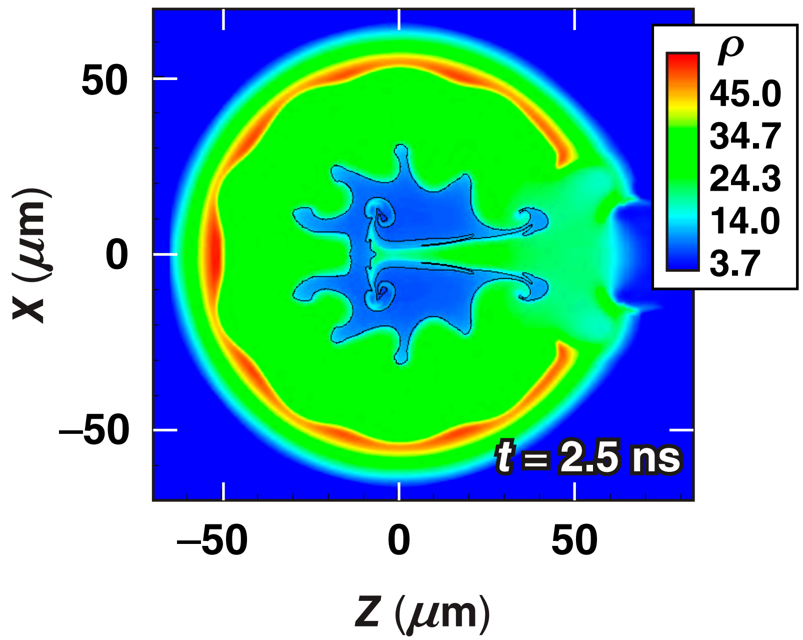
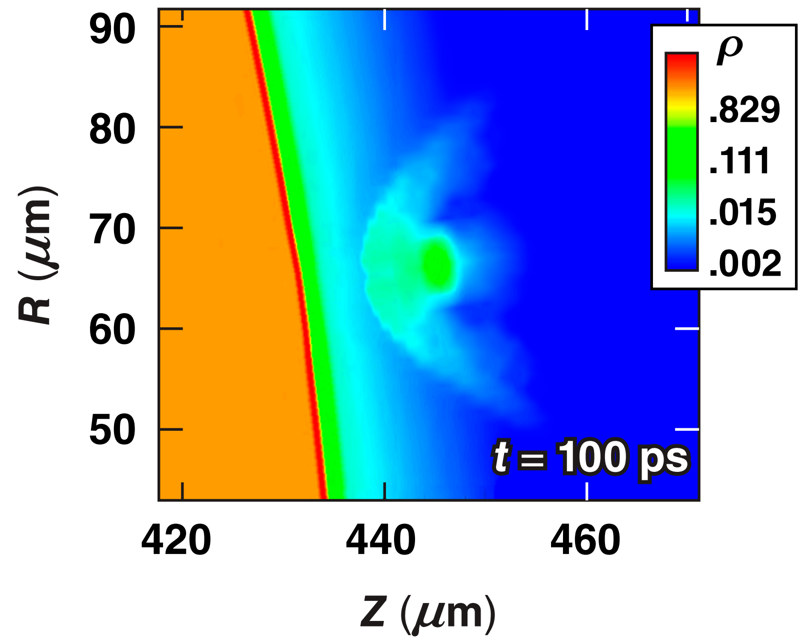
The Effects of Target Mounts in Direct-Drive Implosions on OMEGA

Target with stalk mount at maximum compression



Expanded spider silk in target with C-mount



I. V. Igumenshchev
University of Rochester
Laboratory for Laser Energetics

49th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Orlando, FL
12–16 November 2007

Summary

Target mounts introduce significant asymmetries in direct-drive implosions on OMEGA

- The effects of stalk mounts and C-mounts are studied using the 2-D radiation hydrodynamic code *DRACO*.
- The simulations demonstrate that the stalk mount introduces distortions to the hot spot in plastic implosions, resulting in a reduction of neutron yields.
- Shadowing from spider silks in targets with C-mounts may distort plastic and cryogenic implosions. Planar OMEGA experiments and simulations are designed to further study this effect.

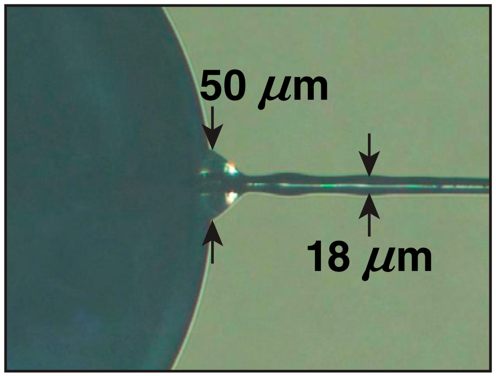
Collaborators

V. N. Goncharov, F. J. Marshall, M. Bonino,
P. W. McKenty, and T. C. Sangster

Laboratory for Laser Energetics
University of Rochester

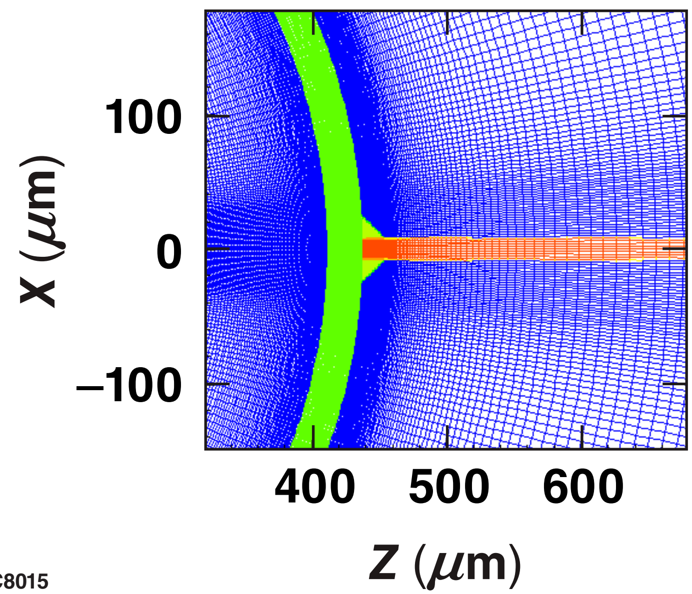
The effect of stalk mounts in plastic implosions was studied using 2-D *DRACO* simulations

Optical image



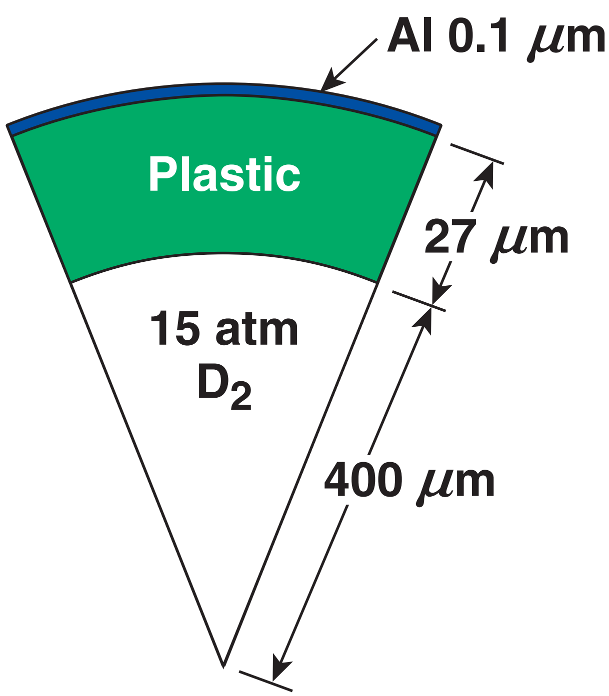
- SiC fiber glued to a plastic capsule
  - fiber density = 3.2 g/cc
  - glue (SCO) density = 1.2 g/cc
  - capsule (CH) density = 1.04 g/cc

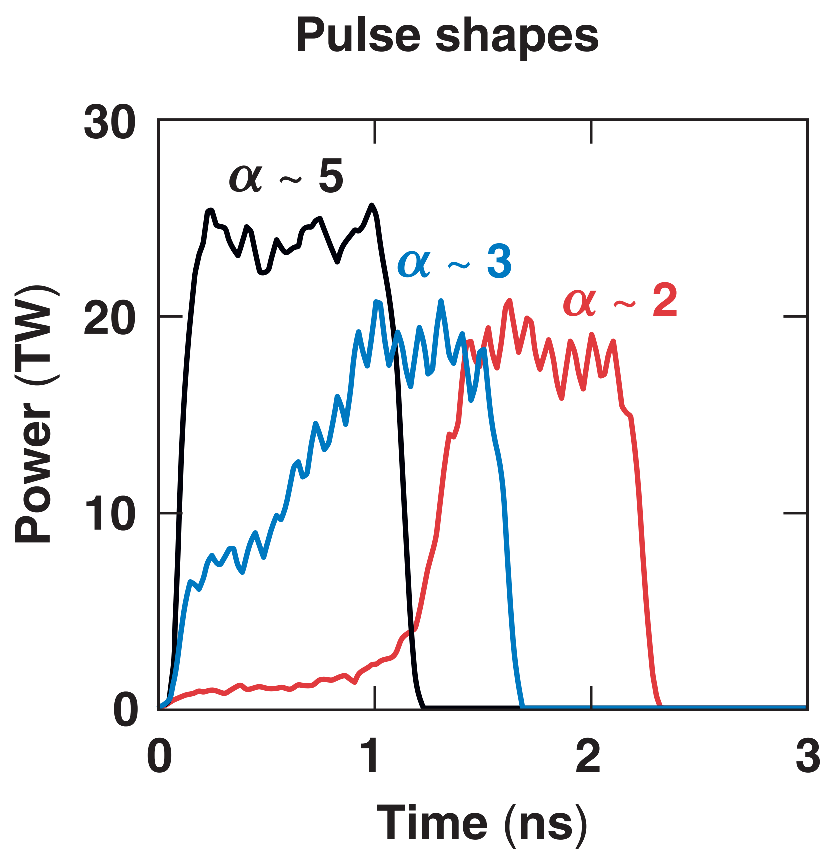
Stalk on the numerical mesh



- *DRACO* radiation hydrodynamic code
  - Eulerian spherical moving mesh
  - 3-D laser ray-trace algorithm (the shadow effect is included)
  - laser illumination with assumed beam-port geometry (ℓ = 10)

Target implosions with different adiabats are considered

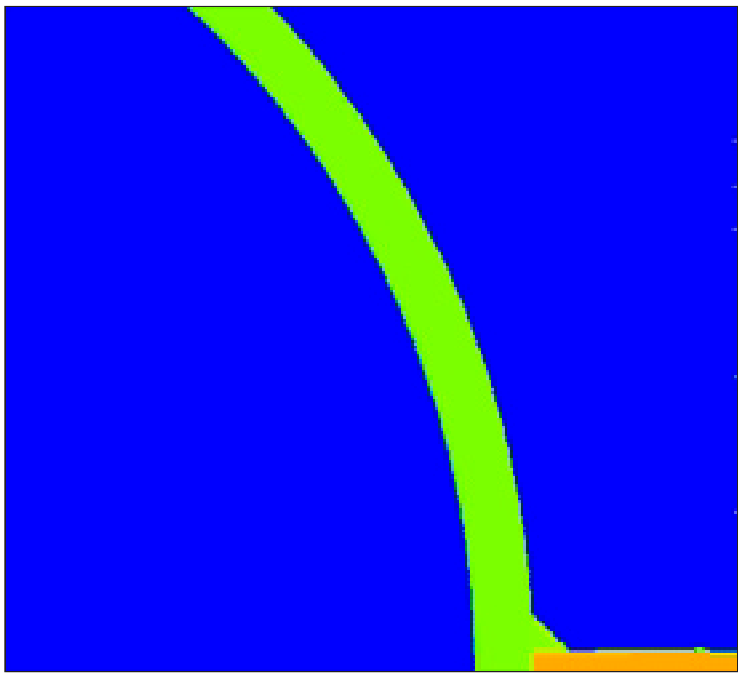




$\alpha = P/P_{Fermi}$

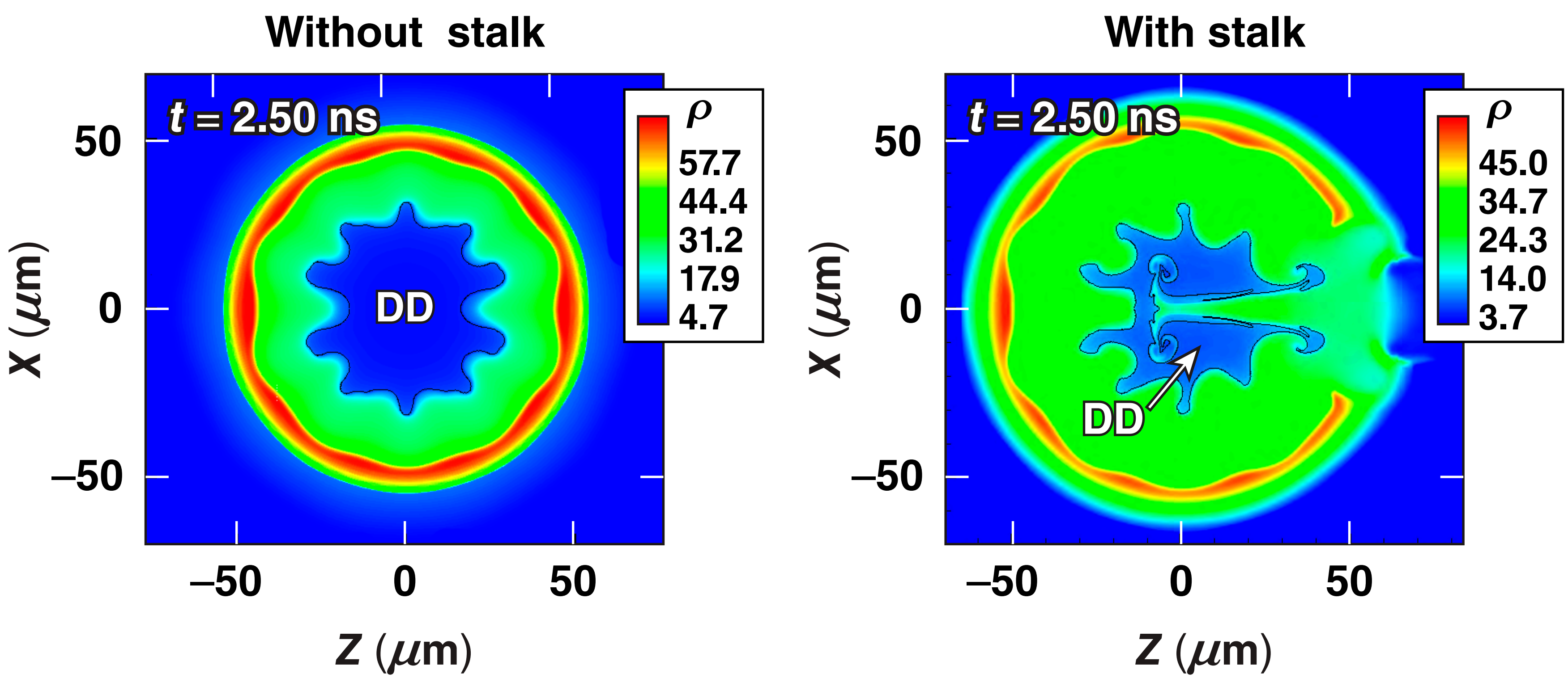
α	CR
2	17
3	15
5	12

Hydrodynamic perturbations in the plastic shell from the stalk are developed early in time



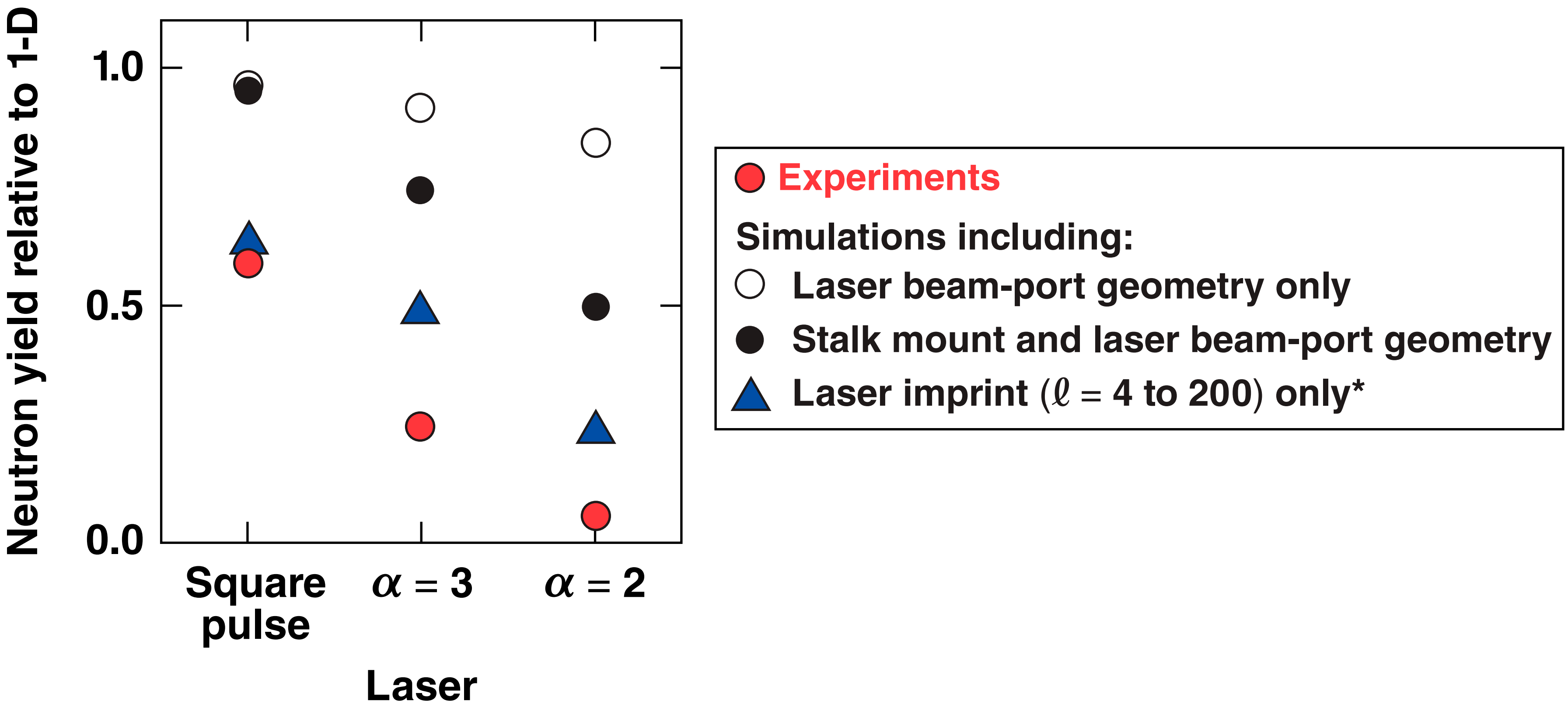
- Evolution from 0 to 1.65 ns (end of $\alpha = 3$ laser pulse)
- Hydrodynamic effects are more important than shadowing of laser light
- Stalk and glue materials are burned off by the shock break-out time
- The jet of the plastic material propagates inside the DD fill region

The plastic jet deeply penetrates into the fuel (DD) region by the time of maximum target compression



- The jet results in further degradation of neutron yield: from 92% to 74% of 1-D yield.

The effect of stalk mounts alone does not explain the observed degradation of target performance



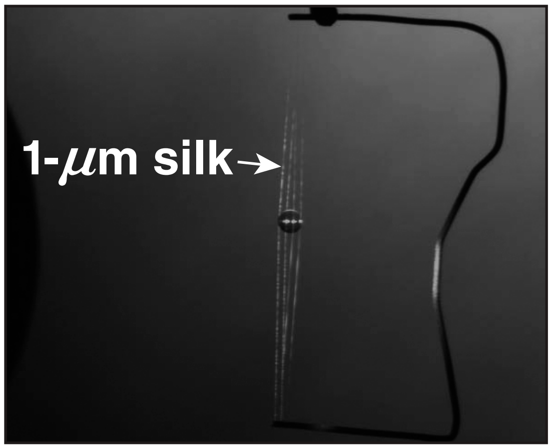
- The low-adiabat implosions are more affected by the stalk mounts
- Laser imprint can explain the additional yield degradation

*P. B. Radha *et al*., Bull. Am. Phys. Soc. 50, 113 (2005); P. B. Radha *et al*., Phys. Plasmas 12, 056307 (2005).

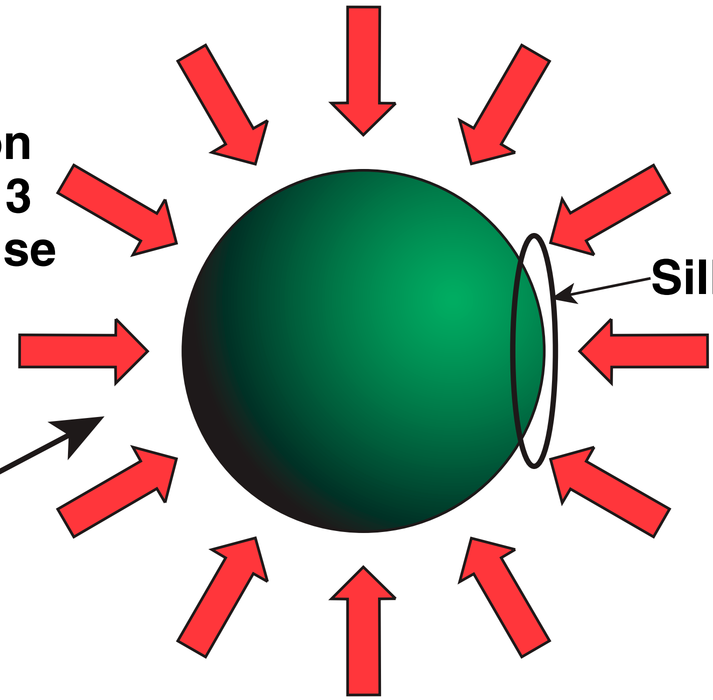
TC8019

The effect of spider silk in targets with C-mounts is modeled in two dimensions

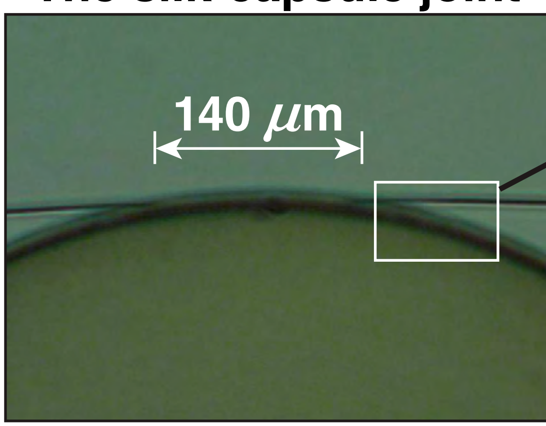
Target with C-mount



Entirely 3-D problem is modeled in 2-D



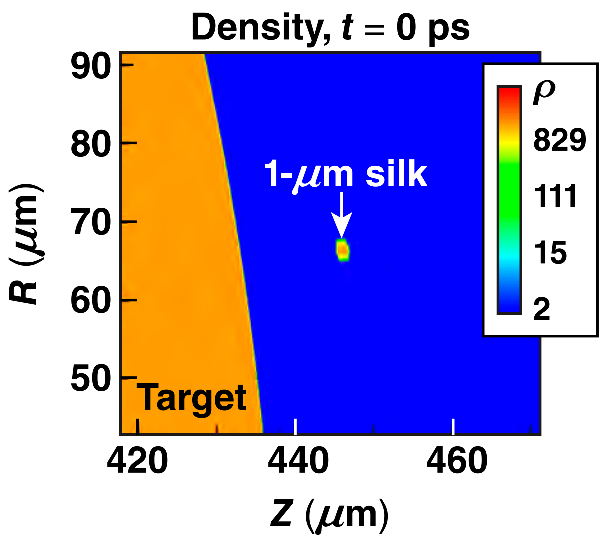
The silk-capsule joint

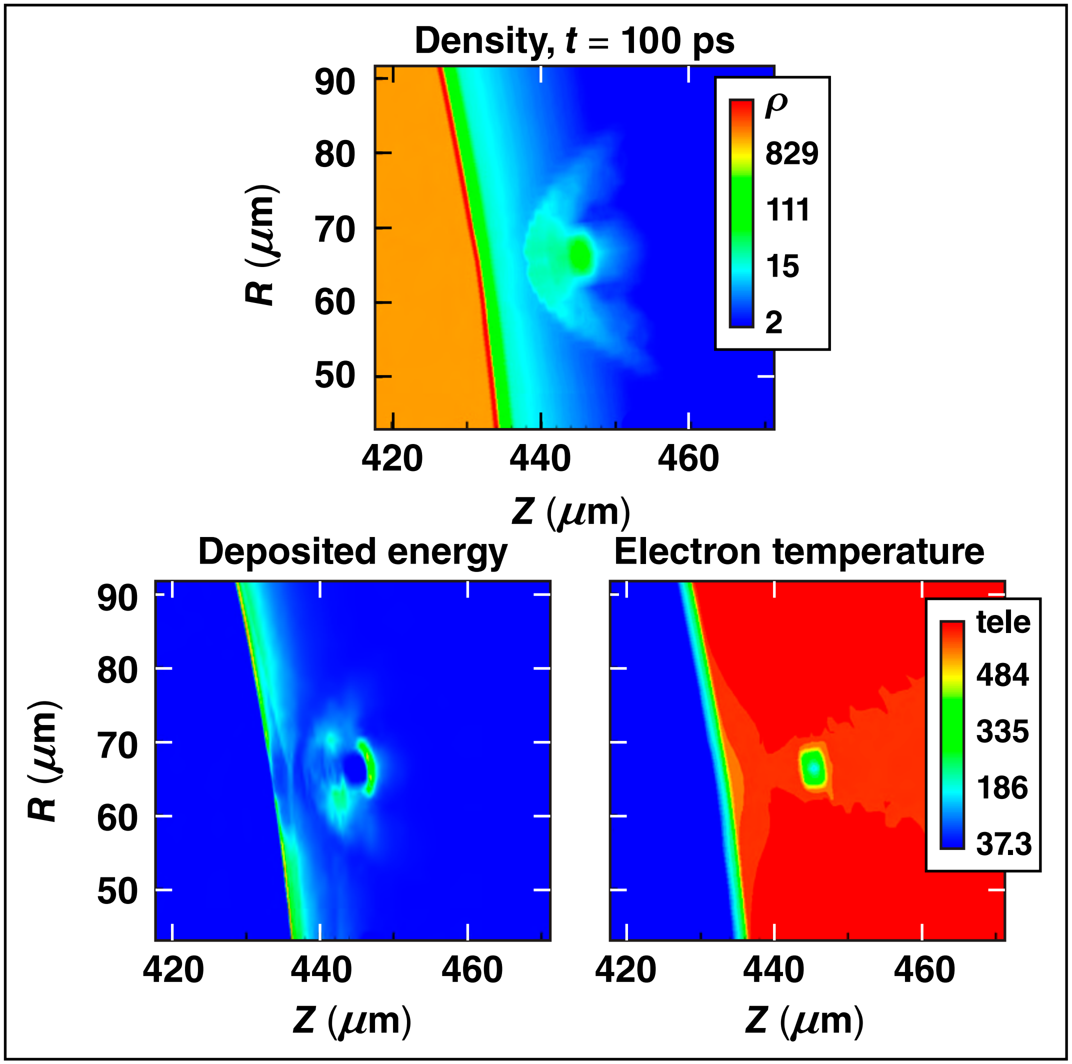


- The mass of silk in simulations corresponds approximately to the mass of silk in the C-mount, which can affect implosions

TC8020

Laser-light shadowing by the expanded silk is present early in time





- The silk is heated by the laser and expanded
- The expanded silk is opaque to the laser light during the first ~120 ps
- The shadowing perturbs the shock front in plastic shell

By the end of the laser pulse, the perturbation of the shock results in a hole in the imploded plastic shell

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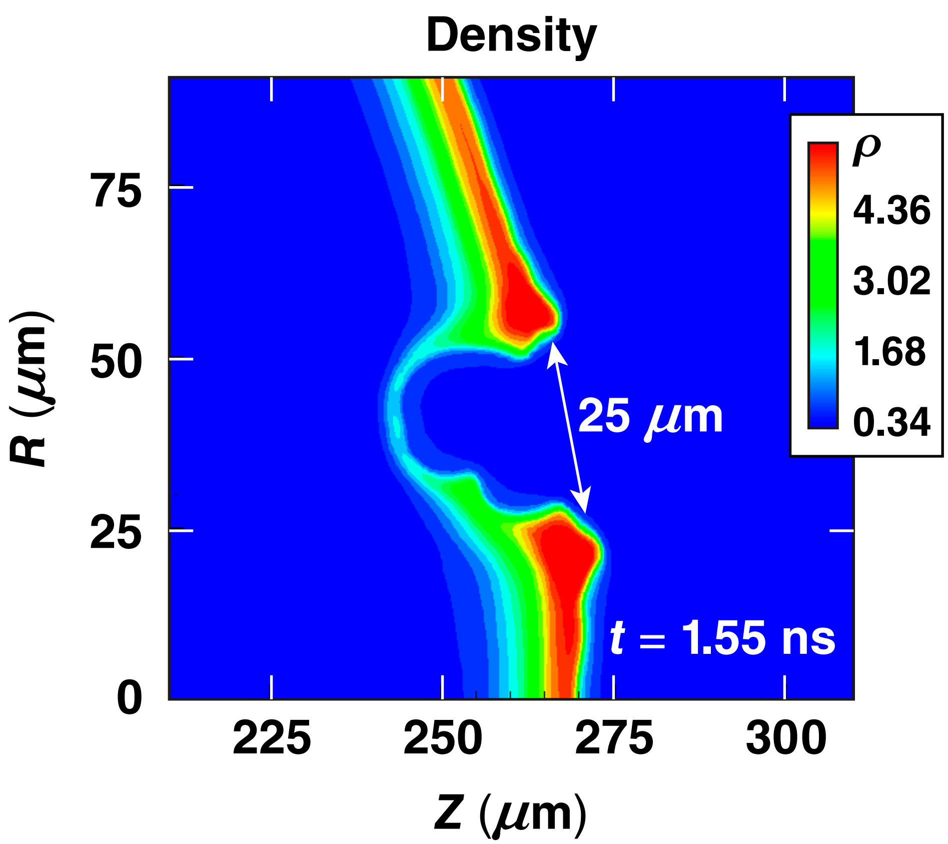

- Perturbations from the spider-silk shadowing are not negligible (64% of 1-D neutron yield)
- Affected area in the real targets with C-mounts could be significant
- 3-D simulations are required for realistic modeling
- Planar experiments with spider silks are being designed

Summary/Conclusions

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