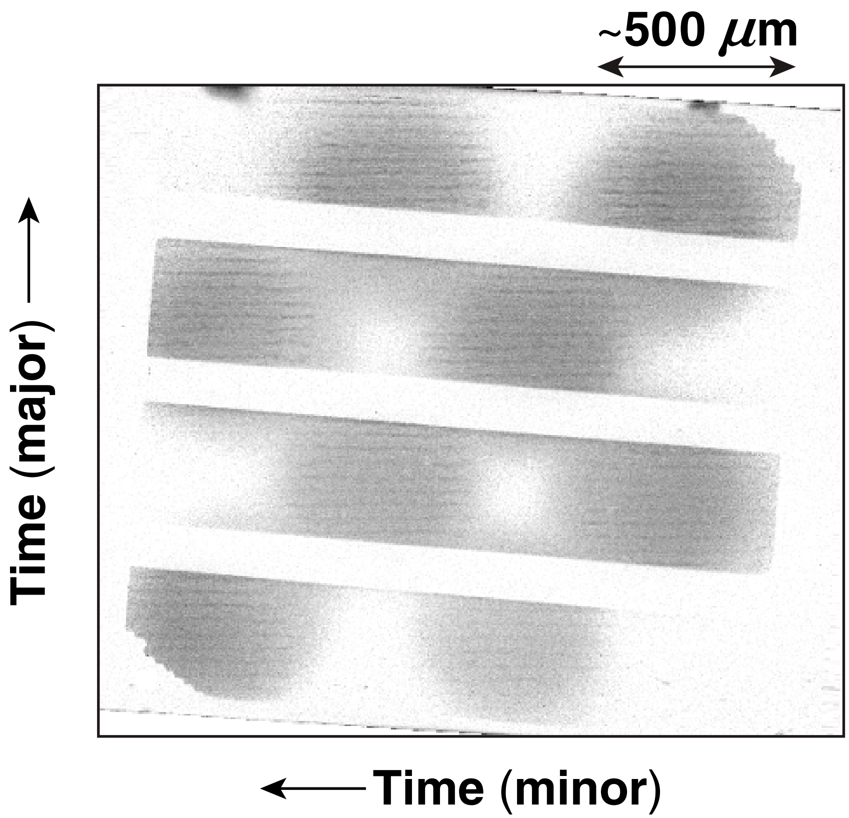
Rayleigh–Taylor Measurements in Planar CH and SiO_2 Foils on OMEGA



Face-on x-ray radiograph of a 20-μm-thick planar SiO_2 target with a $\lambda = 60$-μm 2-D intensity modulation imprinted by a special phase plate on the OMEGA laser

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Summary

Rayleigh–Taylor (RT) experiments at 1×10^{15} W/cm^2 with CH and SiO_2 ablators show significant growth differences

- At peak drive intensities of 5×10^{14} W/cm^2, both CH and CH–SiO_2 targets show significant 2-D modulation growth
- At peak drive intensities of 1×10^{15} W/cm^2
  - CH targets with 2-D modulations (pre-imposed and intensity imprinted) show a reduction in RT growth caused by electron preheat
  - SiO_2 targets with 2-D intensity imprinted modulations show significant RT growth
  - SiO_2 targets with a thin CH ablator with pre-imposed 2-D modulations show a reduction in RT growth
- Future experiments will investigate electron preheat as the stabilizing mechanism in CH-SiO_2 targets at intensities of 1×10^{15} W/cm^2

Collaborators

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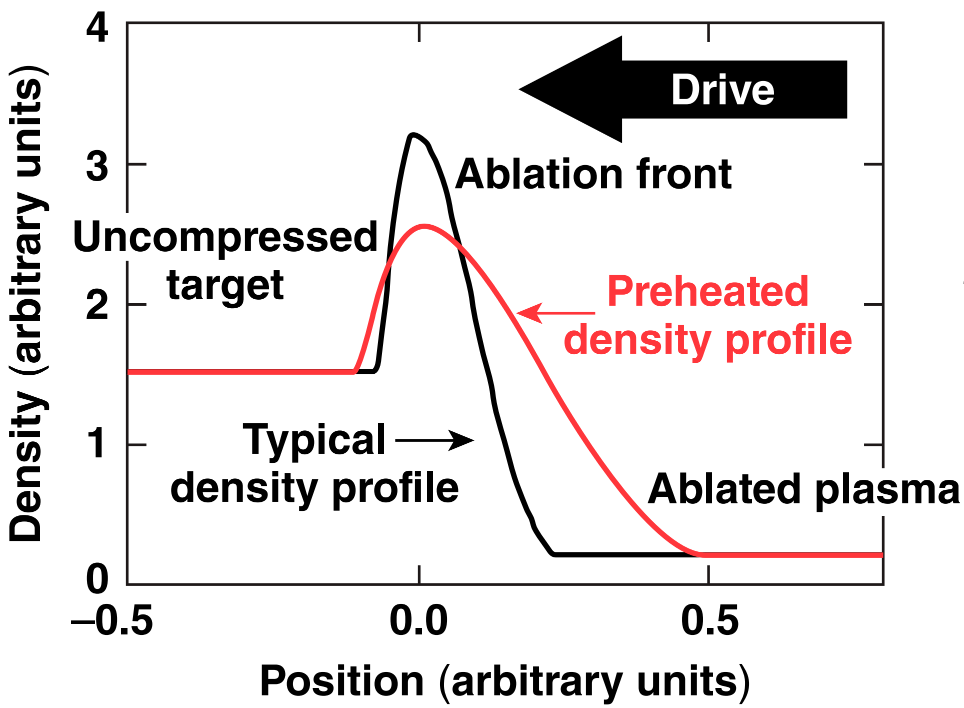
Previous RT experiments demonstrated decreased instability growth at peak laser intensities of 1×10^{15} W/cm^2 in CH targets caused by electron preheat*



Modulations with amplitudes below $\lambda/10$ grow exponentially with a growth rate give by

$$\gamma_{RT} = \alpha \cdot \sqrt{\frac{k \cdot g}{1 + k \cdot L_m}} - \beta \cdot k \cdot V_a \;^{**}$$

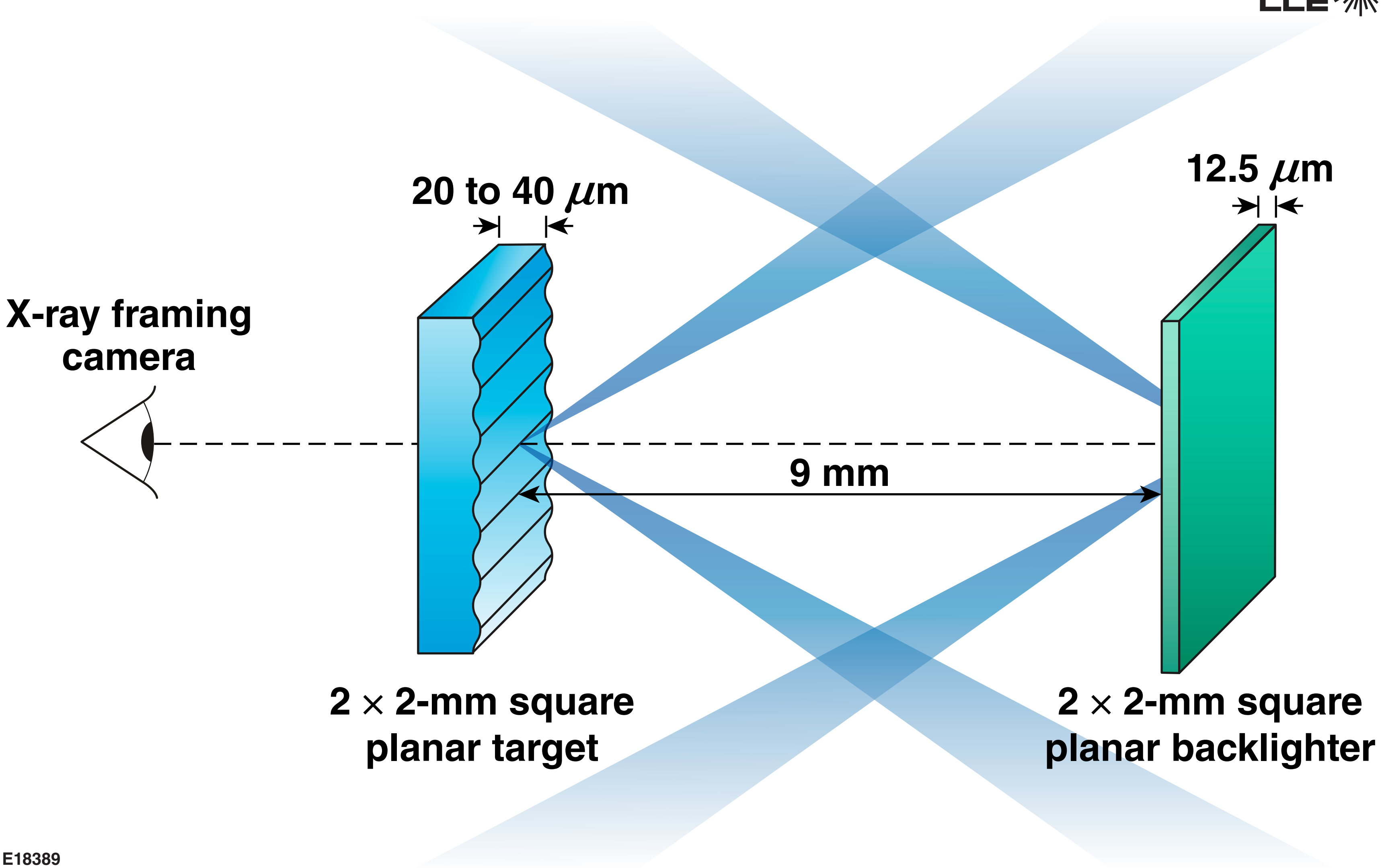
Variable	Description
α, β	Constants
k	Modulation wave number
g	Acceleration
L_m	Minimum density scale length
V_a	Ablation velocity

Target preheat leads to increased density scale length (L_m) and ablation velocity (V_a), resulting in decreased RT modulation growth.

E18388

* V. A. Smalyuk *et al*. Phys. Plasmas 15, 082703 (2008).
** R. Betti *et al*., Phys. Plasmas 5, 1446 (1998).

Planar CH, SiO_2, and CH–SiO_2 targets are driven by 10 to 12 drive beams, while an x-ray backlighter is used to measure areal density modulation growth



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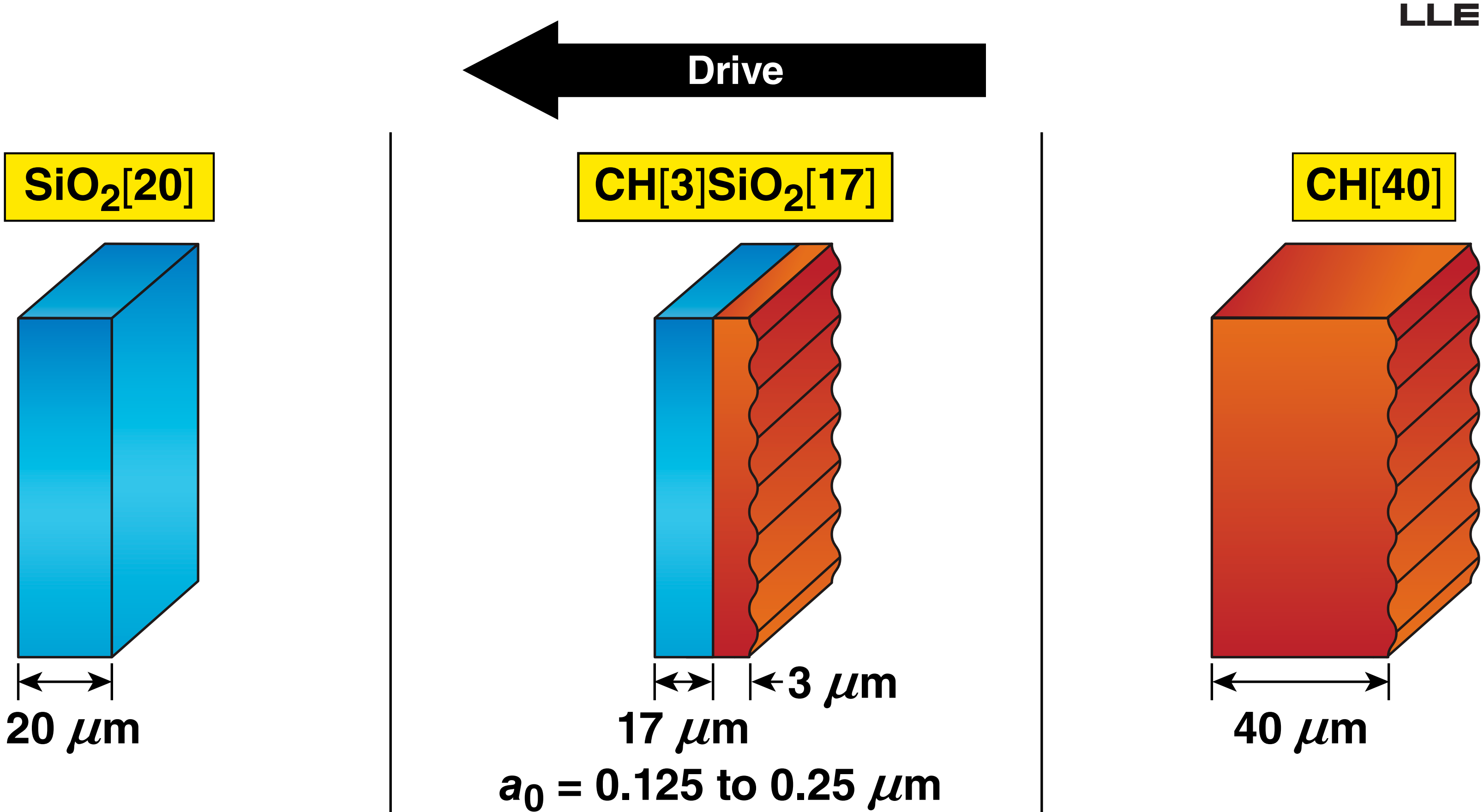
CH and SiO_2 targets were seeded with an intensity-imprinted 2-D modulation, while pre-imposed mass modulations were used on CH and CH–SiO_2 targets



2-D intensity modulations imprinted

2-D mass modulations pre-imposed

2-D modulations pre-imposed and imprinted

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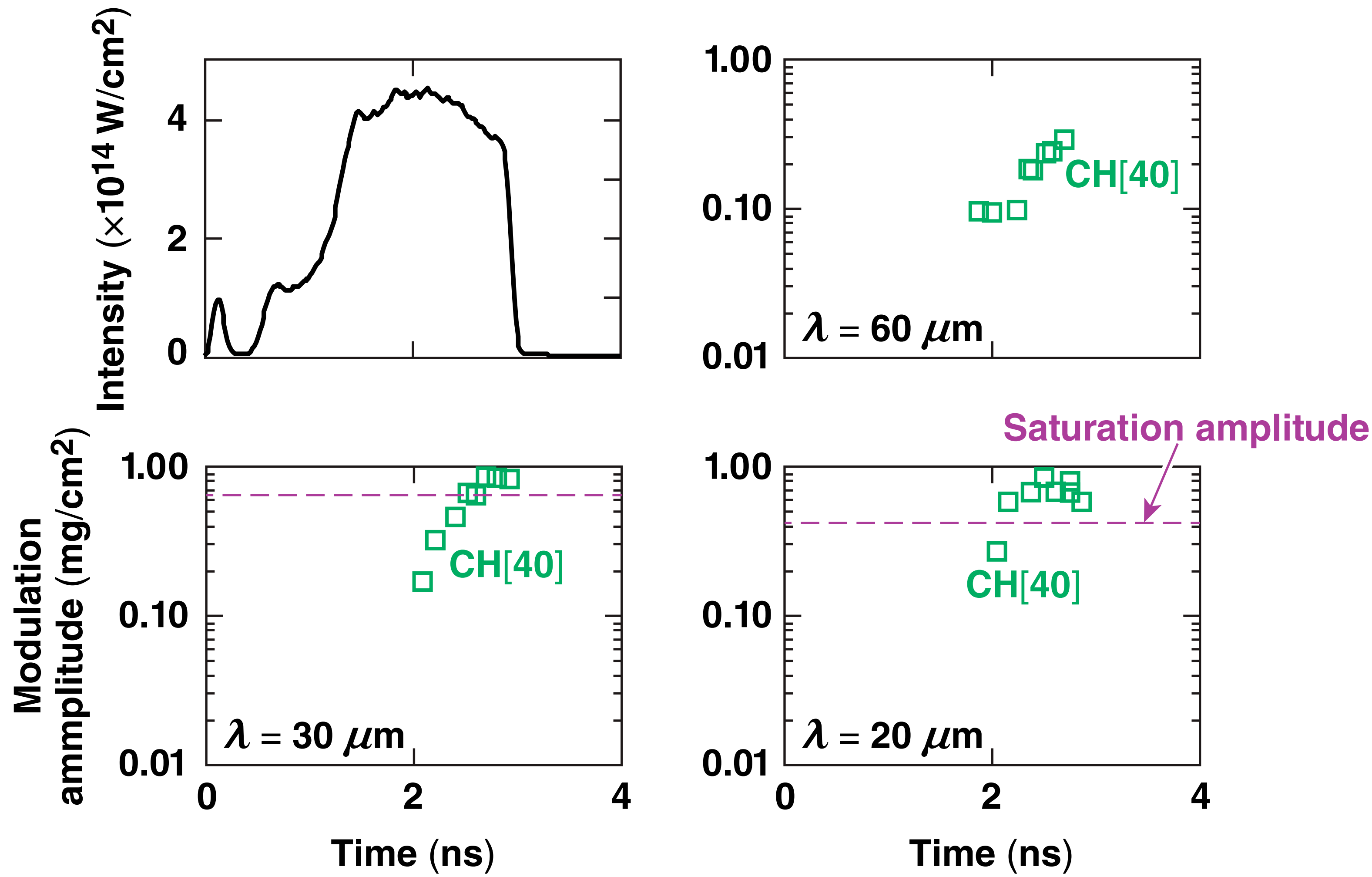
40-μm-thick CH targets driven at low intensities (5×10^{14} W/cm^2) show significant growth up to the modulation saturation amplitude

- Pre-imposed modulations



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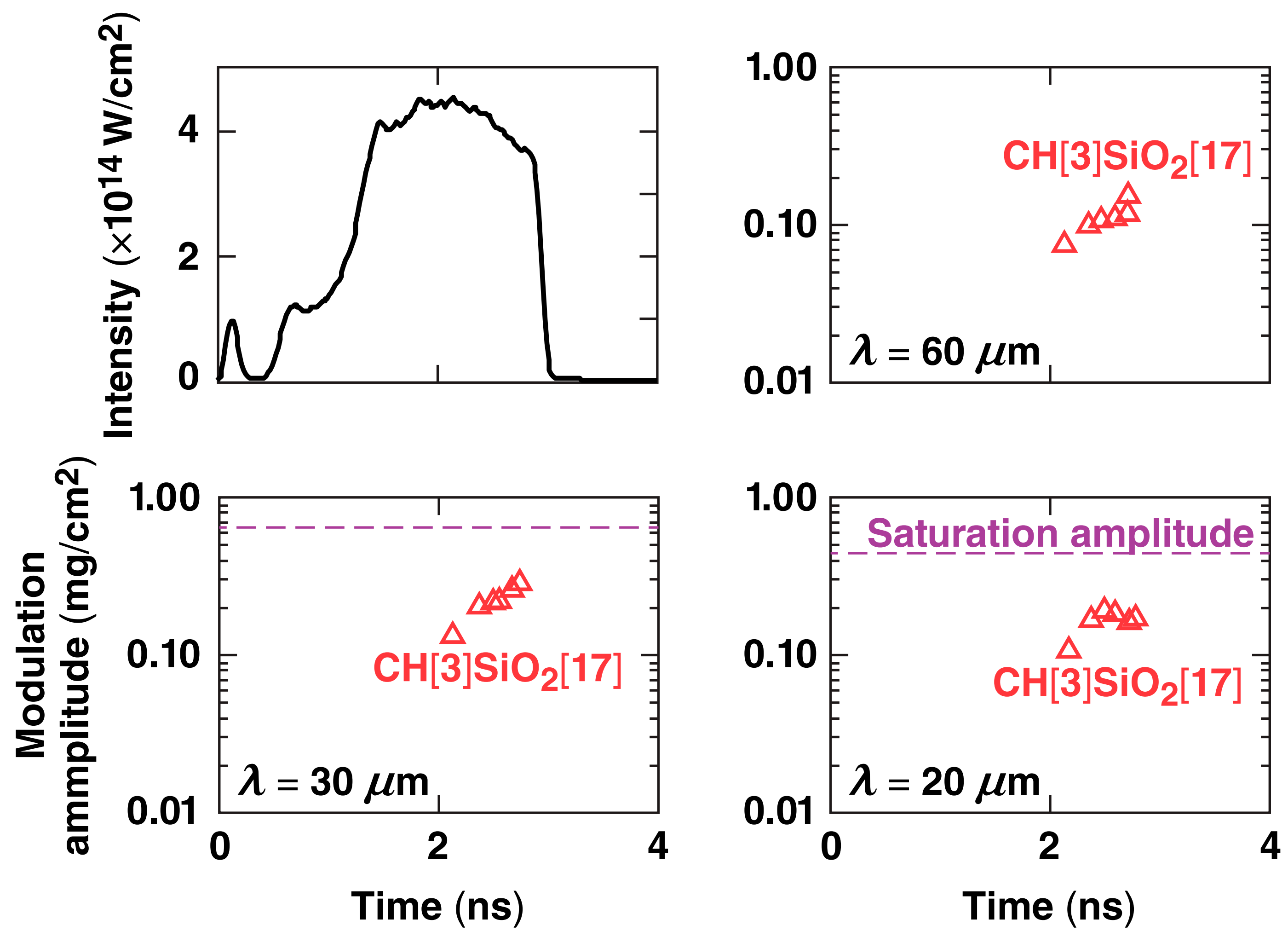
17-μm-thick SiO_2 targets with a perturbed 3-μm CH ablator show significant modulation growth in SiO_2 at low intensities

- Pre-imposed modulations



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At high intensities (1×10^{15} W/cm^2) imprinted modulations grow in SiO_2, while CH targets of comparable mass show no growth

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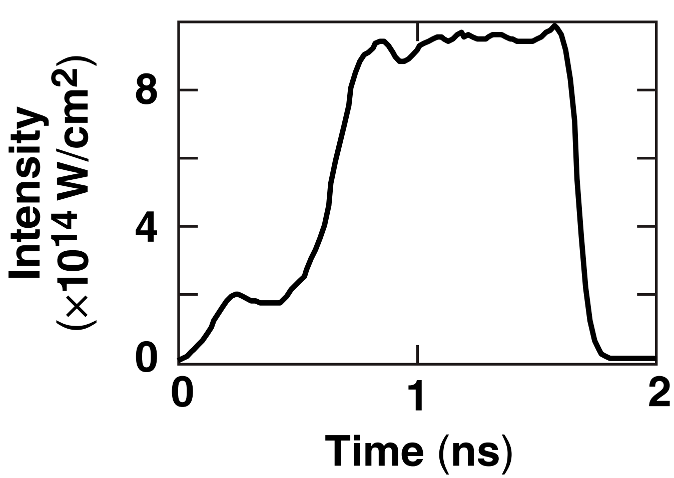
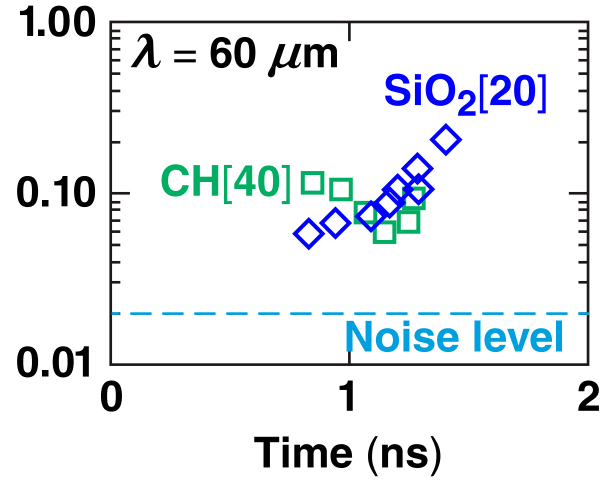
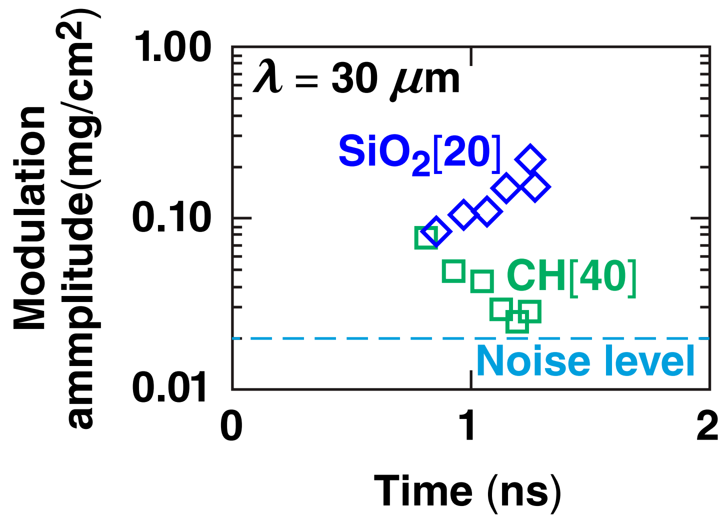
- **Intensity-imprinted modulations**







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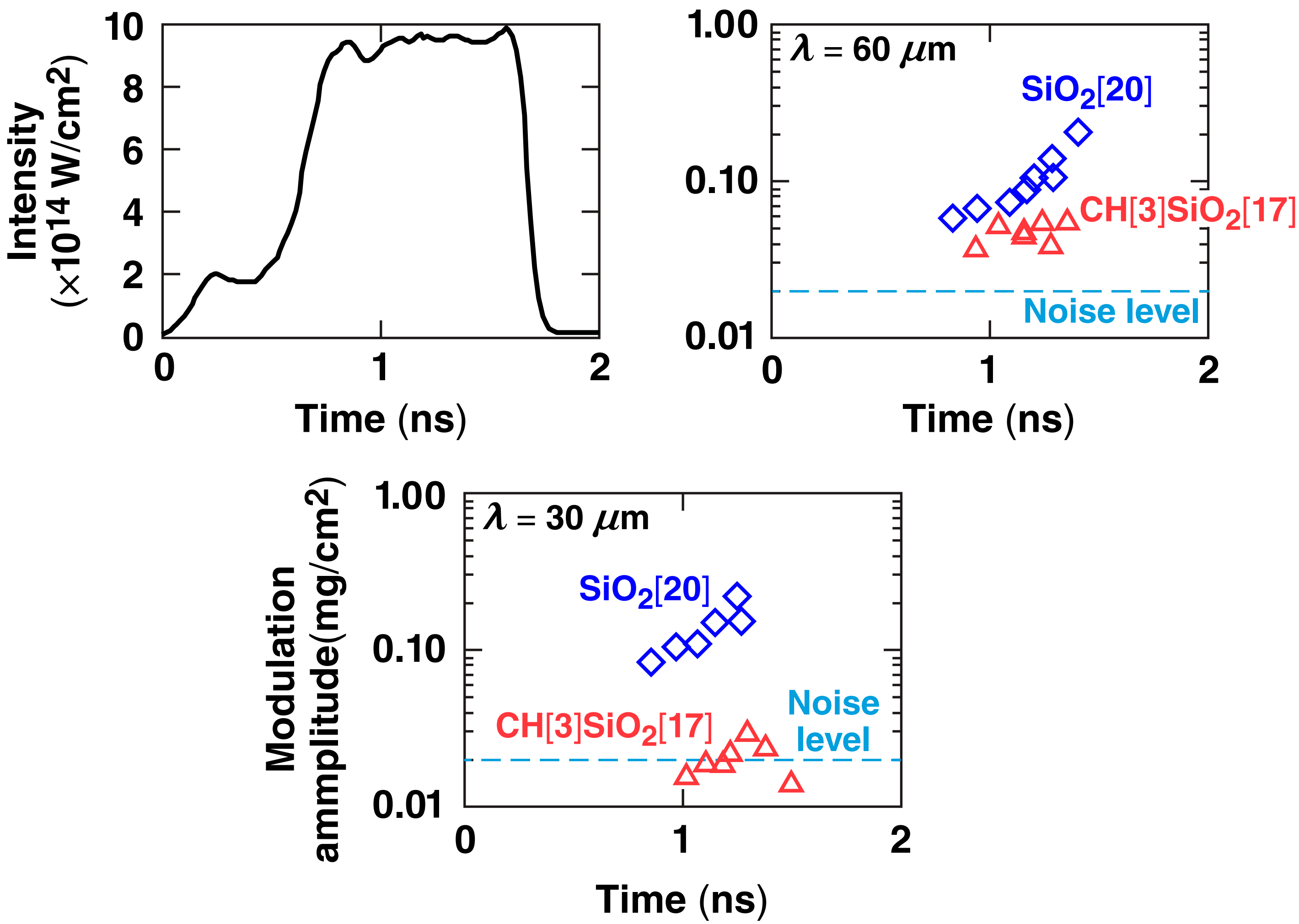
17-μm-thick SiO_2 targets with a perturbed 3-μm CH ablator show no significant instability growth at high intensities, while SiO_2 without CH shows significant modulation growth

- Pre-imposed (CH-SiO_2) and imprinted (SiO_2) modulations



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Future experiments will investigate electron preheat as the stabilizing mechanism in CH-SiO_2 targets at high intensities

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- Gluing pre-imposed CH ablators to SiO_2 creates variations in the ablator thickness and material that may affect growth measurements in SiO_2.
- Initial conditions for pre-imposed and intensity-imprinted modulations are different.
- SiO_2 targets with an unmodulated CH overcoat will be imprinted with intensity modulations.
  - CH overcoats eliminate the need for glue and provide a higher precision ablator thickness.
  - Initial conditions will closely match SiO_2 targets

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