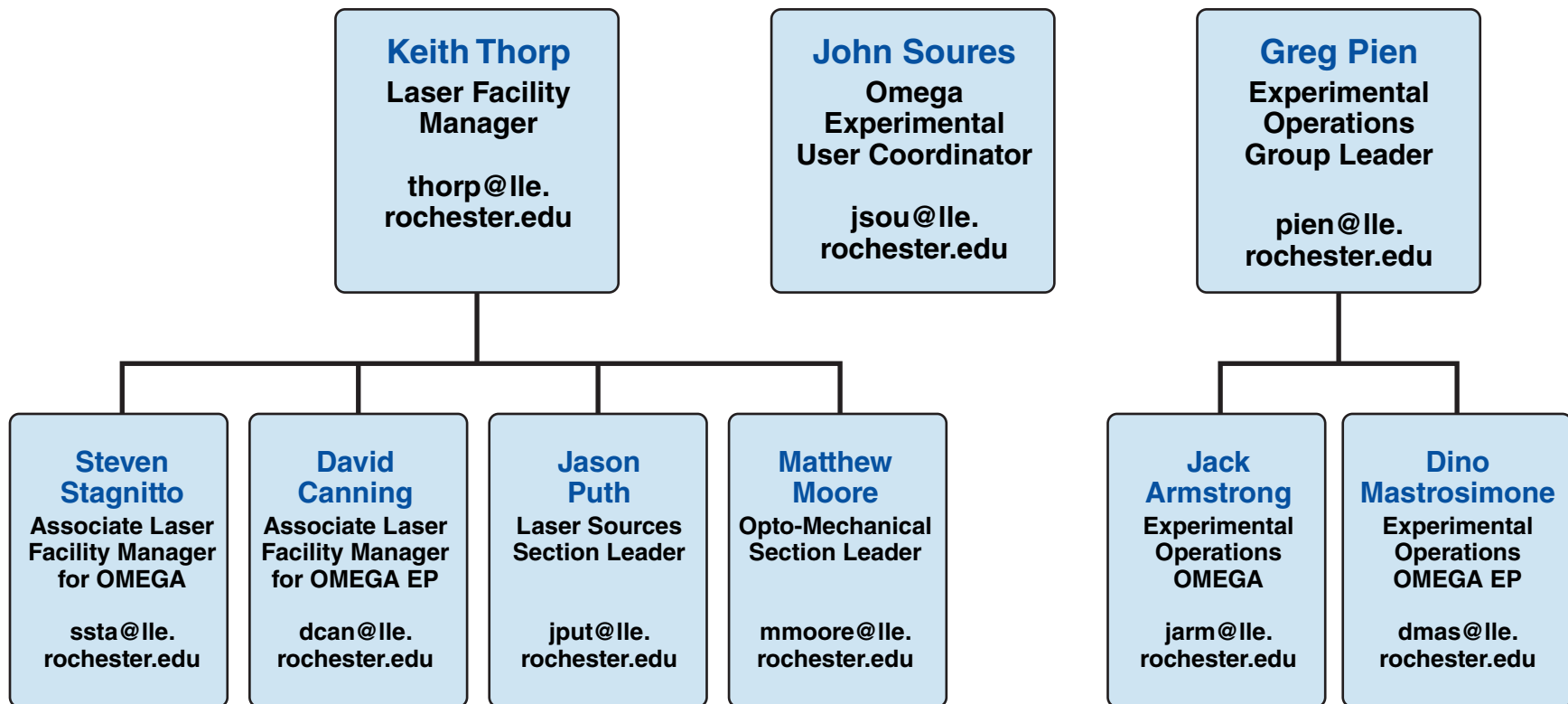
Direct involvement of the PI is required to ensure the success of the experiment

- Involvement prior to each shot may include
 - verification and approval of the pulse shape being generated
 - verification of the target prior to insertion
 - verification of the target positioning
 - confirmation of system configuration via the Shot Director

- Involvement after each shot may include
 - checking the measured pulse shape
 - assessment of pointing
 - checking total energy on target and balance
 - diagnostic film/CCD for filtering, pointing, and timing
 - checking diagnostic trigger monitor if required

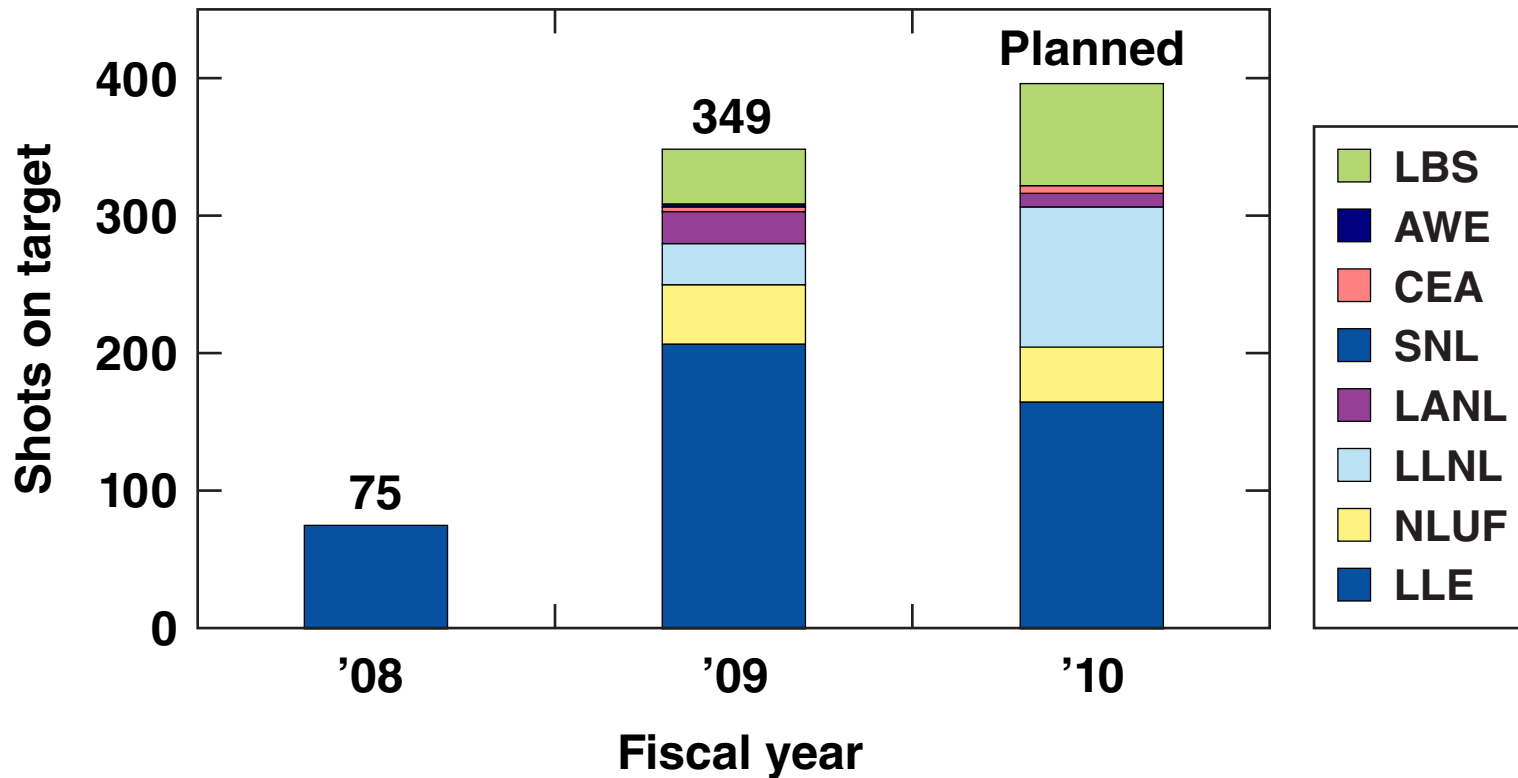


LLE has an experienced team available to all Omega Laser Users for assistance with operational planning and shot support



John Soures, Keith Thorp, and Greg Pien are the user interfaces for scheduling, laser facility, and diagnostic concerns, respectively.

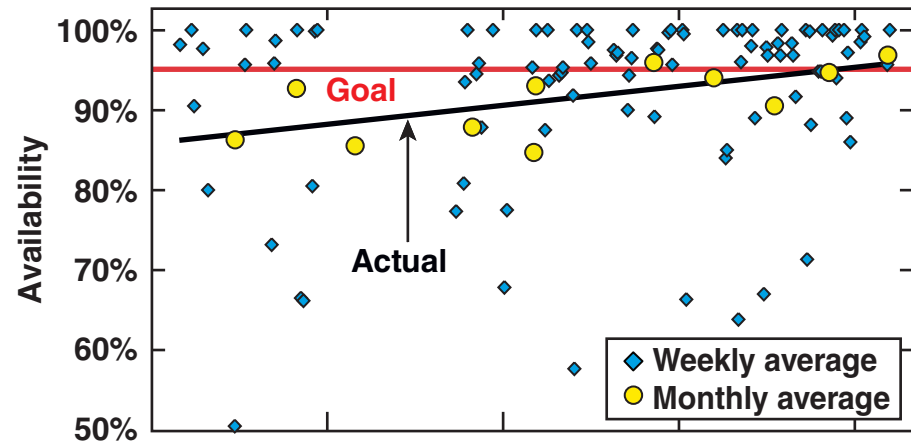
As of 4/1/10, OMEGA EP has conducted 642 target shots for a variety of users



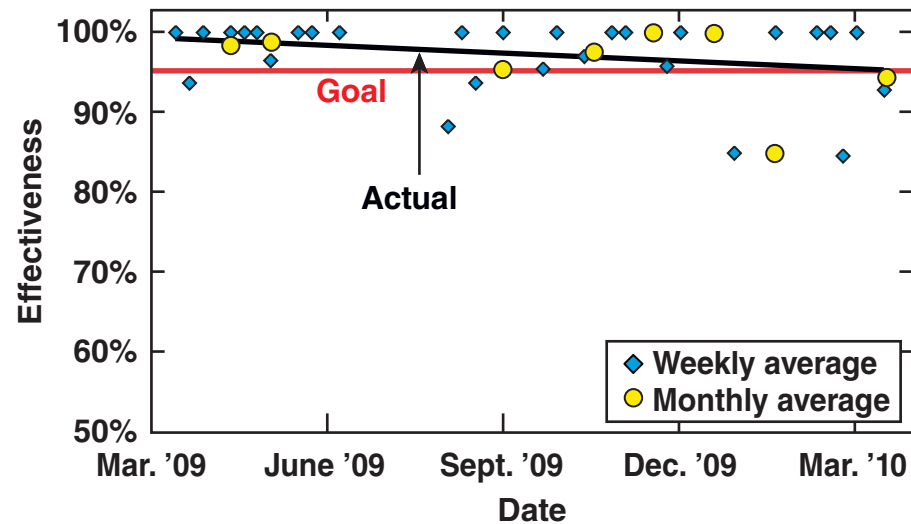
OMEGA EP averages ~4.9 shots per 12-h day with high Availability and Effectiveness



- **Availability:**
Overall Availability = 86%



- **Effectiveness:**
Overall Effectiveness = 96%



>650 OMEGA EP target shots since commissioning in May 2008.

OMEGA EP supports a variety of experimental platforms for a growing user base

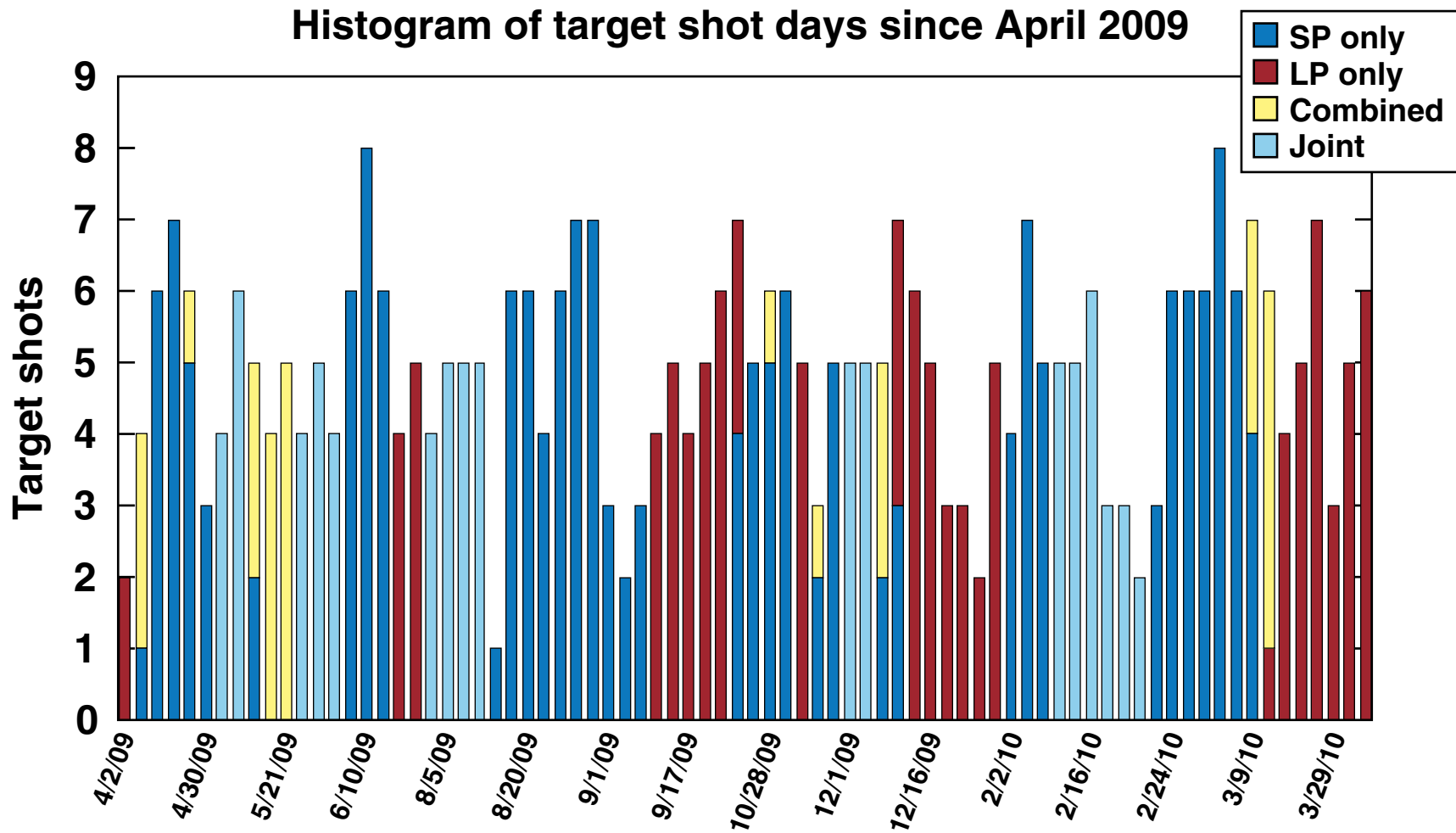


- System configuration is a primary consideration for scheduling experiments
- OMEGA EP supported 348 target shots in FY09
 - 186 short-pulse shots to the OMEGA EP Target Chamber
 - 51 long-pulse shots to the OMEGA EP Target Chamber
 - 25 combined short-pulse and long-pulse shots to the OMEGA EP Target Chamber
 - 86 joint shots into the OMEGA Target Chamber

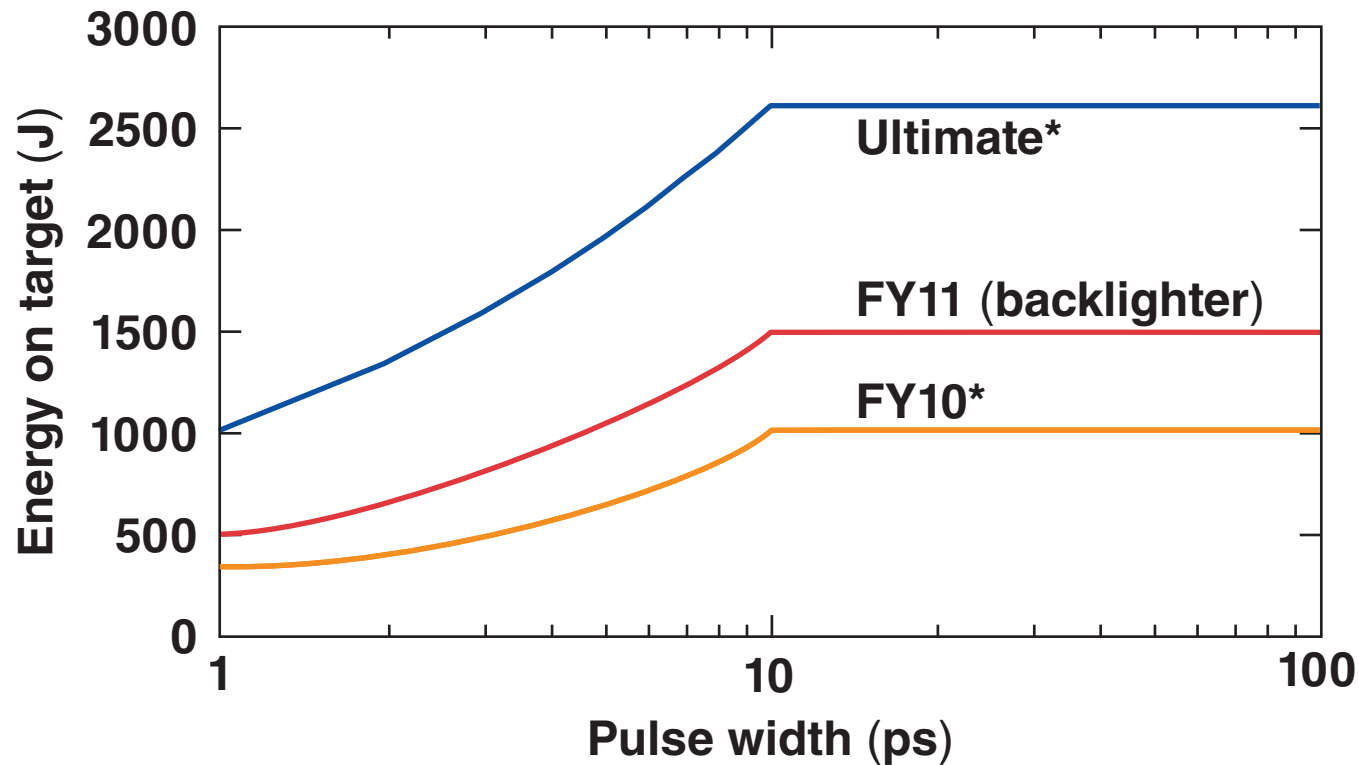
2nd Quarter

Starting	Mon	Tue	Wed	Thur	Fri	Campaign(s)	PI	No. shots
28-Dec-10				Holiday	Holiday			
4-Jan-10				Pump GCC				
11-Jan-10		UV NIC		Laser Calib		AblatorEOS-10A	Boehly	5
18-Jan-10		BL NIC		2UV+BL LBS		FastEScat-10B StrongShock-09	Yaakobi Theobald	5 5
25-Jan-10		TBD HED		BL NIC		FastIon-10A EnhCoupling-10B	Flippo Gao	5 5
1-Feb-10		UV+SL NLUF		BL NIC		eXport-10A IsoHeating-10B	Beg Nilson	5 5
8-Feb-10		Joint HED	NIC	3UV NIC		ICE-TaRT-10A XRTSCond-10A PreheatRT-10B	Park Doepfner Hager	5 5 5
15-Feb-10 President's wk		Joint NIC	Joint LBS	NIC 60 SG4		CryoBL-10B IntFI-10A CompRad	Regan Theobald Tommasini	5 5 5
22-Feb-10		NIC		BL+SL HED		Preheat-10A EPOp-10A	Yaakobi Heeter	5 5
1-Mar-10		4x UV HED		BL LBS		FoamEOS-10B RelLPI-10B	Boehly/Bastea Patel	5 5
8-Mar-10		NIC		3UV+BL LBS		EPDiagDev-10D DynDiff-10A	Stoeckl Park	5 5
15-Mar-10		BL NIC		CEA AWE		Egen-10A MeVSources (BL)	Theobald Courtois/Edwards	5 5
22-Mar-10								

OMEGA EP averages 4.9 target shots per day for a variety of configurations



Gratings for one compressor will be replaced at the start of FY11; the operational envelope is expected to improve to >1.5 kJ at ≥ 10 ps

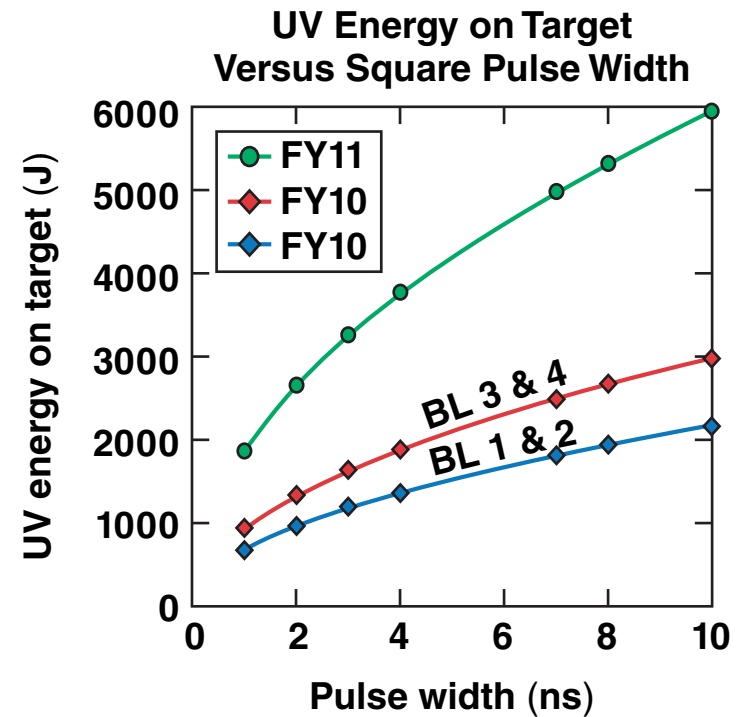
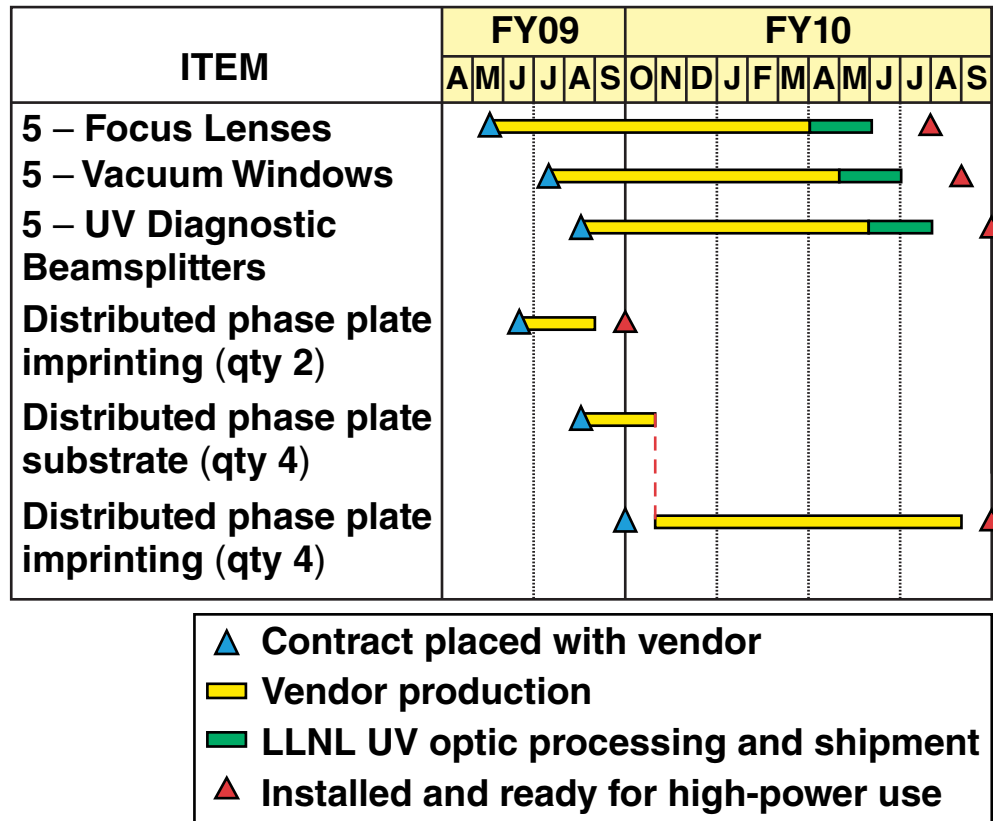


An energy ramp to 2.1 kJ in September 2009 resulted in damage. Acquisition and installation of gratings is underway; first beam will be complete in October 2010.

LLE is obtaining a set of higher damage-threshold UV optics

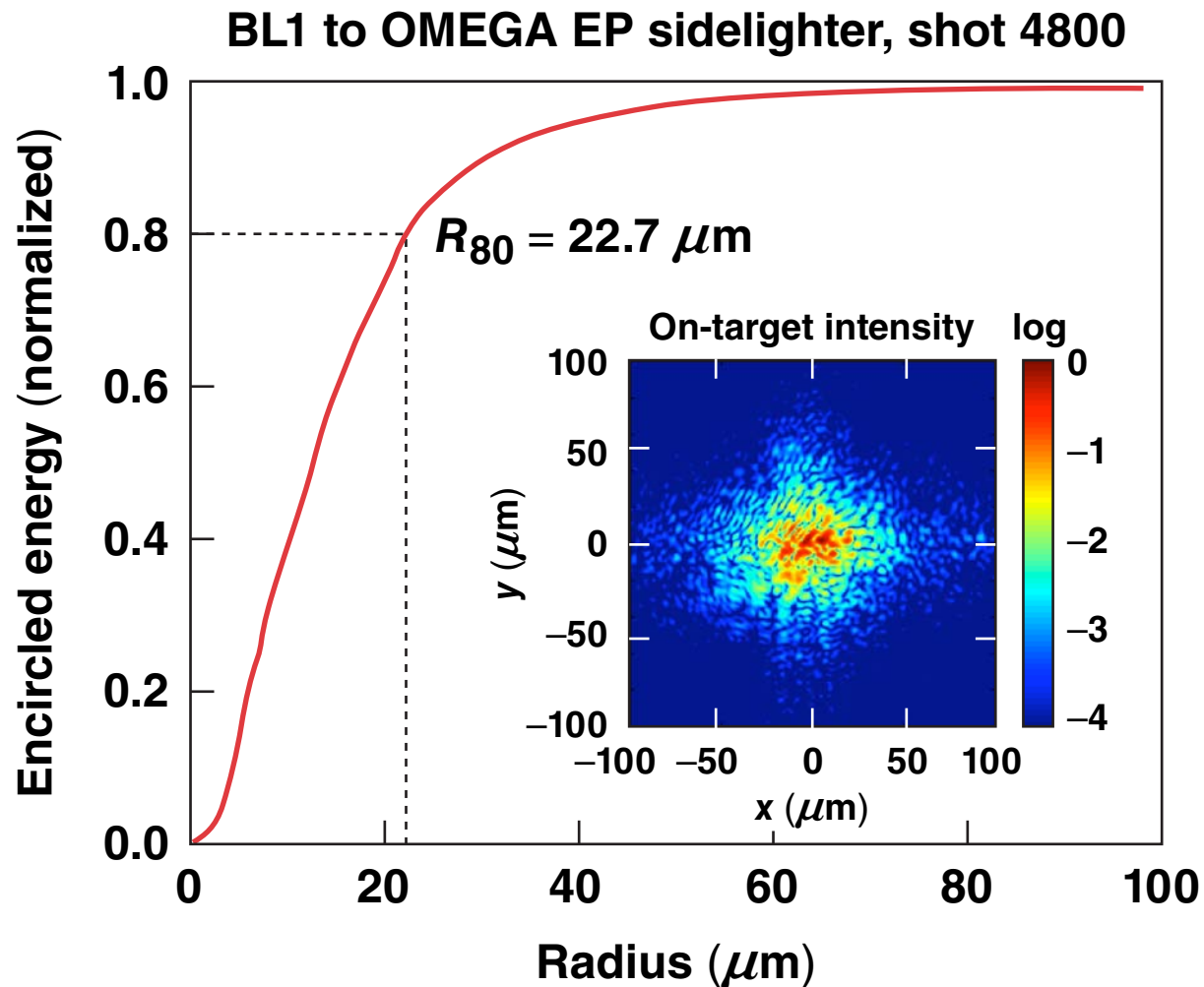


UV Optics Acquisition

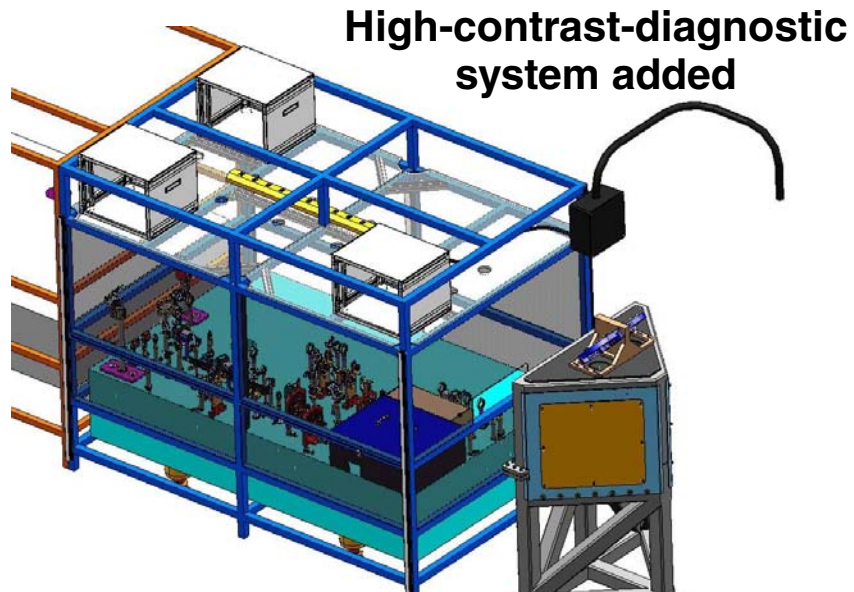


- LLNL is managing the procurement of replacement optics for OMEGA EP

The OMEGA EP short-pulse focal spot routinely achieves $R_{80} < 25 \mu\text{m}$



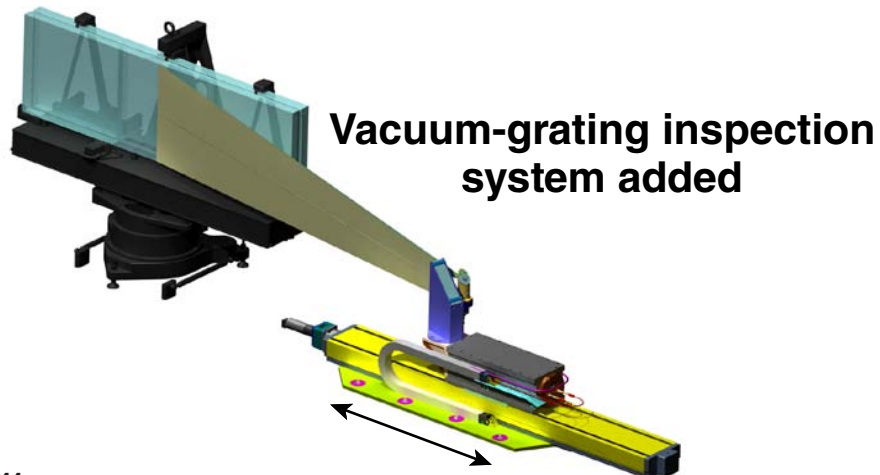
In FY10 a number of additional capability enhancements were made to the Omega EP Facility



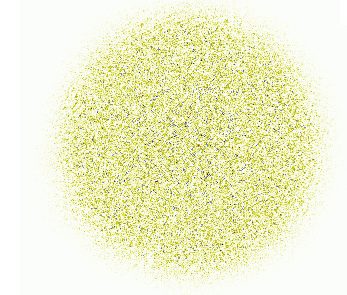
**750- μm DPP (quantity 2)
currently available**



**1100- μm DPP (quantity 3)
available FY11**



**2000- μm DPP (quantity 2)
available FY11**

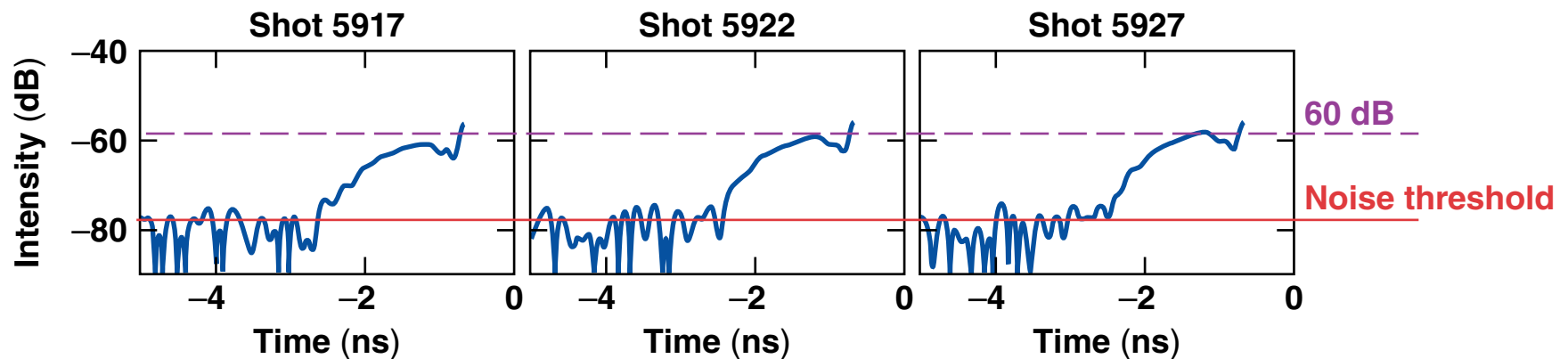


Deployment of OMEGA EP on-shot diagnostics facilitates contrast improvements



- The on-shot OMEGA EP contrast will be measured with two diagnostics
 - fast diode and scope
 - up to ~0.5 ns before the pulse, 80-dB dynamic range
 - currently installed in a temporary location
 - single-shot cross-correlator
 - 0.5 ns before the peak-to-peak, 80 ~ 100-dB dynamic range

Contrast to 0.5 ns before the peak with 1.5-kJ,
10-ps pulse duration relative to 10-ps pulse



The pedestal contains approximately 10^{-4} of the main pulse energy (~150 mJ).

Recently deployed OMEGA EP capability enhancements benefit the user community



- Numerous Availability and Effectiveness improvements include increasing available energy from 40 J to 250 J for the first shot of the day
- Variable focus capability recently deployed on the OMEGA EP Target Viewing System (TVS), significantly improves positioning precision for targets that are positioned away from target chamber center (TCC)
- Recently implemented beam-timing infrastructure improvements facilitate improved timing precision and reliability
- Focal-spot diagnostic reliability improvements facilitate focal-spot data availability at post-shot
- Contrast-diagnostic suite and contrast-tuning improvements

OMEGA EP capabilities are increasing to improve the user experience.

Planned OMEGA EP capability improvements



- **Improved energy performance will be achieved with new high-damage-threshold gratings and UV optics**
- **Spatial-profile improvements, including significant upgrades to the beamline alignment and injection systems, facilitate improved energy performance and reliability**
- **A replacement beam combiner will support short-pulse co-propagation to either OMEGA or OMEGA EP in late FY10**
- **UV-pulse-shape capabilities will include subnanosecond pulses in FY11**

OMEGA EP capabilities are increasing to improve the user experience.

Summary/Conclusions

Omega Facility operations are conducted using both lasers at ~80% of full capacity



- OMEGA continues to have high demand from the user community
- Availability and Effectiveness remain high
- OMEGA EP capability continues to improve
- OMEGA and OMEGA EP are operated independently and simultaneously for joint shots

High availability and proven platform effectiveness are keys to remaining competitive in the changing environment.