Status of the OMEGA EP High-Energy Petawatt Laser Facility



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Summary

Two 2.6-kJ petawatt beamlines will be integrated into OMEGA: OMEGA Extended Performance (EP)

- OMEGA EP is under construction and will be completed in April 2008
 - Most technical issues have been solved (21 of 27 gratings delivered)

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- Beamline 1 is being commissioned in October 2006 (long pulse)
- Two short-pulse (SP) beams can be combined colinearly and routed into the OMEGA target chamber
 - SP beam 1: up to 2.6 kJ at \geq 10 ps or 1 kJ at 1 ps
 - SP beam 2: up to 2.6 kJ at \geq 80 ps
- It has a variety of configurations with up to four 10-ns, 6.5-kJ UV beams to a new target chamber; two can be used in short-pulse mode
 - SP beams: up to 2.6 kJ at \geq 10 ps or 1 kJ at 1 ps

OMEGA/OMEGA EP will provide a flexible HED facility, significantly extending LLE's research capabilities.

Short-pulse OMEGA EP beams can be directed either to OMEGA or to the new OMEGA EP target chamber



- Each beam duration can be as short as 1 ps at reduced energy (grating damage and *B*-integral)
- Beam 2 can produce 2.6 kJ in 10 ps when propagating on a separate path

The OMEGA EP long-pulse UV energy is a function of pulse width with a potential of 6.5 kJ per beam at 10 ns

- Frequency conversion crystals are separate from the target chamber.
 - mirror transport to the target chamber
 - decouples on-target pointing from crystal tuning
 - no unconverted light in the chamber
 - long-pulse performance is limited by the first UV mirror

	Per beam		
Square pulse width (ns)	1.0	4.0	10.0
Potential UV on target (kJ)	2.5	4.8	6.5
Potential intensity (1-mm spot) (W/cm ²)	3 × 10 ¹⁴	$1.5 imes 10^{14}$	$8 imes 10^{13}$

With 4-beam, long-pulse operation greater than 25-kJ UV total in 10 ns is available.

The beams from OMEGA EP will be focused with a 23° f/2 off-axis parabola inside the OMEGA target chamber

- A fast-focusing optic is necessary to meet the 20-µm-diam focalspot requirement.
- The size of the target chamber port limits the input beam size.
- The beam path has to stay clear of the cryogenic target handling equipment.



Simultaneous sidelighting and backlighting will be possible in the new OMEGA EP target chamber



Experimental capabilities for OMEGA EP beyond the original baseline are under development

• The OMEGA EP user workshop in January 2006 identified a number of desired capabilities.

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- a laser contrast diagnostic was identified to be a high-priority requirement
- simultaneous side- and backlighting in the OMEGA EP target chamber is now part of the project baseline
- a 4 ω -probe beam is under development
- a planar cryogenic target handling system is being designed
- a number of new target diagnostics were proposed and development has started on some of them
- A second OMEGA EP user workshop is planned for the Spring of 2007 to start the detailed development of experimental campaigns.

A 4 ω probe beam will be installed on OMEGA EP



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A comprehensive suite of diagnostics is planned to characterize the on-target pulse intensity



- Pulse-width measurement in the range <1 ps to 100 ps using a combination of streak cameras (~8 to 100 ps) and EO-SPIDER (0.5 to 30 ps)
- Near-field intensity and phase measurements, along with transport optic characterization are used to calculate the focal spot.



- The OMEGA EP grating compressor vessel was completed.
 - the chamber vacuum system was activated and achieved its nominal performance $(< 10^{-5} \text{ Mbar})$
- The OMEGA EP target chamber installation was completed.
 - the vacuum system was activated successfully
- The structures for four beamlines were installed.
- The laser sources for beam 1 were activated.
- Power conditioning and amplifiers were completed for beams 1 and 2.
 - all flash-lamps of beamlines 1 and 2 were successfully operated at maximum voltage

OMEGA EP is on track for completion in April 2008



January 2006

October 2006

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