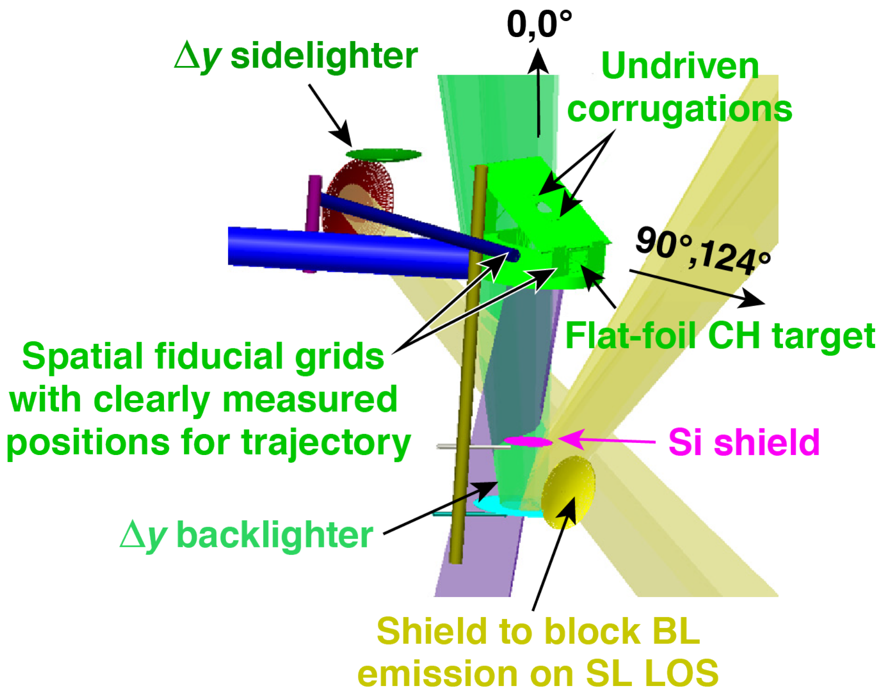
National Ignition Facility Planar Imprint Experiments



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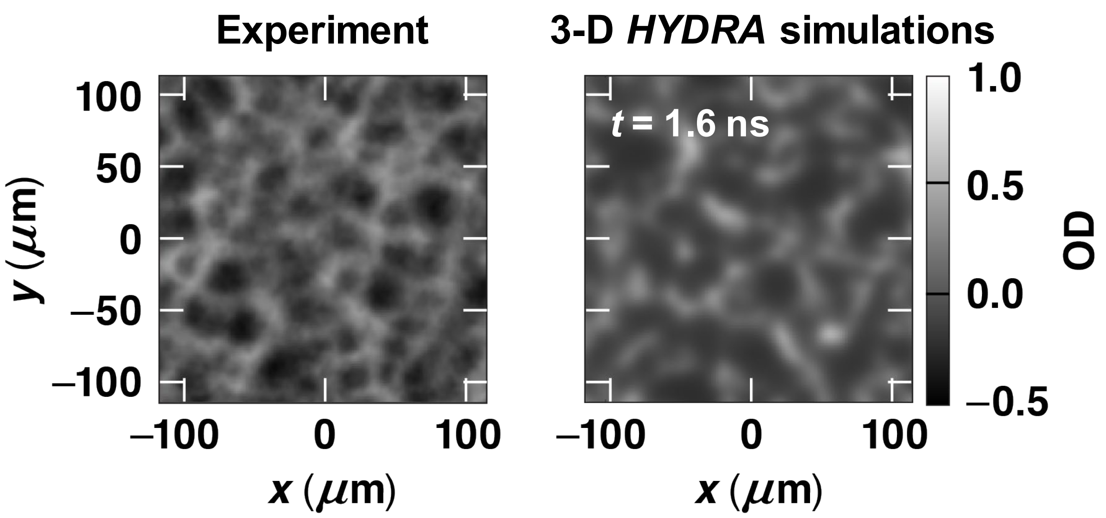

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Summary

NIF experiments were performed to measure imprint-seeded nonuniformities in planar foils driven with no SSD applied to the laser pulse

- The simulated trajectory agrees well with the measured one, indicating accurate drive prediction
- Single-mode growth was benchmarked against simulations by using foils with 50-μm preimposed modulations
- Three-dimensional *HYDRA* simulations show faster initial imprint growth, which can be explained by a reduced shell density in the experiments relative to simulations

Growth of shorter wavelength modes (<20 μm) will be measured using Fresnel zone plate imaging.

NIF: National Ignition Facility
SSD: smoothing by spectral disperson
RT: Rayleigh–Taylor
FZP: Fresnel zone plate

Collaborators

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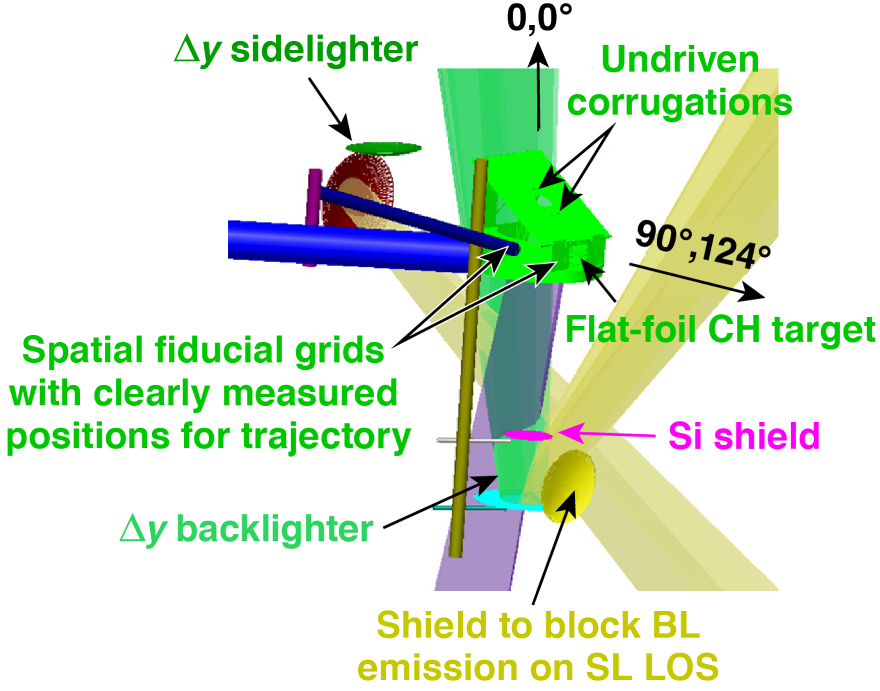
The NIF planar imprint platform uses face-on radiography to diagnose imprint and hydro-growth and simultaneous side-on radiography to measure the foil trajectory



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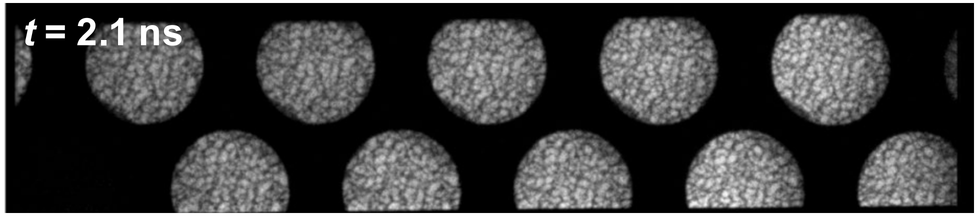
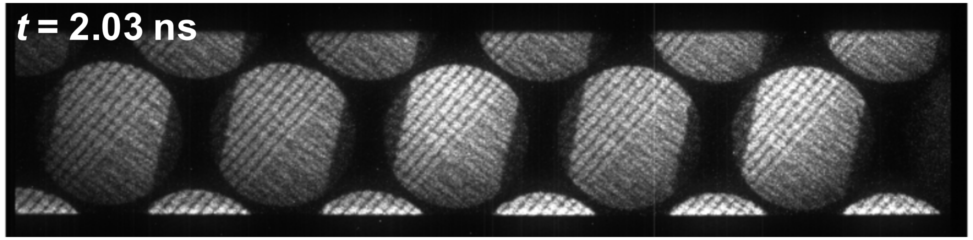
- 20-μm flat CH foil
- 2-TW single-beam square pulse
- 10^{14} W/cm^2
- No SSD
- Δy backlighter and sidelighter with 15-μm pinholes

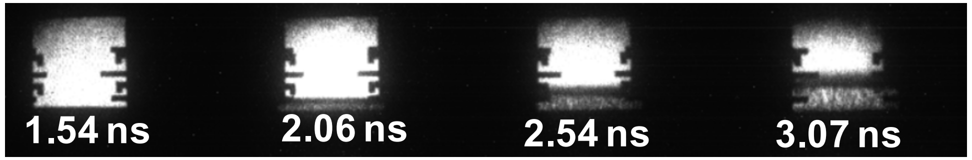
Imprint-seeded modulations



λ = 50-μm surface corrugation



Side-on radiography images foil in flight



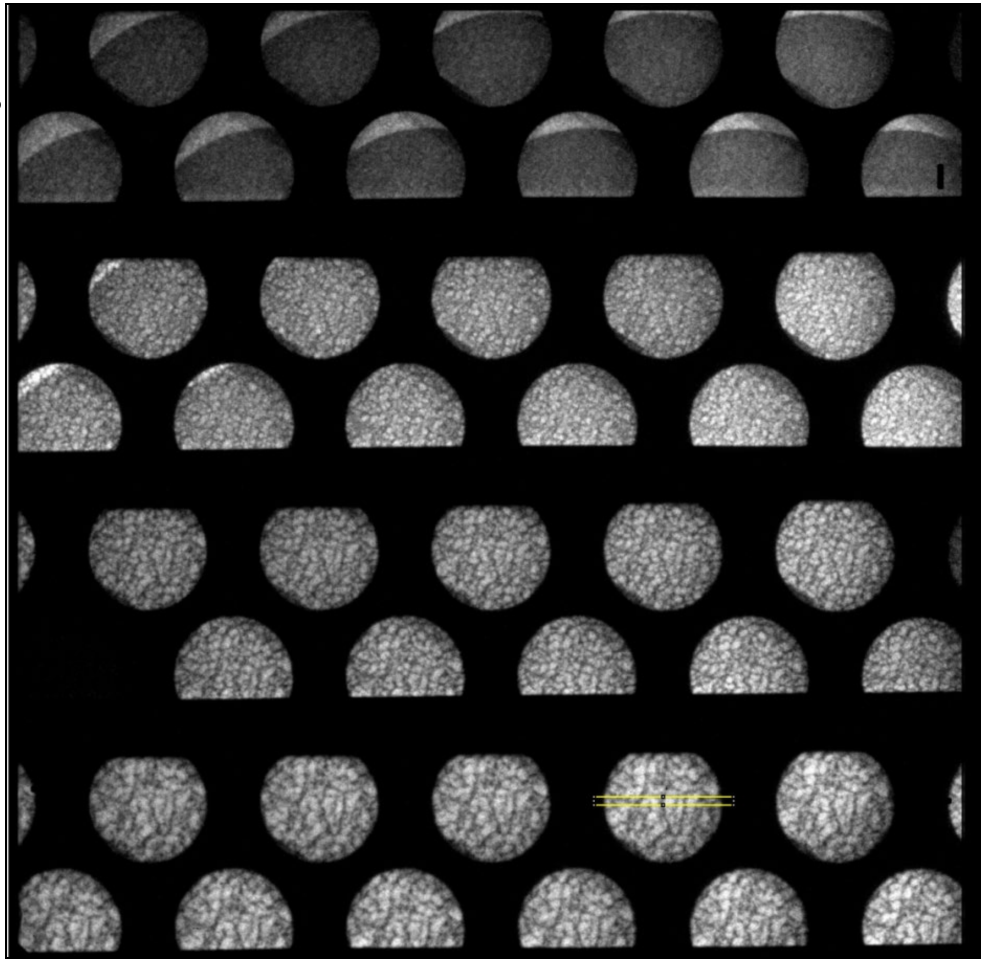
A comprehensive set of high-quality x-ray radiographs covering early and late times have been obtained over several shot days for the no-SSD drive

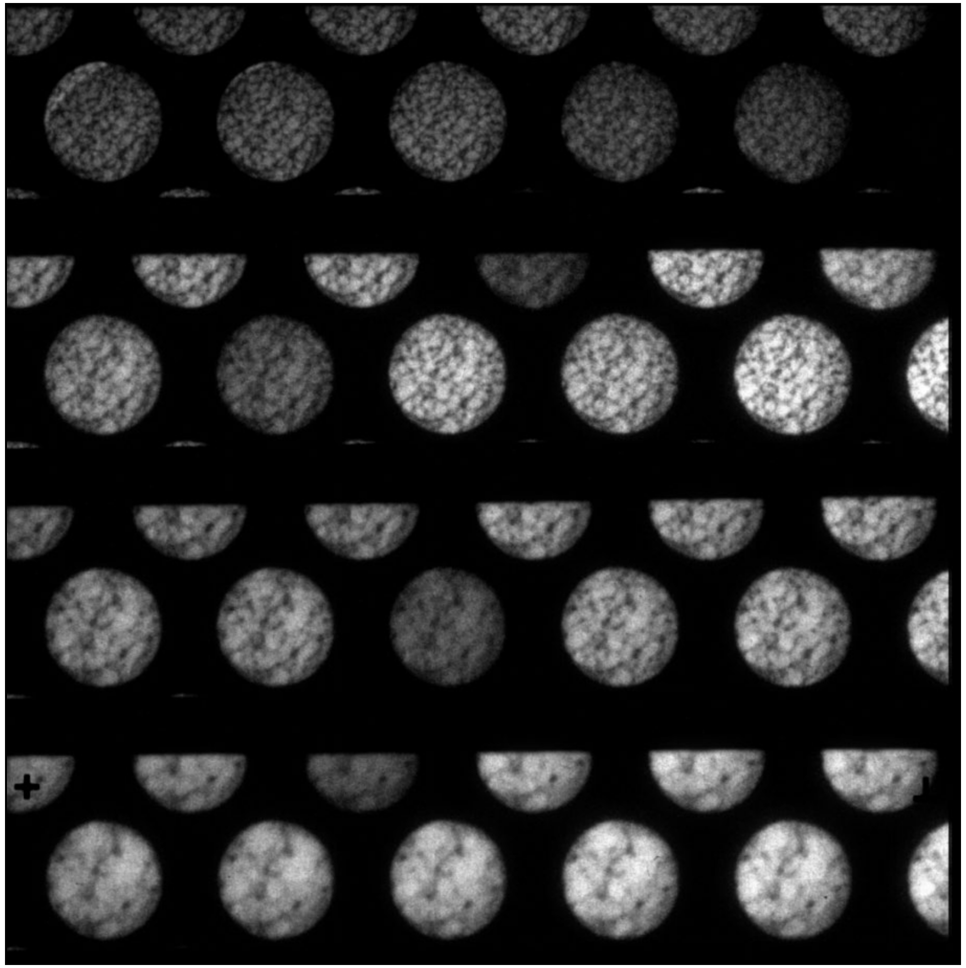
1.1 ns

1.6 ns

2.1 ns

2.6 ns





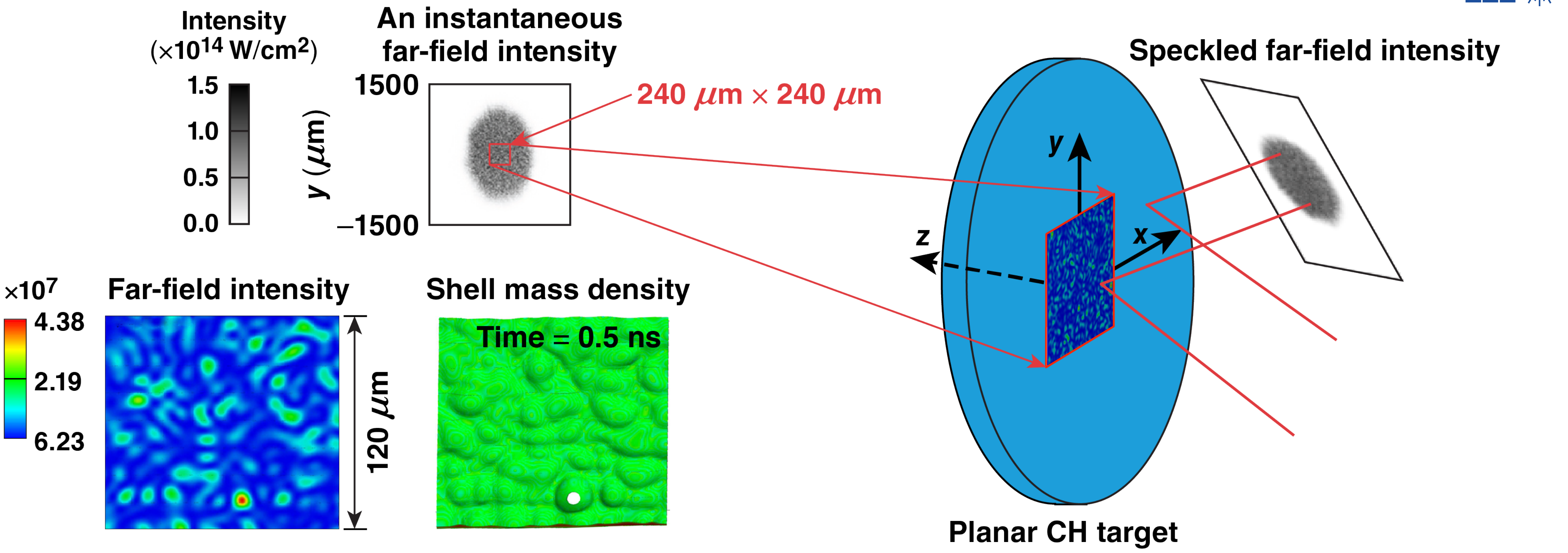
2.6 ns

3.3 ns

3.9 ns

4.6 ns

Calculated far-field spots and 3-D *HYDRA** simulations are used to model the growth of imprint-seeded nonuniformities



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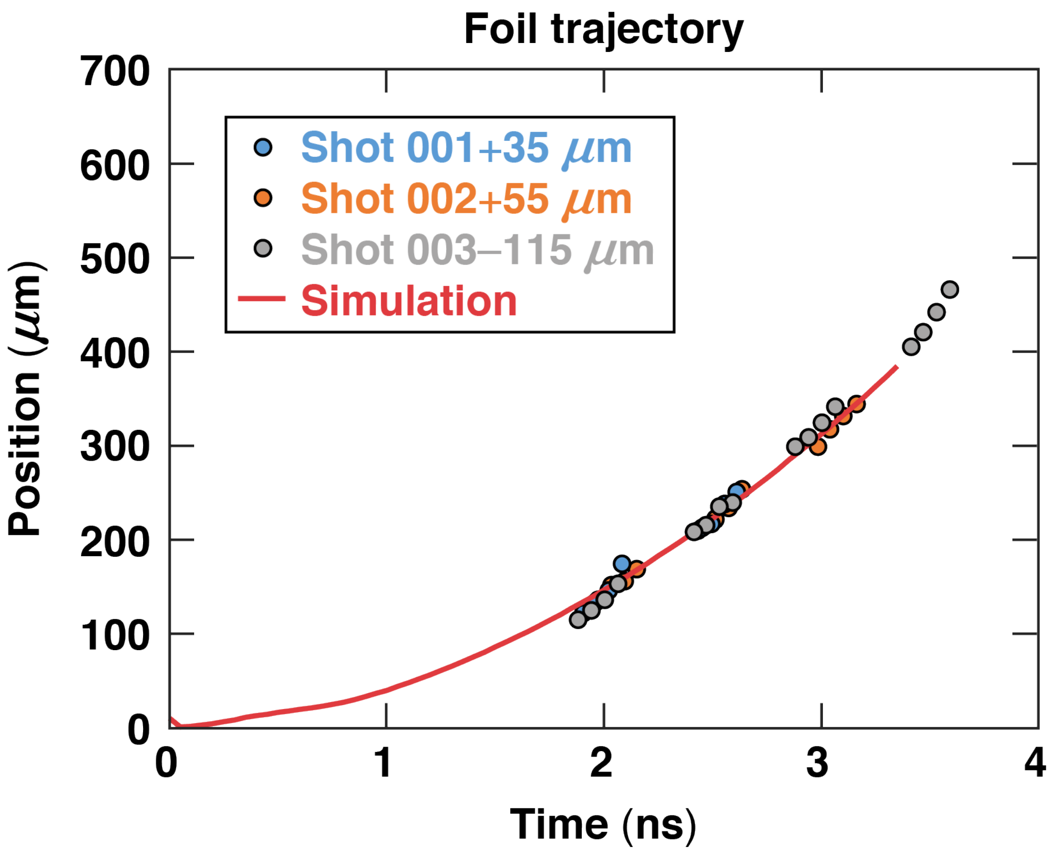
- Simulations use *HYDRA*'s spherical laser deposition model (no refractive smoothing)
- *HYDRA* simulations resolve individual speckles ($F\lambda/D$ ~ 5-μm cutoff length)

* M. M. Marinak *et al*., Phys. Plasmas 8, 2275 (2001).

Simulated foil trajectory agrees with measured ones indicating that the drive is modelled well



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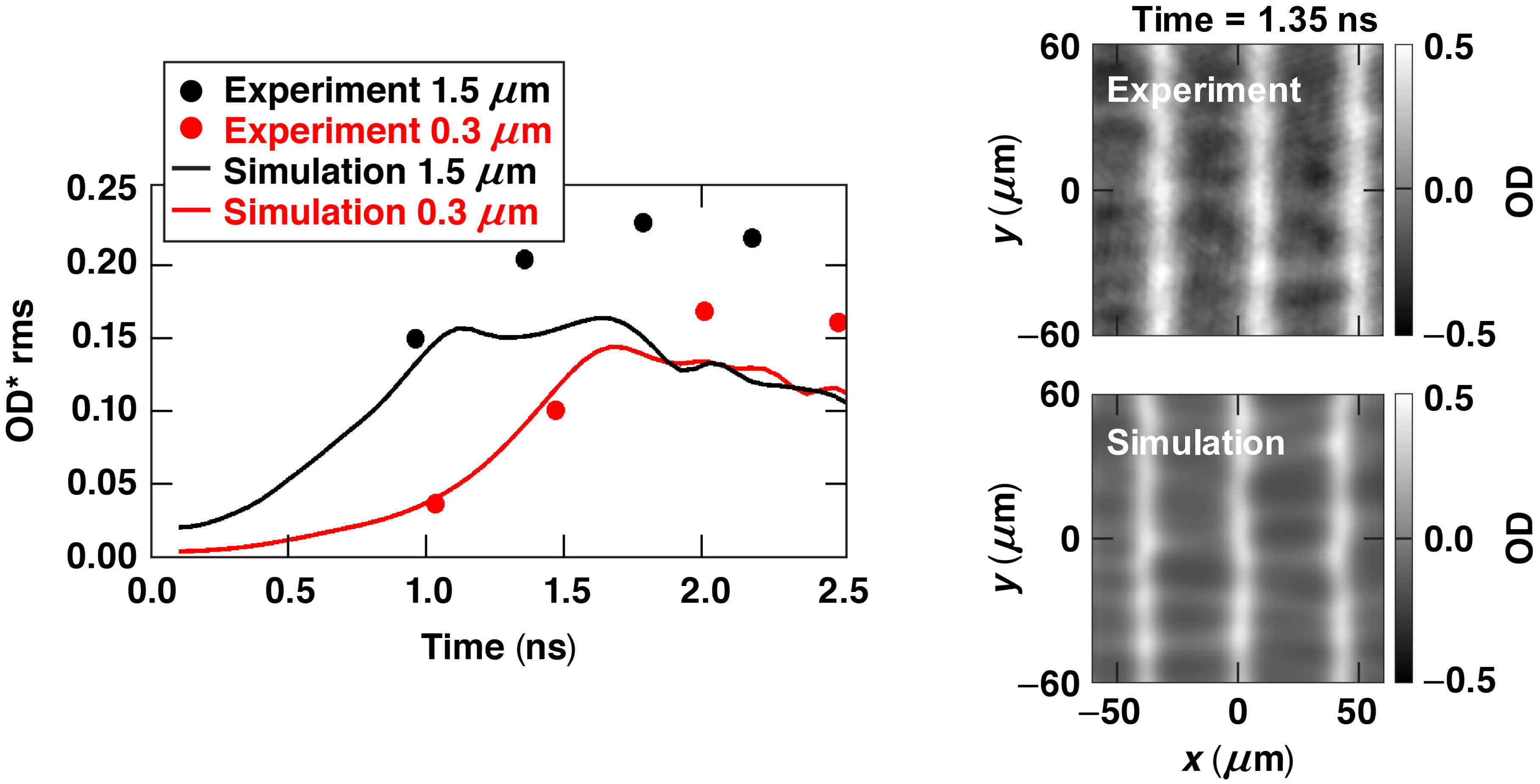
HYDRA simulations predict the growth of 50-μm-wavelength corrugations well but underpredict the saturation amplitude



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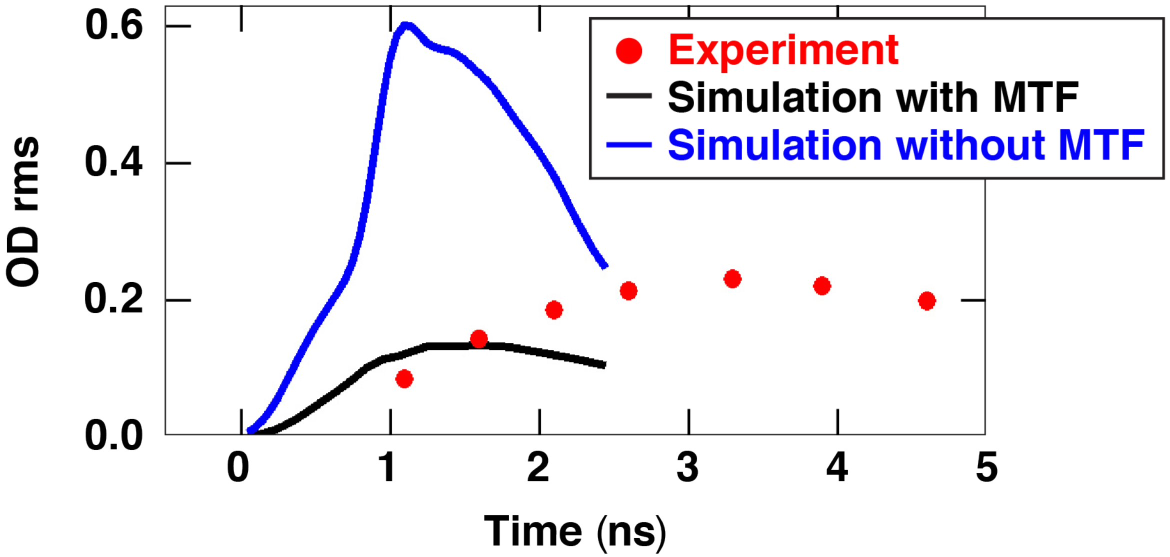
* OD: optical density

Experimental analysis shows slower rms of OD growth and later saturation at higher amplitude of imprint-seeded modulations than observed in simulations



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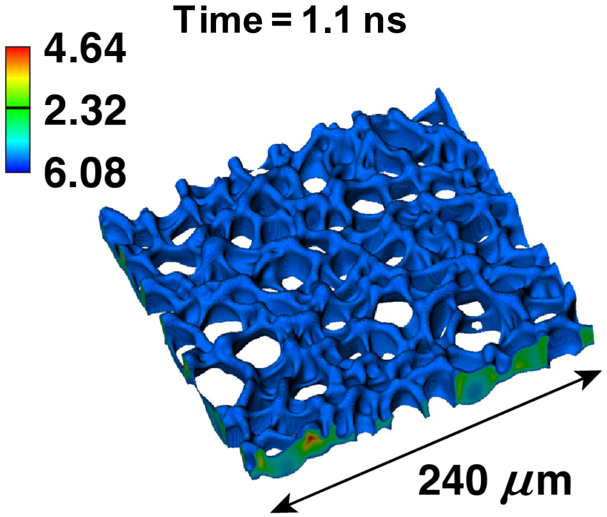
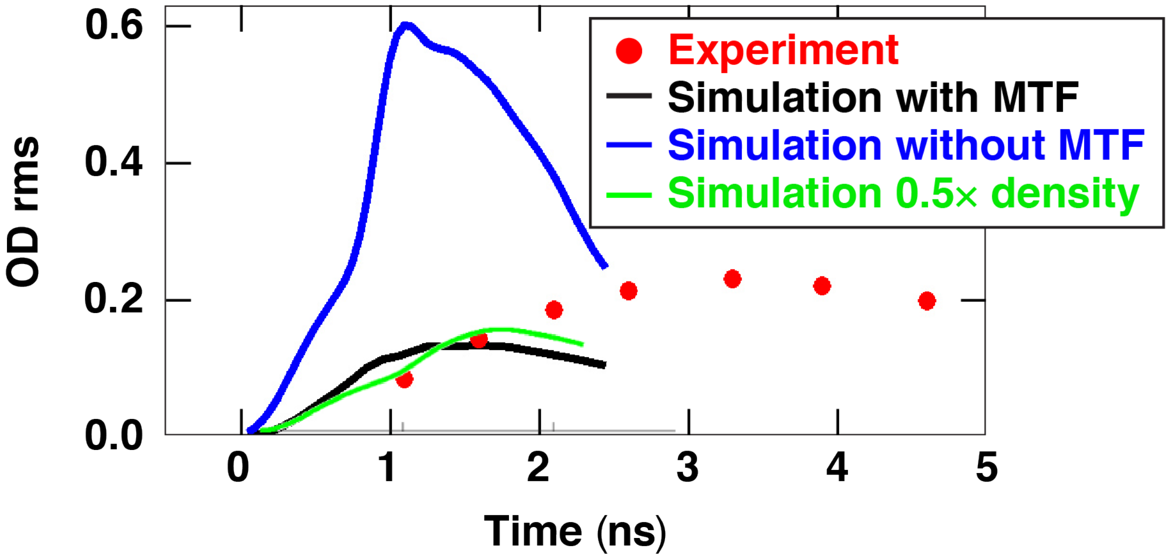
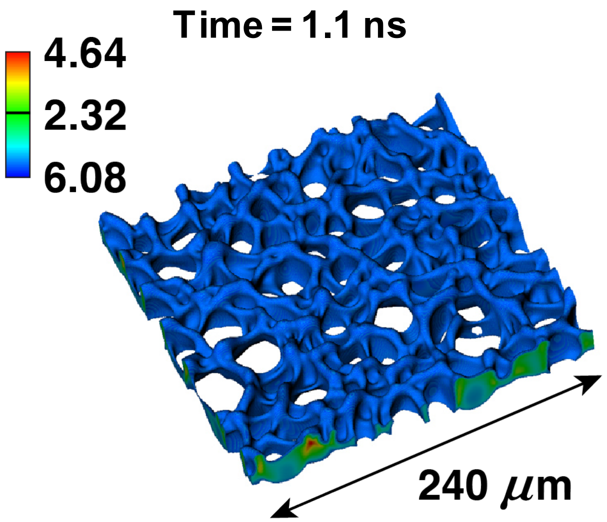


MTF: modulation transfer function of the x-ray imaging system used in the experiments

Simulations using reduced initial density show slower growth of the modulations

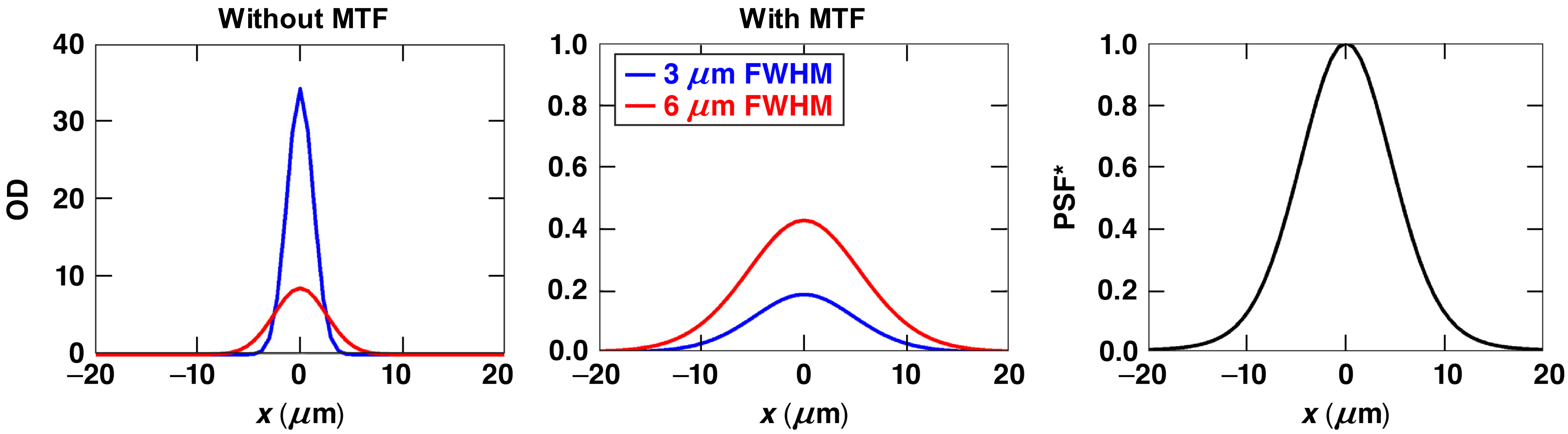


TC15959a



MTF: modulation transfer function

Spike width smoothed by the MTF of the imaging system controls the optical density saturation amplitude



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* PSF: point spread function corresponding to the MTF of the x-ray imaging system used in the experiments

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