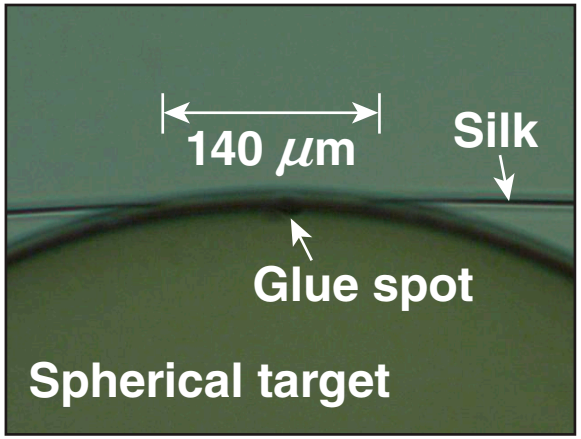
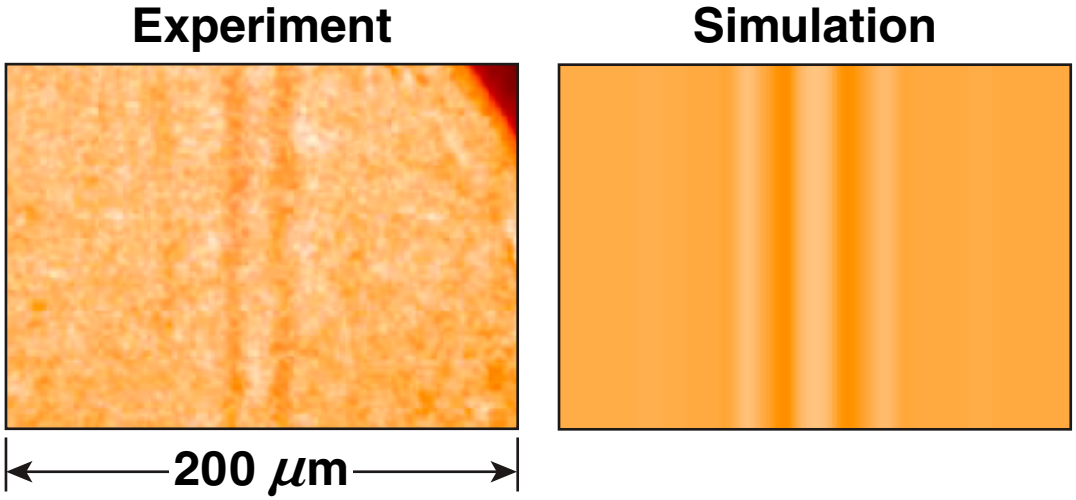
Investigation of the Effects of Target Mount on Direct-Drive Implosions on OMEGA

UR LLE

Spider silk glued to target



Imprint induced by a single spider silk



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

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Summary

Hydrodynamic simulations reproduce the main features of spider silk imprint experiments

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- The effects of mounting an implosion target with spider silks were investigated in planar direct-drive experiments on OMEGA.
- Results of these experiments indicate that spider silks can induce a significant mass modulation in imploding shells.
- Simulations reproduce
  - single-line mass modulation from a zero-offset spider silk
  - multiple-line mass modulation from an offset spider silk
- These modulations are produced by two mechanisms
  - hydrodynamic wave from the expanding silk plasma
  - laser light shadow and refraction due to the silk plasma

Collaborators

F. J. Marshall

J. A. Marozas

V. A. Smalyuk

R. Epstein

T. J. B. Collins

M. Bonino

V. N. Goncharov

T. C. Sangster

University of Rochester
Laboratory for Laser Energetics

Spider silks are used to support targets in cryogenic implosion experiments on OMEGA

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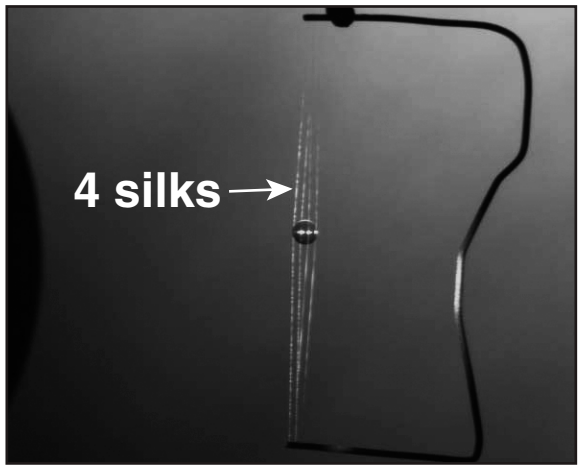
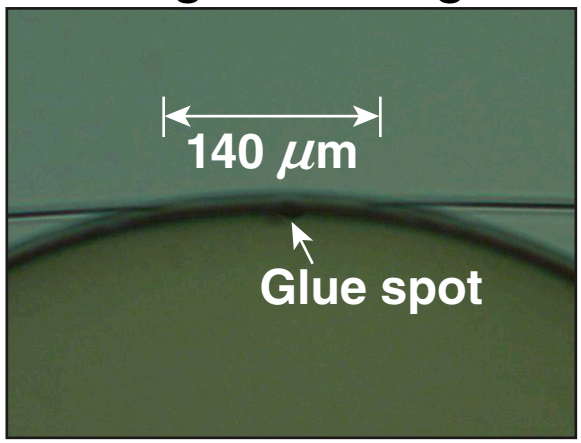
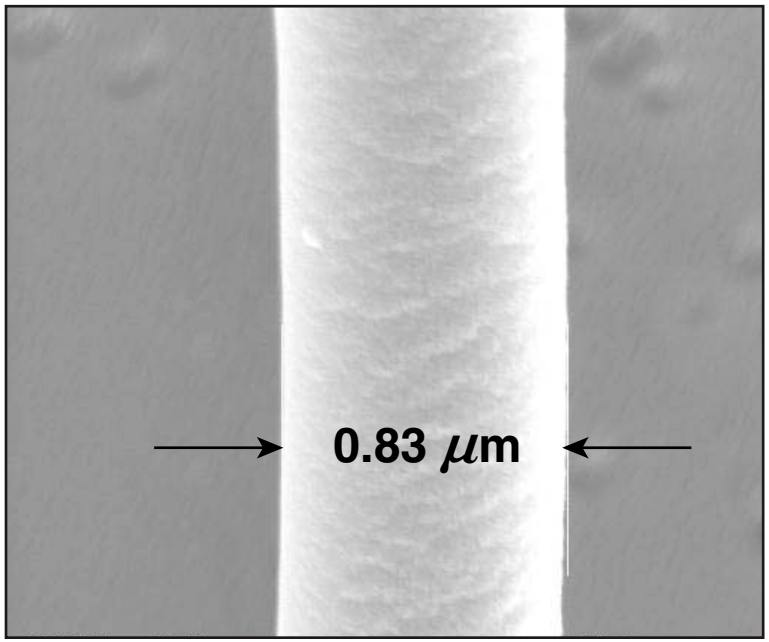
Target with C-mount



Silk glued to target



SEM of a single strand of spider silk



- **Typical spider silks used for target mounting on OMEGA consist of two such strands**

TC8298

Planar experiments on OMEGA were performed to study perturbations from spider silks in laser-driven plastic foils

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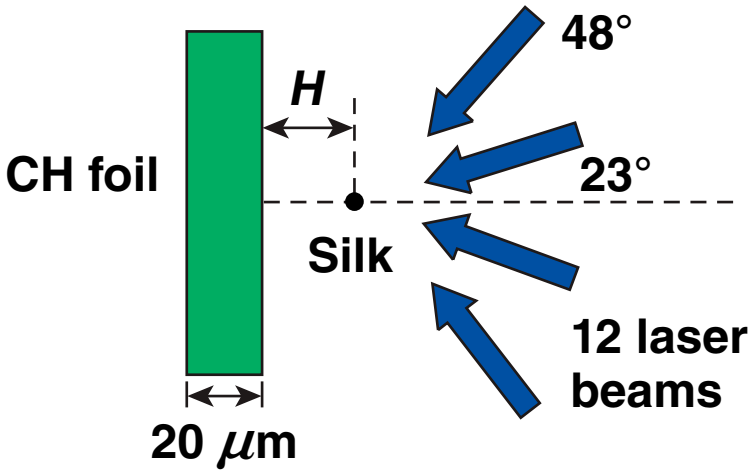
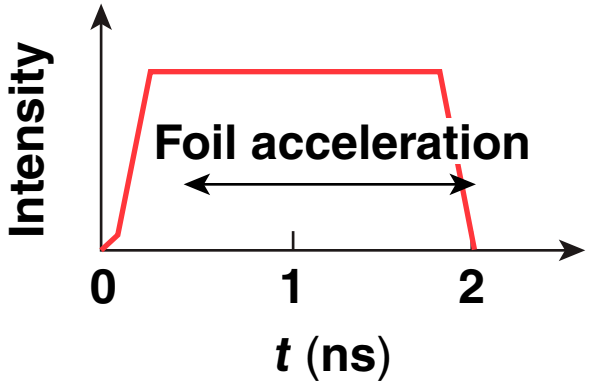
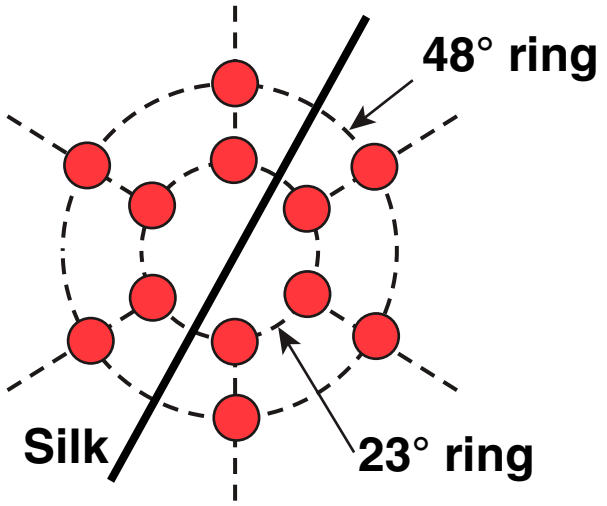
Experimental setup





Beam ports and silk configuration



- 1.6-ns square laser pulse
- On-target intensity $I \sim 7 \times 10^{14}$ W/cm^2

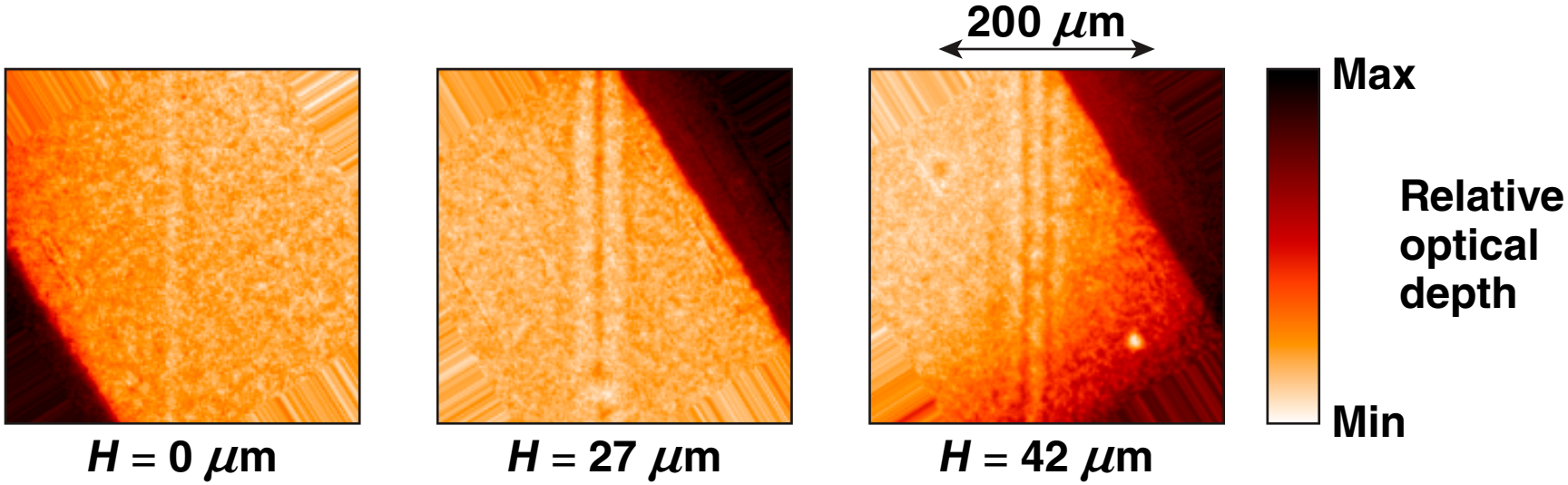
The perturbation due to the silk is amplified during the acceleration phase.

TC8299

Experiments show that a spider silk can induce a significant mass perturbation in a foil

- Imprints in foils were detected by a framing camera using through-foil x-ray radiography with a uranium backlighter.

Example experimental images at t = 1.76 ns



- The imprint shapes depend on the silk offset H.

Planar experiments were simulated using the 2-D hydrodynamic code *DRACO* with 3-D laser ray trace

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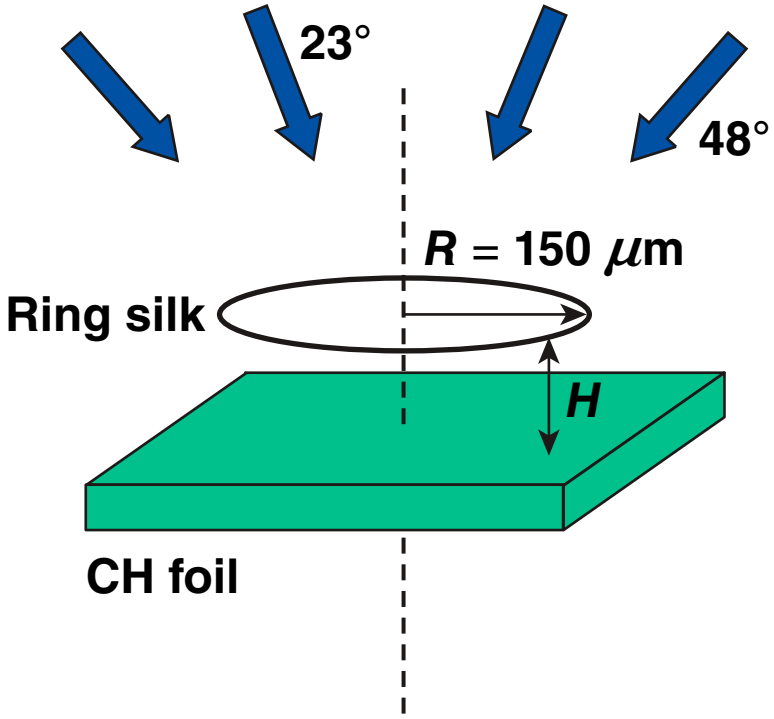
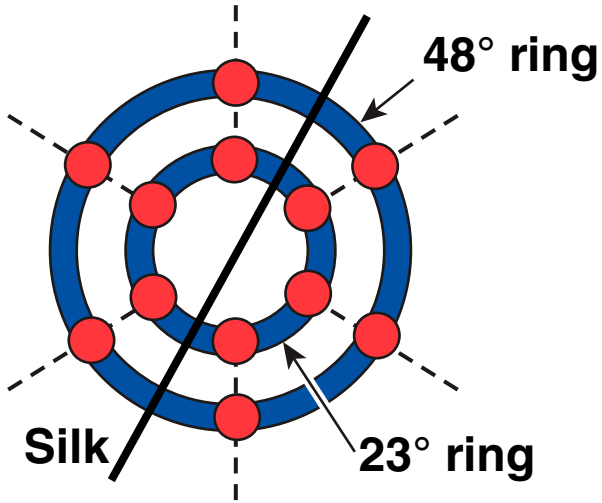
- Ring silks with a large radius are used to simulate straight silks



- Discrete laser beams are approximated by continuous ring sources



- $R > H = 0$ to 42 μm
- $R <$ (laser-spot radius) ~ 300 μm

See talk by T. J. B. Collins (CO5.00002); discrete beam simulations

Spider silks significantly affect laser-light trajectories during the first 200 ps

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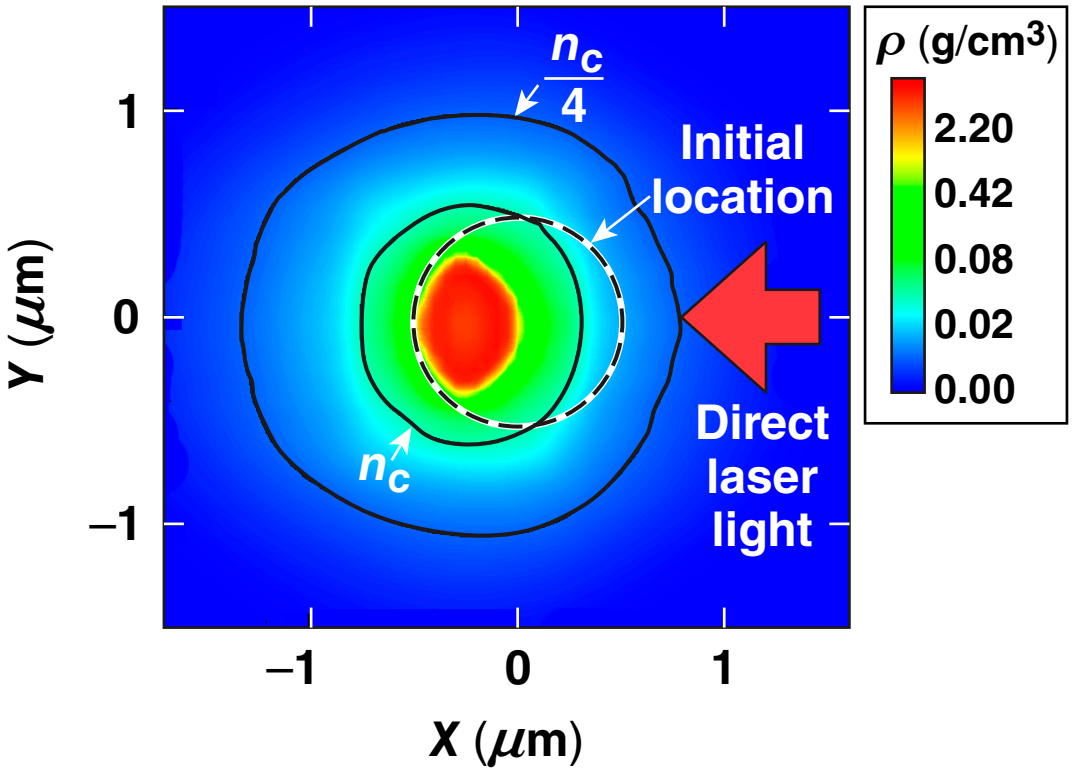
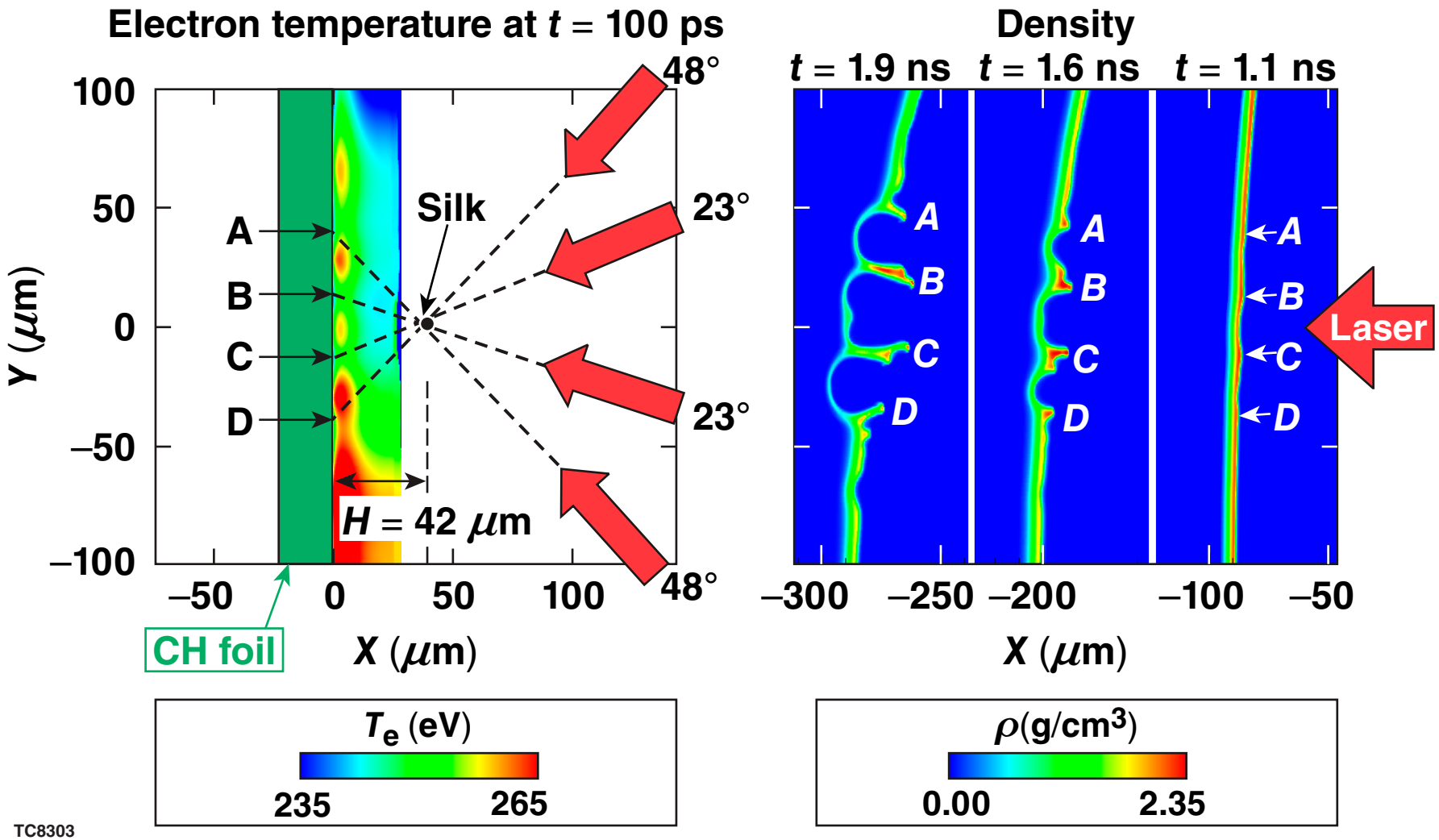
Density of compressed and ablated spider silk at t = 100 ps



- The plasma formed by the silk remains opaque to laser light for ~150 ps.
- This plasma reflects and refracts the direct laser light, creating a shadow effect.
- A pressure wave from the expanding silk plasma can significantly perturb a CH foil for offset $H < 10$ μm.

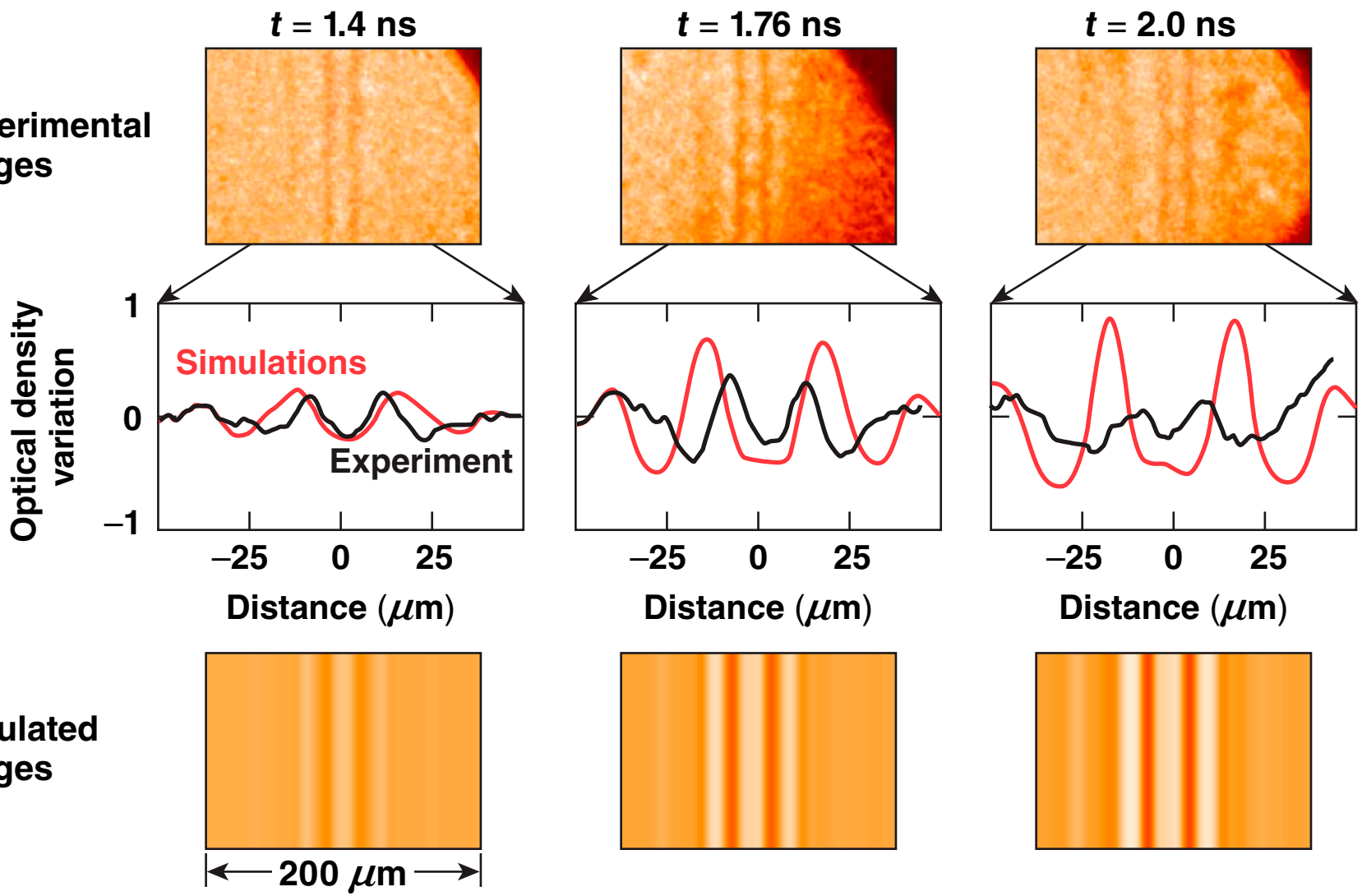
TC8302

An offset spider silk illuminated by a two-ring source produces four shadow regions that develop a three-line low-density structure in the CH foil



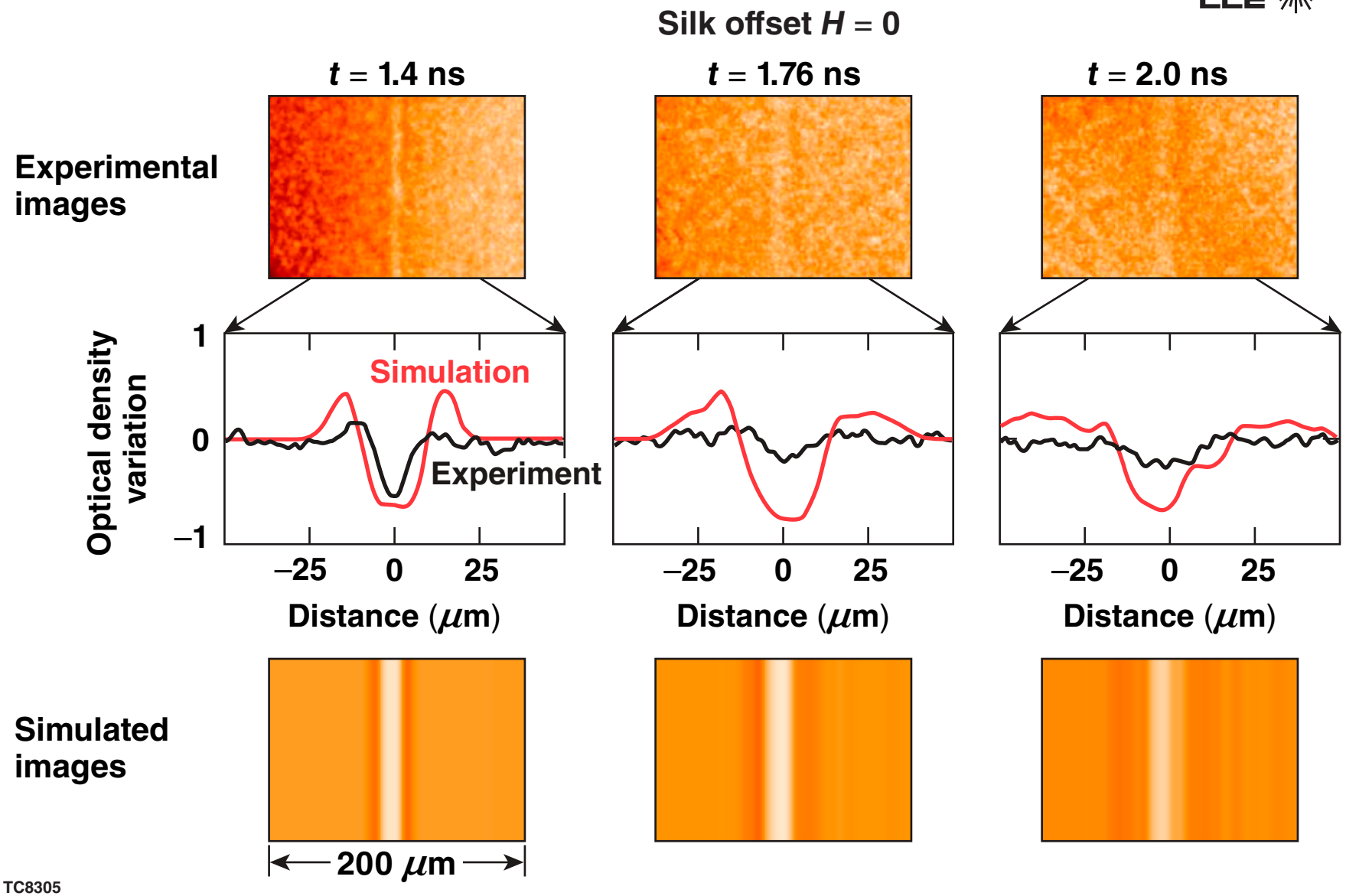
TC8303

Simulations show the same structures observed in experiments for a 42-μm silk offset



TC8304

Pressure wave from expanding silk plasma seeds a single-line mass modulation for zero offset



TC8305

Summary/Conclusions

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