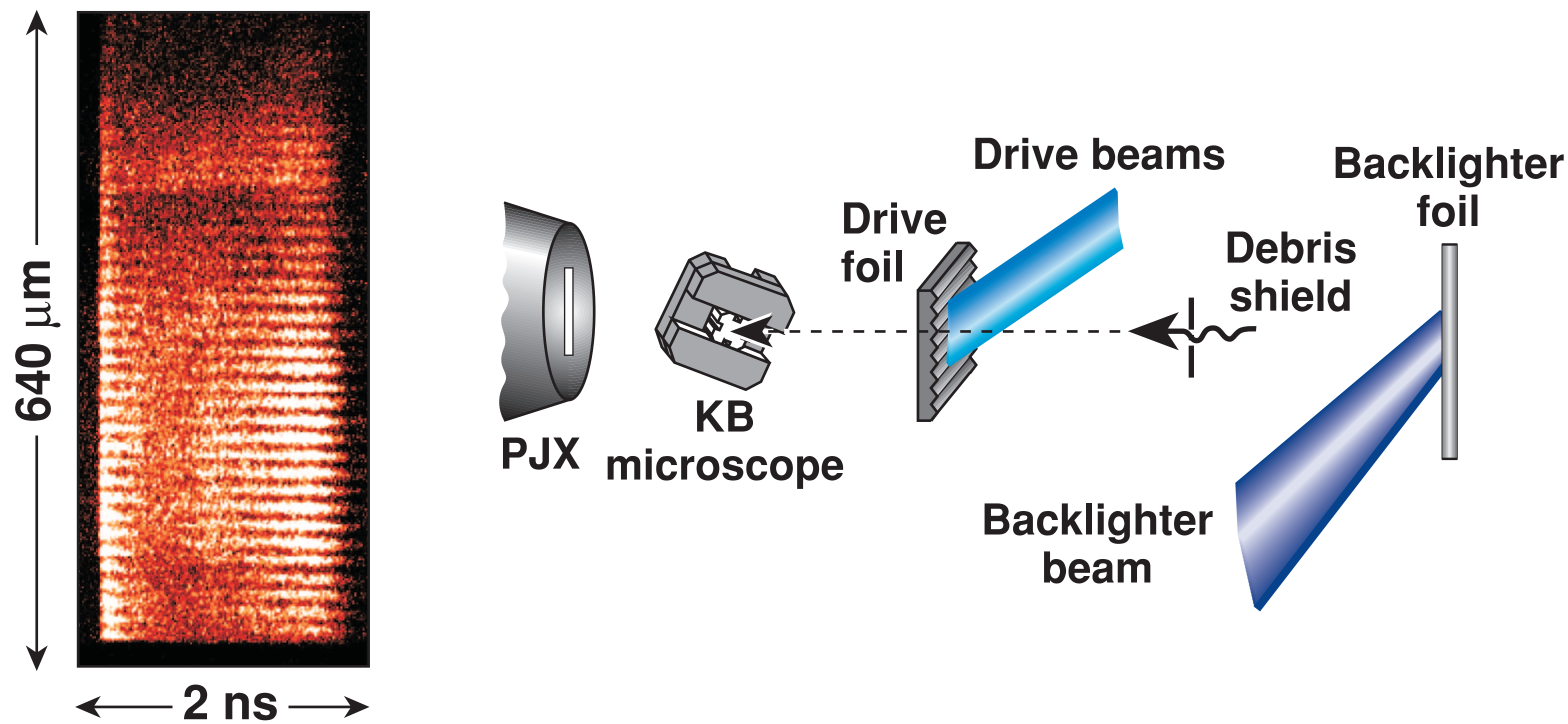
# Ablative Richtmyer–Meshkov Growth in ICF Targets on OMEGA

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Summary

# Ablation-front oscillations due to dynamic overpressure have been observed

- Analysis of the data shows phase inversion of the ablation-front ripples.
- Observed areal-density modulations are in good agreement with theory and simulations during the shock transit.
- The data obtained from two independent experiments match very well.
- The experimental results are used to validate numerical codes for ICF hydrodynamic simulations (see V. Goncharov, LO.001).

Motivation

# Experimental verification of the effect of "dynamic overpressure" is important to implosion stability studies in direct-drive ICF

UR LLE

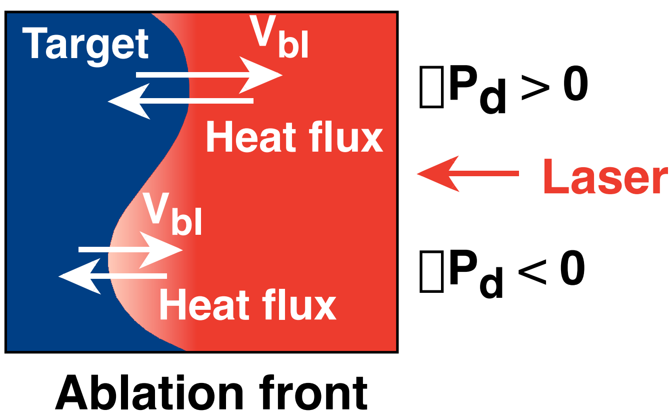
- Dynamic overpressure sets the initial conditions for the Rayleigh–Taylor (RT) growth.
- The magnitude of dynamic overpressure stabilization during the Rayleigh–Taylor phase can be estimated:

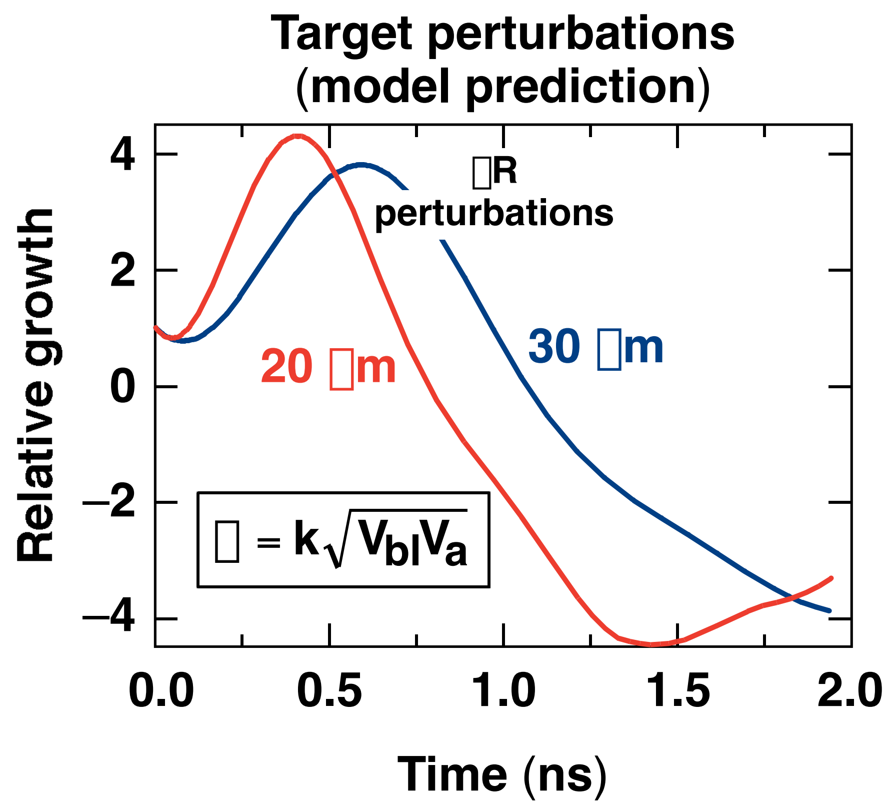
$$\gamma = \sqrt{kg - k^2 V_a V_{bl}} - 2\,kV_a$$

- The cutoff wavelength for RT growth in cryogenic targets is set by the dynamic overpressure term.

# Dynamic overpressure is the main physical mechanism stabilizing ablative Richtmyer–Meshkov growth

$\delta(\nabla T) \rightarrow \delta V_a \rightarrow \delta V_{bl} \rightarrow \delta P_d$




- Classical RM growth: $\eta \sim k c_s \eta_0 t$
- With ablation:[1] $\eta \sim \eta_0 \cos(\omega t)$
- Oscillations are observable only before the onset of RT growth.[2]
- For short-wavelength modes, more oscillations are registered during shock transit.

[1] V. N. Goncharov, Phys. Rev. Lett. 82, 2091 (1999).
[2] Y. Aglitskiy *et al.*, Phys. Plasmas 9 2264 (2002).

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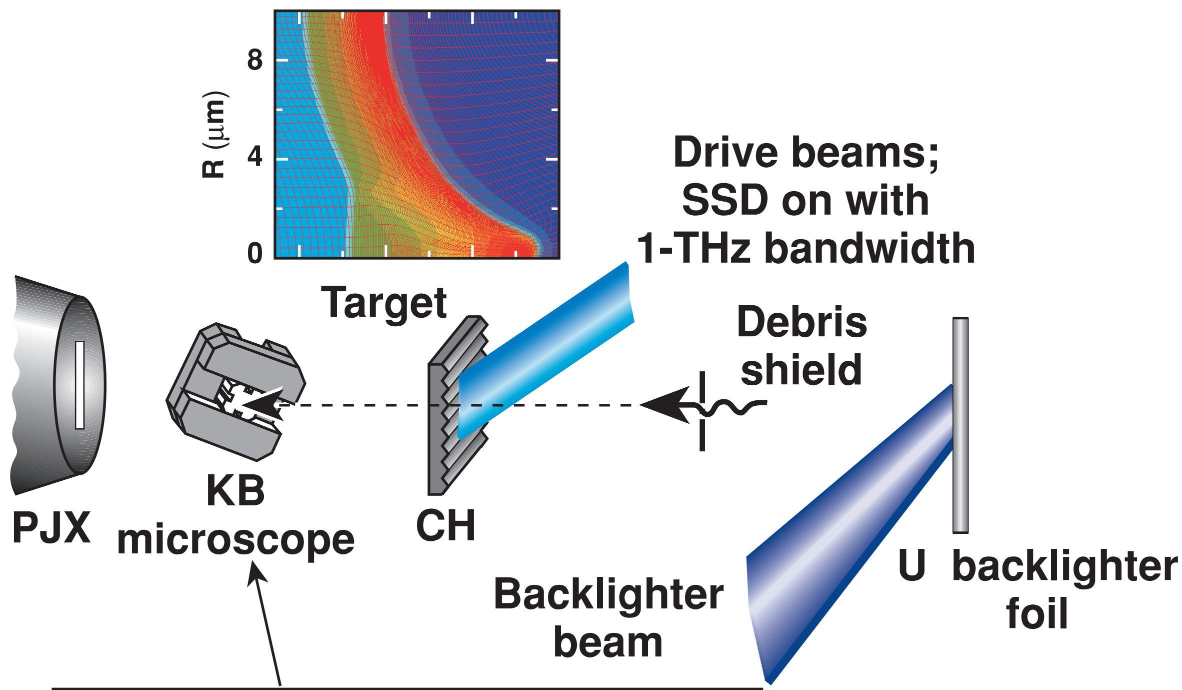
# Through-foil x-ray radiography is used to measure the evolution of the target ρR perturbations

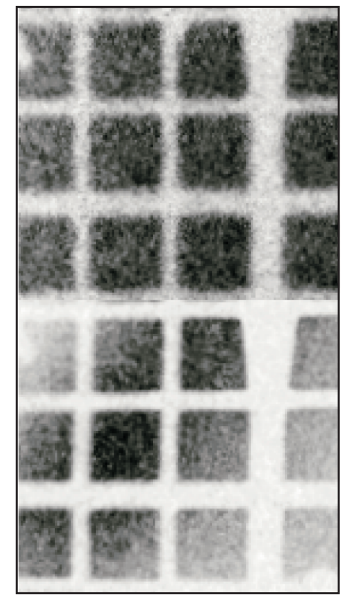



Two-orders-of-magnitude-higher throughput

3-μm resolution on axis and 6-μm over a 300-μm field of view

| λ (μm) | d (μm) | $a_0$ (μm) | I (TW/cm$^2$) |
|---|---|---|---|
| 20 | 40, 60 | 1.65 | 200 to 400 |
| 30 | 60 | 2.75 | 400 |

Framing camera



KB microscope

Images of 400-lines/inch mesh taken with the two instruments.

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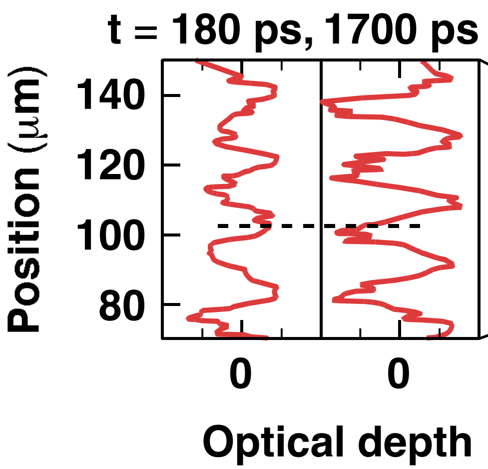
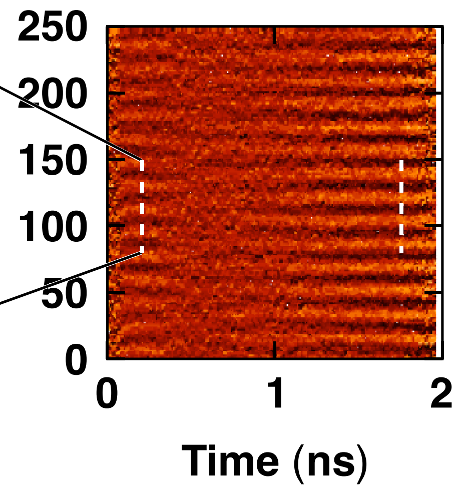
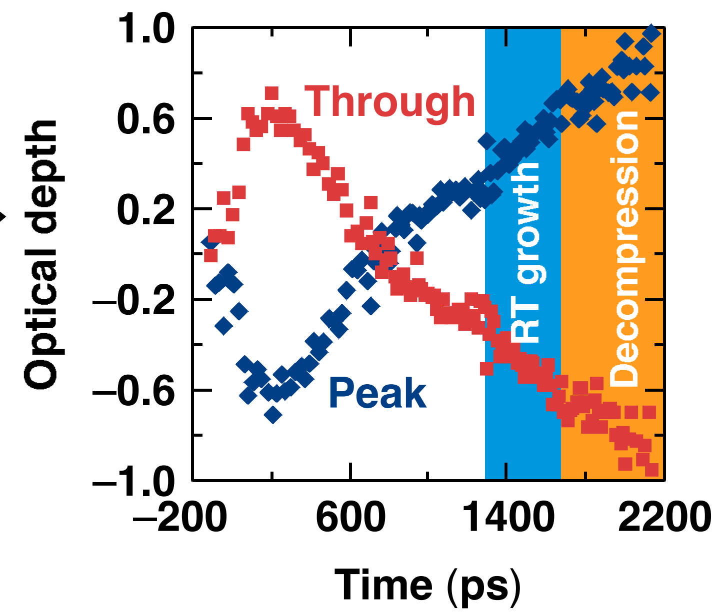
# A streaked image of a driven planar CH target acquired with the PJX provides a continuous record in time




Spatial profiles taken at two different times clearly show phase inversion in the data.

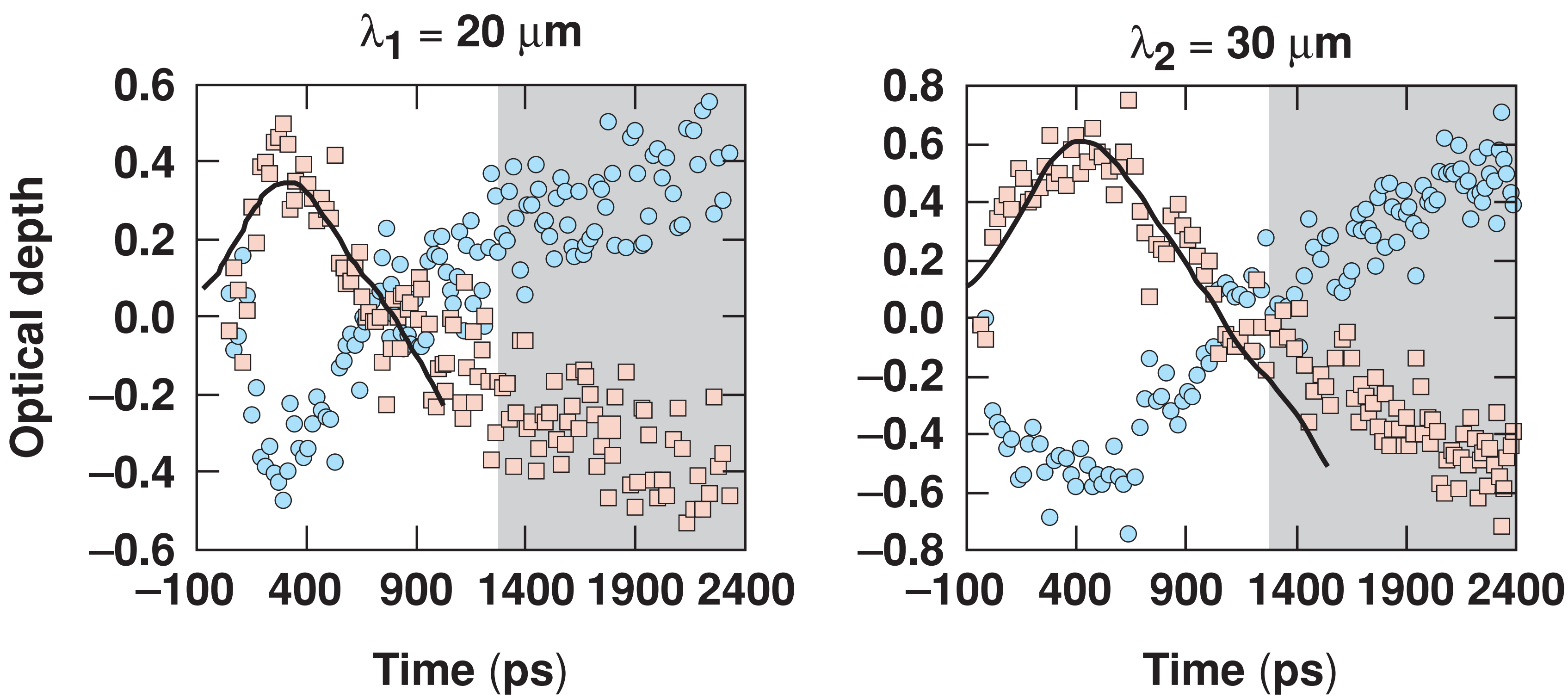



Streaked image of a planar CH target with 60-μm thickness and single-mode (λ = 20 μm) surface modulations on the front




Evolution of the peak and valley of ρR perturbations

# Numerical simulations are in good agreement with experimental data




$t_{rb}$ ~ 1.3 ns, $U_s$ ~ 63 μm/ns, d = 60 μm

- In the numerical code, thermal transport with a flux limiter f = 0.06 models well the evolution of different modes.

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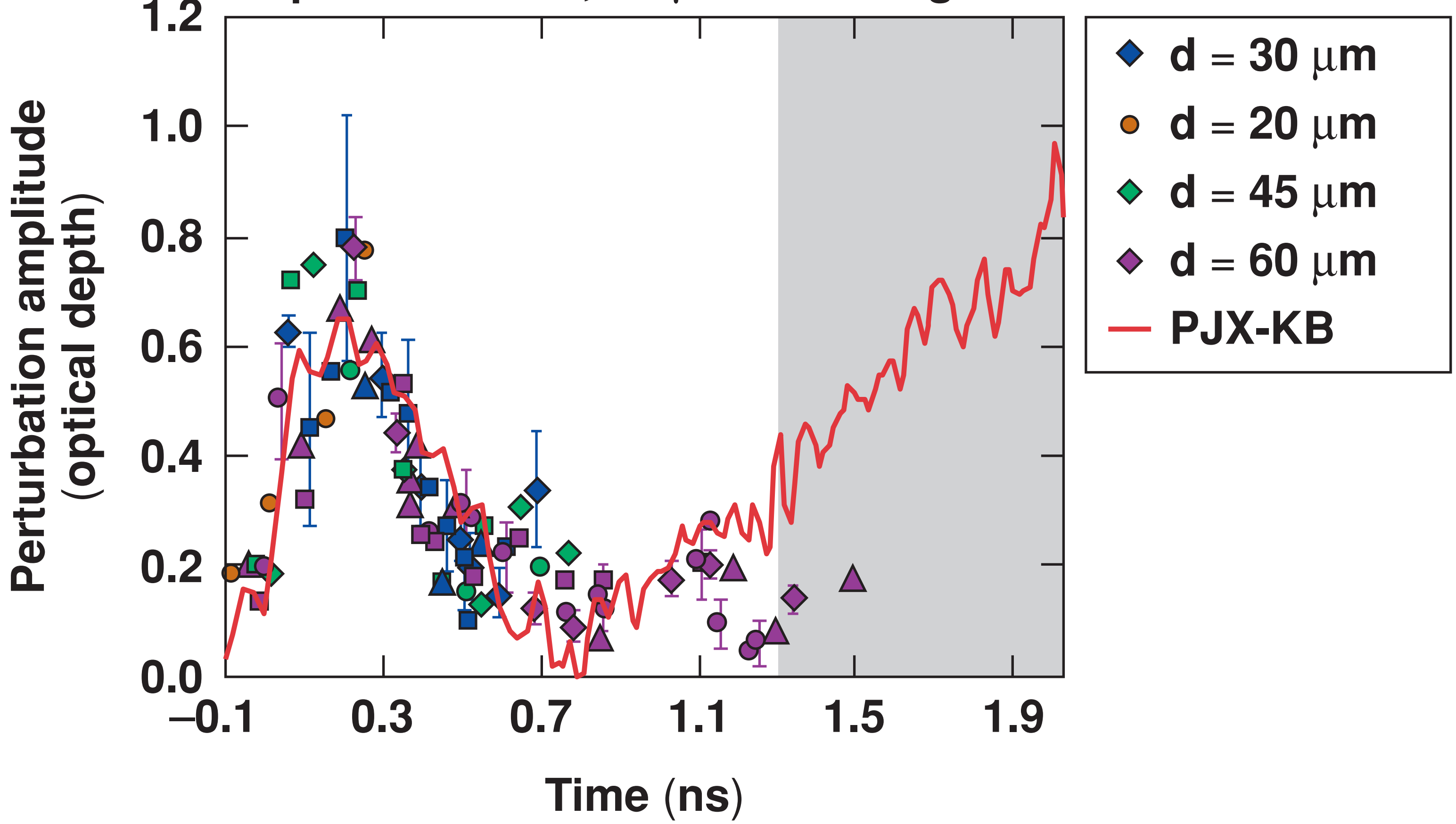
# PJX data agree very well with previous framing camera results

Evolution of single-mode perturbations, 20-μm wavelength

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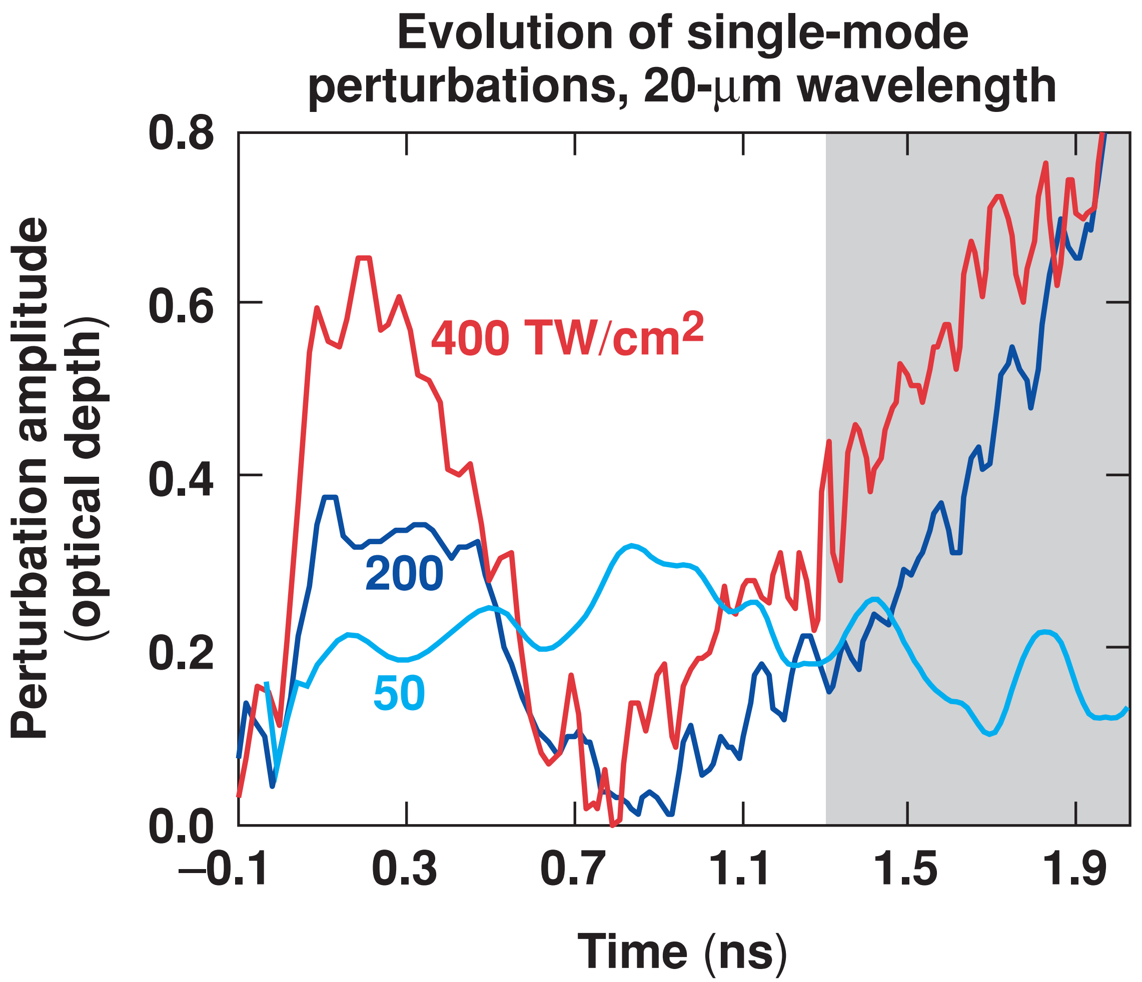
# Laser intensity affects evolution of modulation amplitude

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Summary/Conclusions

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