OMEGA EP: Status and Use Planning

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Summary

OMEGA EP is on track for completion in Q3 FY08

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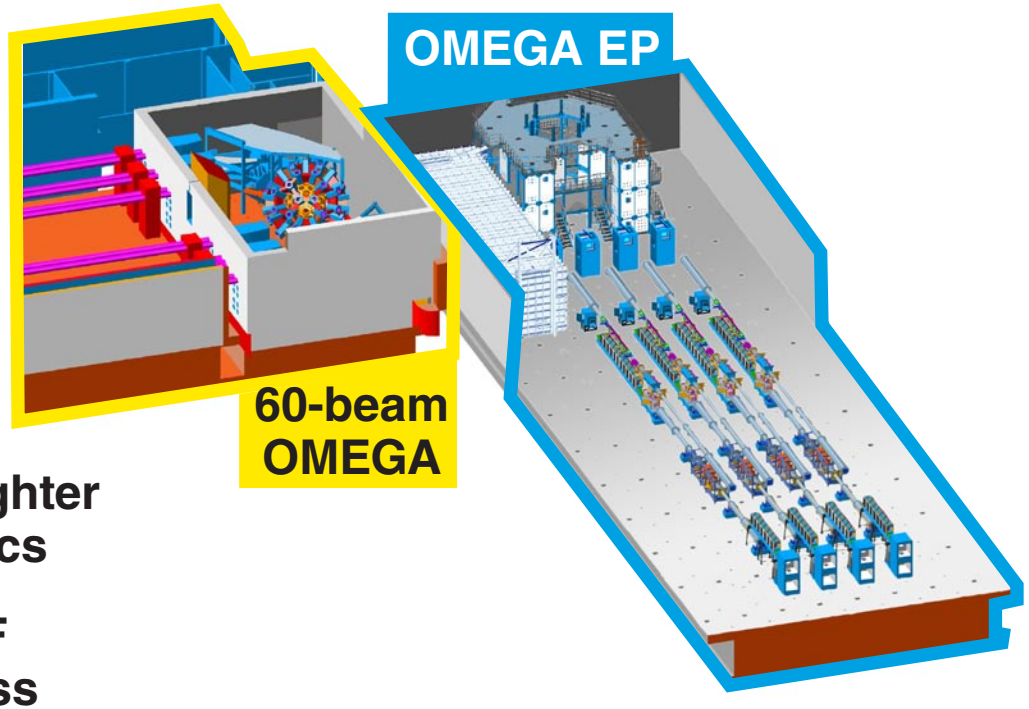
- Completed activation of all long-pulse and short-pulse frontends
- Completed integration and initial activation of all IR beamlines
- Successfully operating key enabling technologies
- Compressor integration and activation is the critical path for OMEGA EP
- The OMEGA EP Use Planning process is ongoing
- The initial ~100 shots have been laid out

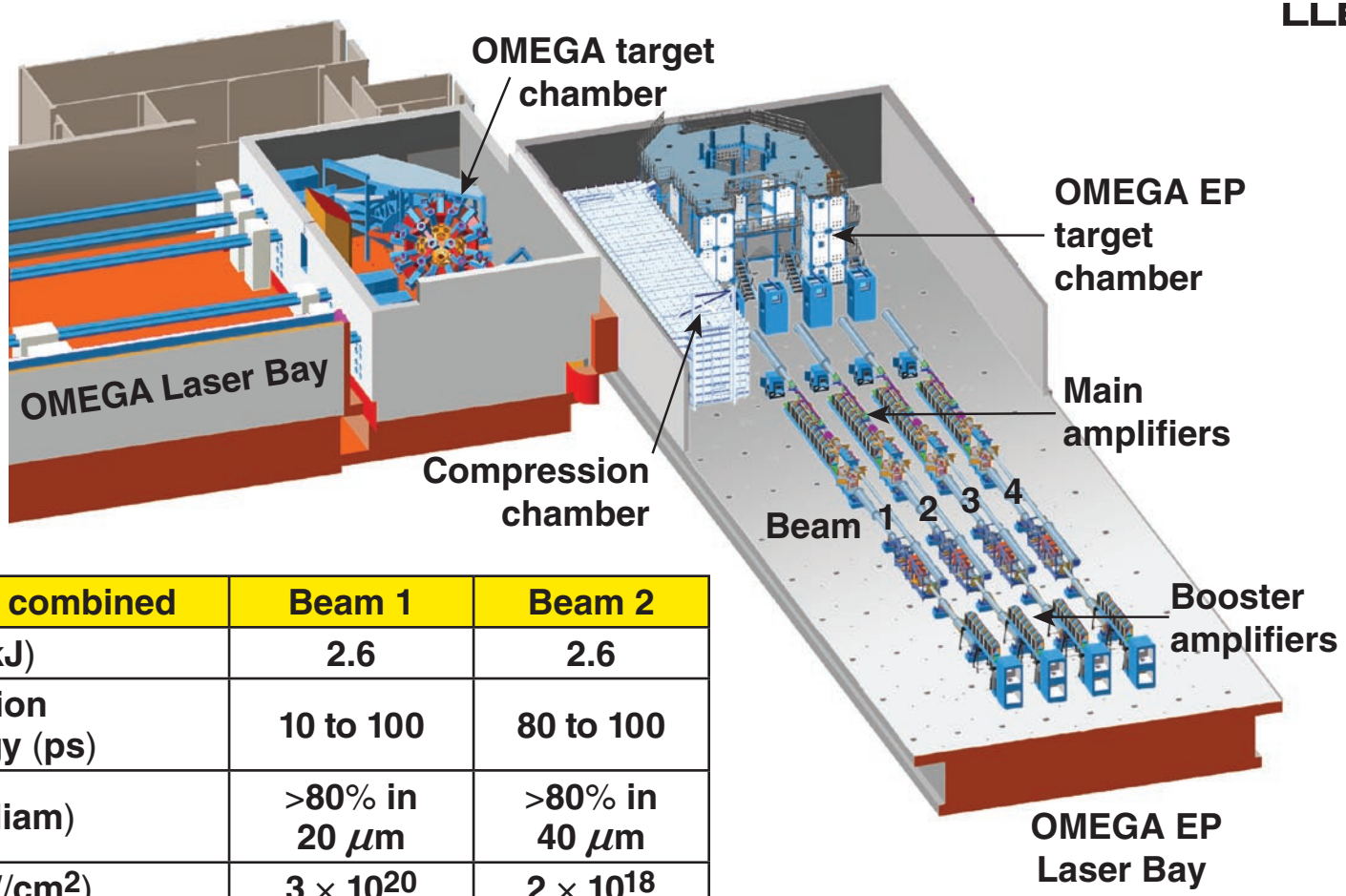
OMEGA EP will be completed in Q3 FY08

- There are five primary missions.

1. Extend HED research capabilities with high-energy and high-brightness backlighting
2. Perform integrated advanced-ignition experiments
3. Develop advanced backlighter techniques for HED physics
4. Staging facility for the NIF to improve its effectiveness
5. Conduct ultrahigh-intensity laser–matter interactions research



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



Short pulse combined	Beam 1	Beam 2
IR energy (kJ)	2.6	2.6
Pulse duration at full energy (ps)	10 to 100	80 to 100
Focusing (diam)	>80% in 20 μm	>80% in 40 μm
Intensity (W/cm^2)	3×10^{20}	2×10^{18}

- 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

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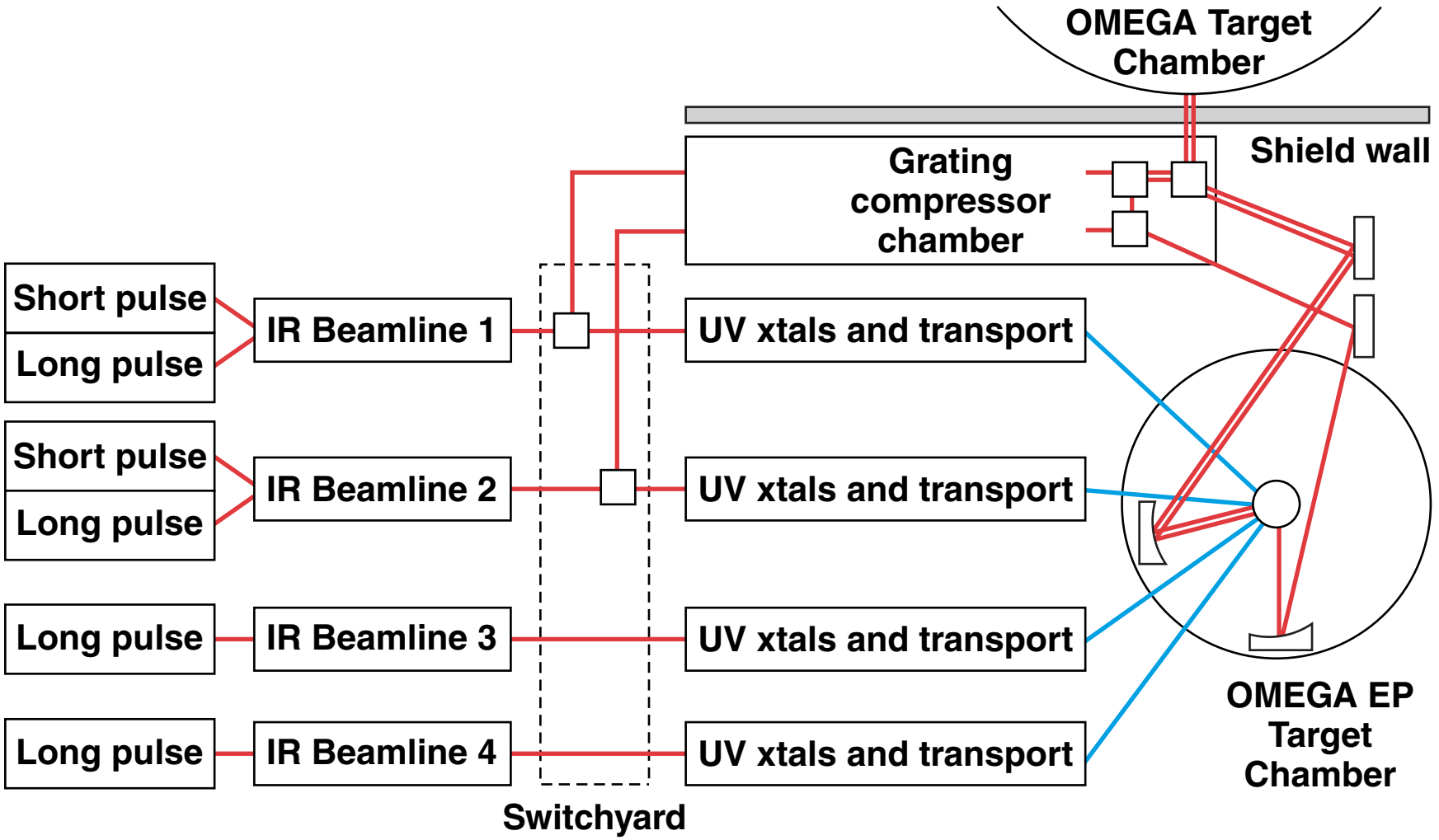
The OMEGA EP architecture is based on multi-configurable beam paths



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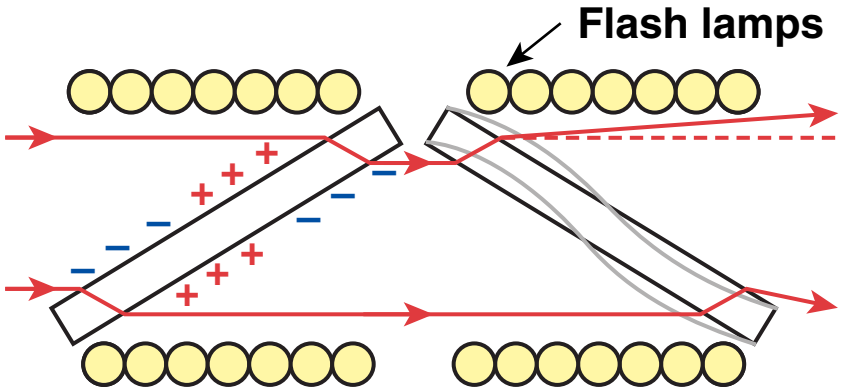
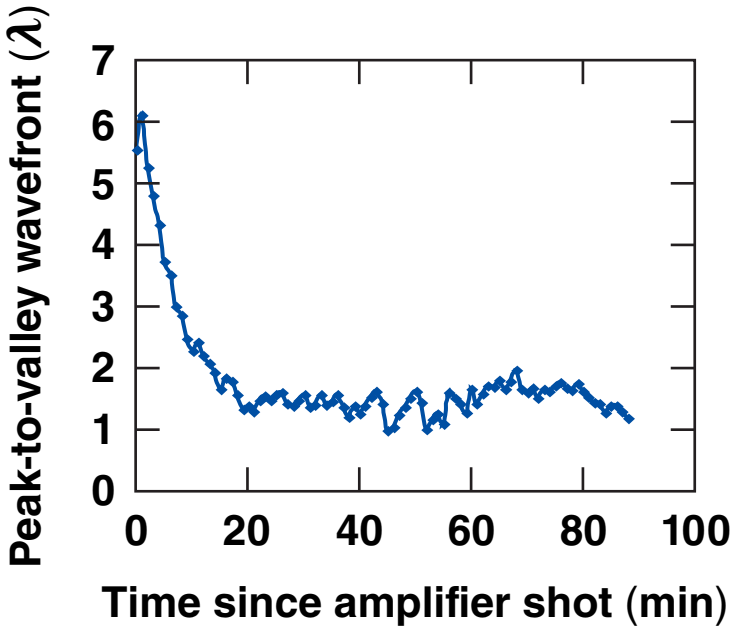
Recovery from amplifier thermal distortion supports 1-h repetition rate

- Nonuniform heating of amplifier disks causes an S-bend, leading to an astigmatic defocusing of the beam.

- Water cooling allows rapid recovery of wavefront.





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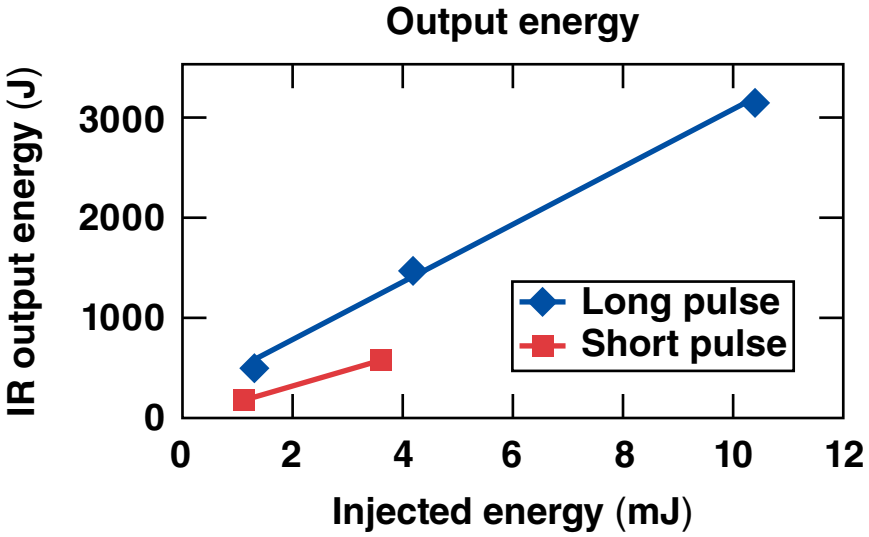
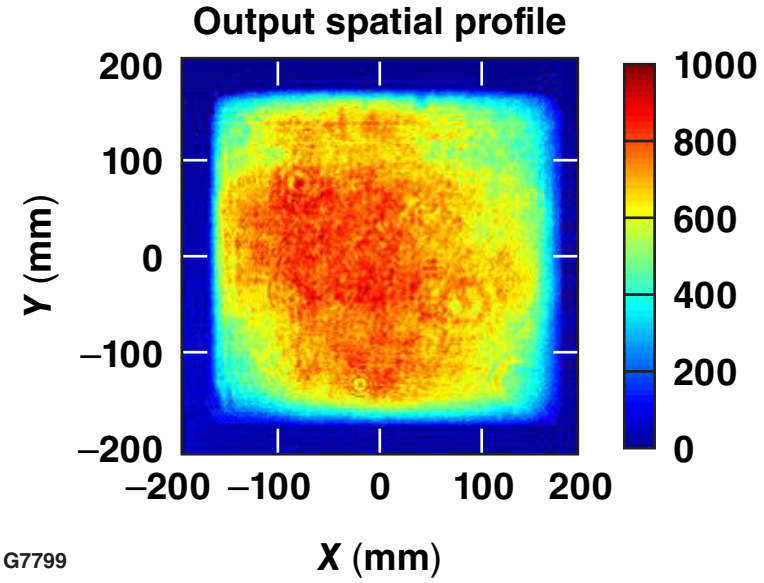
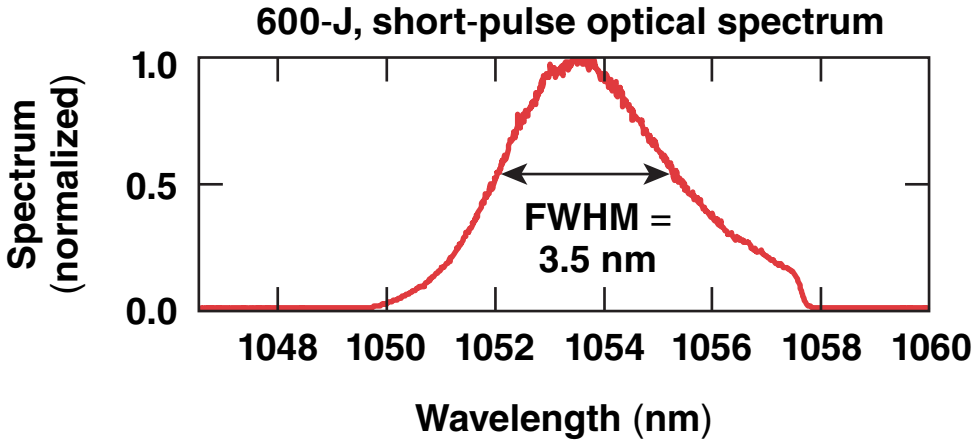
IR beamlines meet initial-activation performance requirements



- >600-J stretched-pulse energy
- >3-kJ long-pulse energy
- 3.5-nm bandwidth to support picosecond pulses





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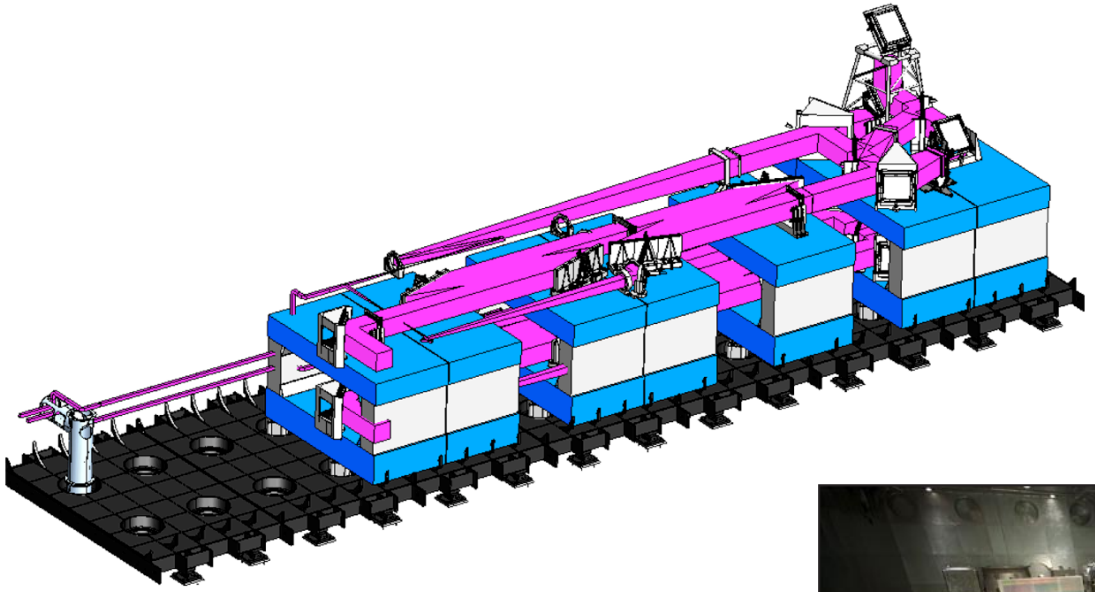
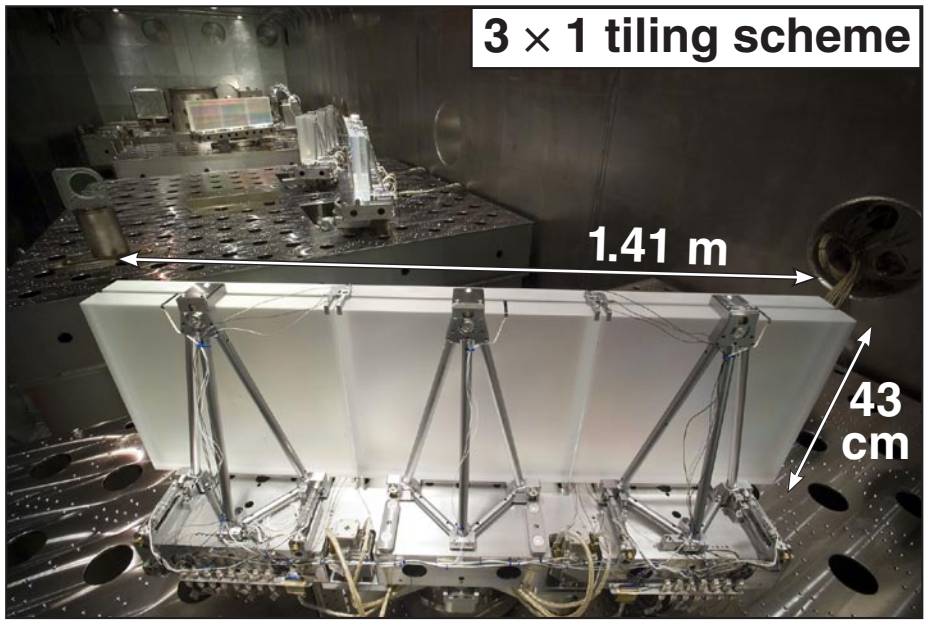
The grating compressor chamber (GCC) is being integrated and is the critical path for OMEGA EP activation



GCC

- 4.6 × 4.6 × 21.3 m internal dimensions
- Dual-level optical tables
- Four-grating compressor layout



Integration

- All gratings loaded
- Tiling hardware and controls
- Both vacuum-compatible DM's

Three OMEGA EP full-aperture gratings have been tiled using the near-field tiling method

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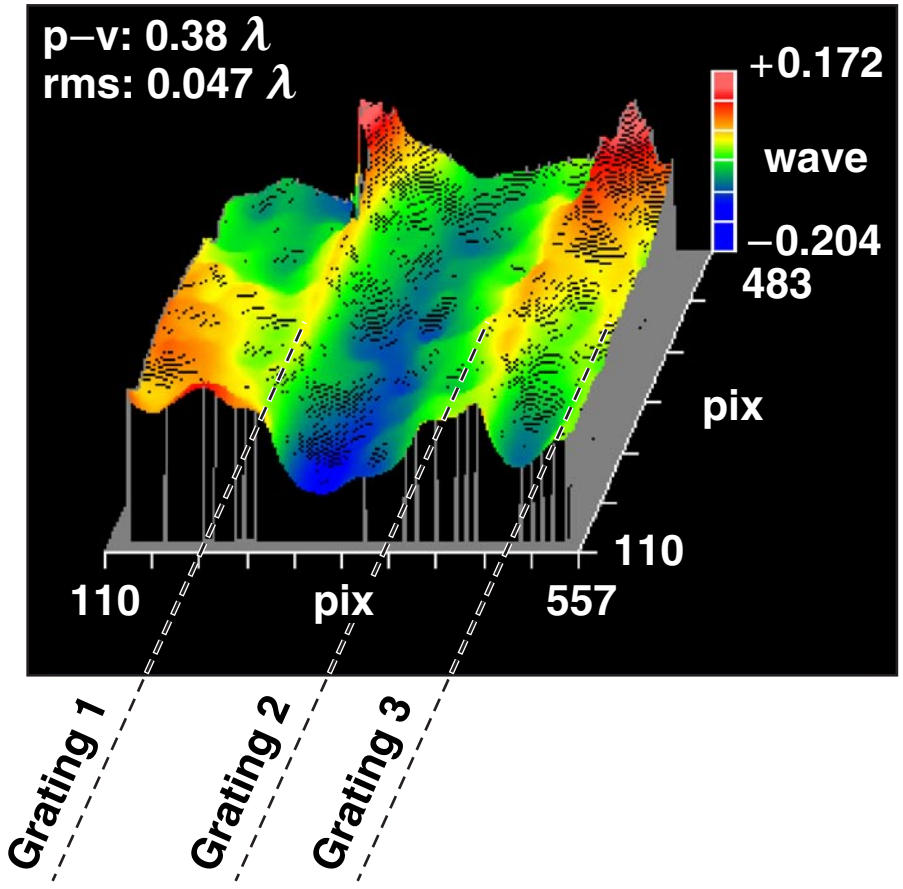
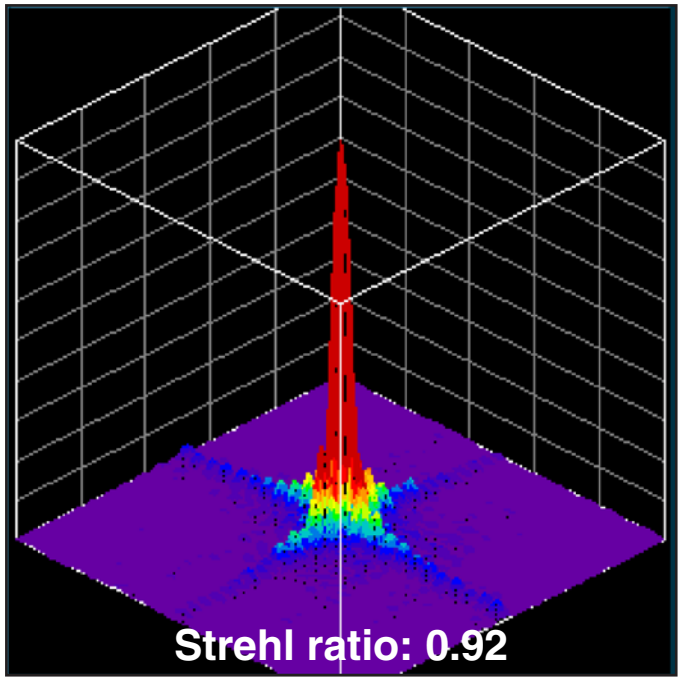
Wavefront of three tiled OMEGA EP full-sized gratings Aperture size: 90 cm × 38 cm on TGA



Calculated far field



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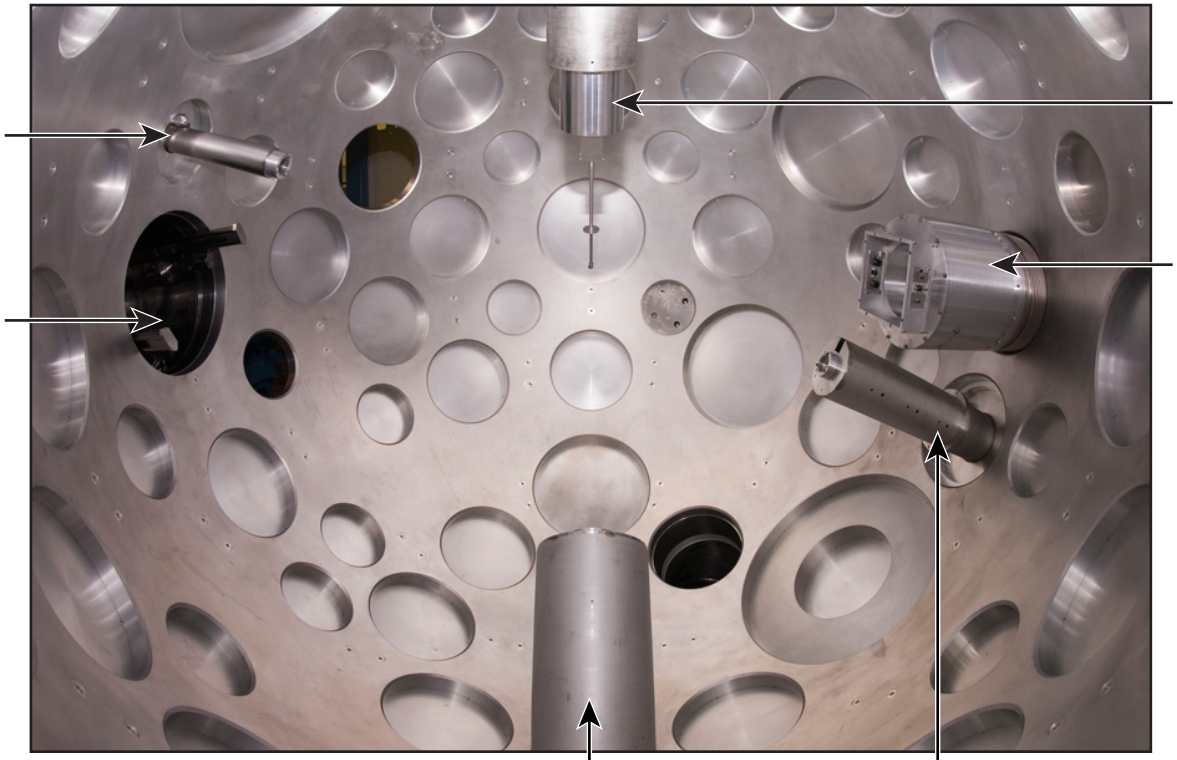
The OMEGA EP target chamber infrastructure is being deployed



- The beam path into the OMEGA target chamber has been cleared and structures are being integrated.

The second OMEGA EP Use Planning Workshop (30 May 2007) defined experimental plans in various areas

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- OMEGA EP will be completed in Q3 FY08.
- The remainder of FY08 will be for laser system science and to learn how to carry out experiments.
  - shot opportunities will exist on short notice
- Scheduled User shots will begin in FY09.
- A series of working groups has been set up.
  - chair to provide a written summary after the workshop
  - continued discussions among working groups in advance of third workshop—February 2008
- A proposal for the first ~100 shots (FY08) was generated.

The goal of this process is to understand and prioritize capabilities needed to most effectively use the facility.

A set of working groups has been created

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- Working Groups
  - Hard-x-ray backlighting
  - High-brightness ~keV sources and diagnostics
  - Ion-source development and diagnostics
  - Fast ignition
  - ICF
  - Warm dense-matter physics
  - HED materials
  - Complex hydrodynamics
  - High-intensity physics, etc.
- Each working group should develop a plan for its initial shots, including
  - laser capabilities
  - target requirements
  - diagnostic capabilities

The first ~100 OMEGA EP shots for FY08 have been laid out

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Target	Goal	Diagnostics	Number of Shots
Fast Ignition: Sandwich planar targets Al/Cu/Al, Al, free study	Electron/proton production temperature with 10-ps pulses	K_α spectroscopy	15
CH foil with witness layer	Initial channeling	X-ray imaging, transmitted light	5
Hard x-ray, WDM: Ag and Sm foil/flag/wire, resolution grid	Hard x-ray and keV broadband	50~100 mic spots, x-ray spectometers, imagers	15
High brightness keV sources: F~Si materials, foams, colloidal targets	High brightness for ICF backlighting	keV x-ray spectrometer, x-ray streak camera with spectrometer	10
Long-pulse backlighting: Thick foil (pinhole for PPB)	Develop capability	X-ray streak	5
Low and high Z-ions: Thin foil	Develop capability	Optical pyrometer, heating source, RCF	5
HED materials: Thin Al/$Si0_2$ foil	Initial shock velocity	ASBO/VISAR	10
Al foil	Direct measure of Al EOS	Hard-x-ray source and detector	5
WDM: Planar foil	Double/colliding shock	SOP	5
ICF: Planar foil	Initial scale-length	FABS, HXRD 4ω probe	5
Complex Hydro: Washers/foam	Initial episodic jet	X-ray image	5
D^3He proton source: Exploding pusher	Monoenergetic proton source	WRF	2
High-intensity physics: Planar foil, gas jet	Magnetic-field + MeV proton generation	Proton diagnostic, proton beam, nuclear activation	10

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