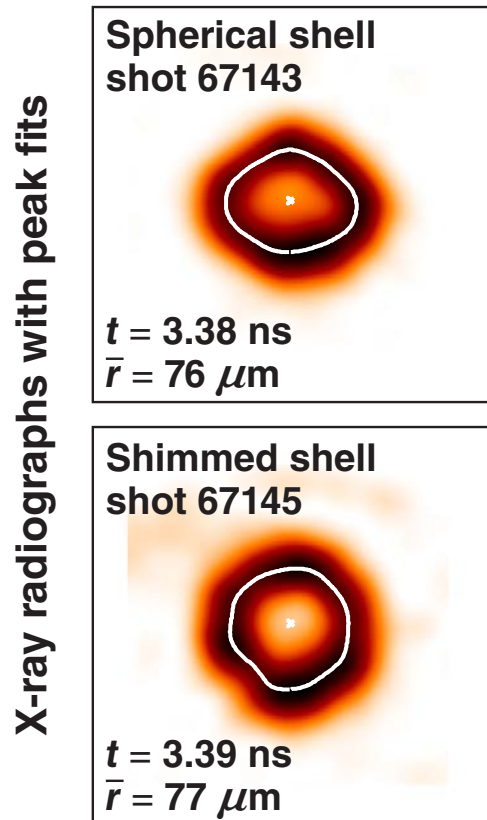
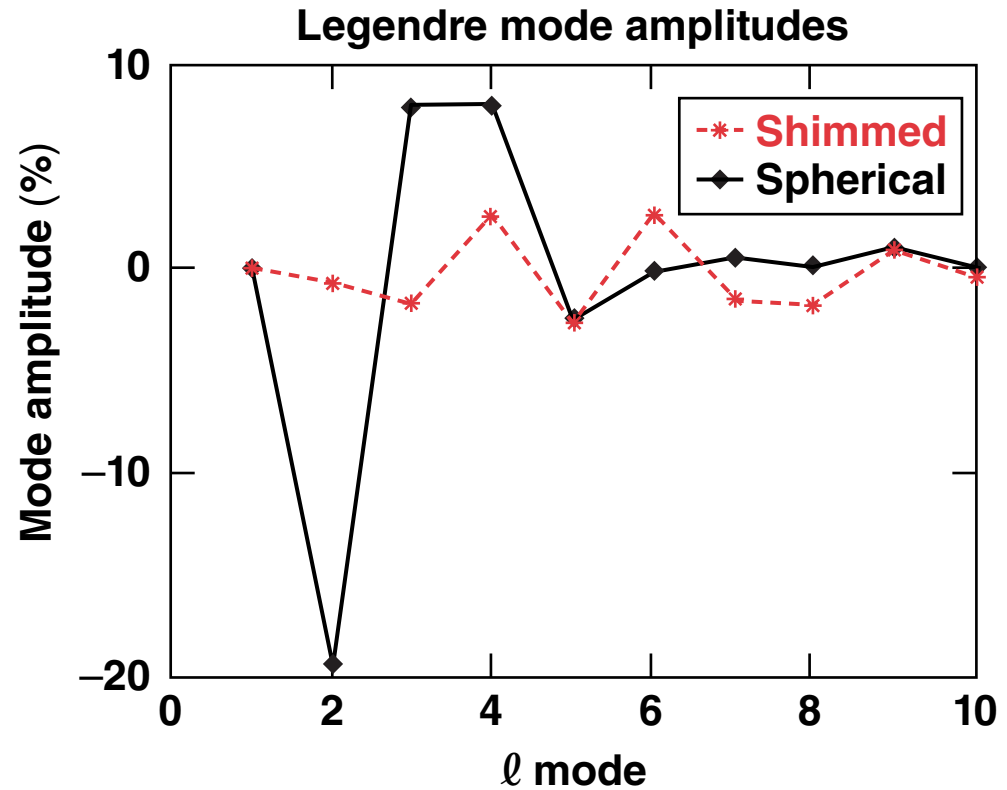


# Polar-Drive Experiments with Shimmed Targets on OMEGA



500 × 500- $\mu\text{m}$  regions



F. J. Marshall  
University of Rochester  
Laboratory for Laser Energetics

54th Annual Meeting of the  
American Physical Society  
Division of Plasma Physics  
Providence, RI  
29 October–2 November 2012

## Summary

# Polar-drive (PD) implosion symmetry on OMEGA has been improved by the use of shimmed targets

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- Low adiabat, high convergence polar-driven implosions of D<sub>2</sub>-filled, CH shells at a convergence ratio of 19 have been performed with triple-picket laser pulses
- The low-mode symmetry of the implosions, diagnosed with x-ray radiography, has been improved by using “shimmed” or shaped shells
- The combination of beam repointing and shell shimming has improved low-mode implosion symmetry over beam repointing alone

# Collaborators

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**P. B. Radha, M. J. Bonino, J. A. Delettrez, R. Epstein, and S. Skupsky**

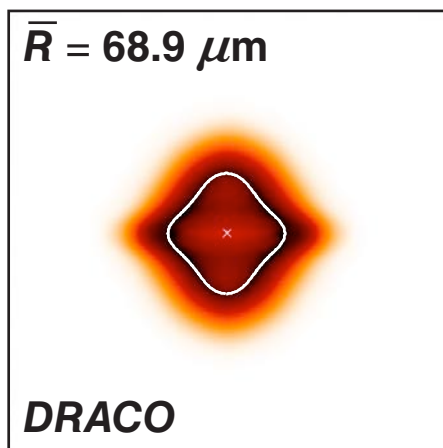
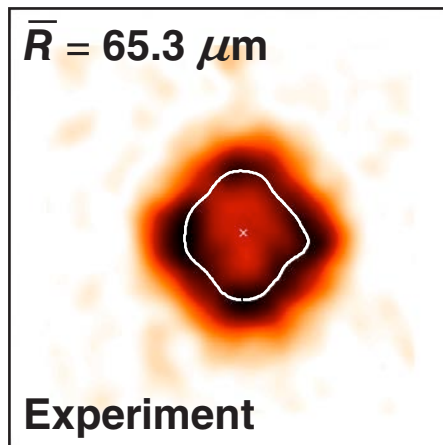
**Laboratory for Laser Energetics  
University of Rochester**

**E. Giraldez**

**General Atomics, San Diego, CA**

# High-convergence-ratio PD implosions with spherical shells achieved a small $\ell = 2$ with a remaining $\ell = 4$

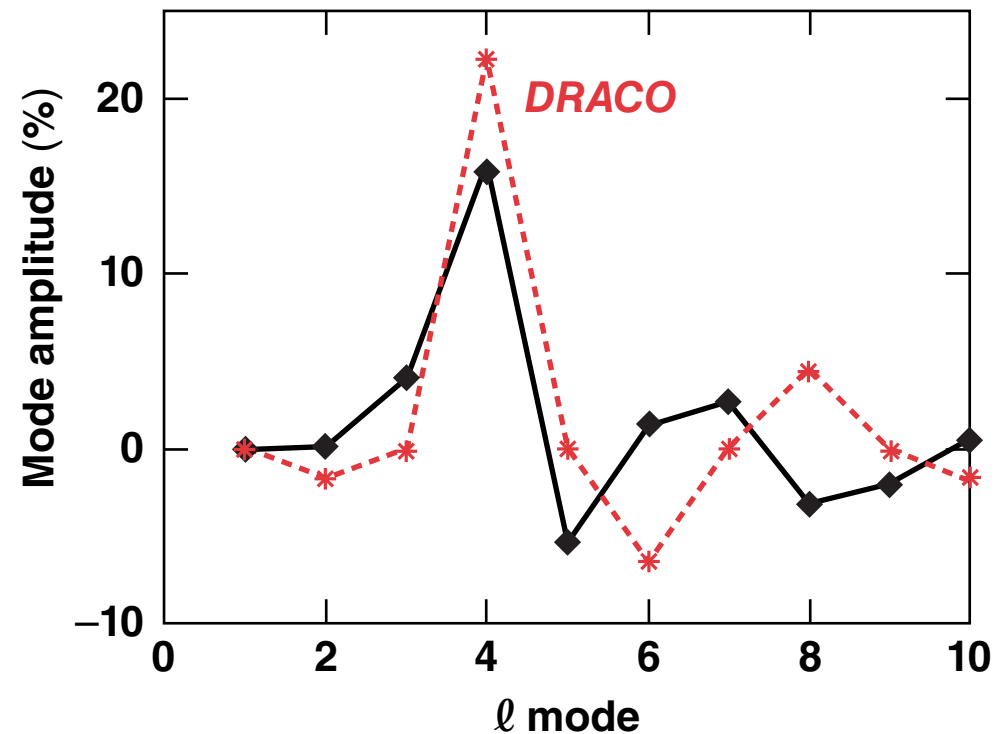
X-ray radiographs  
( $E \sim 4.7$  keV) with peak fits



$500 \times 500\text{-}\mu\text{m}$  regions

10-atm- $\text{D}_2$ -filled,  $27\text{-}\mu\text{m}$ -thick CH shell,  
13.7 kJ, triple picket implosion

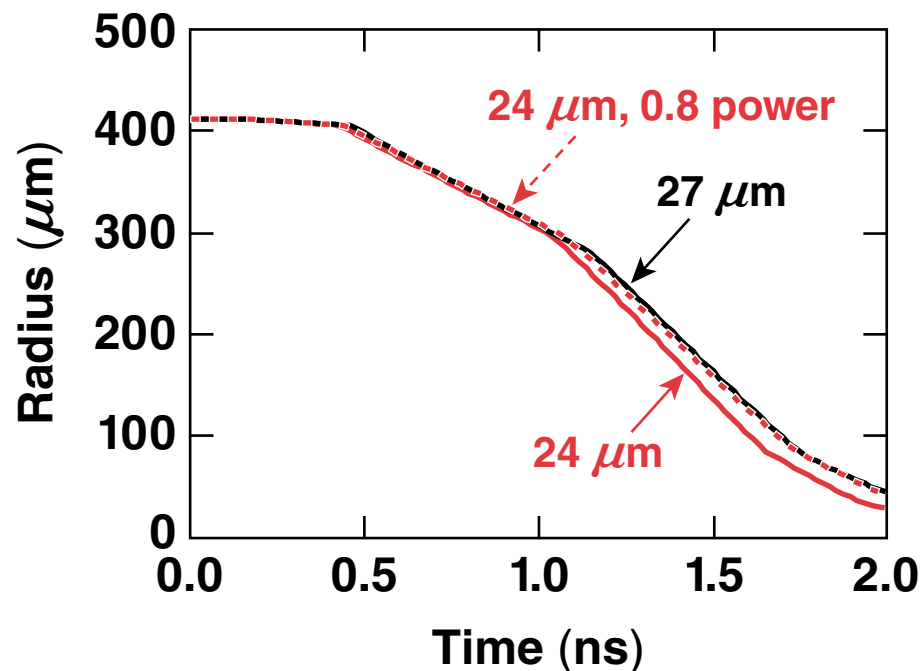
Rings 1, 2, 3 – 90, 133, 133- $\mu\text{m}$  offsets  
OMEGA shot 60661, 3.55 ns



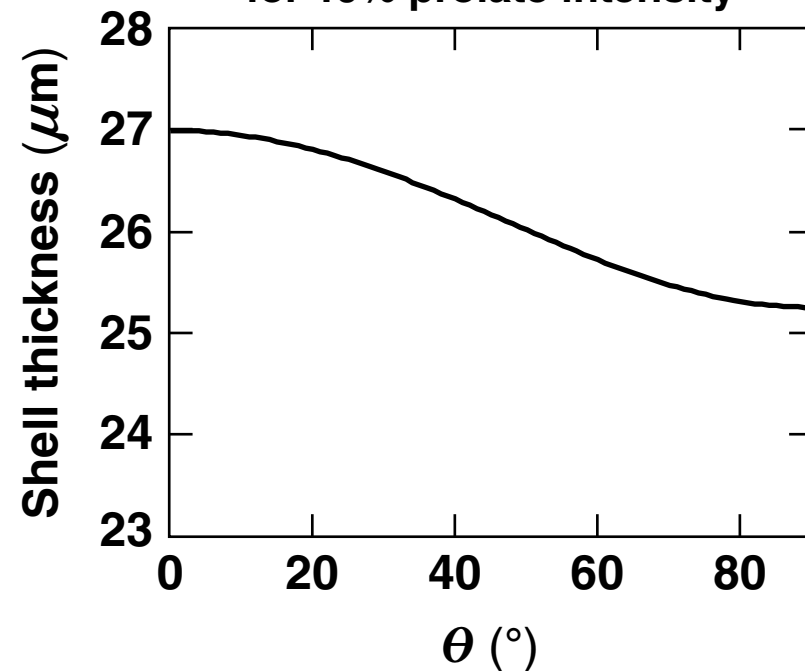
# Polar-drive shimmed targets consist of a capsule with a contoured wall thickness

- A series of *LILAC* runs (1-D hydro) were used to determine the shell thickness needed as a function of intensity

*LILAC* fuel/shell interface for 1-ns square pulse 27 kJ, 10 atm D<sub>2</sub>-filled CH shells

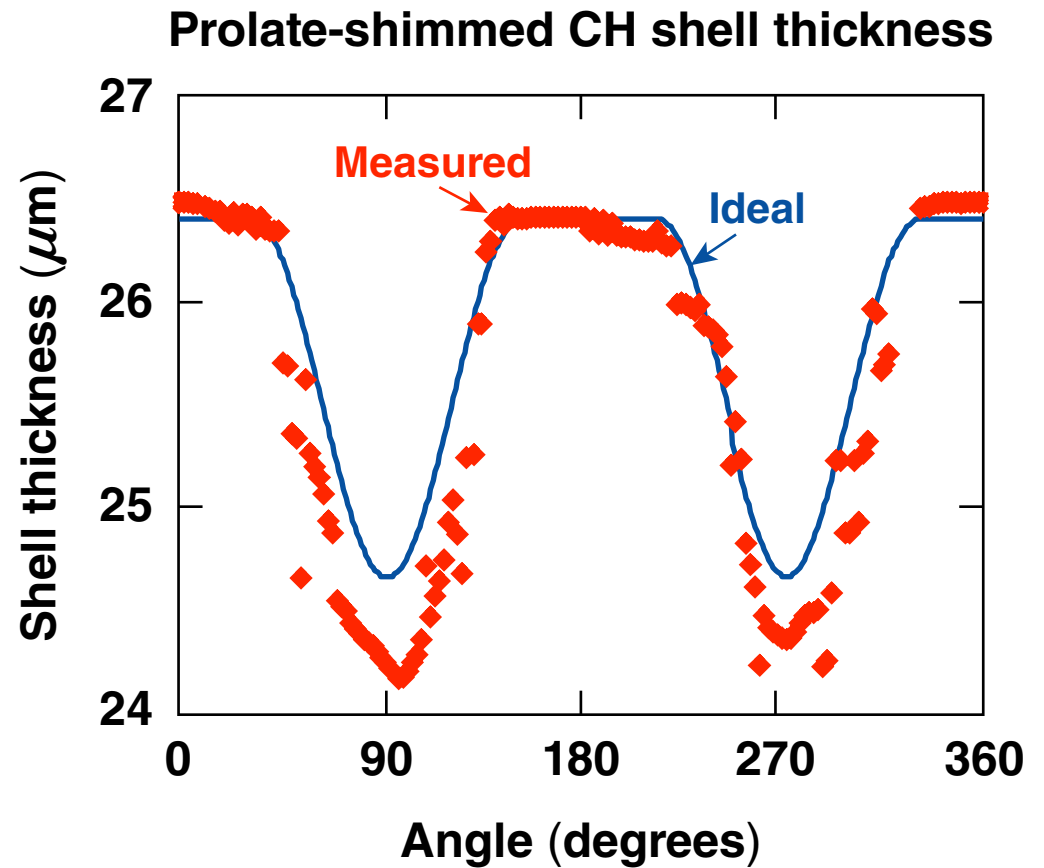
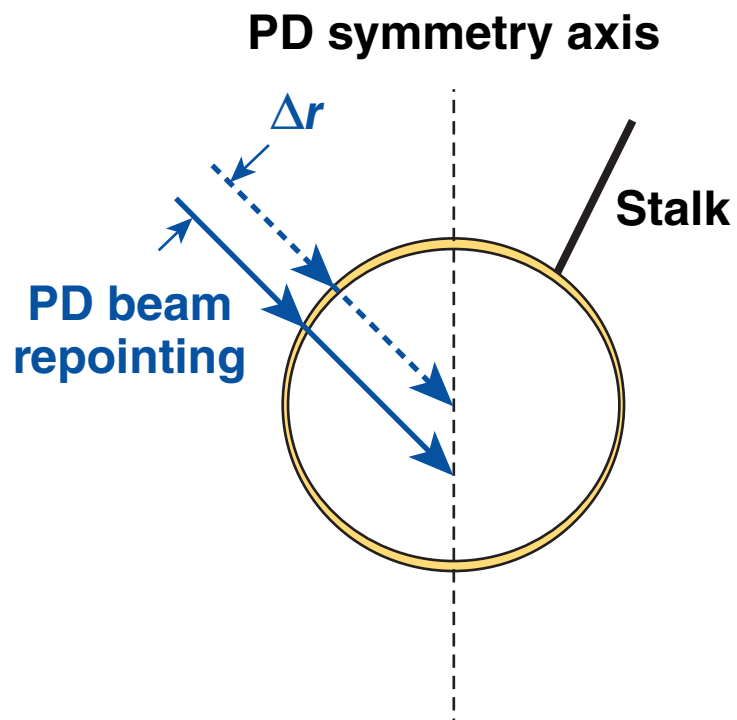


Shell thickness to compensate for 10% prolate intensity



***DRACO* (2-D hydro) was used to optimize the beam pointing that minimized the asymmetry of the imploded shimmed shell.**

# CH shells were precision machined at General Atomics to be as close as possible to the desired profile

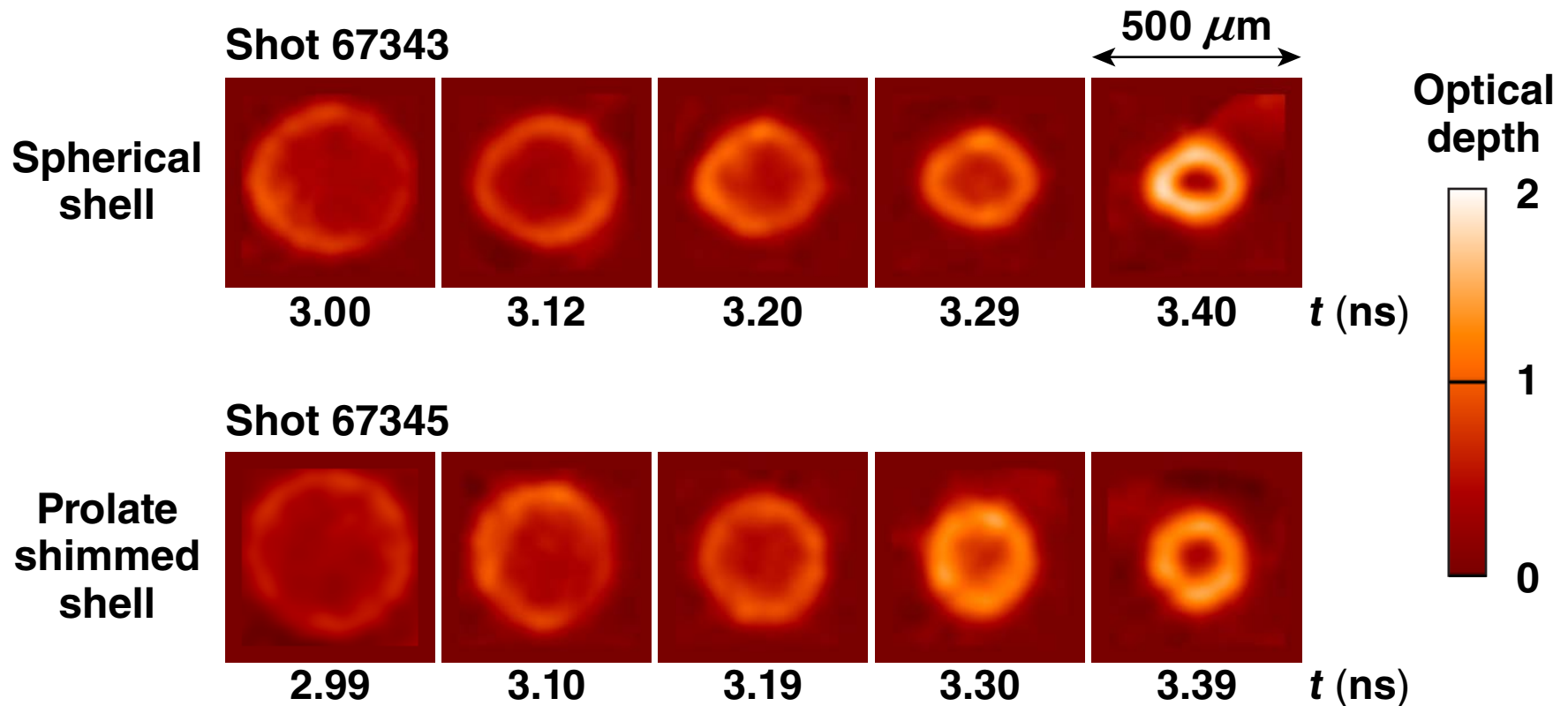


# Shimmed shells implode more symmetrically than spherical shells for the optimum polar-drive beam pointing



10-atm-D<sub>2</sub>-filled, 27- $\mu$ m-thick CH shell, 14 kJ, triple picket implosions

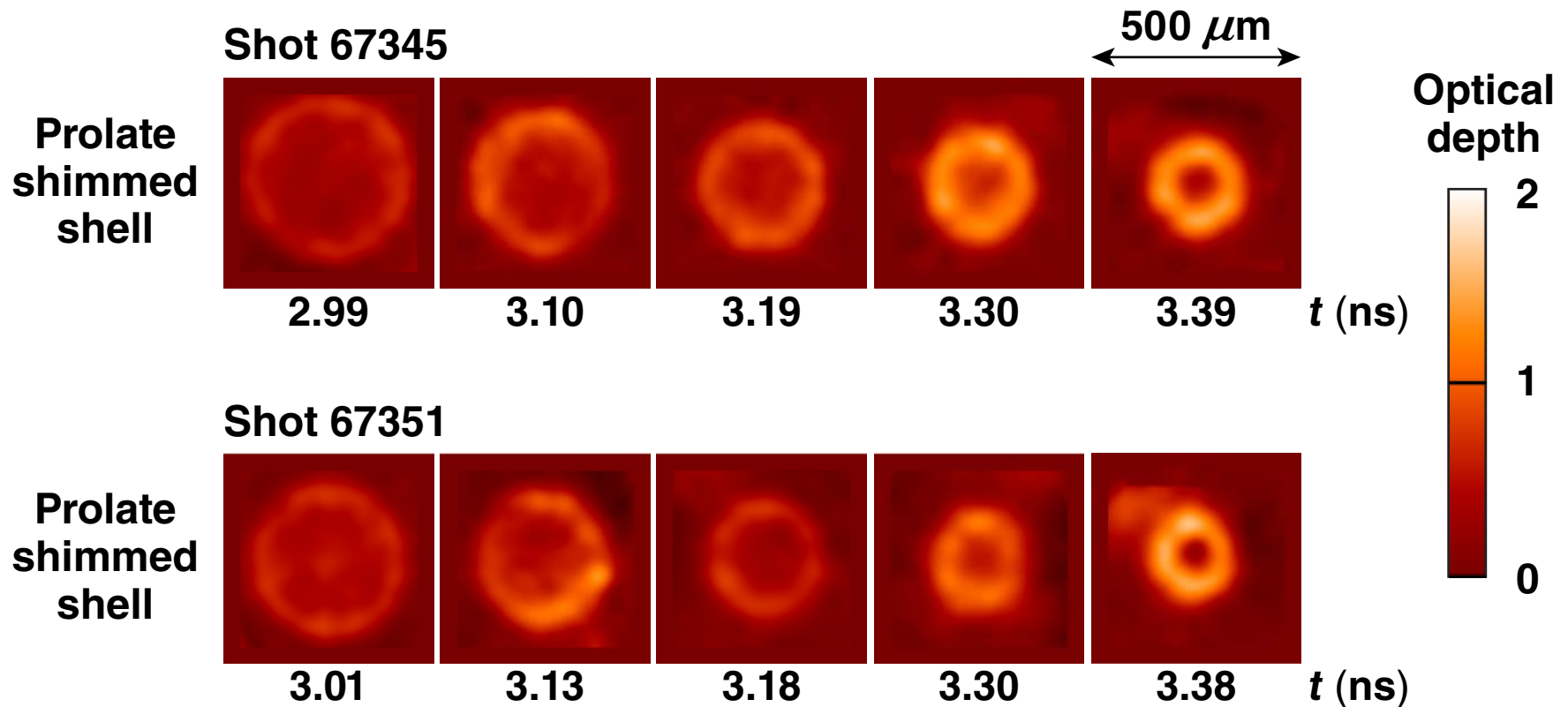
- Framed x-ray radiographs, Ti backlighter ( $E \sim 4.7$  keV)



# Shimmed shell implosions are more symmetric and show good repeatability

10-atm-D<sub>2</sub>-filled, 27- $\mu$ m-thick CH shell, 14 kJ, triple picket implosions

- Framed x-ray radiographs, Ti backlighter ( $E \sim 4.7$  keV)

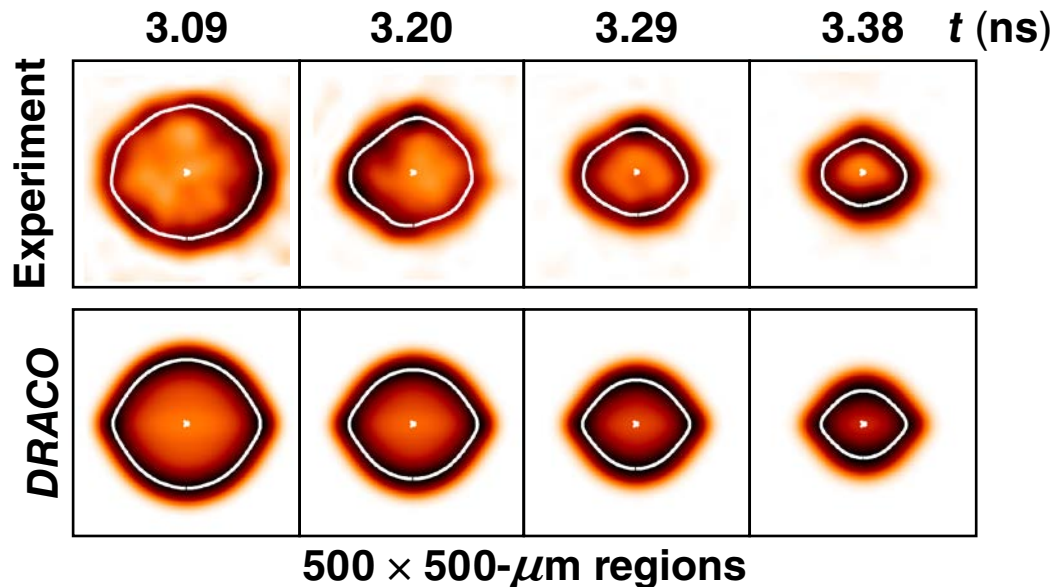




# The spherical shells become oblate at stagnation with the beam pointing used for the shimmed experiments

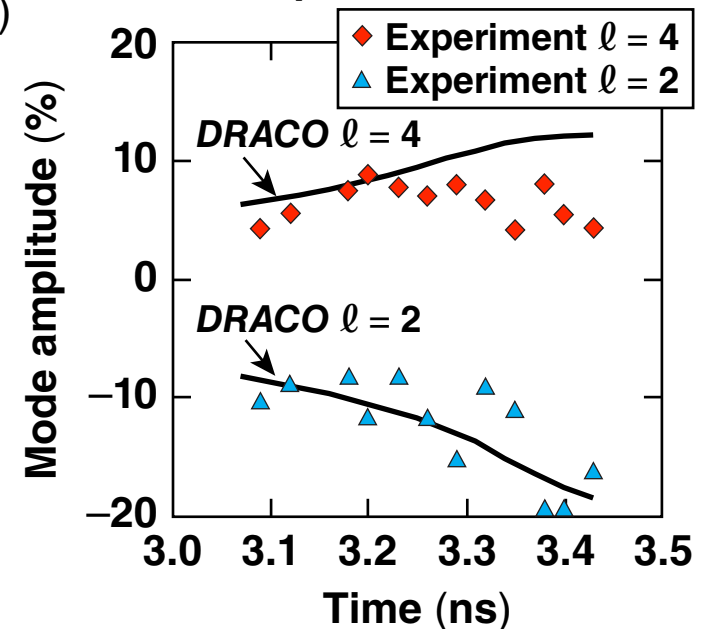
10-atm-D<sub>2</sub>-filled, 27- $\mu$ m-thick CH shell, 14 kJ, triple picket implosion

X-ray radiographs ( $\sim 4.7$  keV) with peak fits



Beam pointing (rings 1, 2, 3): 0, 120, 140- $\mu$ m offsets

OMEGA shot 67343,  
spherical shell

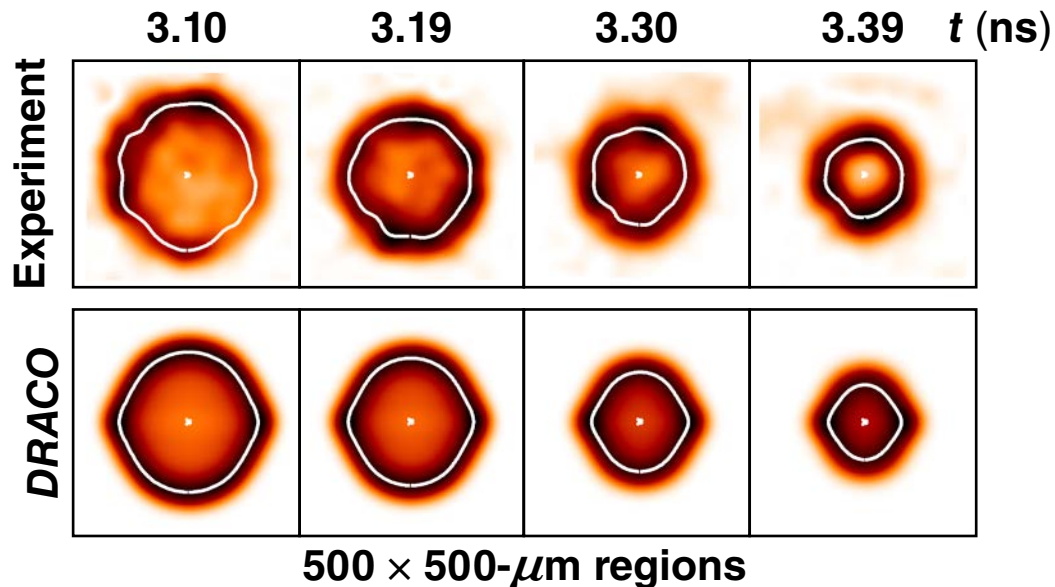


**DRACO simulations predict a shape close to that seen in the experiments.**

# The shimmed shells are much closer to spherical at stagnation for this choice of beam pointing

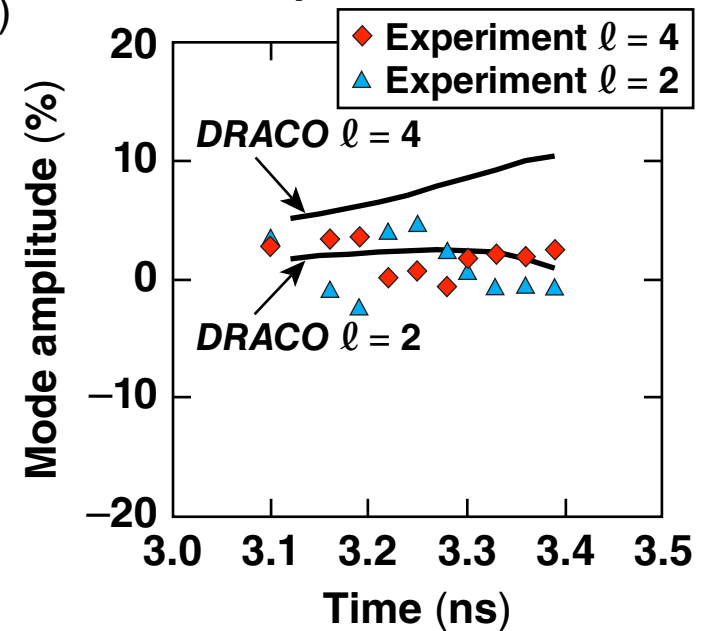
10-atm-D<sub>2</sub>-filled, 27- $\mu$ m-thick CH shell, 14 kJ, triple picket implosion

X-ray radiographs ( $\sim 4.7$  keV) with peak fits



Beam pointing (rings 1, 2, 3): 0, 120, 140- $\mu$ m offsets

OMEGA shot 67345,  
spherical shell

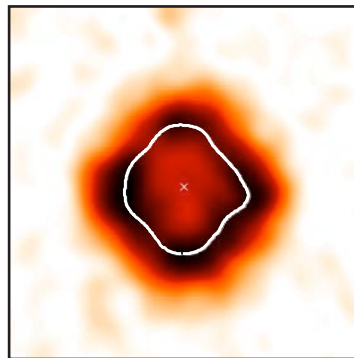


**DRACO simulations predict an  $\ell = 4$  component larger than measured.**

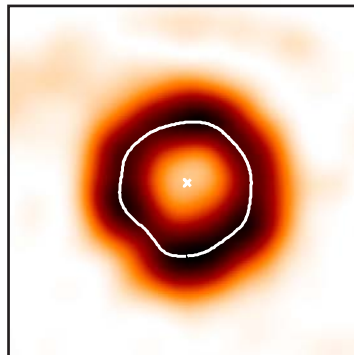
# The best symmetry in PD implosions on OMEGA has been achieved with shimmed shells

## X-ray radiographs with peak fits

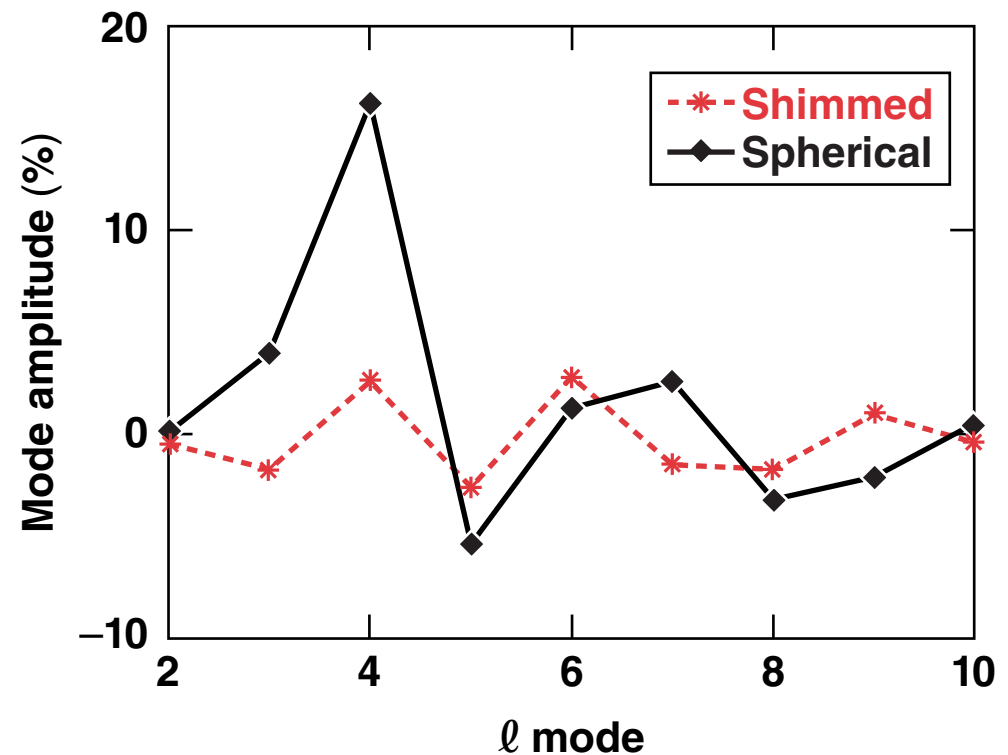
Shot 60661  
No shim  
CR ~ 6  
 $\bar{R} = 65 \mu\text{m}$   
Pointing ( $\Delta r$ )  
90, 133, 133  $\mu\text{m}$



Shot 67345  
With shim  
CR ~ 5  
 $\bar{R} = 77 \mu\text{m}$   
Pointing ( $\Delta r$ )  
0, 120, 140  $\mu\text{m}$



400 × 400- $\mu\text{m}$  regions



# Polar-drive (PD) implosion symmetry on OMEGA has been improved by the use of shimmed targets

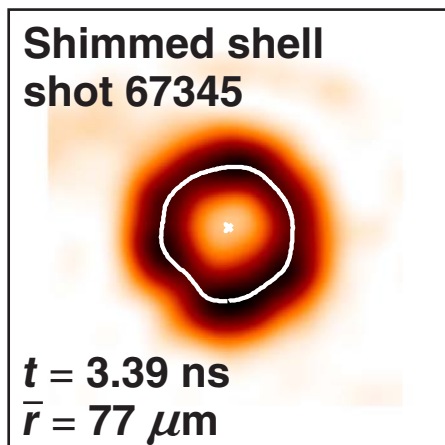
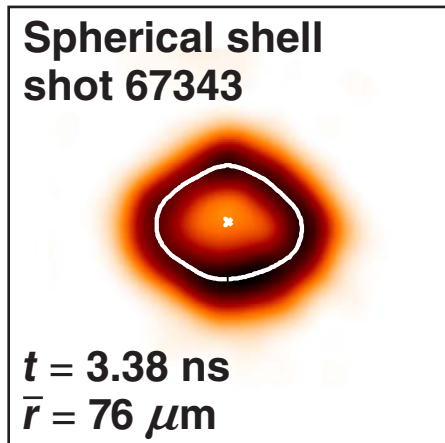
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- Low adiabat, high convergence polar-driven implosions of D<sub>2</sub>-filled, CH shells at a convergence ratio of 19 have been performed with triple-picket laser pulses
- The low-mode symmetry of the implosions, diagnosed with x-ray radiography, has been improved by using “shimmed” or shaped shells
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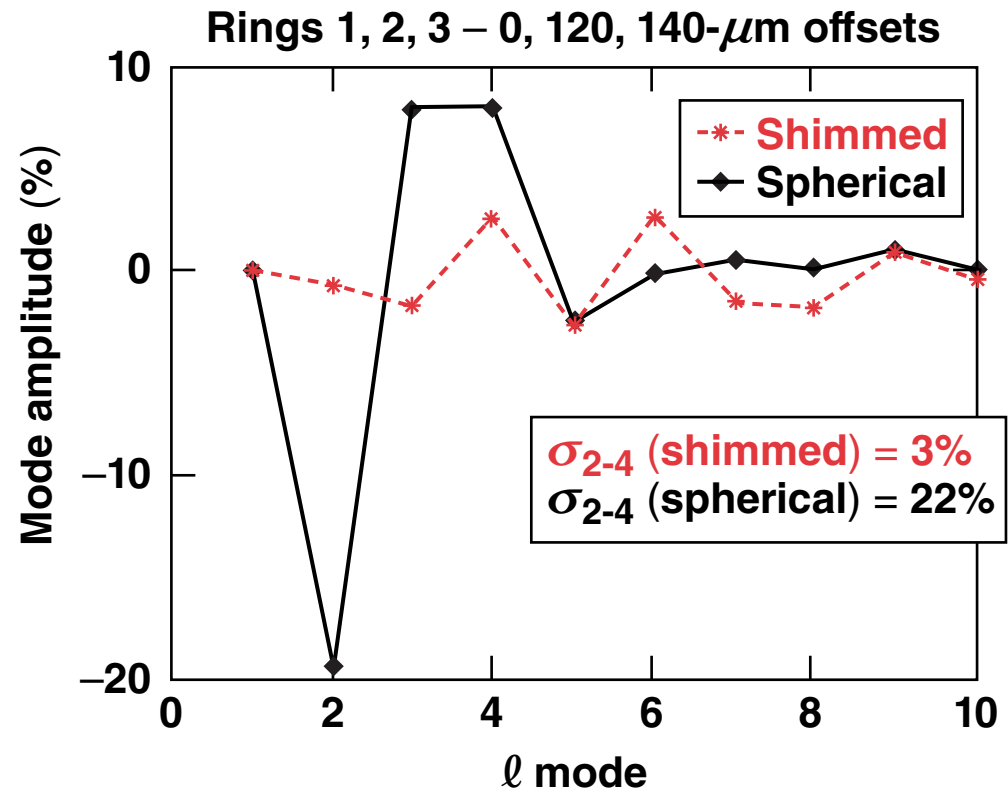
# With the appropriate polar-drive pointing, the shimmed shell implodes more uniformly than the spherical shell

X-ray radiographs  
( $E \sim 4.7$  keV) with peak fits



$500 \times 500$ - $\mu$ m regions

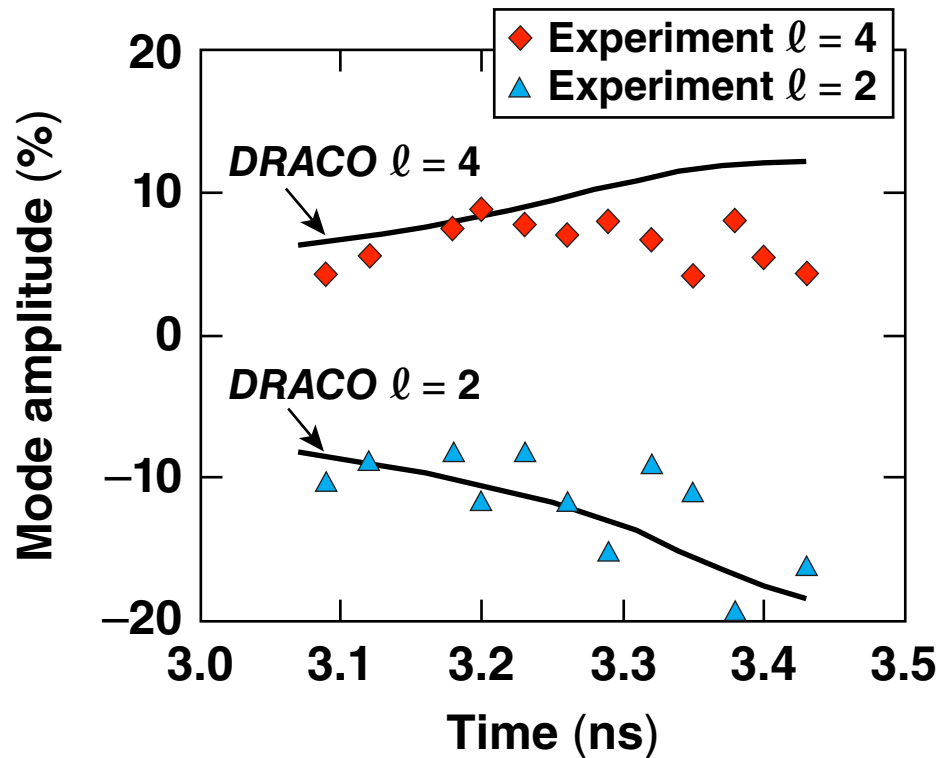
10-atm-D<sub>2</sub>-filled, 27- $\mu$ m-thick CH shell,  
14 kJ, triple picket implosions



# With the appropriate polar-drive pointing, the shimmed shell implodes more uniformly than the spherical shell



Shot 67343, spherical shell



Shot 67345, prolate shimmed shell

