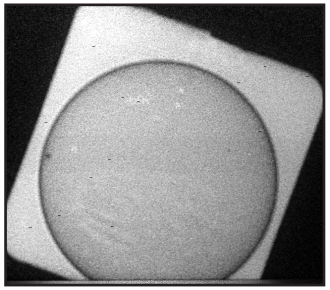
Measurements of P6 and P8 Modes in NIF-Scale Hohlraums Using Point Projection Radiography

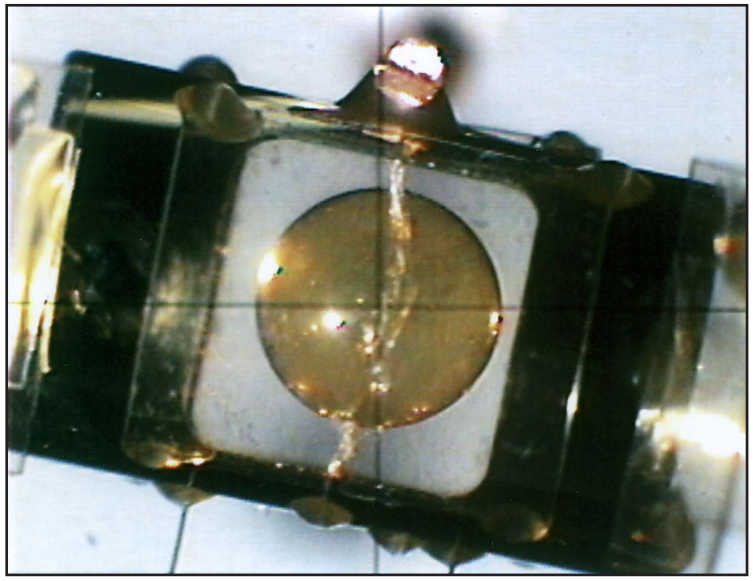
D. K. Bradley, S. Pollaine, S. G. Glendinning, O. L. Landen, R. E. Turner,
P. Amendt, and R. Wallace

Lawrence Livermore National Laboratory

We present results of experiments carried out on the University of Rochester's OMEGA laser facility to study the development of P6 and P8 flux asymmetries inside scale-3 vacuum hohlraums in conditions that approximate the foot of the NIF drive pulse. These experiments use a new point-projection backlighting technique in which a pair of backlit pinholes situated 22 mm from the hohlraum were used to produce point sources of 4.7-keV x rays. This radiation was used to project images of thin, 2- to 3-mm diam Ge-doped shells at two different times onto a large-area gated detector with a magnification of ~5.5 to 6.5 and a resolution of 30 μm. Distortions in the position of the capsule's limb, resulting from drive asymmetries, can be measured with this technique to a predicted accuracy of 2 μm. We will compare the asymmetries measured using the thin shells with similar measurements using foam balls. This work was performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48.

Measurements of P6 and P8 Modes in NIF-Scale Hohlraums Using Point Projection Radiography*





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Seattle, WA
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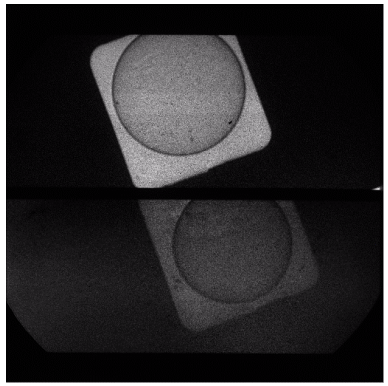
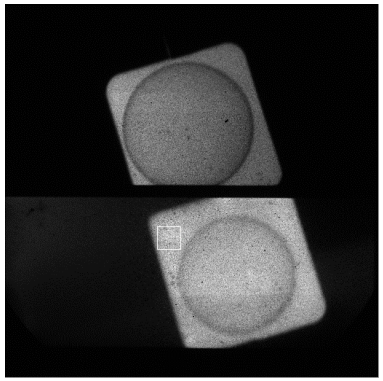
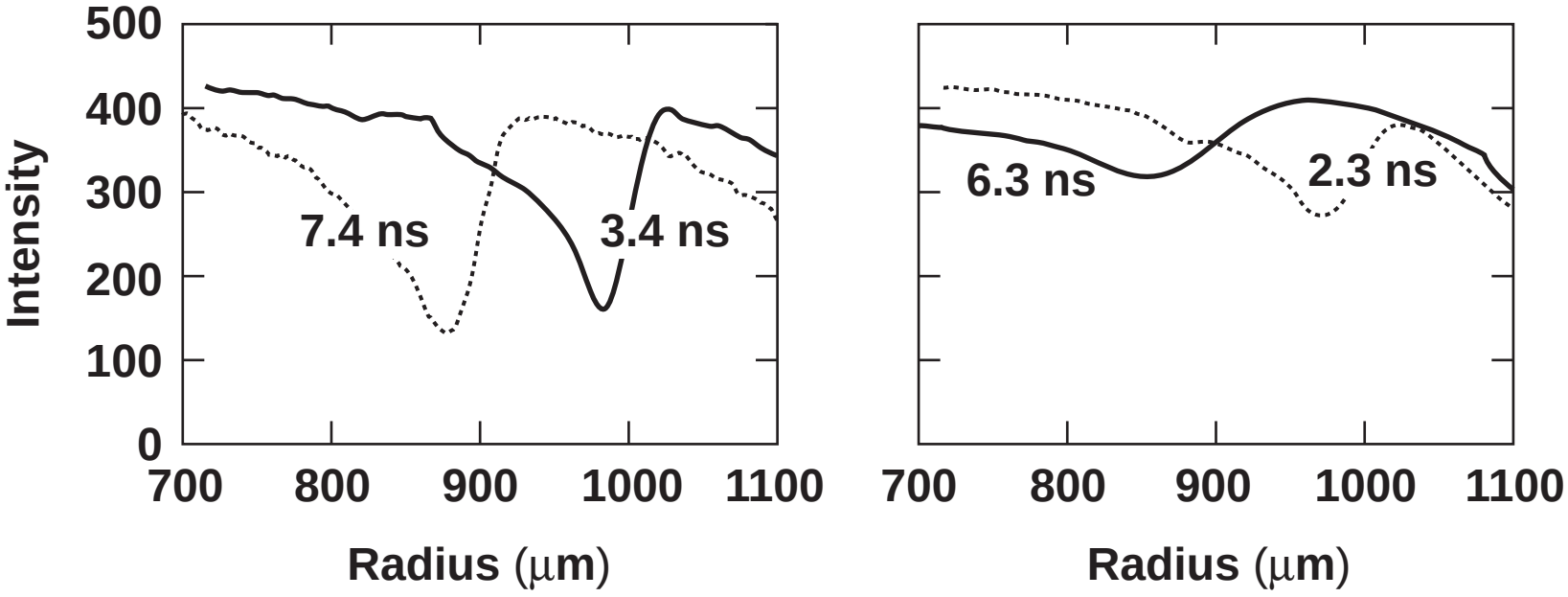
Comparison with no-pinhole shot shows higher contrast with pinholes

50-μm pinholes





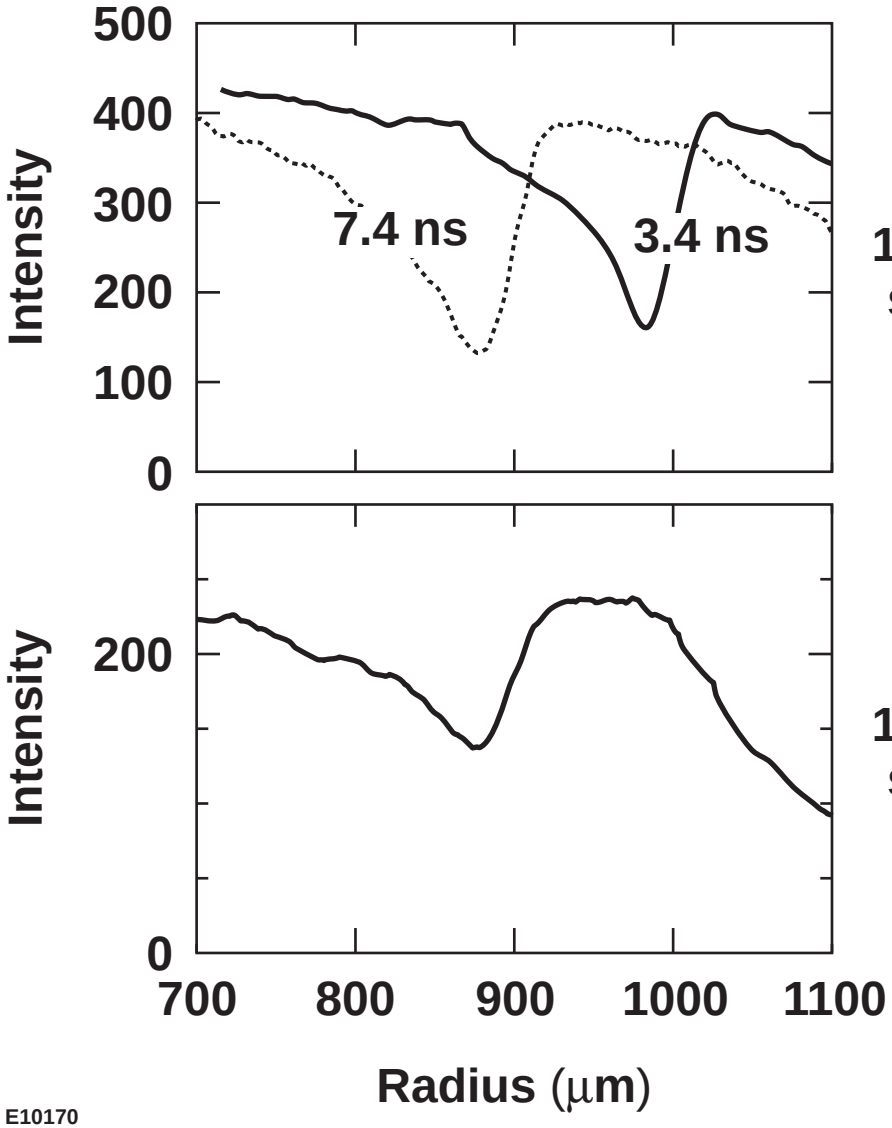
100- to 120-μm focused beams

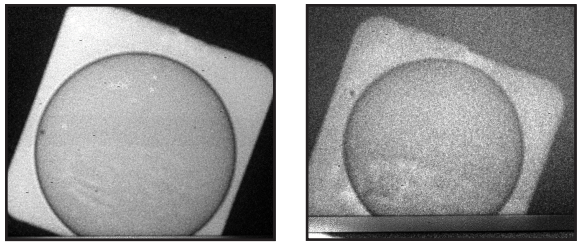


Scatter between pixels is 2.5× higher with no pinholes.

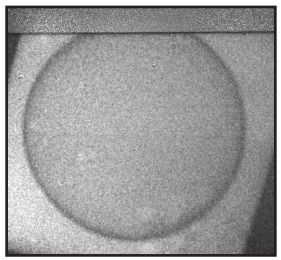
E10169

Data was recorded from both 14-μm- and 10-μm-thick shells





3.4 ns 7.4 ns

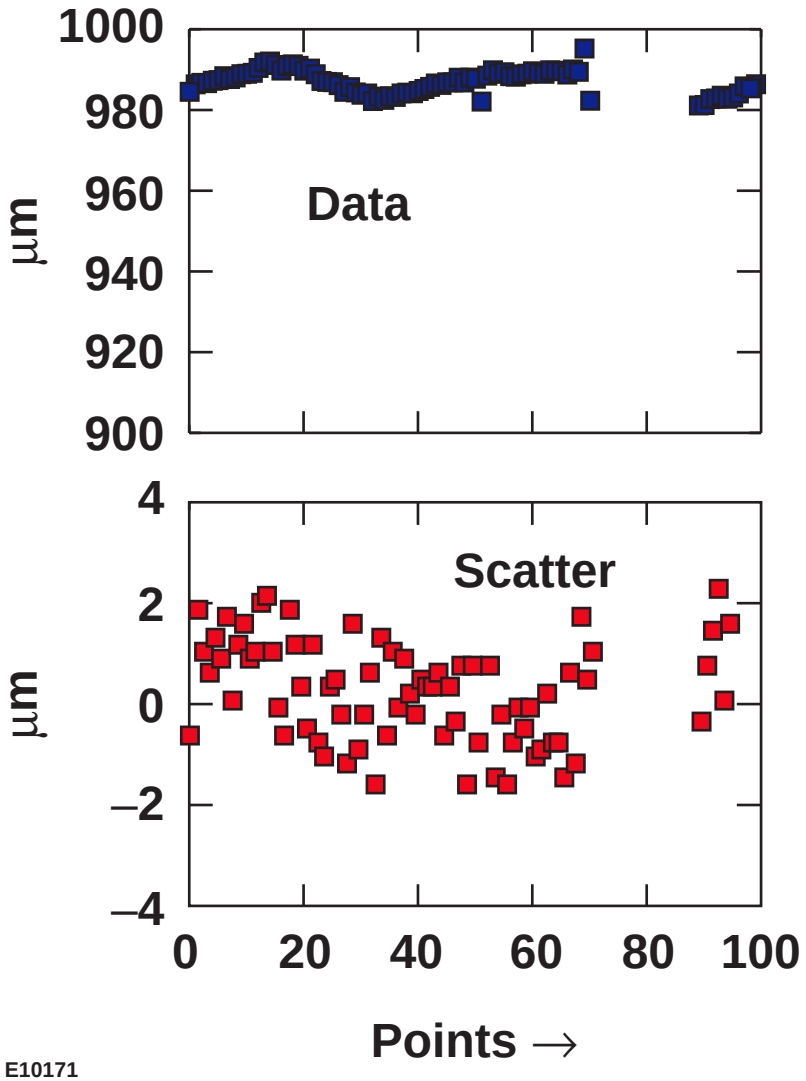


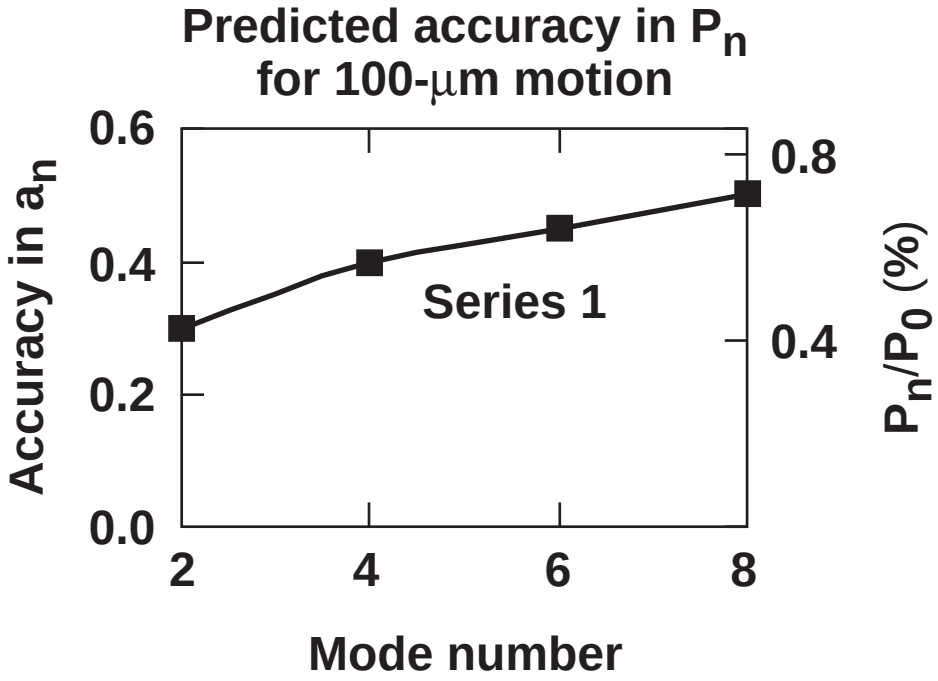
7 ns

10-μm shell has a lower contrast but still has a clear limb.

E10170

The standard deviation in scatter between points is about 0.85 pixels (1.2 μm)



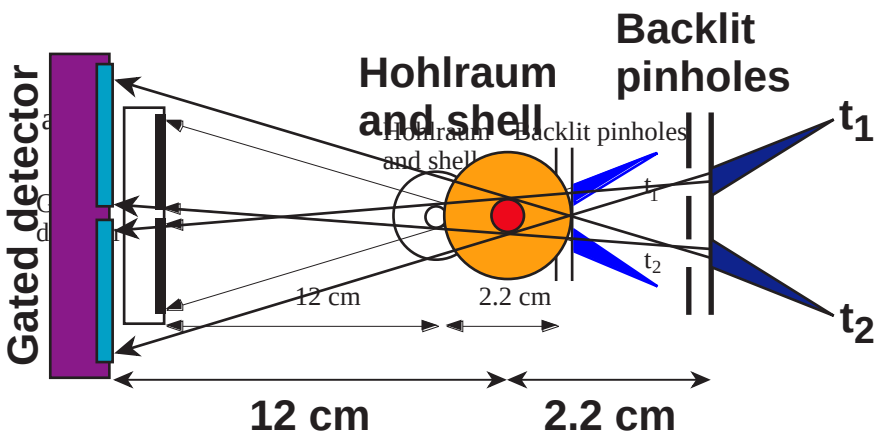


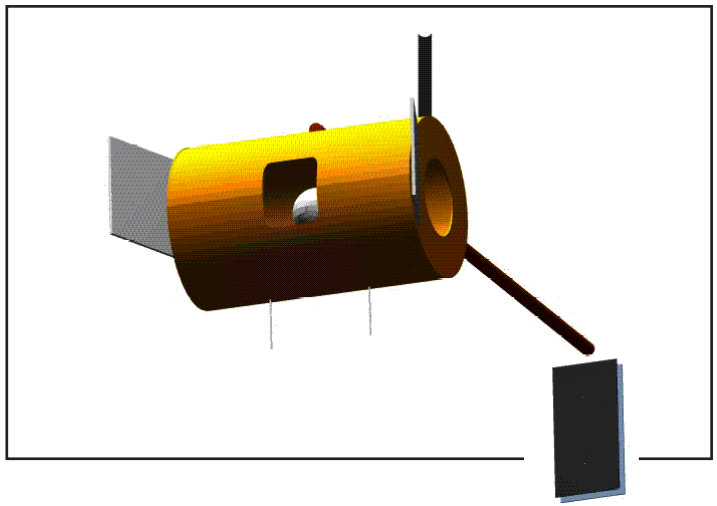
$$\frac{\Delta P_l}{P_0} = \frac{\sqrt{2} \times a_l}{a_0} = \sqrt{2l+1} \times \frac{\sigma_{rms}}{\sqrt{n}} \times \sqrt{2}$$

For 100 μm traveled, this projects to an accuracy of 0.6% to 0.7% in P6 and P8.

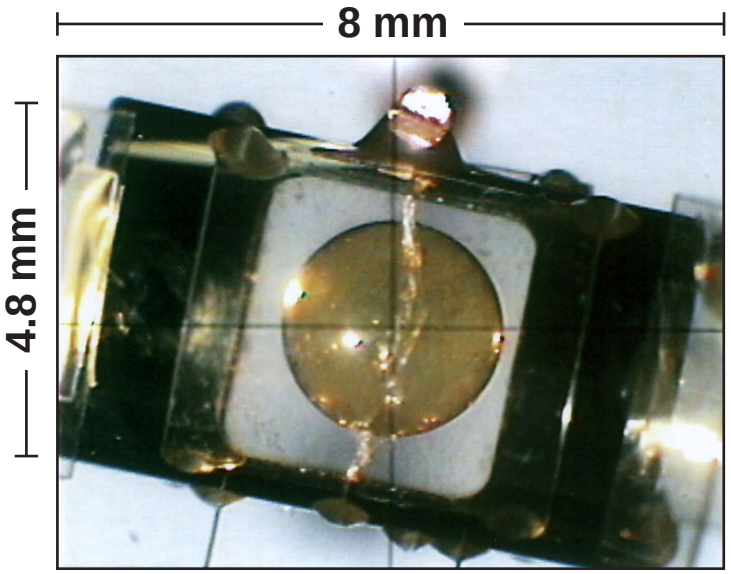
E10171

Backlit pinholes were used to produce a pair of time-gated radiographs of the accelerating shell



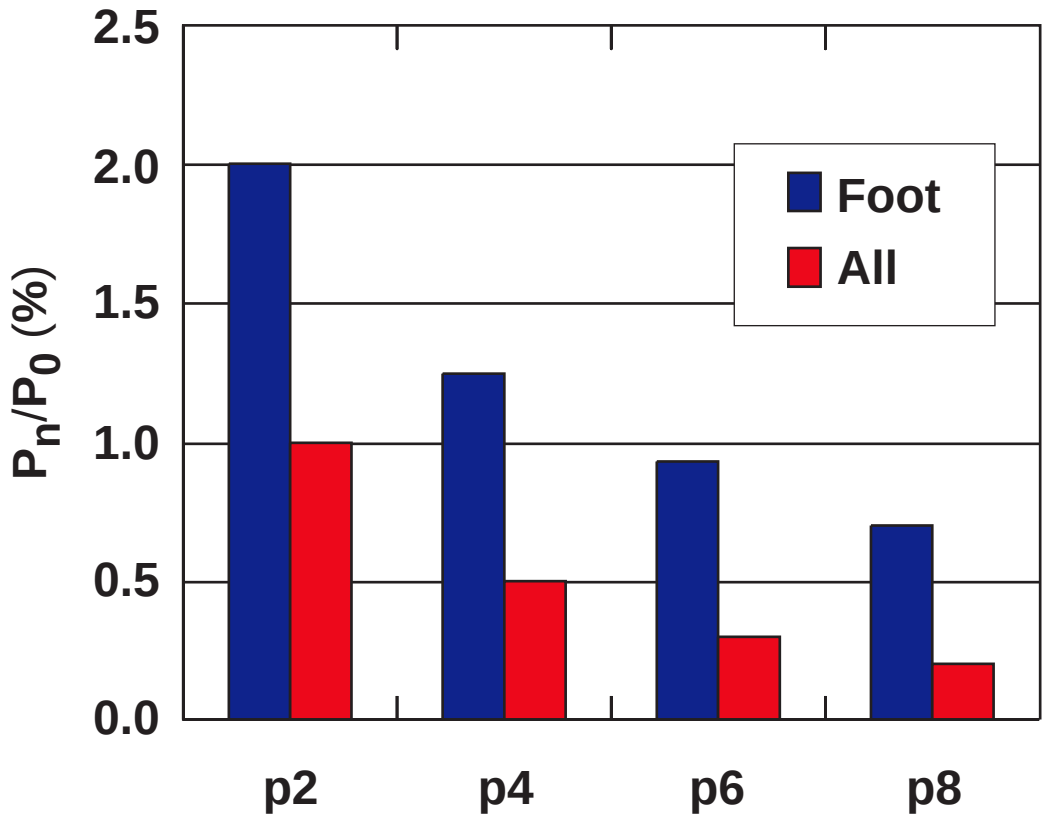


- 50-μm pinholes—projecting to 35 μm at target plane
- 0.5-μm Au patches to reduce asymmetries
- Various shell thicknesses
- CCD recording
- Time resolution: 240 ps

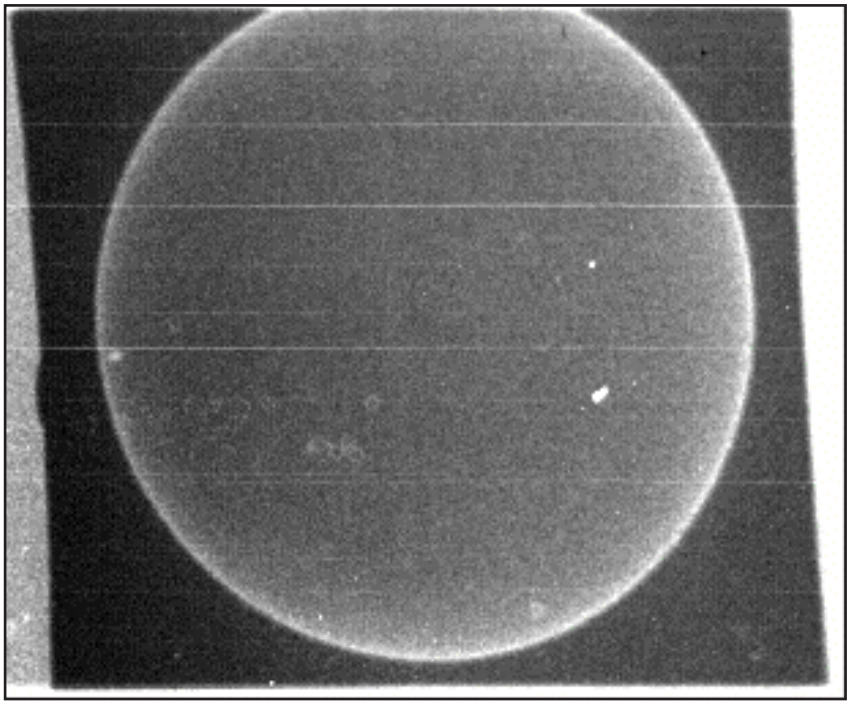


We need to evaluate and optimize higher-order asymmetry mode detection techniques

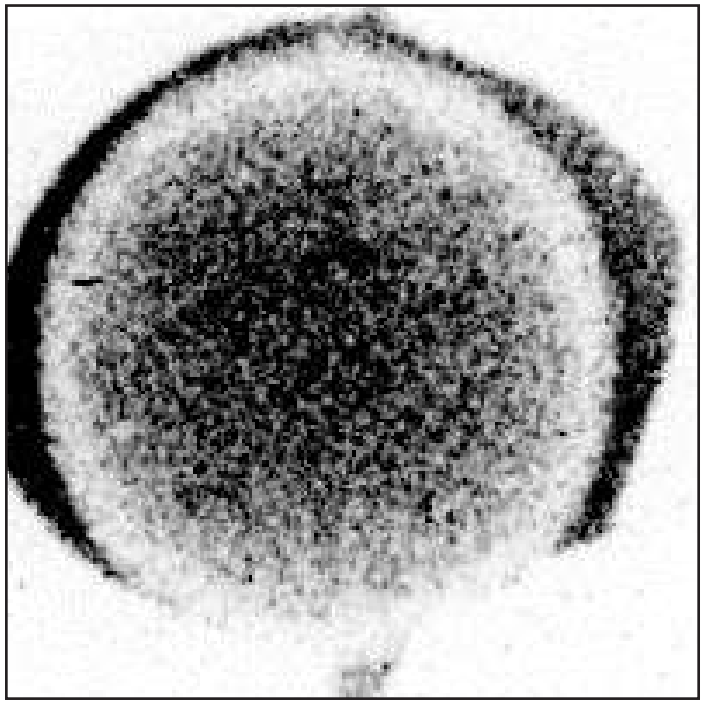
- **P6 and P8 need to be measured to the 0.5% to 1.0% levels on the NIF foot.**



Comparison of backlit pinhole with area backlighter shows improvements in data quality



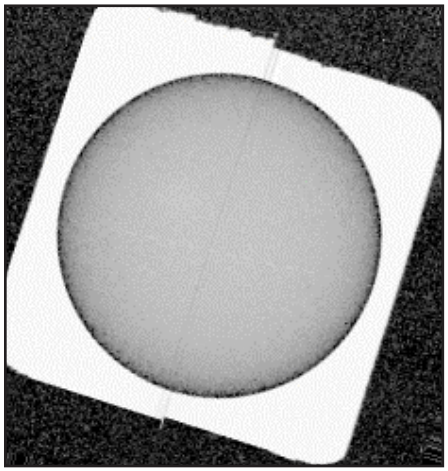
Backlit pinhole backlighter



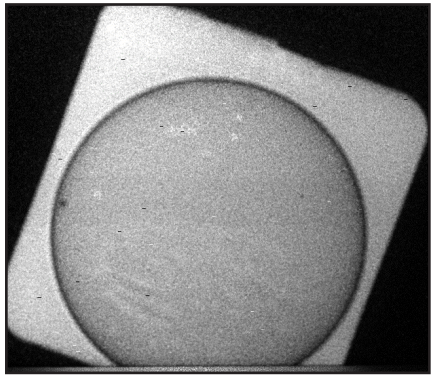
Area backlighter

Data obtained on shots is comparable in quality to pre-shot radiographs

14-μm shell

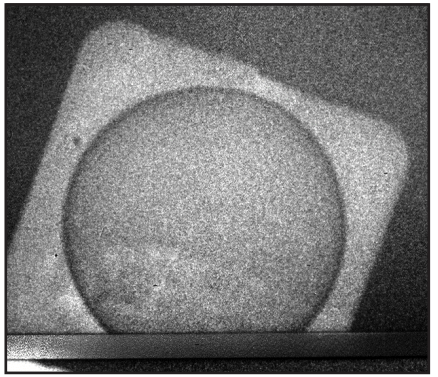


Pre-shot radiograph at 2.3 KeV



3.4 ns

4.7 keV

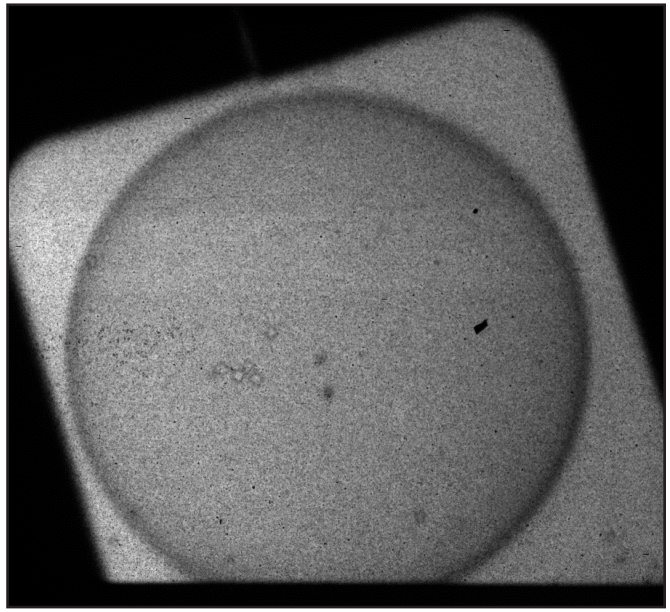


7.4 ns

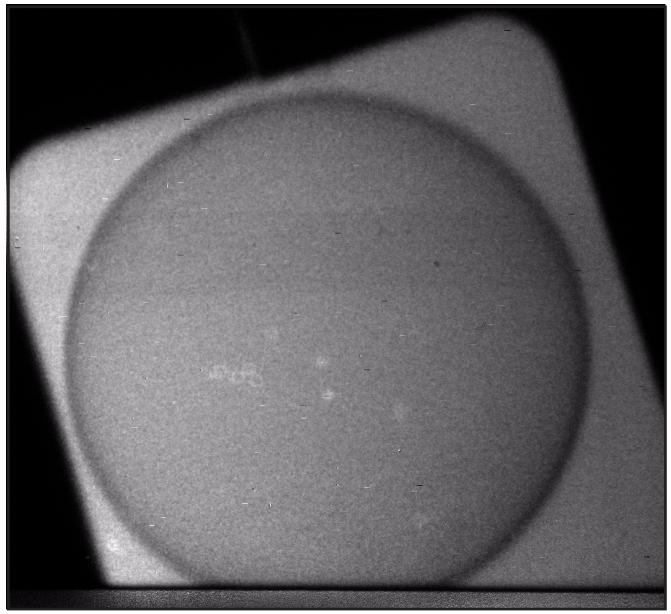
E10192

Improvement is visable in image

Before

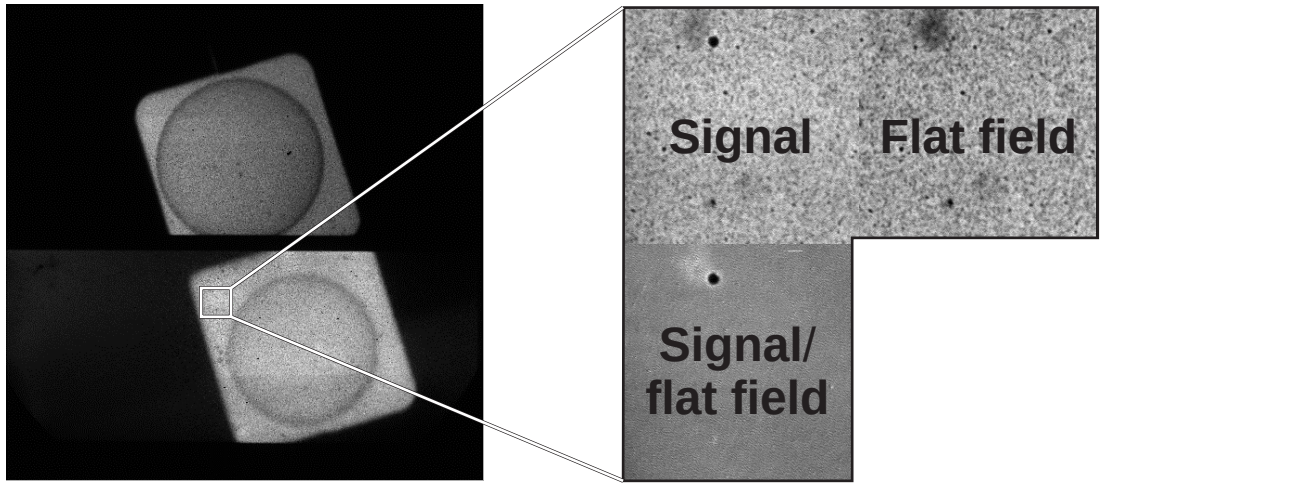


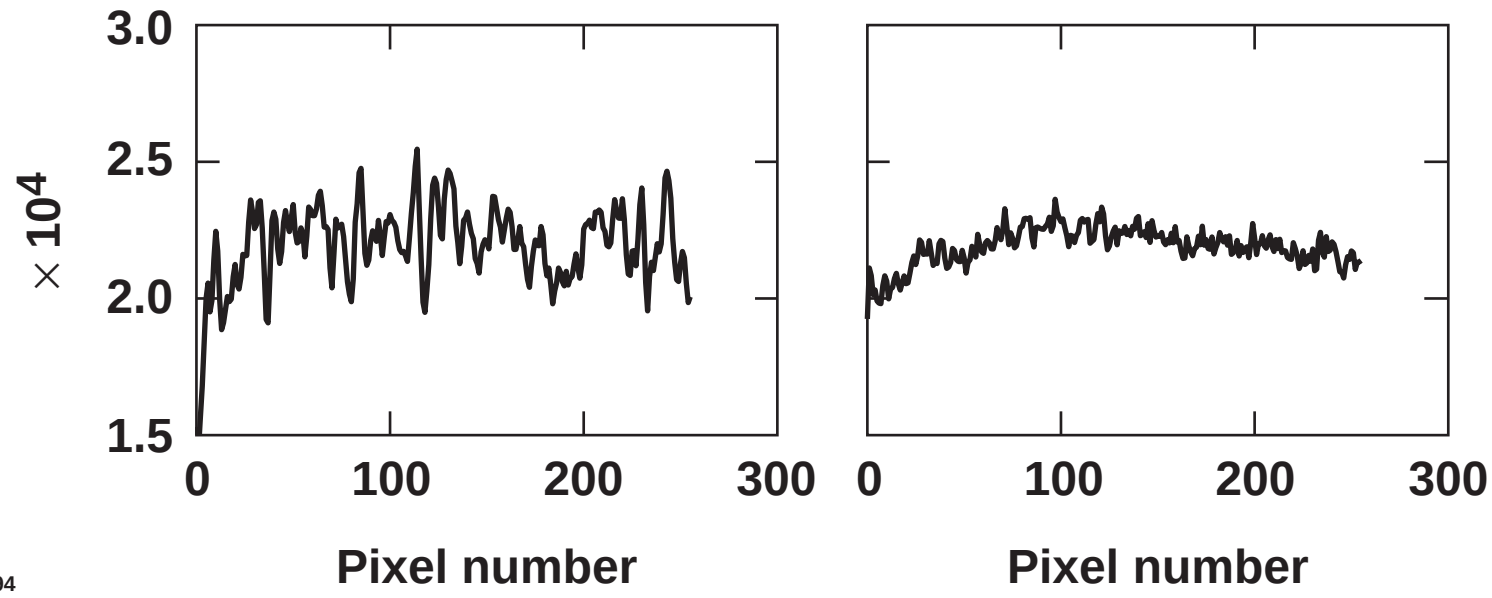
After division



- **Resulting improvement in measured position of limb is 20%.**

Division by flat-field image allows removal of fixed pattern noise





E10194

The limb position is analyzed as a function of angle