Status of the OMEGA EP Laser System

Beam-2 static corrector wavefront specification

Transmitted wavefront (wv, 1.053 nm)

Focal spot at beamline output (10-meas. ensemble average, wavefront control active)

\( \langle R_{80} \rangle = 9 \mu \text{m} \)

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LLE continues to improve the performance of the OMEGA EP Laser System

- A static wavefront corrector on an OMEGA EP high-energy petawatt (HEPW) beamline reduces the focal-spot diameter by 25%
- New ultraviolet optics have increased the available UV beam energies
- An engineered diffuser will improve the temporal measurement of 8- to 250-ps pulses

Further discussion of OMEGA EP performance and improvements at tonight’s Omega Laser Users’ Group Meeting – 1730–1900 in room 151 ABCG.
Collaborators


University of Rochester
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Static wavefront correction is used to reduce high-order residual wavefront error in the IR beamlines after active correction.

The static wavefront corrector compensates for wavefront errors in the IR beamlines only (not compressor or UV sections).
Focal-spot improvement with active wavefront control was confirmed at beamline and compressor outputs.

Before

- Beamline output
  - \( \langle R_{80} \rangle \approx 16 \, \mu m \)

- Compressor output
  - \( \langle R_{80} \rangle = 17.5 \, \mu m \)

After

- Beamline output
  - \( \langle R_{80} \rangle = 9 \, \mu m \)

- Compressor output
  - \( \langle R_{80} \rangle = 13 \, \mu m \)

Ensemble averages of ten measurements each are shown.

Shot-to-shot pointing changes were removed.
Target-plane focal-spot performance has been improved with the SWC; disk heating is the next challenge.

An upcoming revision of the static corrector will compensate for disk heating effects to optimize performance for the 3rd to 4th shot of the day.

Recent target shot data (with and without static corrector)

- June 2010 to Aug. 2011 (No SWC)
- Aug. to Sept. 2011 (Rev. 1 SWC)

Effect of amplifier disk heating (with static corrector)

- 8/30/2011
- 8/31/2011
- 9/7/2011

An upcoming revision of the static corrector will compensate for disk heating effects to optimize performance for the 3rd to 4th shot of the day.
OMEGA EP UV maximum energy was increased in FY11 after a damage-threshold campaign was completed

- Damage testing on BL4 led to a determination of the operational fluence for new optics
- A four-segment beam was launched to increase the efficiency of the measurement
- Four-fold increase in data collected allowed for a sufficient number of shots at each fluence to ensure initiation and growth of damage
- Damage observed early on segment 4 caused the segment to be blocked before continuing the campaign

Updated energy table at www.epops.lle.rochester.edu
The high-speed Rochester Optical Streak System (ROSS) is used to measure pulse widths from 8 to 250 ps

Short-pulse measurement using a streak camera is sensitive to beam quality and space-charge–broadening effects

- Wavefront aberrations create modulations in the far field
- Hot spots in the foci exacerbate space-charge broadening
- Shot-to-shot pulse measurement is compromised by the pointing variations
A $10^\circ \times 0.4^\circ$ anamorphic diffuser has been developed to homogenize the far-field image in space

- Provides different divergence angles in two orthogonal directions
- All points on the diffuser plane contribute to the energy collected at each location on the focal plane

Anamorphic diffuser ($10^\circ$)

Anamorphic diffuser ($0.4^\circ$)

**cw measurement at 1053 nm using a charge-coupled device (CCD) camera**

- $\text{FWHM} = 6.1 \text{ mm}$
- $\text{FWHM} = 270 \text{ \mu m}$
The improved illumination mitigated the temporal distortion induced by the hot spots.
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