Design of Platforms for Backlighting Spherical Implosions on OMEGA and the NIF

Without repointing

Shot 77085

$t = 2.8\text{ ns}$

$19\text{ kJ}$

$Y_n = 5 \times 10^9$

With repointing

Shot 79643

$t = 3.0\text{ ns}$

$15\text{ kJ}$

$Y_n = 1.2 \times 10^{10}$

400 $\mu$m

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Summary

Designs have been developed for OMEGA and the NIF to allow for nearly symmetric implosions when beams are removed for backlighting.

- Using the hydrodynamics code SAGE, a design for OMEGA that adjusts beam pointings and energies has been demonstrated to give uniform 54-beam implosions.
- An improved design for OMEGA removes the need for energy adjustments.
- A design for the NIF allows for uniform implosions with two missing quads.
Collaborators


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*LLE Summer High School Program
In the OMEGA experiment, six beams irradiated the backlighter, leaving 54 beams to drive the implosion.
18 OMEGA beams in the vicinity of the six backlighter beams were repointed and given 33% more energy than the other beams.

In practice the unaltered beams were given $\frac{1}{1.33}$ less energy.
With the optimized configuration the deposited energy is uniform to 0.74%.

- Deposited energy ($\sigma_{\text{rms}} = 0.74\%$)
- $\sigma_{\text{rms}} = 0.40\%$ for 60 beams
- $t = 2.5$ ns
The symmetry of 54-beam implosions on OMEGA was greatly improved by adjusting the beam energies and pointings.

**Without repointing**

\( \sigma_{\text{rms}} \approx 17 \, \mu\text{m} \)

\[ t = 2.8 \, \text{ns} \quad \text{Shot 77085} \]

\( 19 \, \text{kJ} \)

\[ Y_n = 5 \times 10^9 \]

**With repointing**

\( \sigma_{\text{rms}} \approx 3 \, \mu\text{m} \)

\[ t = 3.0 \, \text{ns} \quad \text{Shot 79643} \]

\( 15 \, \text{kJ} \)

\[ Y_n = 1.2 \times 10^{10} \]
An improved design repoints all 54 beams without any energy adjustments

- Deposited energy ($\sigma_{\text{rms}} = 0.67\%$)
- $t = 2.5$ ns

The full 19 kJ can be used.
For backlighting experiments on the NIF using two quads, the energies and pointings of 16 surrounding beams were adjusted.

- Center-of-mass radius (1.6% rms)
- $t = 6 \text{ ns}$
- $\bar{r} = 630 \mu\text{m}$

Additionally:
- $d = 2200 \mu\text{m}$, 100 $\mu\text{m}$ CH

### Notes:
- Backlighter quad
- Energy $\times 1.5$
The Ring 3b beams deposit more energy near the backlighter quads

- Deposited energy (Ring 3b)
- $t = 6$ ns
The Ring 4 beams deposit less energy near the backlighter quads

- Deposited energy (Ring 4)
- $t = 6 \text{ ns}$
The total deposited energy is uniform near the backlighter quads with a residual nonuniformity pattern
A self-emission image from the pole shows no evidence of nonuniformity caused by the missing backlighting quads.
Summary/Conclusions

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- Using the hydrodynamics code SAGE, a design for OMEGA that adjusts beam pointings and energies has been demonstrated to give uniform 54-beam implosions
- An improved design for OMEGA removes the need for energy adjustments
- A design for the NIF allows for uniform implosions with two missing quads