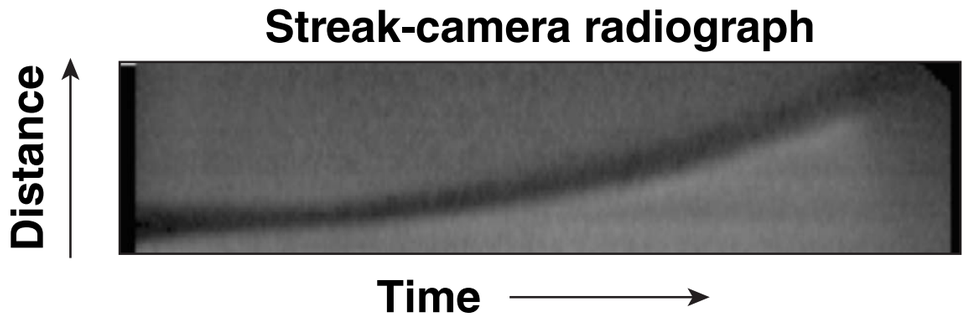
Density Profile of a Foil Accelerated by Laser Ablation



J. P. Knauer
University of Rochester
Laboratory for Laser Energetics

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Summary

Simulated radiographs of accelerated foil qualitatively agree with measured radiographs

- Release of excess material into the hot spot reduces peak compression of inertial confinement fusion (ICF) implosions
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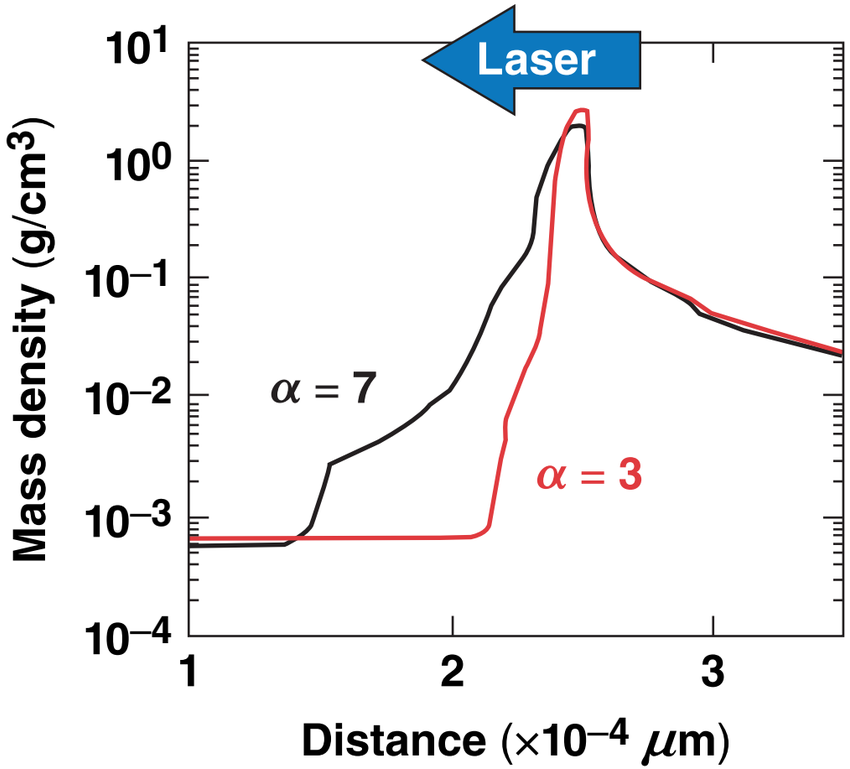
- Shape of rear-surface blowoff is modeled well early in time
- Rear-surface scale length is smaller in the simulation at the end of the laser drive
  - material may have a higher speed-of-release off rear surface
- Measured data do show a wider foil than the simulation after the laser has turned off
  - target is decompressing more than simulated when ablation pressure is released

Collaborators

S. X. Hu, V. N. Goncharov, D. Haberberger, and P. M. Nilson

University of Rochester
Laboratory for Laser Energetics

Release of excess material into the hot spot reduces peak compression of ICF implosions

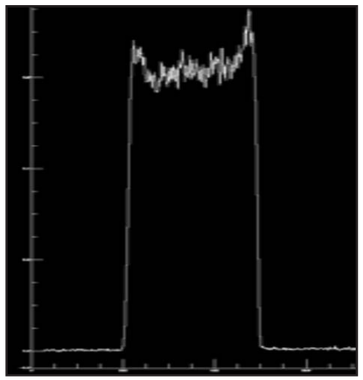


- Material added to the hot spot
  - indicates a higher adiabat
  - reduces compressibility
  - reduces hot-spot pressure

Shell density in higher-adiabat designs adds material to the hot spot.

E25723

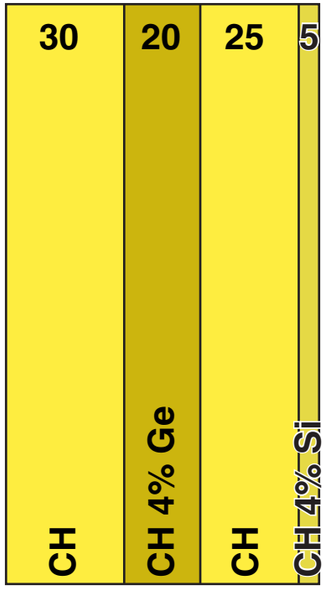
OMEGA EP experiments to measure accelerated foil-density profiles use the x-ray streak camera to measure an edge-on radiograph versus time



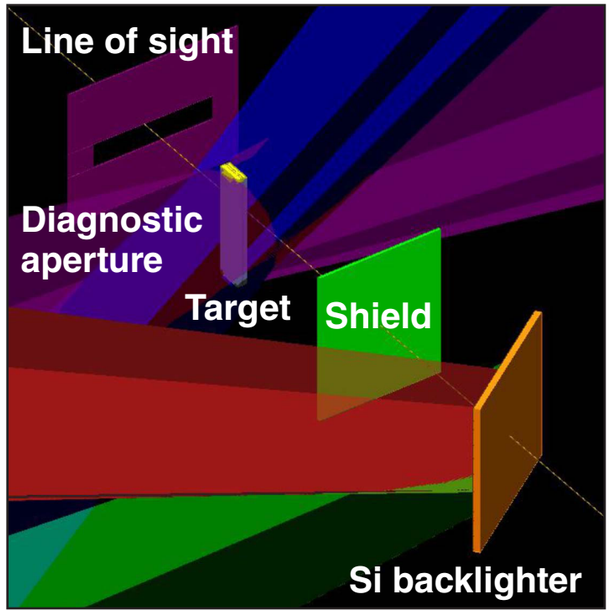
Laser
λ = 351 nm
Width = 5 ns
Power = 1.1 TW
Intensity = 2.5×10^{14} W/cm^2

Laser

Thickness μm



Total thickness = 80 μm
0.9-mm high × 0.2-mm wide



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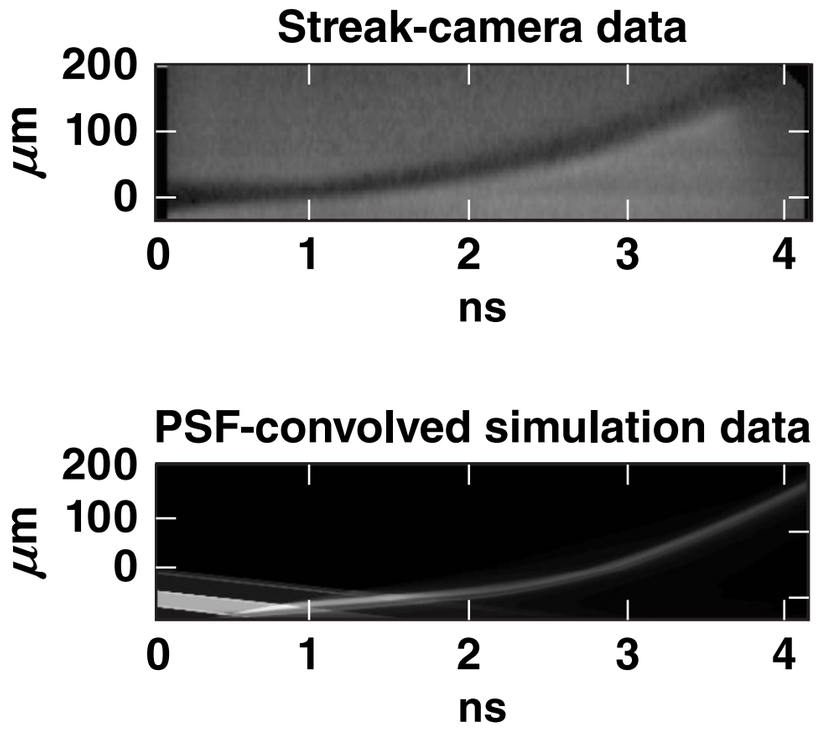
Streak-camera data are analyzed to determine the density profile of the accelerated target

- Compute streak-camera point-spread function (PSF) from resolution data
  - calculate for radiographic system
  - measure system magnification
- Streak-camera data
  - data averaged to reduce noise
  - backlighter shape fit with a fourth-order polynomial
  - position versus time determined from outer diameter (OD) peak
- Simulation data
  - streak-camera PSF convolved with simulation output
  - convolved simulation data analyzed with the same method as the experimental data
  - equivalent times compared to experimental OD



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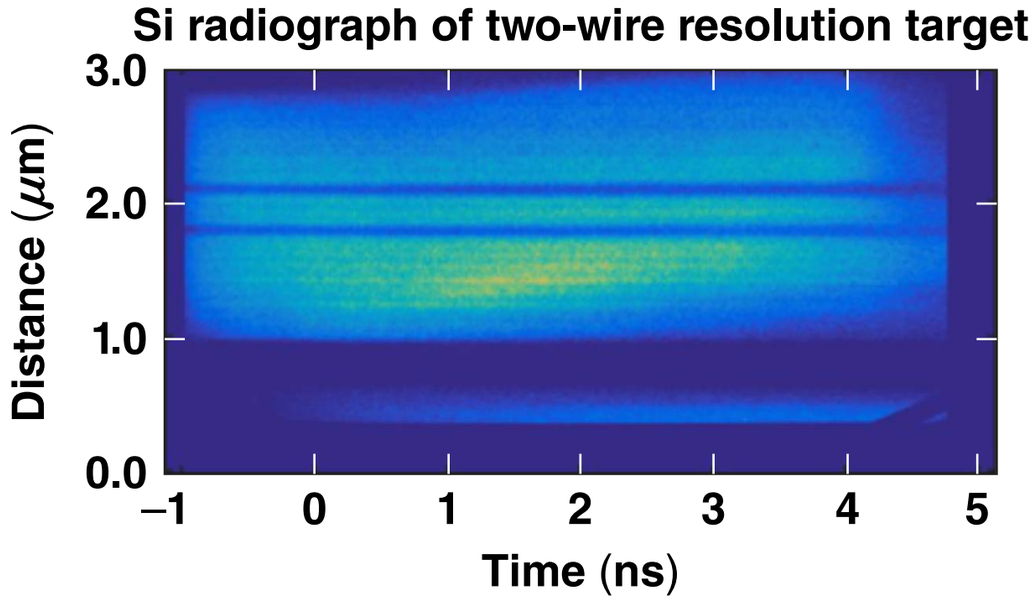
Resolution targets were used to measure the magnification and PSF of the x-ray streak camera



25-μm-diam Ta wires
Separation = 155 μm

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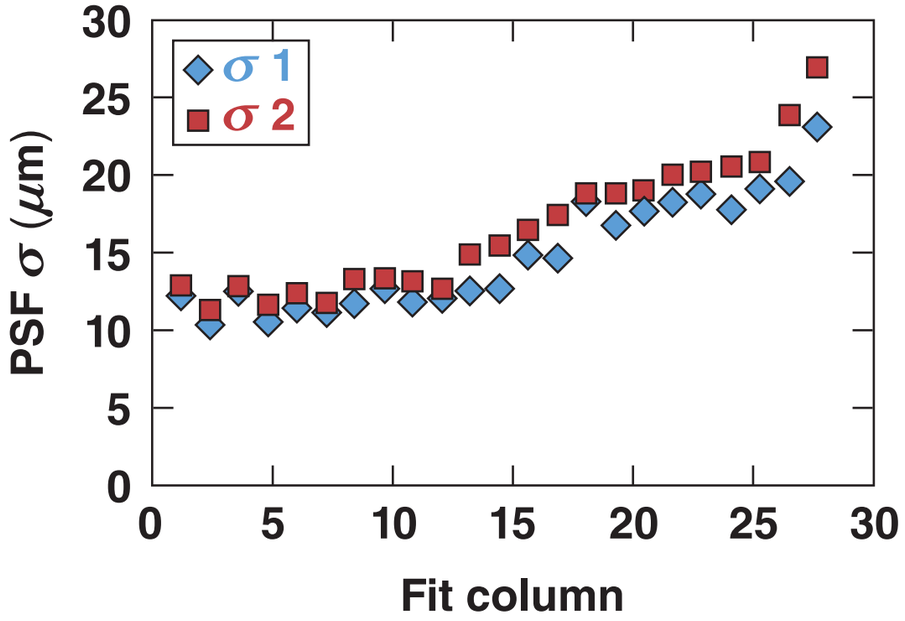
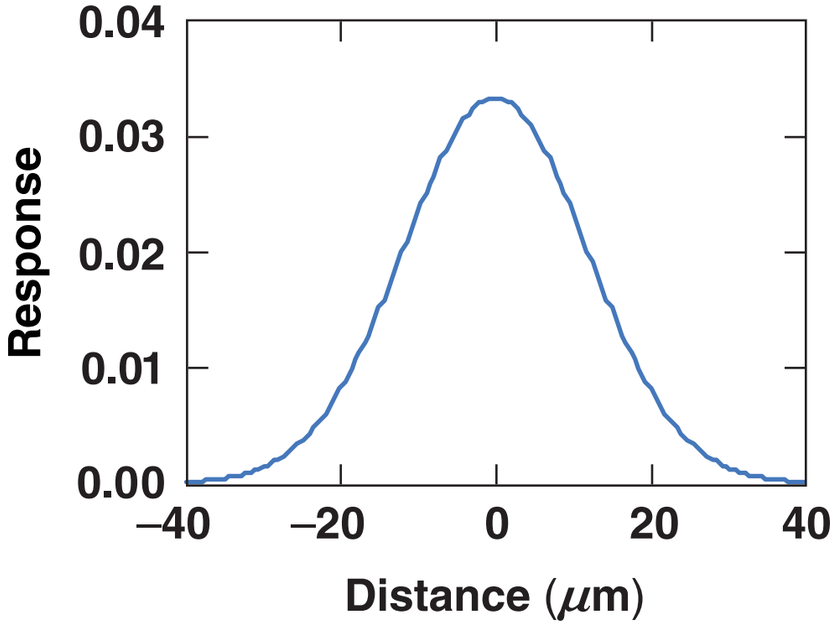
Early time data were used to measure the streak-camera PSF



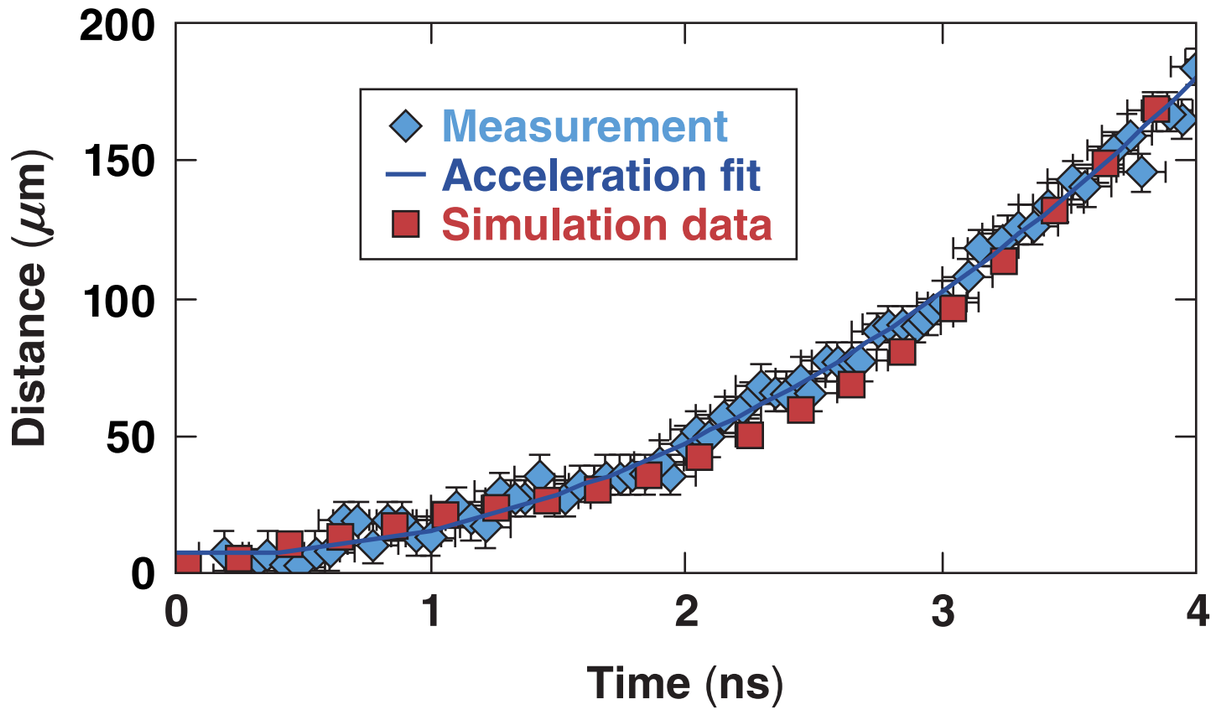


Late-time data show that the Ta wires expand because of x-ray absorption.

PSF σ 12.0±0.5 μm

E25727

The *DRACO* simulation agrees with the measured foil position as measured to within errors



χ^2/degree-of-freedom = 1.0 for a distance error of 7 μm.

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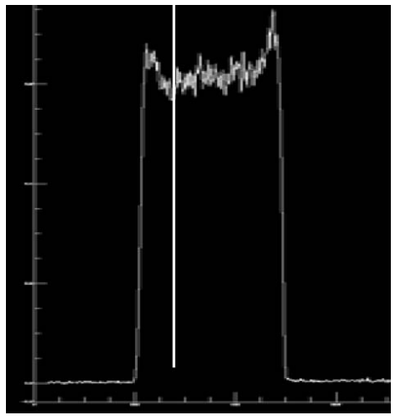
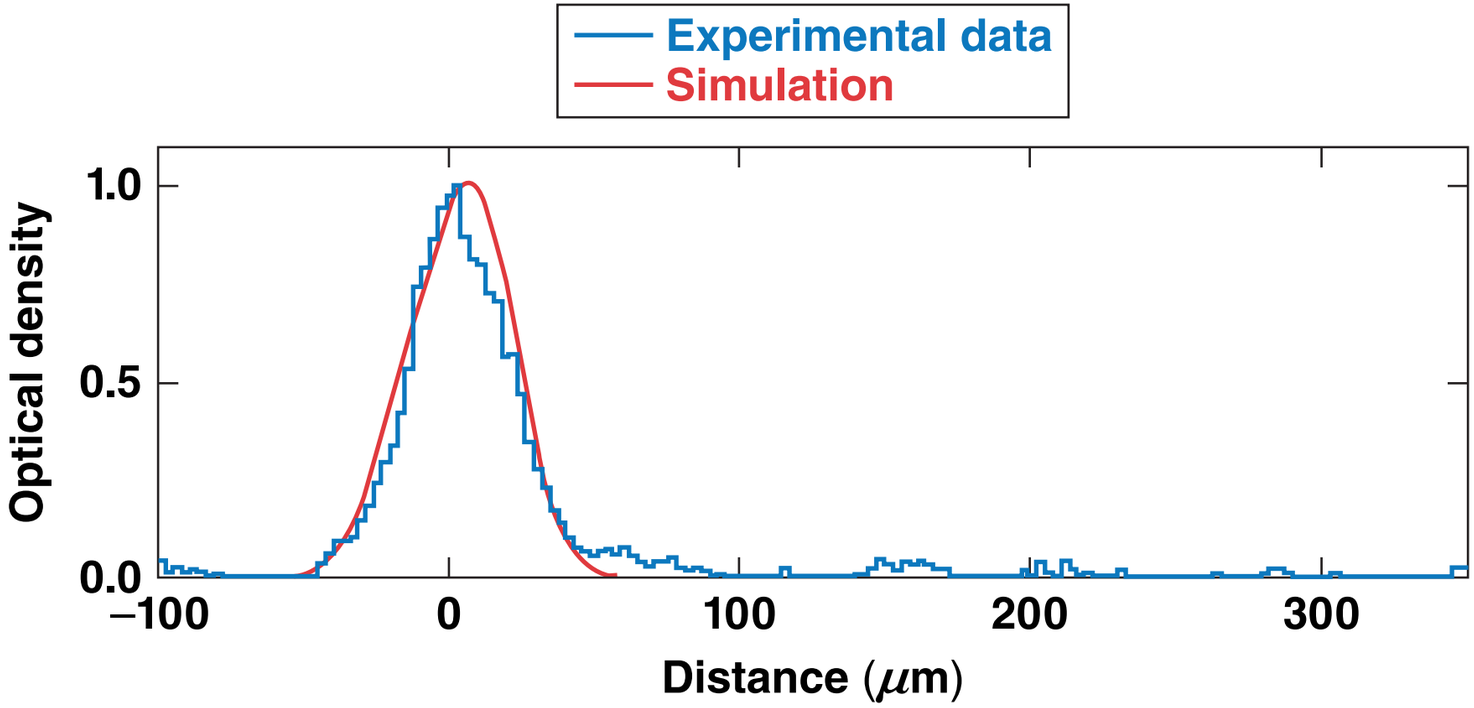
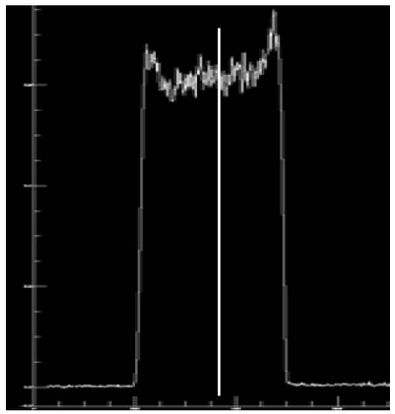
The simulation OD profile agrees with the measured data at time = 1.65 ns after the start of the laser pulse

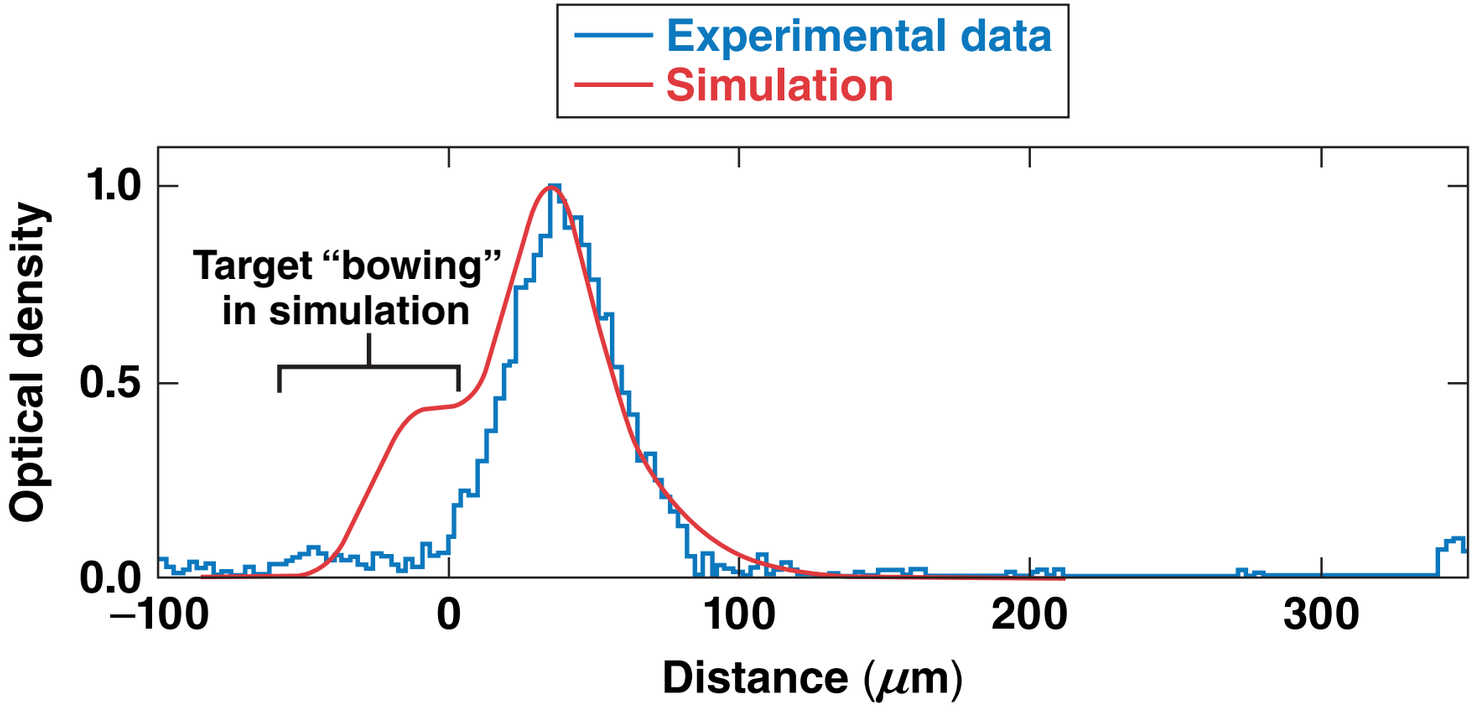




E25729

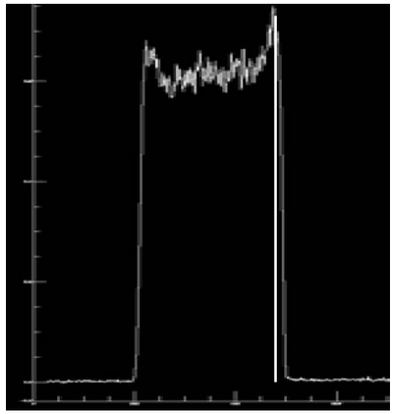
DRACO simulations show good agreement with the target rear profile for time = 3.0 ns

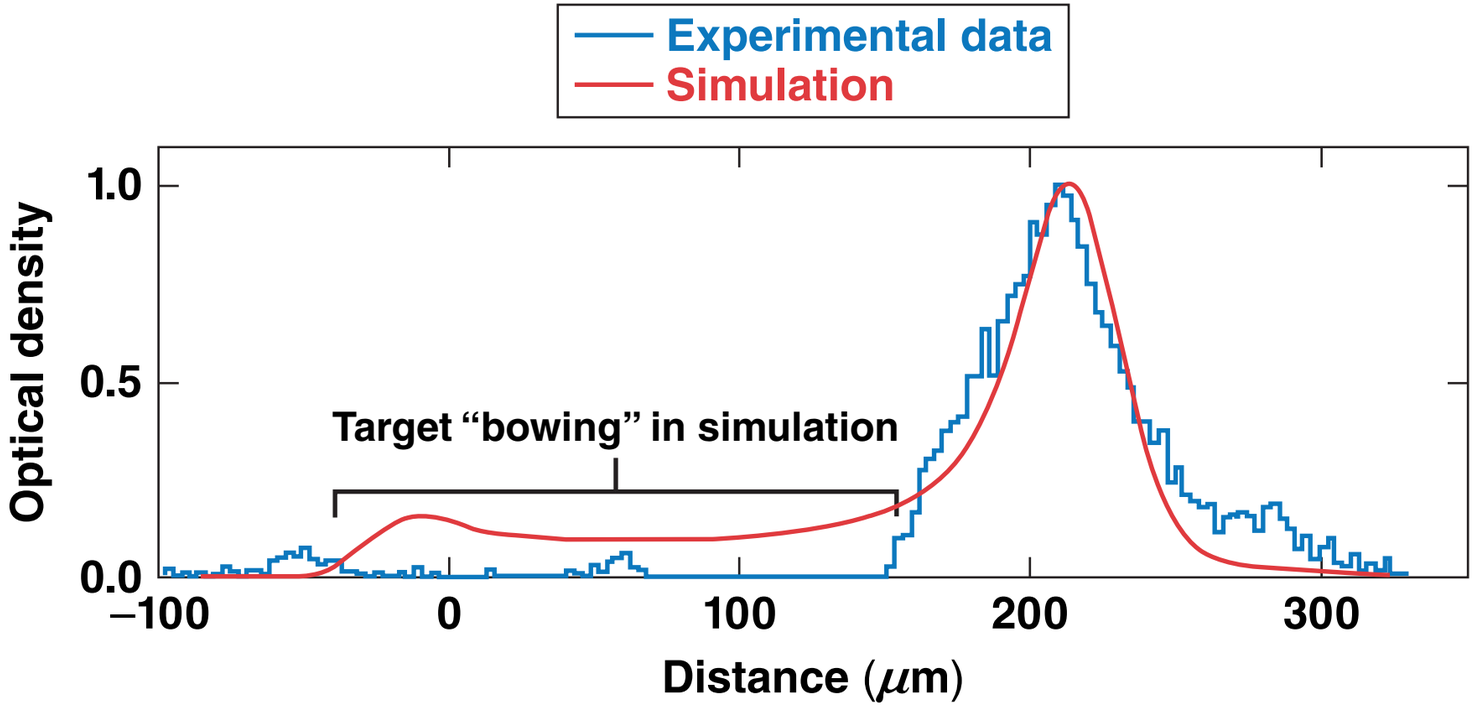




E25729a

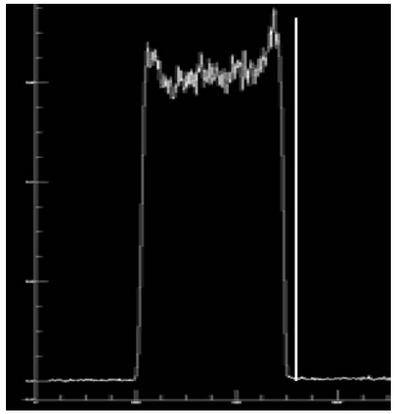
The *DRACO* simulation rear scale length is smaller than the measured data at the end of the laser pulse (time = 5 ns)

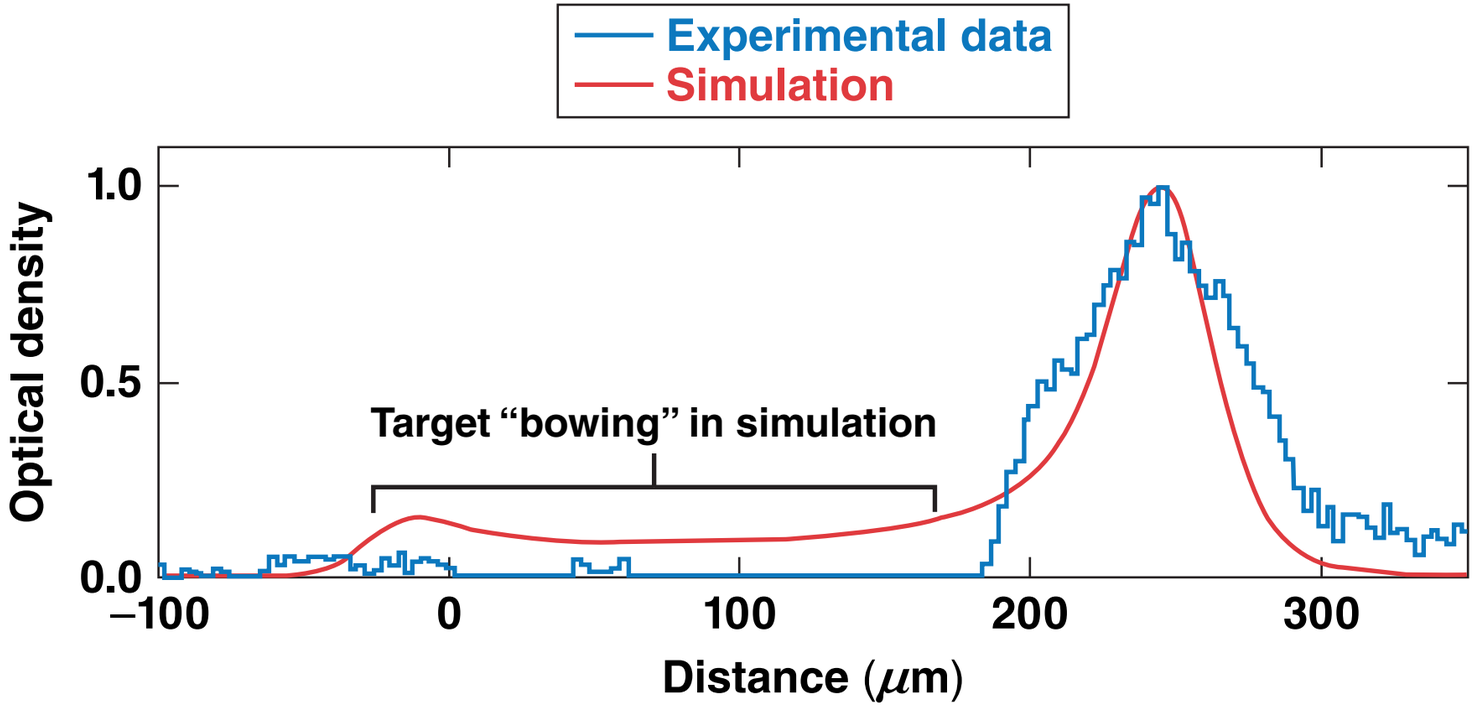




E25729b

The *DRACO* simulation is narrower than the measured data after the laser has turned off (time = 5.4 ns)





E25729c

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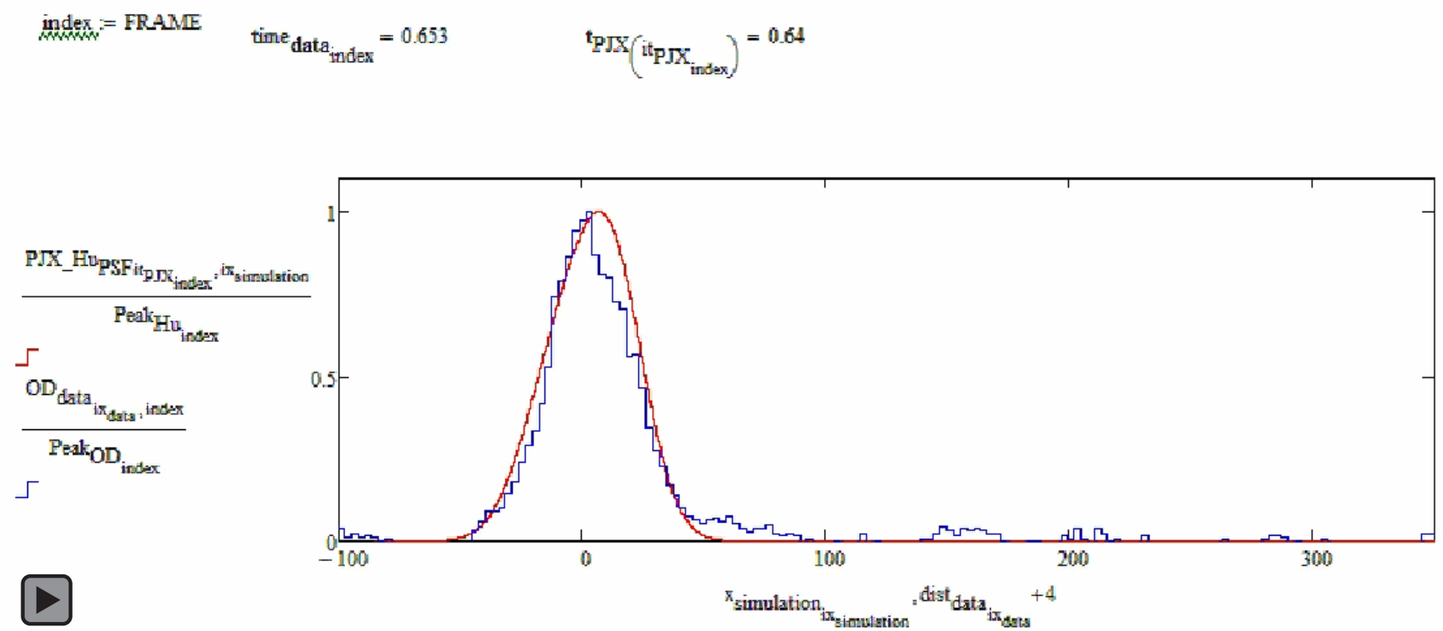
DRACO simulations show qualitative agreement with the data for foil acceleration and shape



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