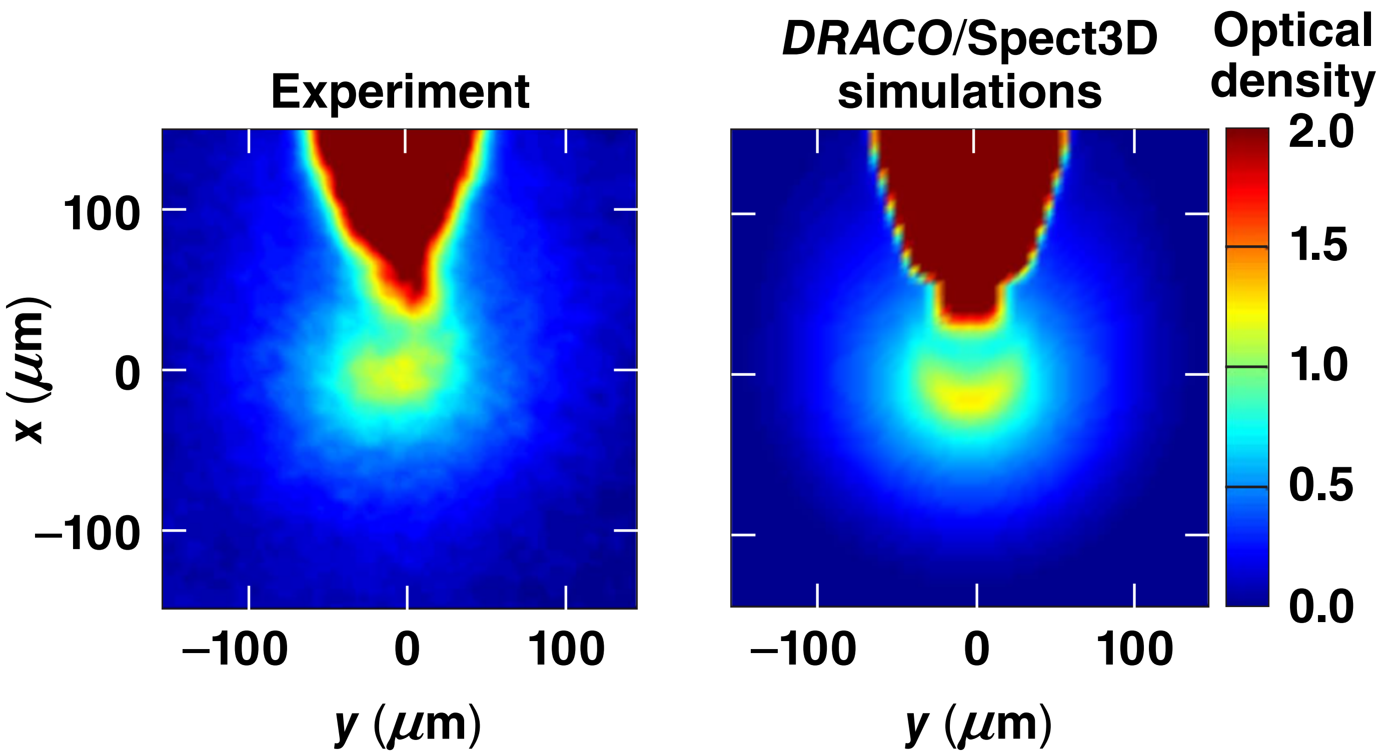
Simulations of Cone-in-Shell Targets for Integrated Fast-Ignition Experiments on OMEGA

8.05-keV flash radiography of cone-in-shell implosions



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Summary

Performance of cone-in-shell fast-ignition targets is studied using *DRACO–LSP* integrated simulations

- *DRACO** simulations agree well with the recent 8.05-keV flash radiography of cone-in-shell implosions on OMEGA and shock-breakout measurements
- A new target with an extended aluminum cone tip promises a better resilience against the strong shock from the implosion
- *LSP*** simulations suggest an improved electron transport: reduced scattering losses and resistive collimation in the extended aluminum cone tip

TC10246

* R. B. Radha *et al*., Phys. Plasmas 12, 056307 (2005).
** D. R. Welch *et al*., Phys. Plasmas 13, 063105 (2006).

Collaborators

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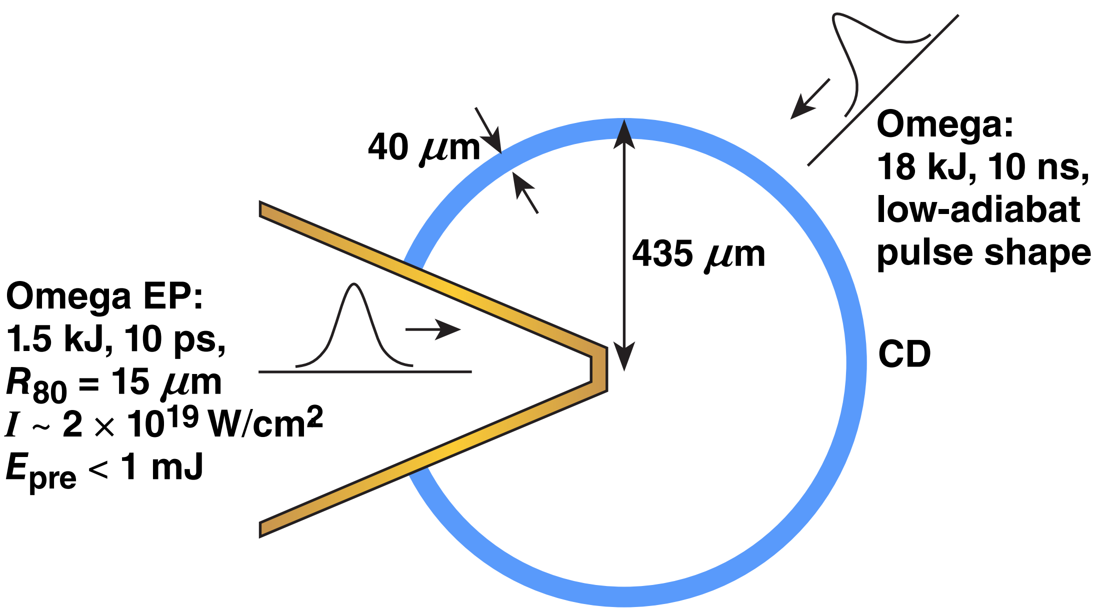
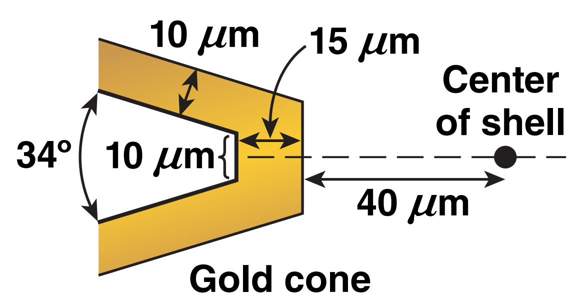
General Atomics

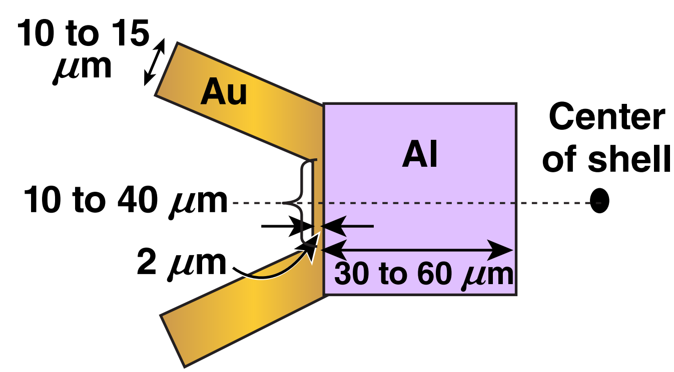
Integrated fast-ignition experiments with re-entrant cone-in-shell targets are performed at the Omega Laser Facility



Au cone-tip design



Al cone-tip design



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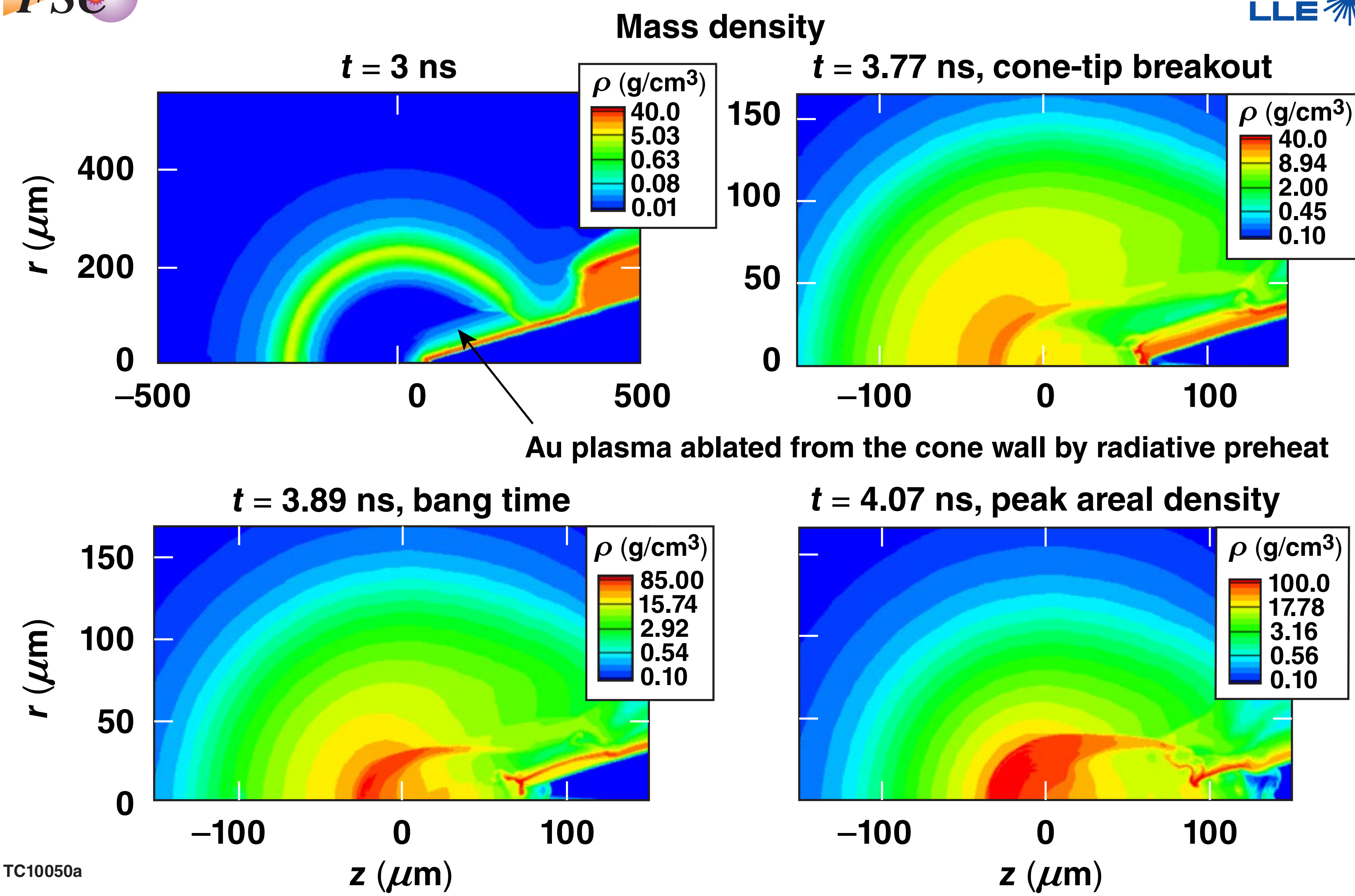
DRACO simulations include the physics necessary to model cone-in-shell implosions on OMEGA

DRACO

- Simulates the implosion in 2-D cylindrically symmetric geometry
- Improvements over the last year
  - radiation transport is modeled
  - 3-D laser ray trace is included
  - laser cross-beam energy transfer* and nonlocal thermal transport** are accounted for approximately

*I. V. Igumenshchev *et al*., Phys. Plasmas 19, 056314 (2012).
**V. N. Goncharov *et al*., Phys. Plasmas 15, 056310 (2008).

DRACO simulations of gold cone-tip targets predict tip breakout ~120 ps before the bang time, ~300 ps before the peak compression



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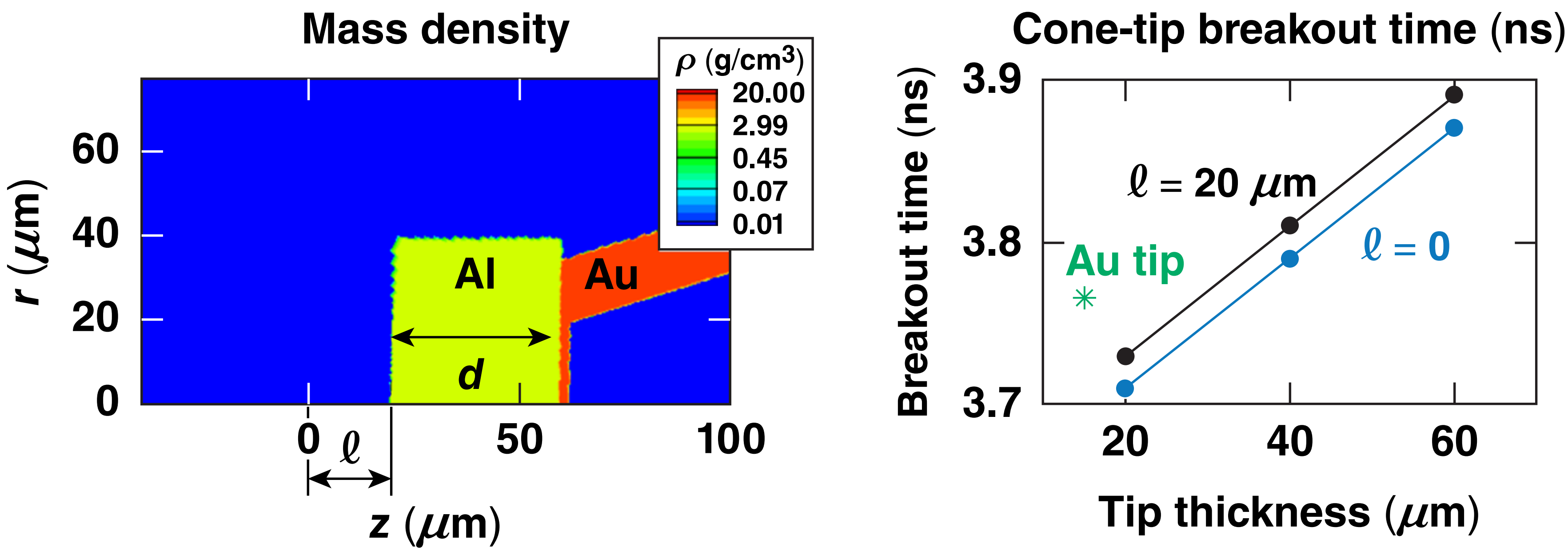
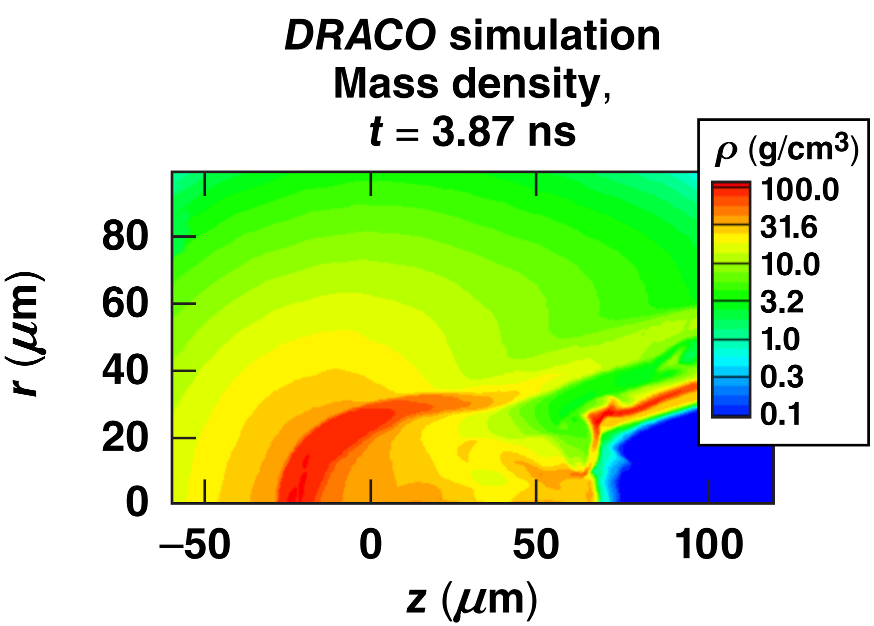
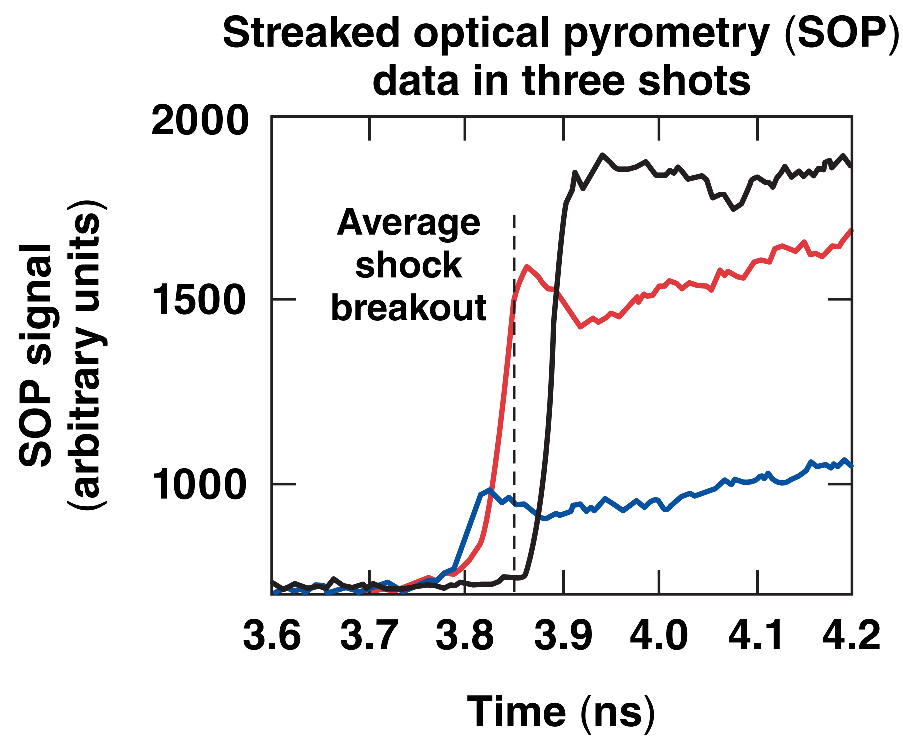
Cone-tip breakout can be delayed by using targets with a thicker, lower-Z cone tip



- A very thin (~2-μm) gold layer inside the cone tip
  - serves as a mounting layer for the Al block
  - helps to shield the radiation

DRACO simulations for a 60-μm-thick Al-tip target are confirmed by shock-breakout measurements





Average of SOP and VISAR:
t = 3.85±0.05 ns

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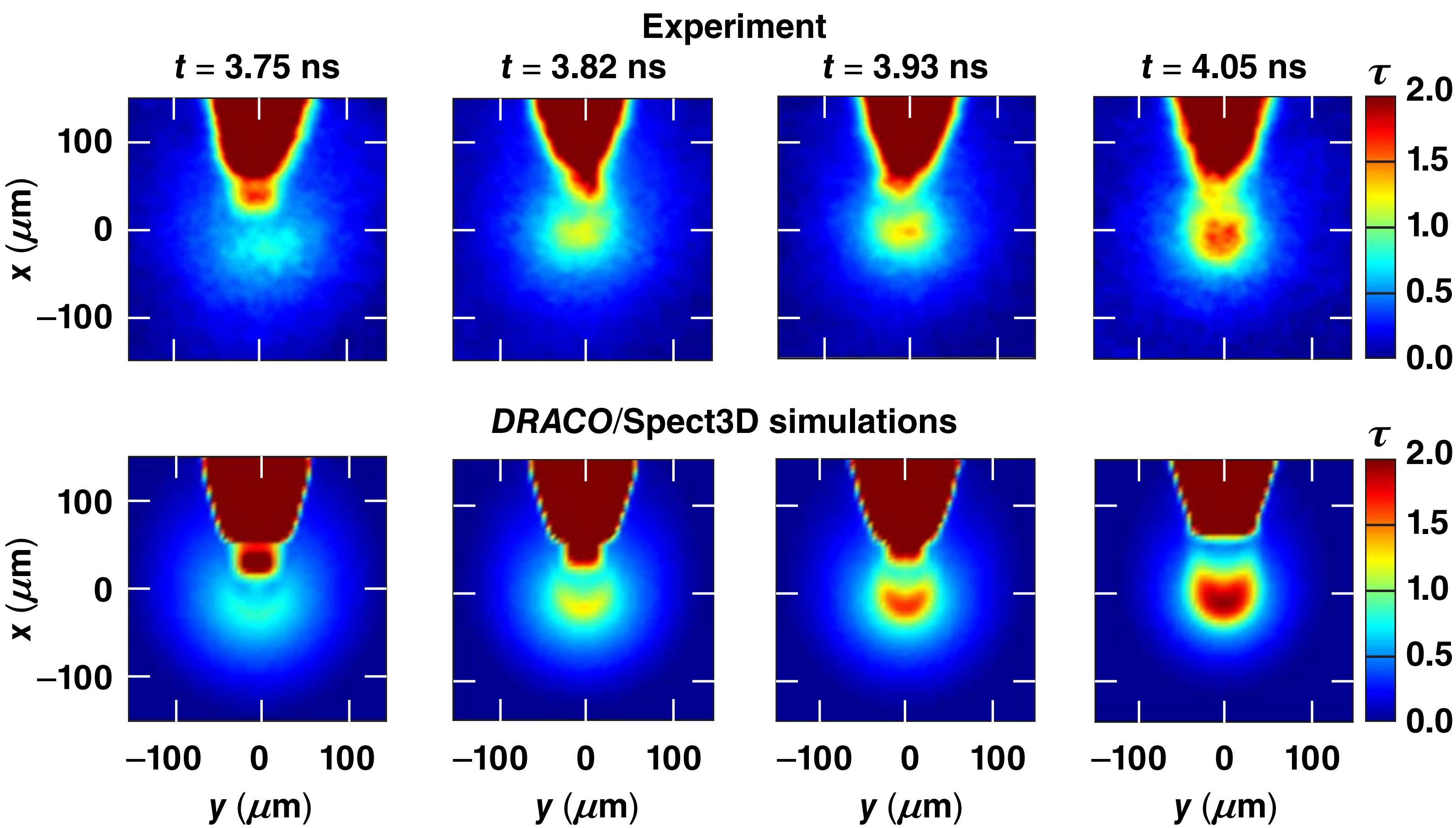
DRACO/Spect3D* simulations compare well with the implosion images obtained using 8.05-keV, Cu-K_α flash radiography**

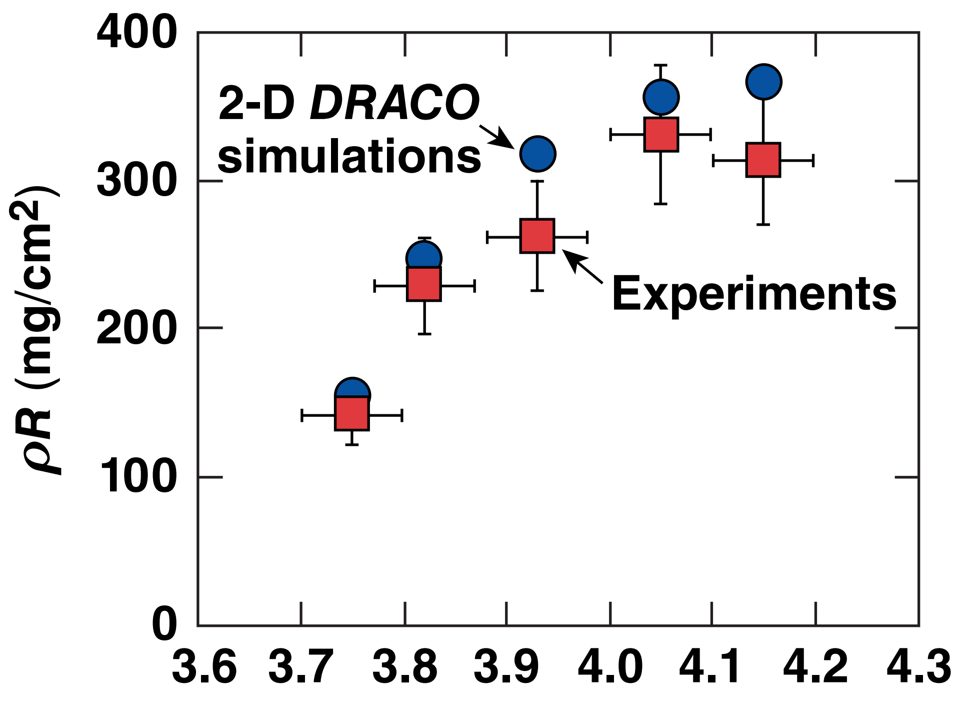
Optical density $\tau = -\ell n\,(I/I_0)$



*Prism Computational Sciences, Inc., Madison, WI.
**W. Theobald *et al*., GO5.00004, this conference.

TC10327

A peak areal density exceeding 300 mg/cm^2 is inferred from the radiograph, which agrees with *DRACO* simulations

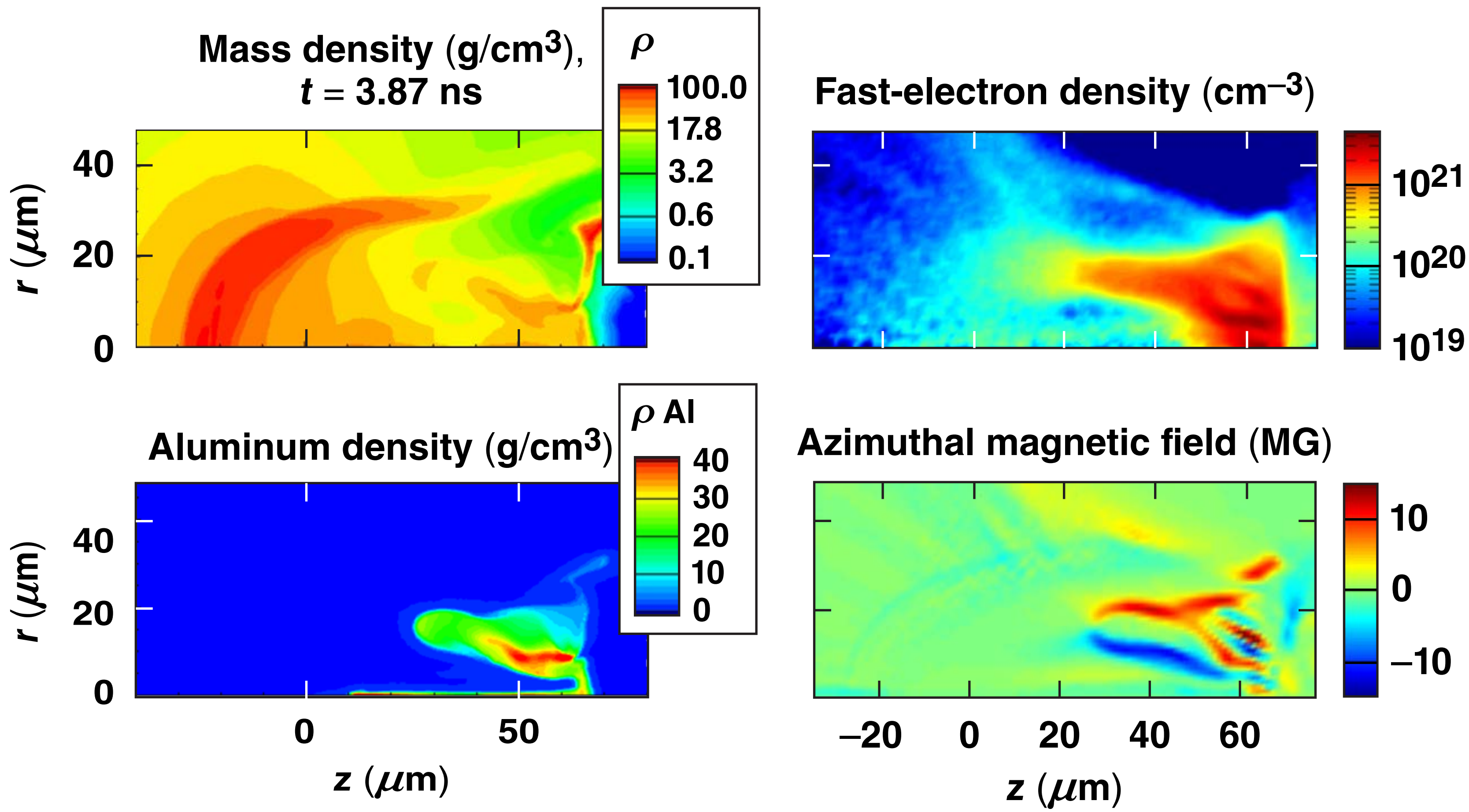


- Experimental areal densities are >85% of the 2-D predicted values

*W. Theobald *et al*., GO5.00004, this conference.

LSP simulations suggest that fast electrons can be collimated by self-generated resistive magnetic fields to the core

Fast-electron temperature T = 0.6 MeV (I_{laser} ~ 10^{19} W/cm^2), divergence half-angle $\theta_{1/2}$ = 50°, total energy E = 300 J



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27% of fast-electron energy is coupled to the core (ρ_{CD} > 15 g/cm^3)

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