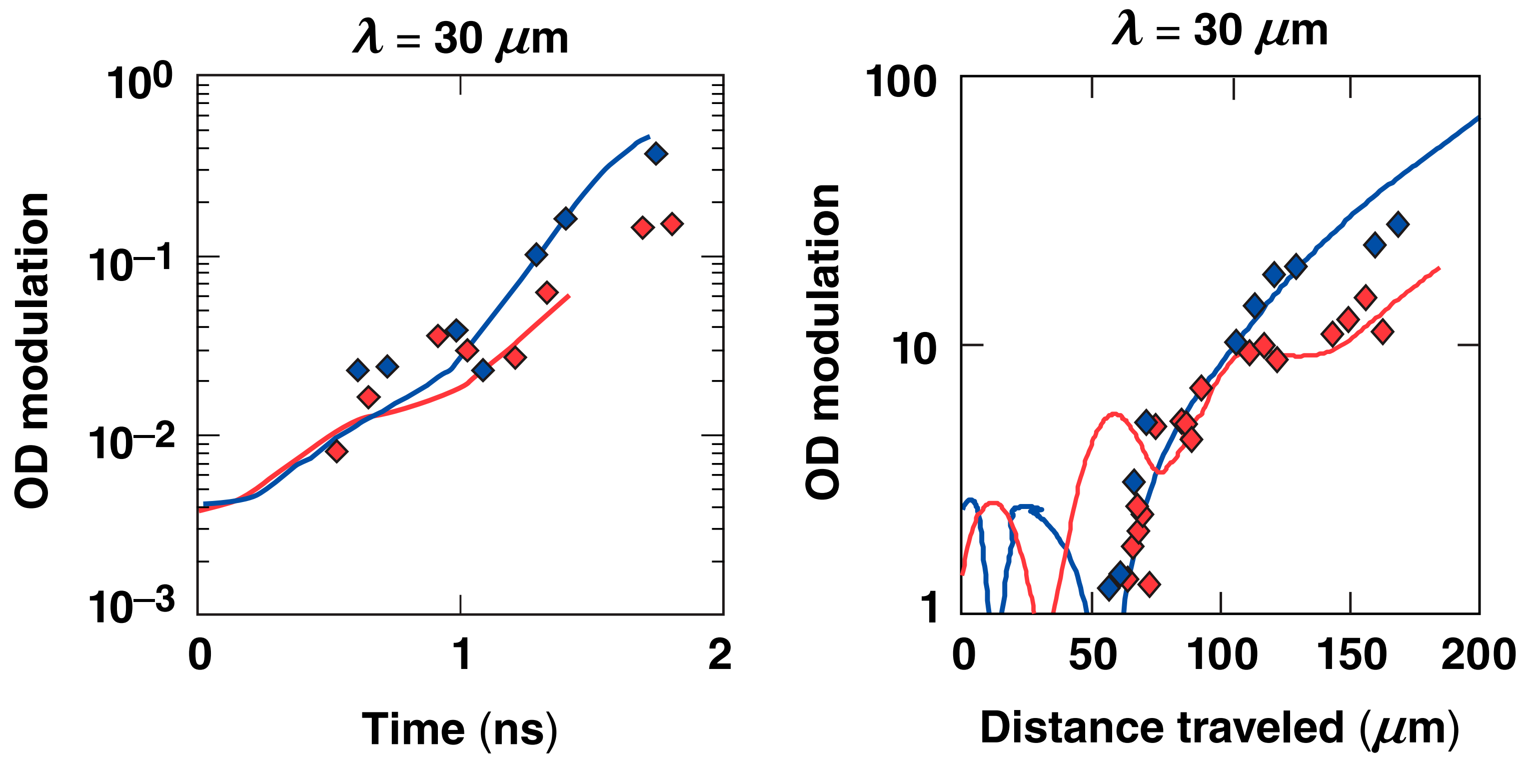
Rayleigh–Taylor Growth and Spherical-Compression Measurements of Silicon-Doped Ablators



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

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Summary

Si doping reduces ablation-front RT growth

- Silicon doping reduces hard x rays from two-plasmon decay*
- 2-D hydrodynamic simulations of silicon-doped ablator experiments agree with the measured Rayleigh–Taylor (RT) growth
  - experiments with 3% Si-doped CH foils
  - experiments with 6% Si-doped ablators that are planar surrogates for cryogenic implosions
- Measured neutron yields from $\alpha = 2$ warm target implosions increase when silicon is added to the ablator

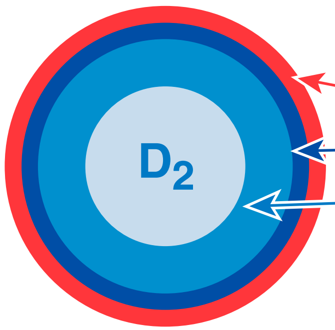
*P. B. Radha (JO3.00002), J. A. Delettrez (JO3.00003)

Collaborators

I. V. Igumenshchev, P. B. Radha, T. J. B. Collins, R. Betti, J. A. Delettrez,
R. Epstein, V. N. Goncharov, F. J. Marshall, D. D. Meyerhofer,
S. P. Regan, S. Skupsky, and V. A. Smalyuk

Laboratory for Laser Energetics
University of Rochester

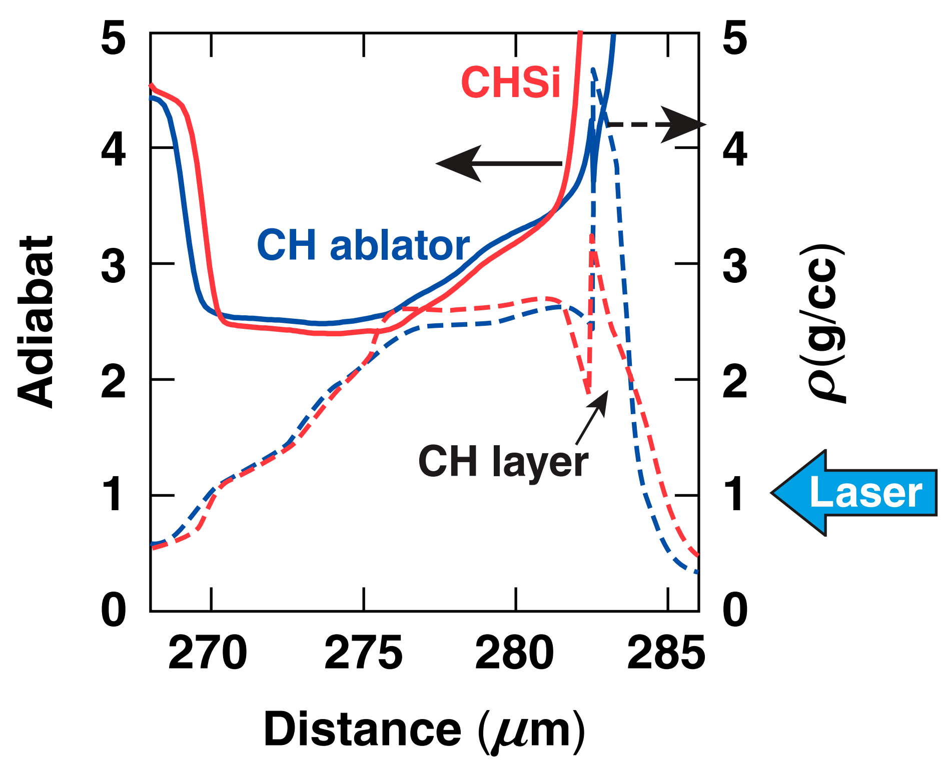
Calculations show Si-doped ablators reduce number of fast electrons and RT growth at the ablation surface



- Laser intensity
  $I = 8 \times 10^{14}$ W/cm^2
- Calculated implosion velocity
  $V_i = 3 \times 10^7$ cm/s
- TPD threshold parameter (η)[1] reduced

$$\eta = \frac{I_{14} \cdot L_{\mu m}}{230 \cdot T_{keV}}$$

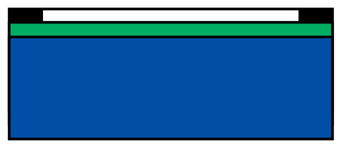
- A high adiabat in the ablation region reduces RT growth.[2]



[1]A. Simon *et al.*, Phys. Fluids 26, 3107 (1983).
[2]S. E. Bodner *et al.*, Phys. Plasmas 5, 1901 (1998).

E16270

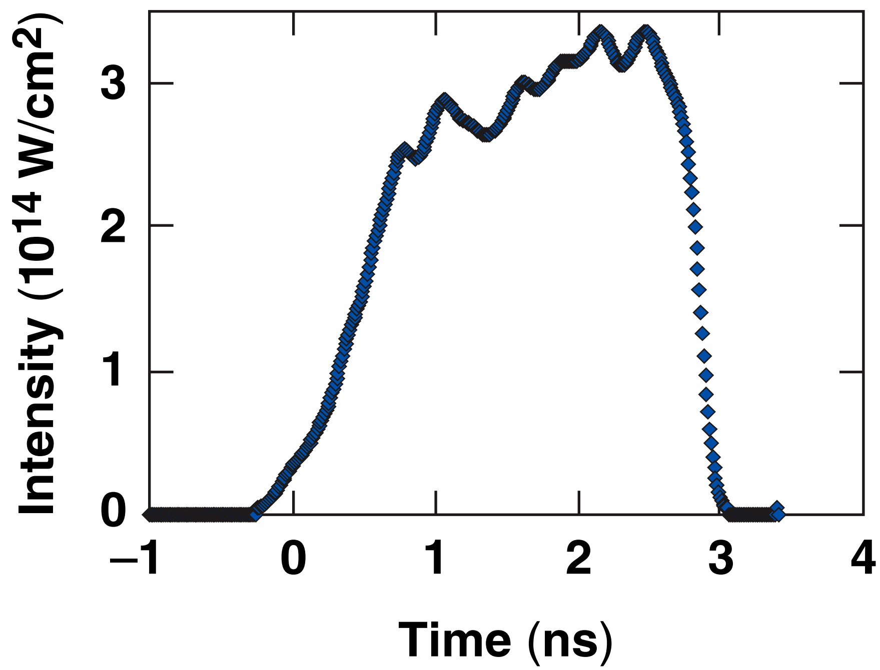
Ablation-interface RT growth was measured for silicon-doped CH planar foils



3% Si-doped CH foil

- Imposed perturbations
  - $\lambda = 60\ \mu m$
    $a_0 = 0.25\ \mu m$
    ($0.5\ \mu m$ p–v)
  - $\lambda = 30\ \mu m$
    $a_0 = 0.125\ \mu m$
    ($0.25\ \mu m$ p–v)

Minimized initial shock wave constant acceleration pulse shape



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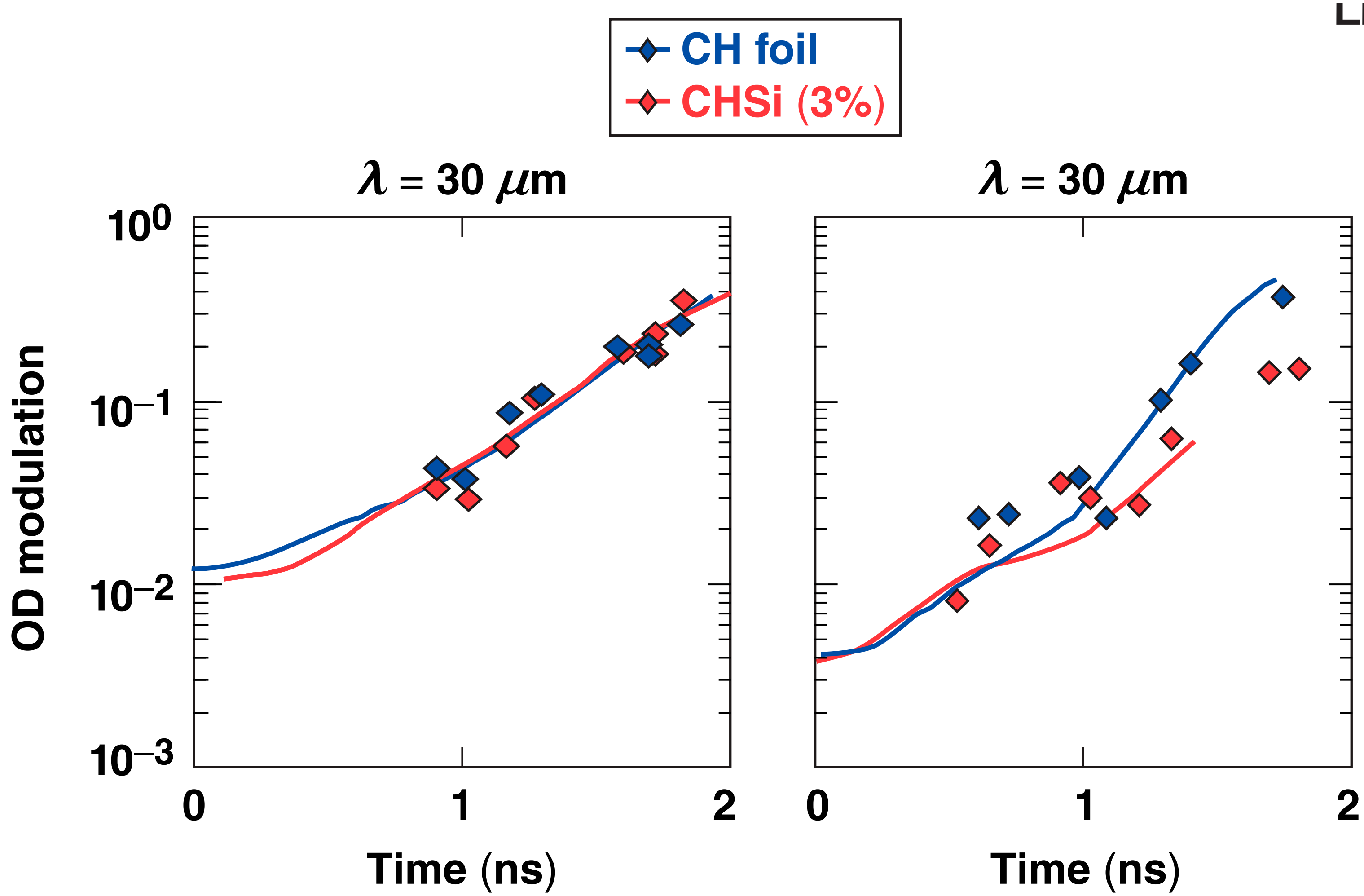
2-D simulations for undoped and Si-doped targets agree with the experimental data

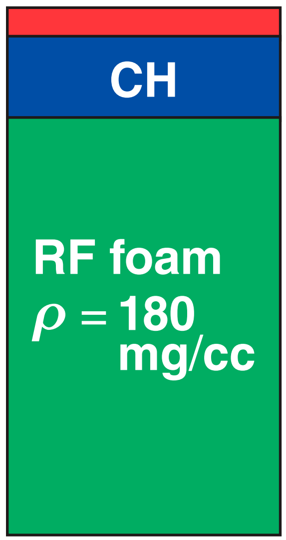


Ablation-interface RT growth in reduced for 30-μm-wavelength perturbations when Si is added to the CH.

E16271

Current planar-RT experiments are surrogates for spherical cryogenic target implosions

6% Si-doped CH

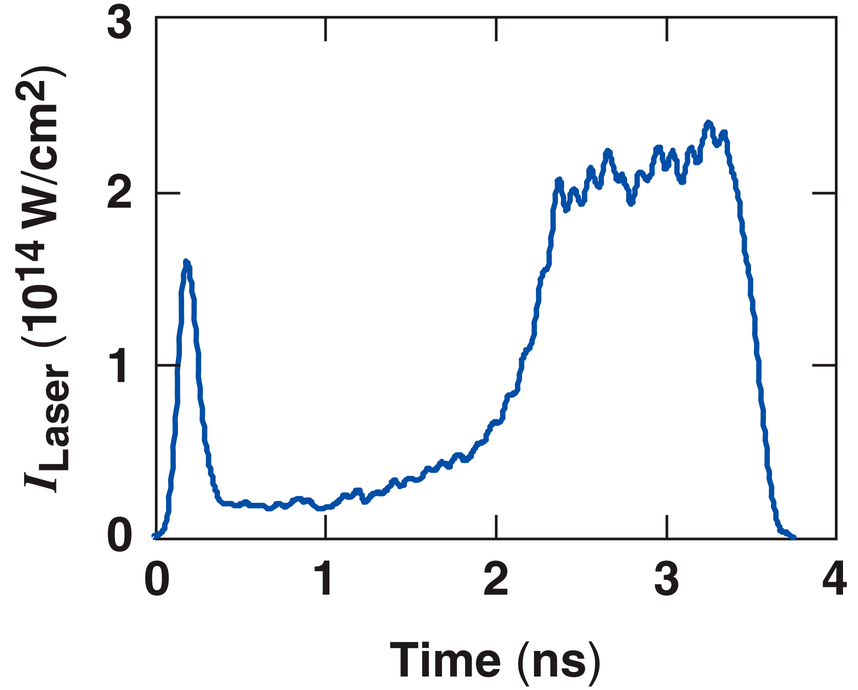


- Imposed perturbations

  λ = 30 μm
  a_0 = 0.25 μm
  (0.5 μm p–v)

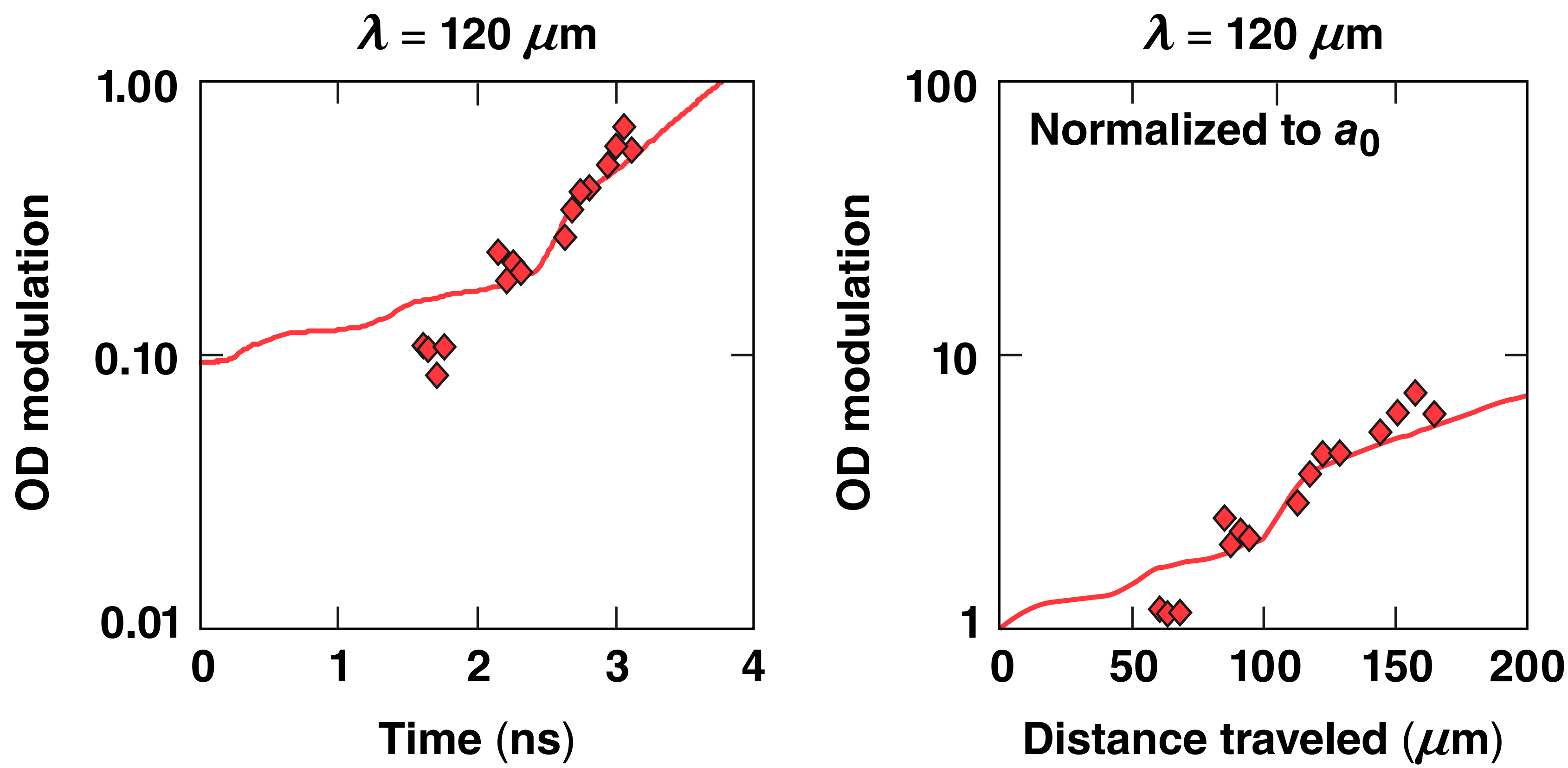
  λ = 120 μm
  a_0 = 1.0 μm
  (2.0 μm p–v)

α = 3
Cryogenic implosion pulse shape



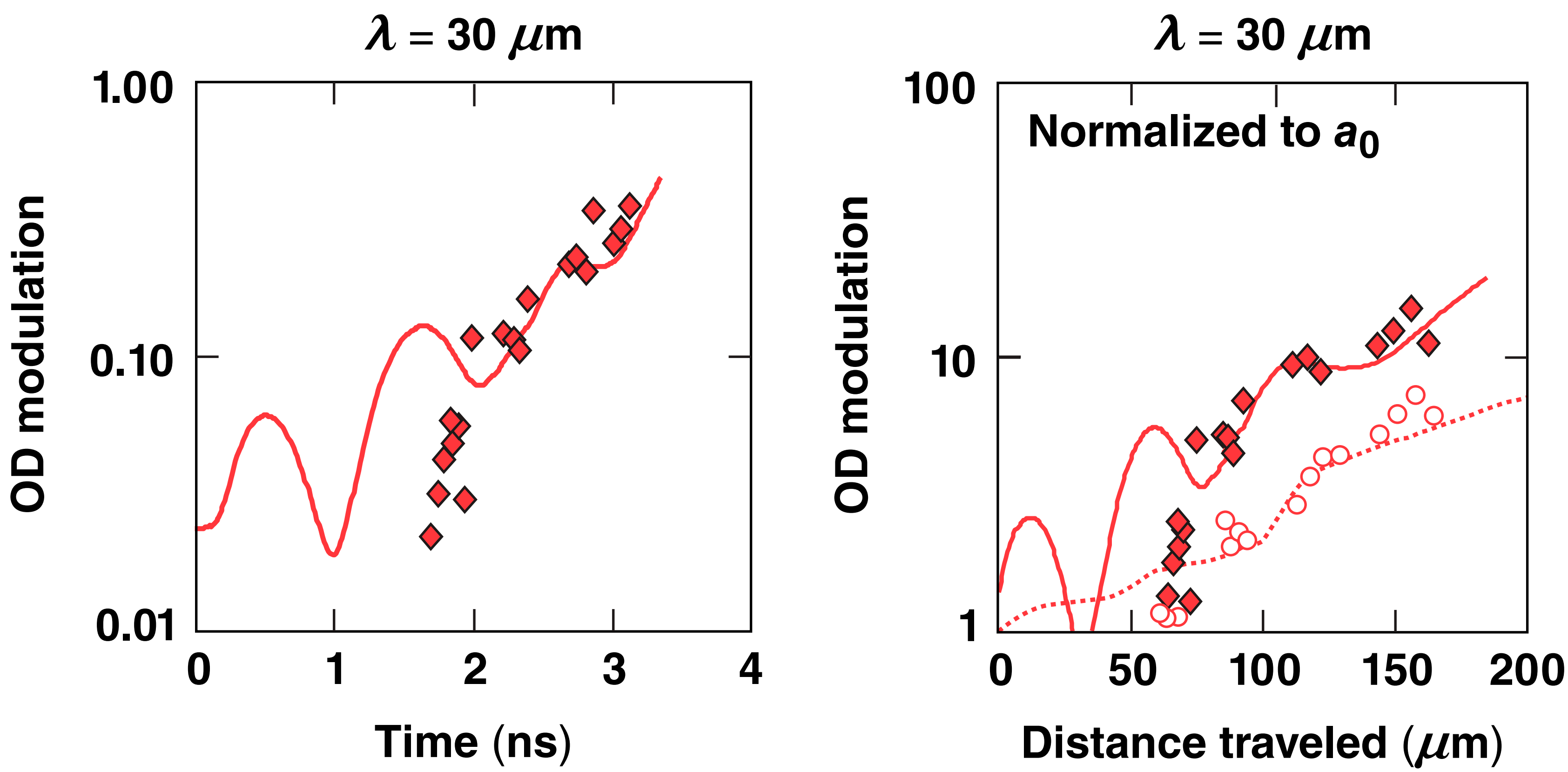
E16272

Perturbation amplitudes calculated by 2-D hydrodynamic simulations agree with the measured amplitudes



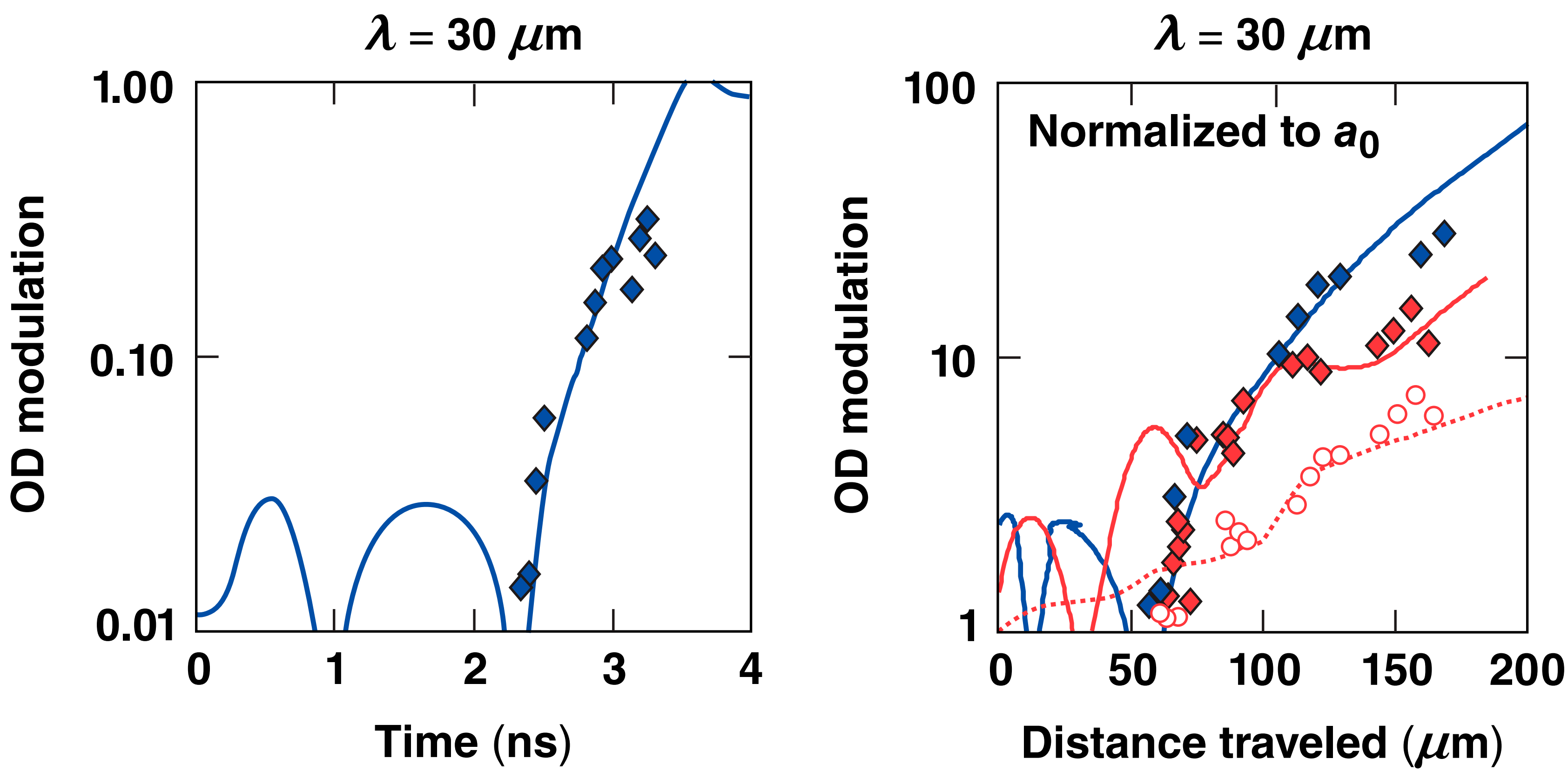
E16273-1

Perturbation amplitudes calculated by 2-D hydrodynamic simulations agree with the measured amplitudes



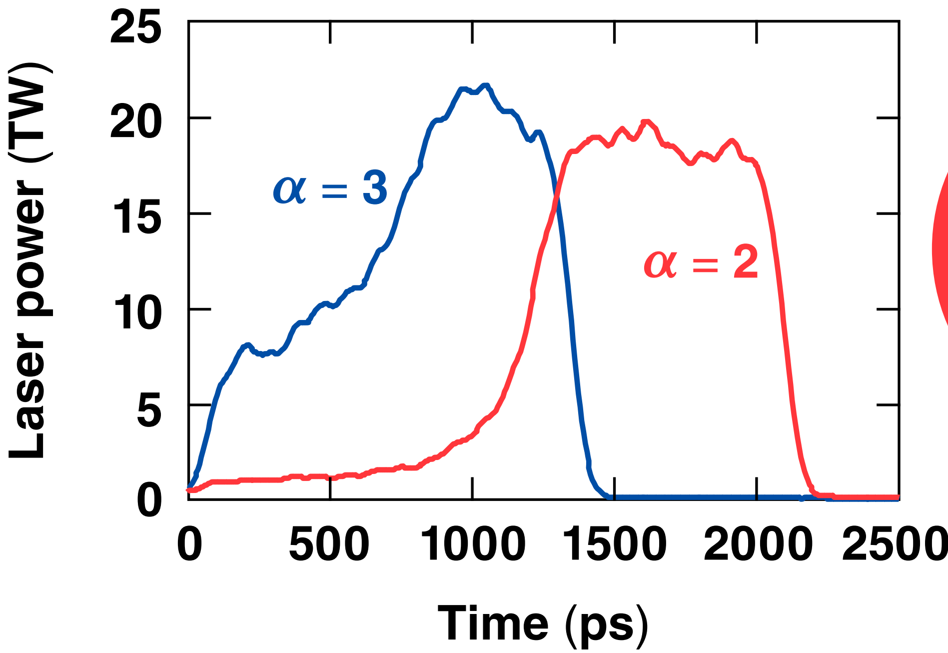
E16273-2

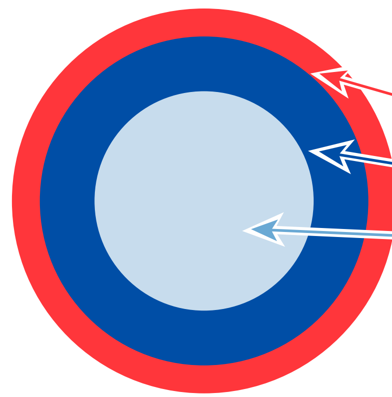
Perturbation amplitudes calculated by 2-D hydrodynamic simulations agree with the measured amplitudes



E16273-3

Neutron yields and absolute x-ray intensities were measured with spherical target implosions





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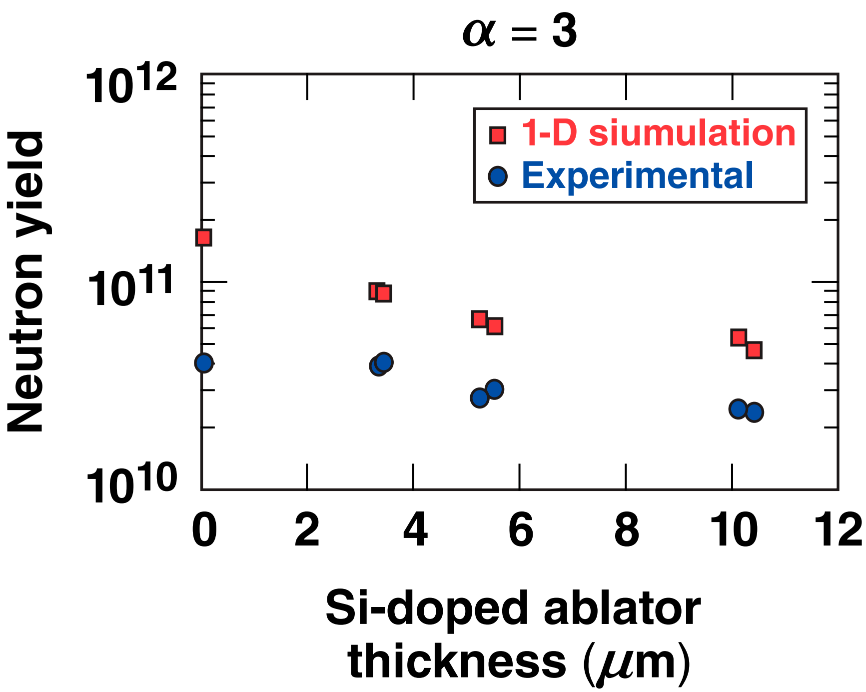
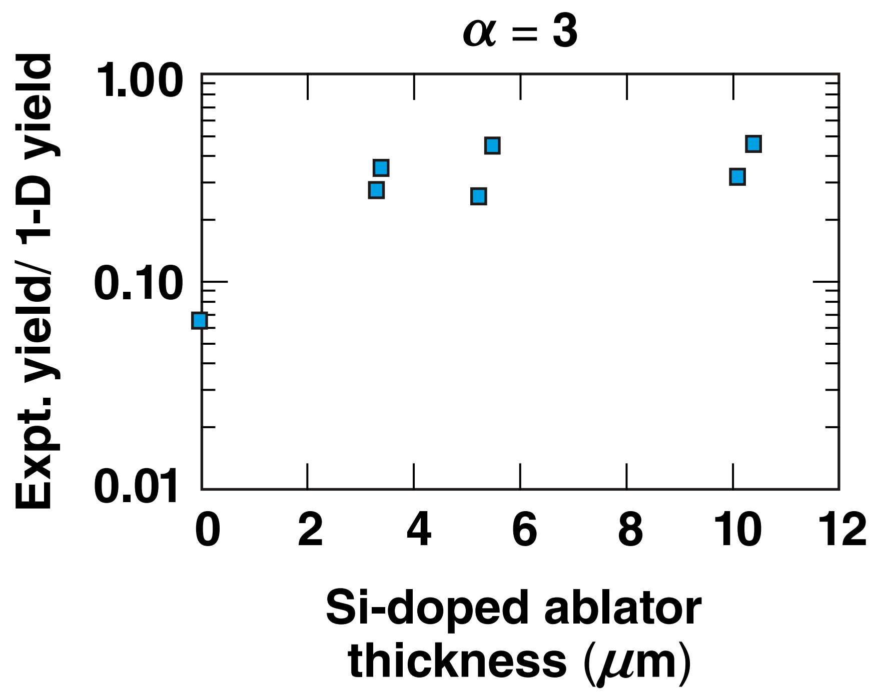
P. B. Radha (JO3.00002), J. A. Delettrez (JO3.00003)

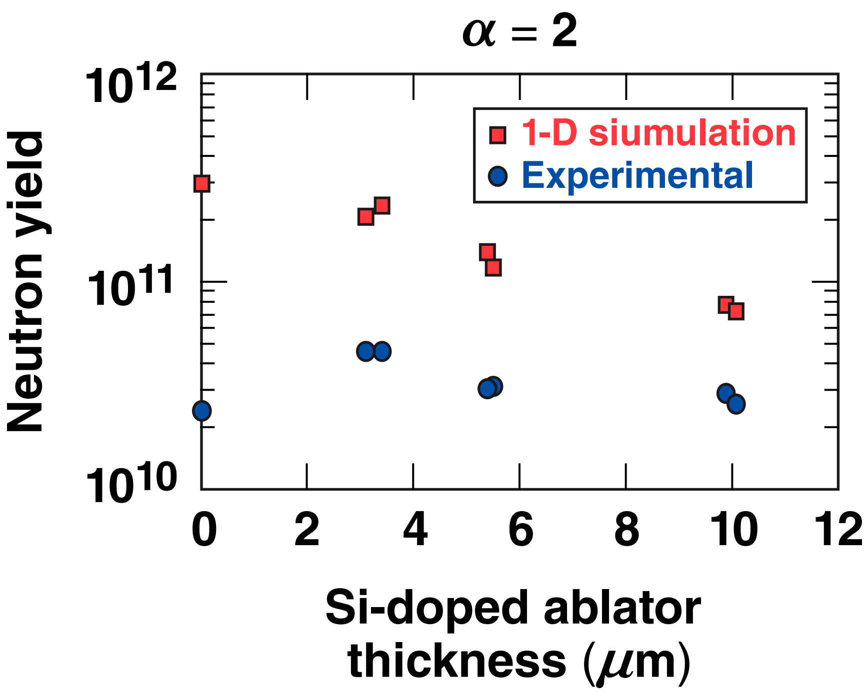
The measured neutron yields become closer to simulation as Si thickness is increased

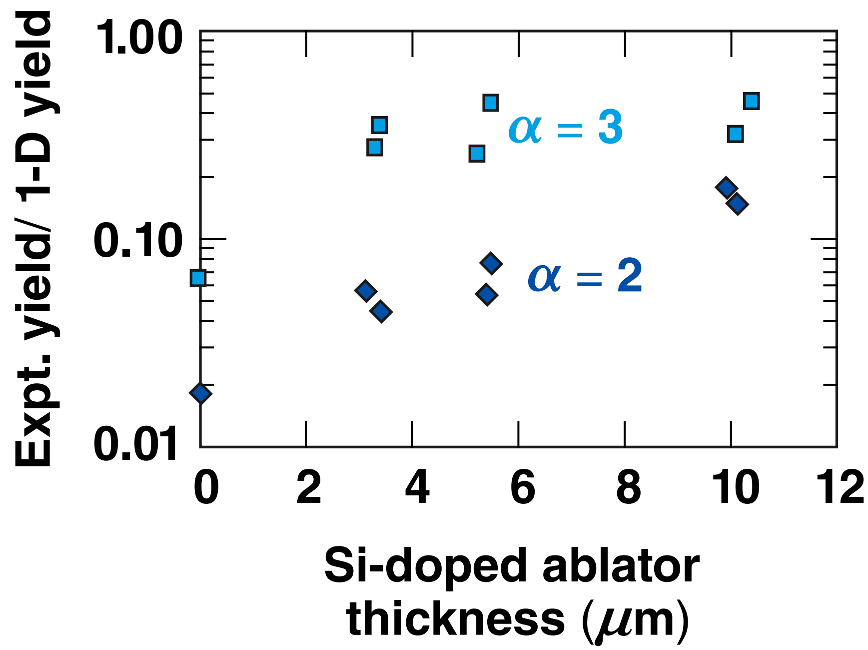




E16275-1

The measured neutron yields become closer to simulation as Si thickness is increased





Measured neutron yield for $\alpha = 2$ implosions increases when 3 μm of Si doped CH is added to the ablator.

E16275

Summary/Conclusions

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