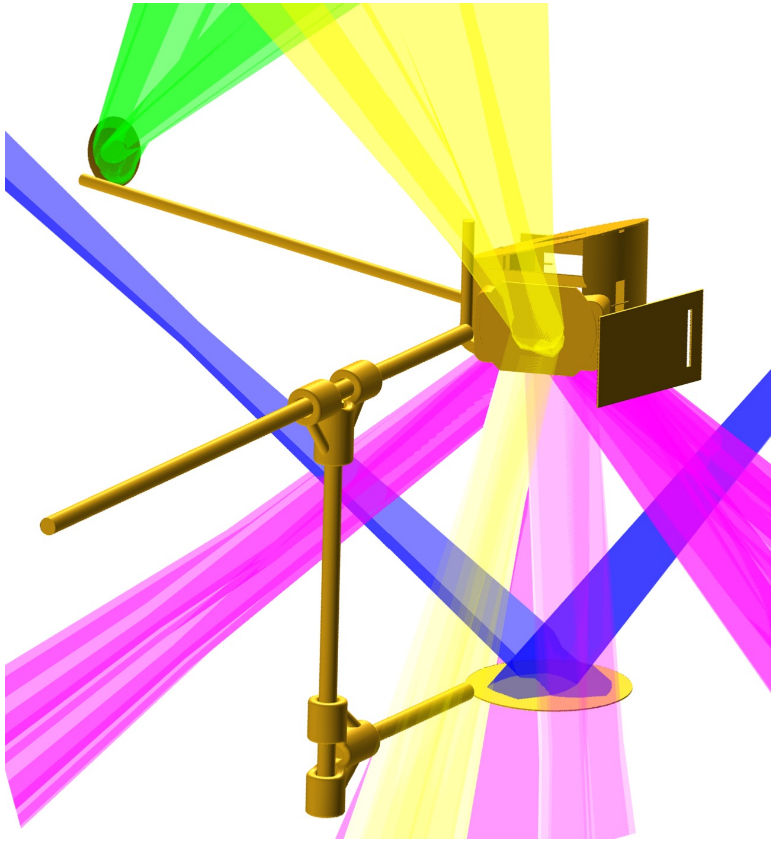
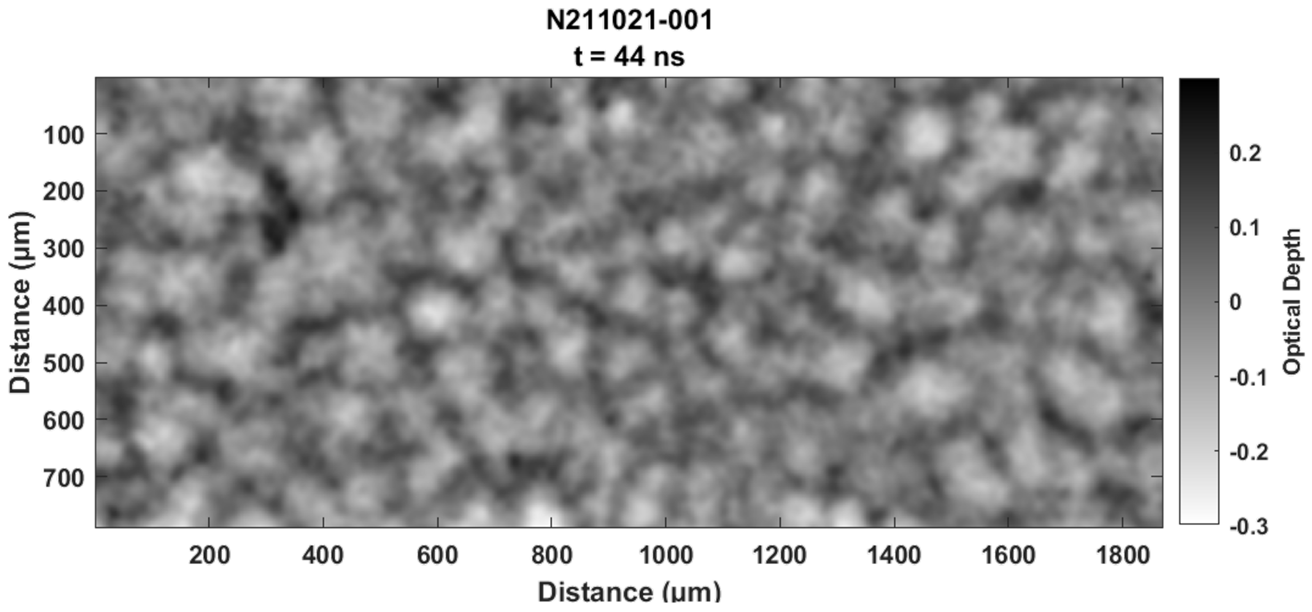
Effects of ablation and mode coupling on the deeply nonlinear stages of the Rayleigh-Taylor instability





Luke Ceurvorst
University of Rochester
Laboratory for Laser Energetics

63^{rd} Annual Meeting of the
American Physical Society
Division of Plasma Physics
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* C. Mailliet, et al. Physics of Plasmas 26, 082703 (2019).
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† L. Ceurvorst, et al. High Energy Density Physics 37, 100851 (2020).
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Collaborators

L. Masse, S. F. Khan, D. Martinez, N. Izumi, V. Smalyuk
Lawrence Livermore National Laboratory, Livermore, USA

T. Goudal, V. Bouffetier, A. Casner
Université de Bordeaux-CNRS-CEA
CELIA, Talence, France

B. Canaud
CEA DAM, DIF, Arpajon, France

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

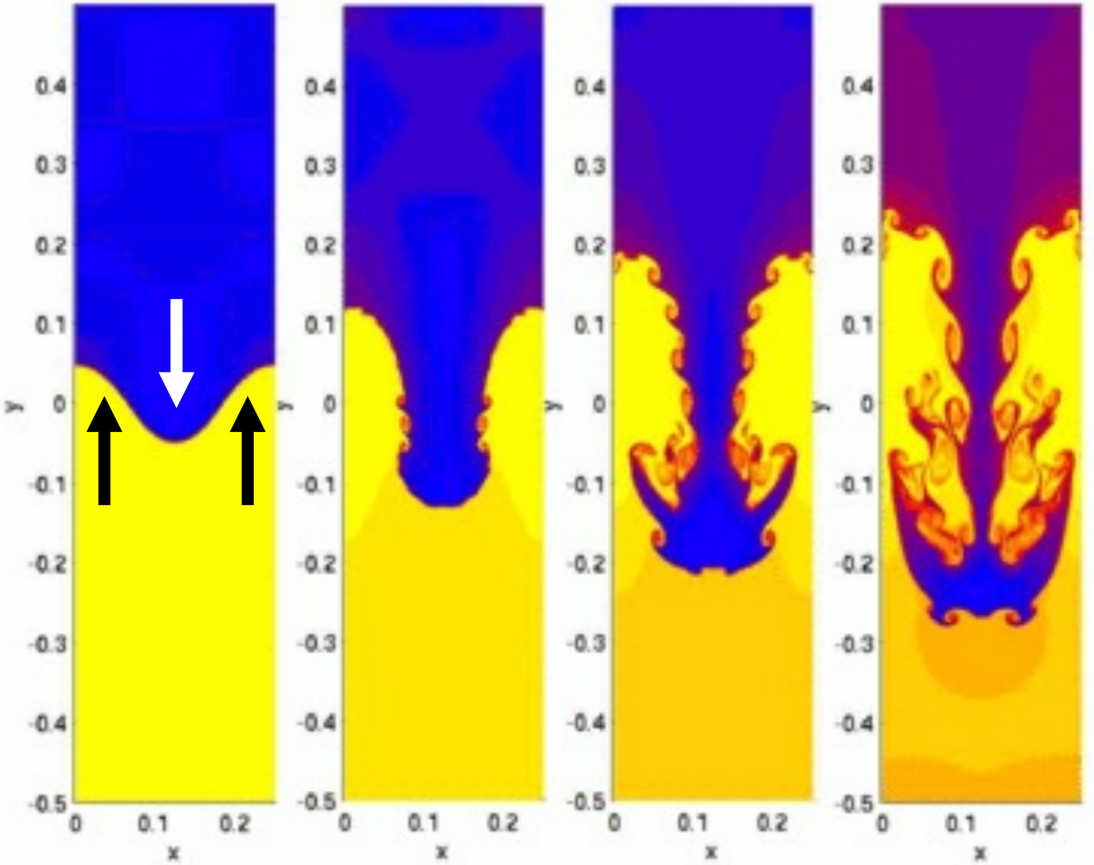
The ablative Rayleigh-Taylor instability is expected to reach a self-similar behavior in its nonlinear stage

- **Constant bubble velocity expected beyond so-called saturation limit****

- **Predicted self-similar behavior in this nonlinear stage:**

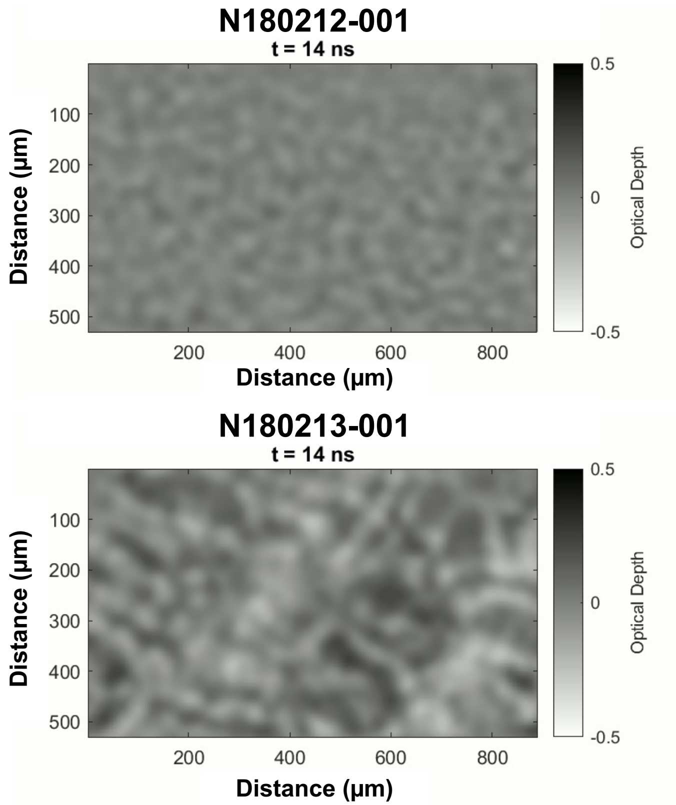
$$h_b = \alpha_b g t^2$$

h_b	**Bubble height**
g	**Acceleration**
t	**Time**
α_b	**Mixing parameter**



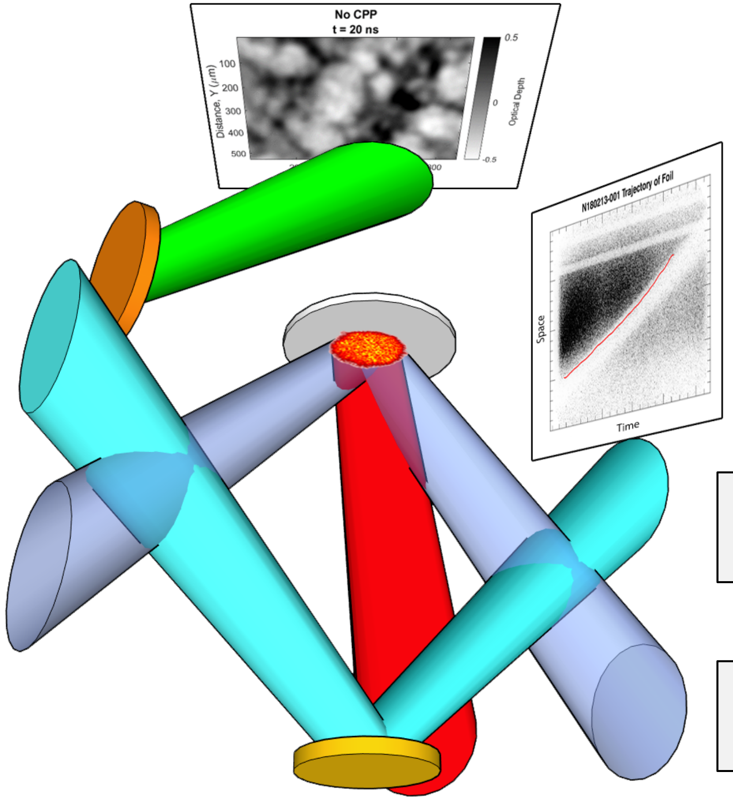
* Y. Zhou, Physics Reports 723-725, 1-160 (2017).
** S. Haan, Physical Review A 39, 5812 (1989).

Previous experiment captured face-on images



Post-processed radiographs*

Bubbles in white
Spikes in black



300 µm CH
$g \approx 5.4\ \mu m/ns^2$

Drive 30 ns
440 kJ

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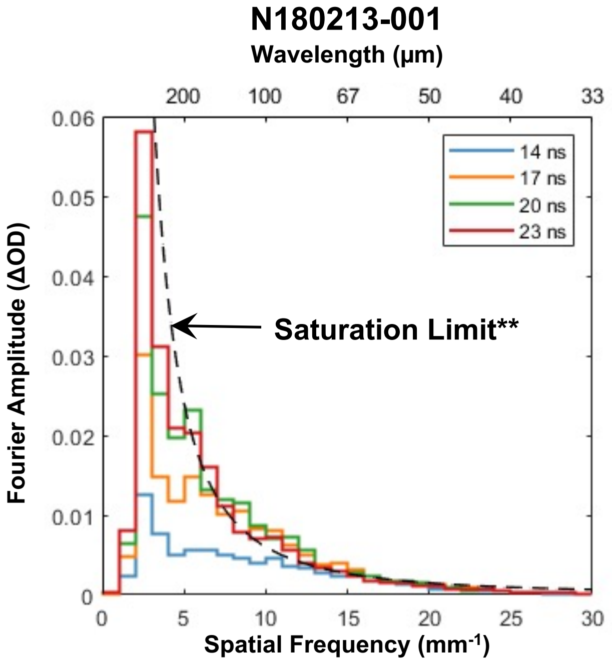
Previous experiment captured face-on images, but saw no growth beyond saturation



Modes stagnated upon reaching saturation

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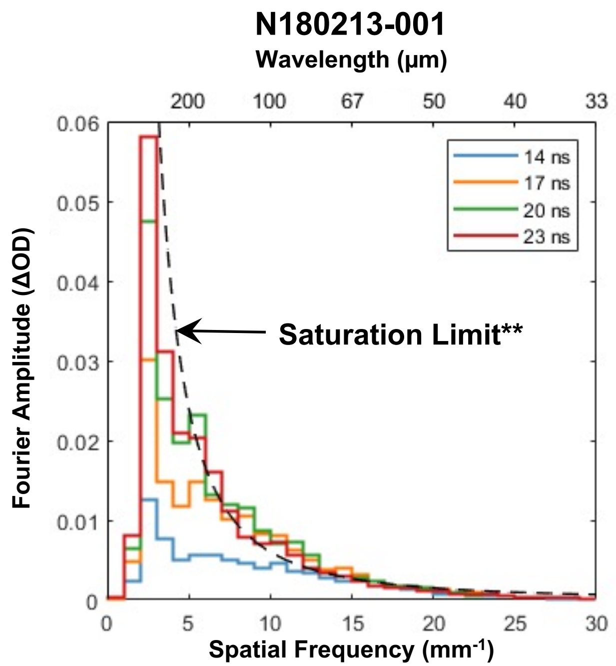

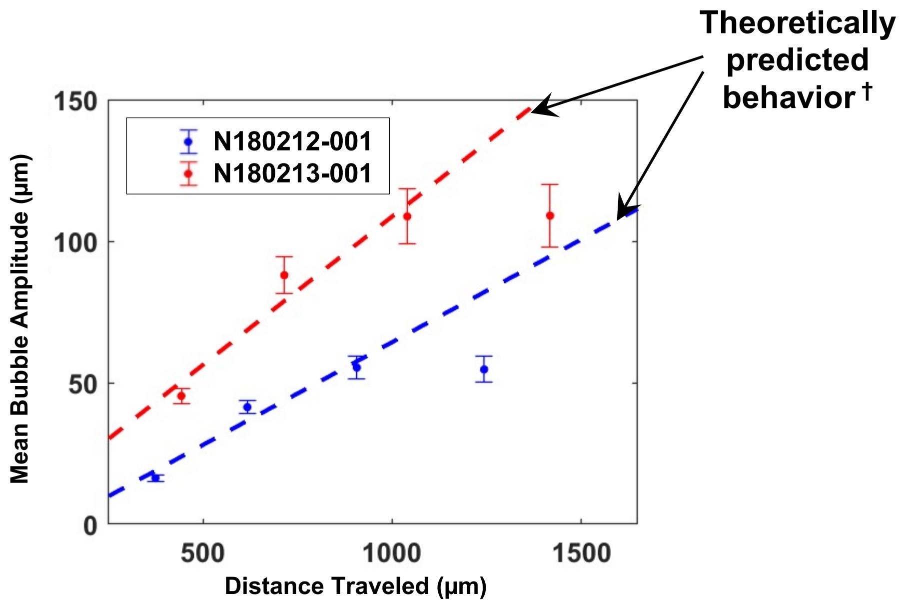

Modes stagnated upon reaching saturation

No self-similar behavior observed

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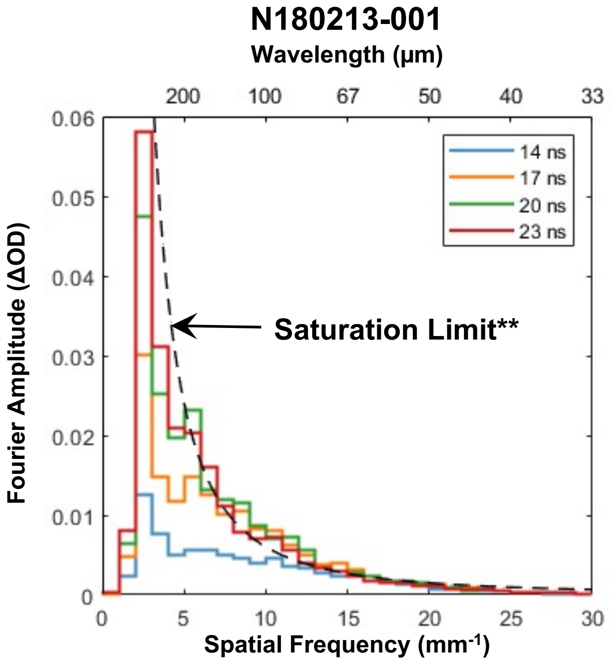

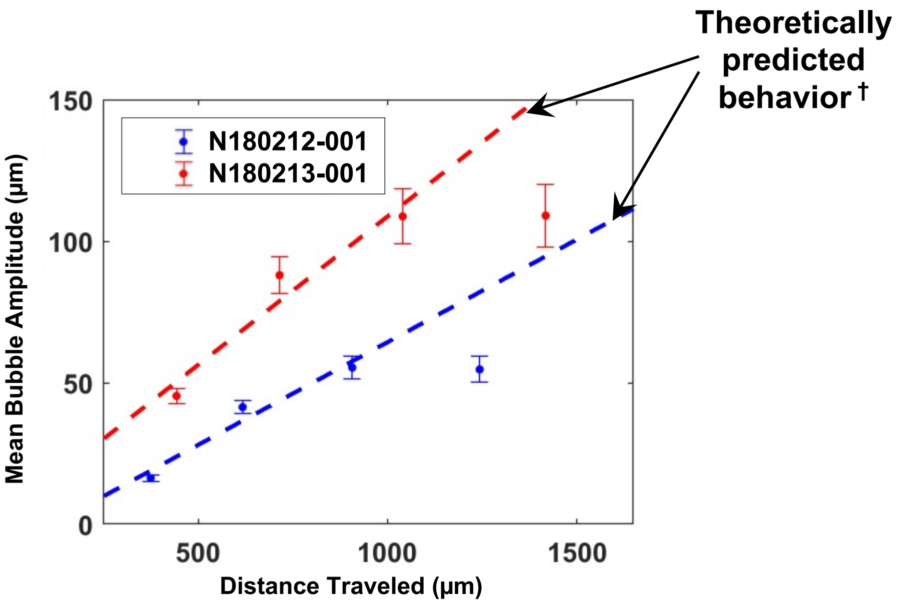

Why do these modes stagnate, and why is this not seen in classical RTI experiments?

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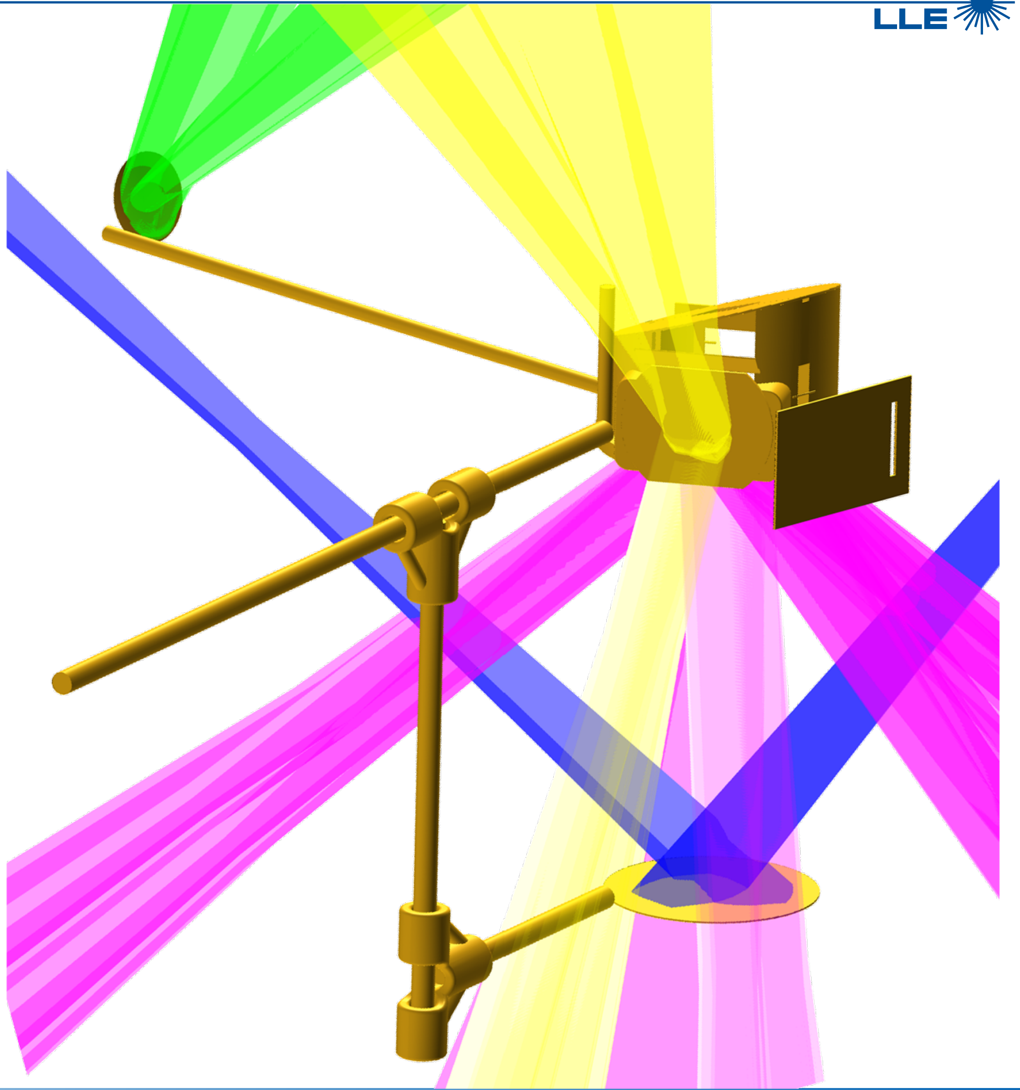
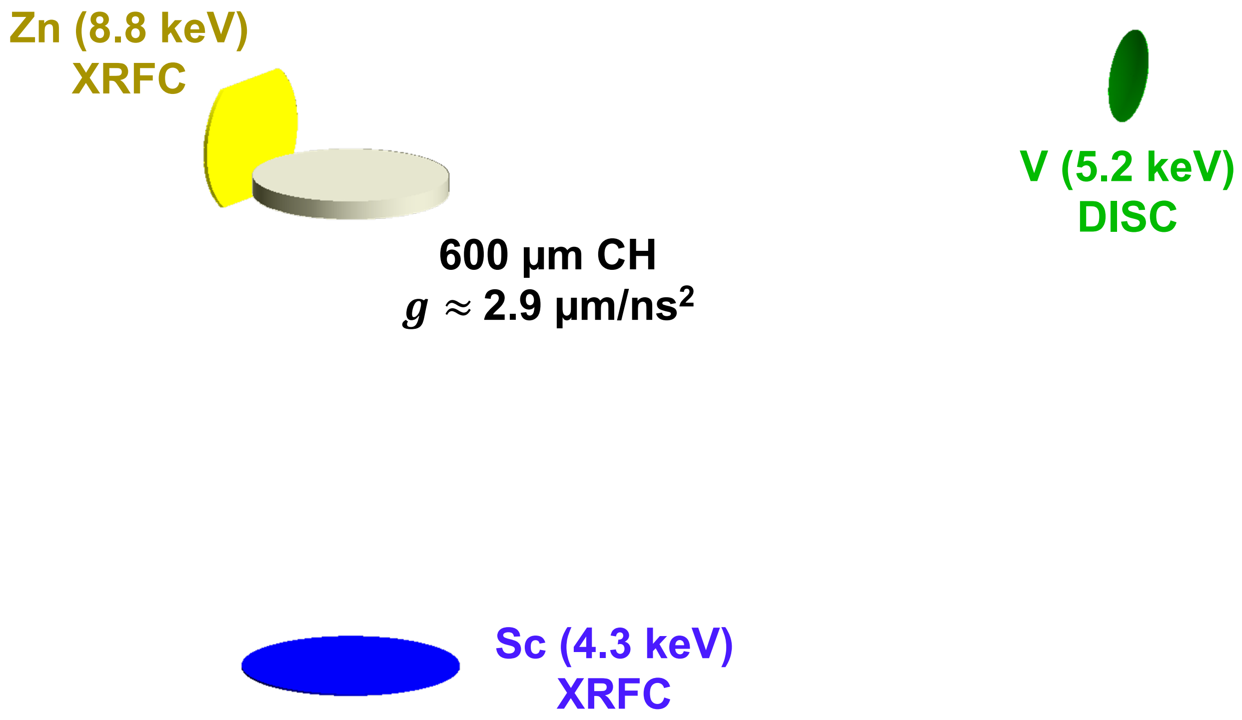
New experiment designed to examine these discrepancies by doubling target thickness

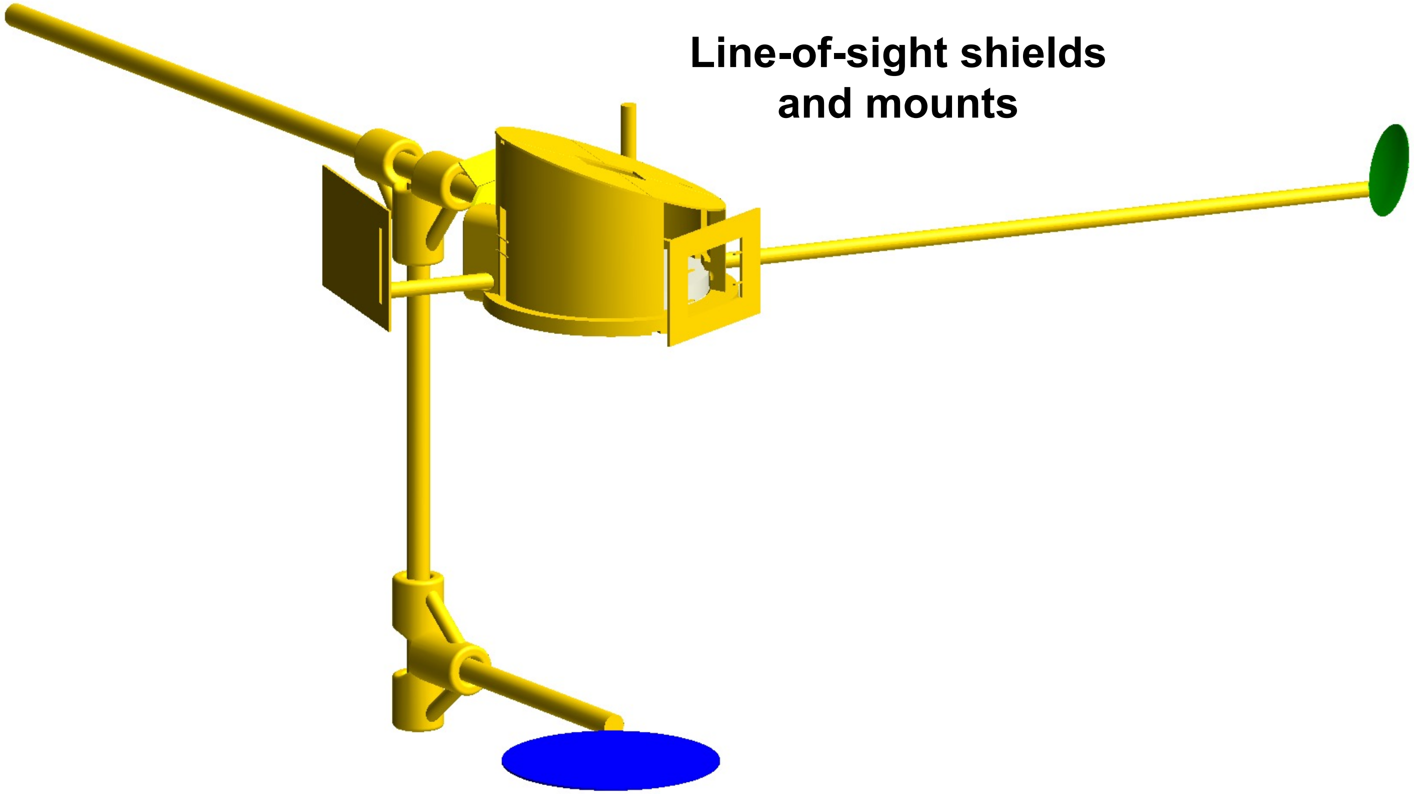
- Increase target thickness to 600 μm
  – Prevents perforation
  – Reduces acceleration
  – Increases role of ablation
- Increase drive duration to 44 ns
  – Allows similar distance-traveled to be observed
- Add gated side-on radiography
  – Monitor for perforation
  – Observe any bowing effects



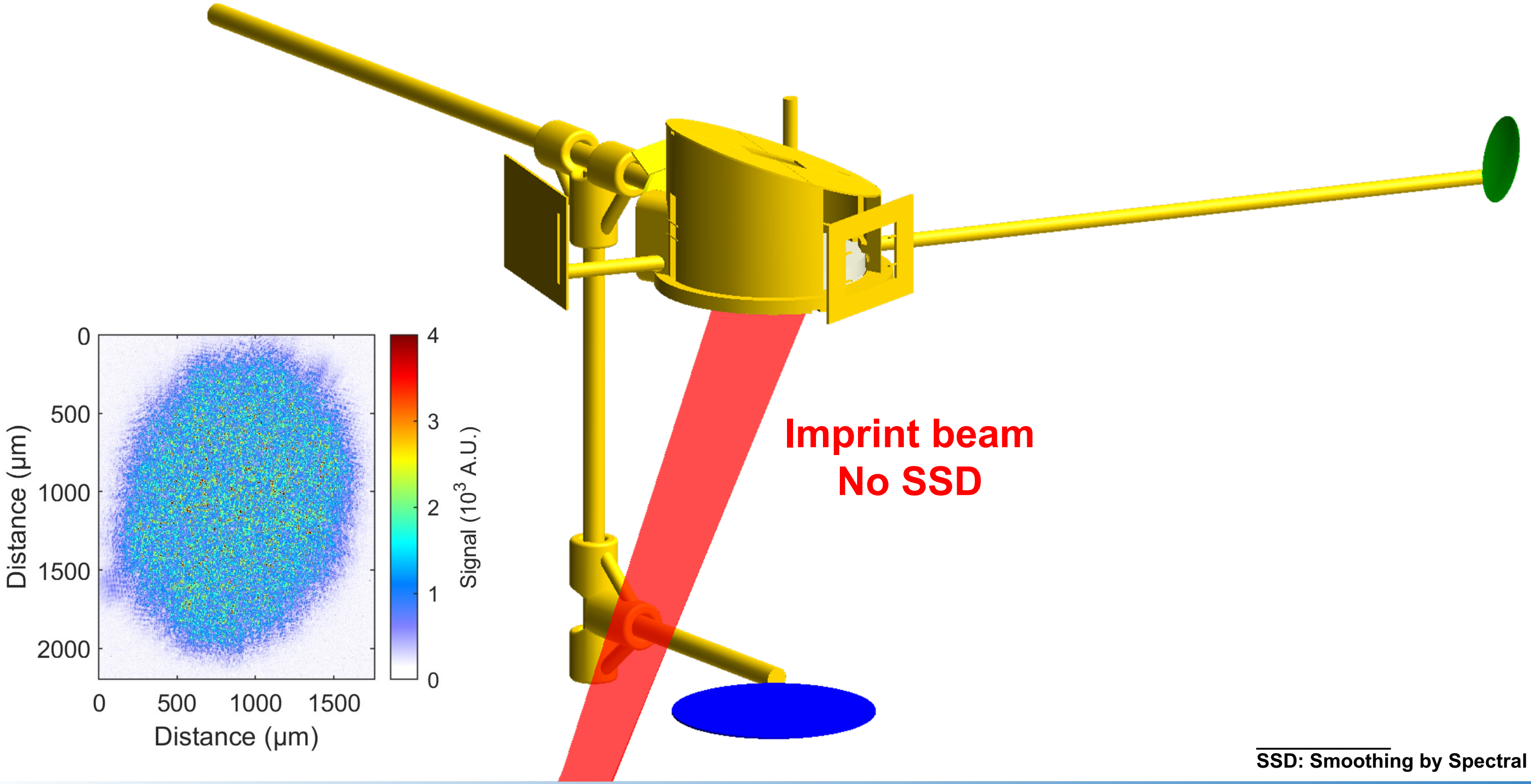
Thicker targets are diagnosed by three lines of radiography



Thicker targets are diagnosed by three lines of radiography, each guarded with line-of-sight shields



The same imprint beam as the previous experiment was used to create the initial surface perturbations 300 ps before main drive

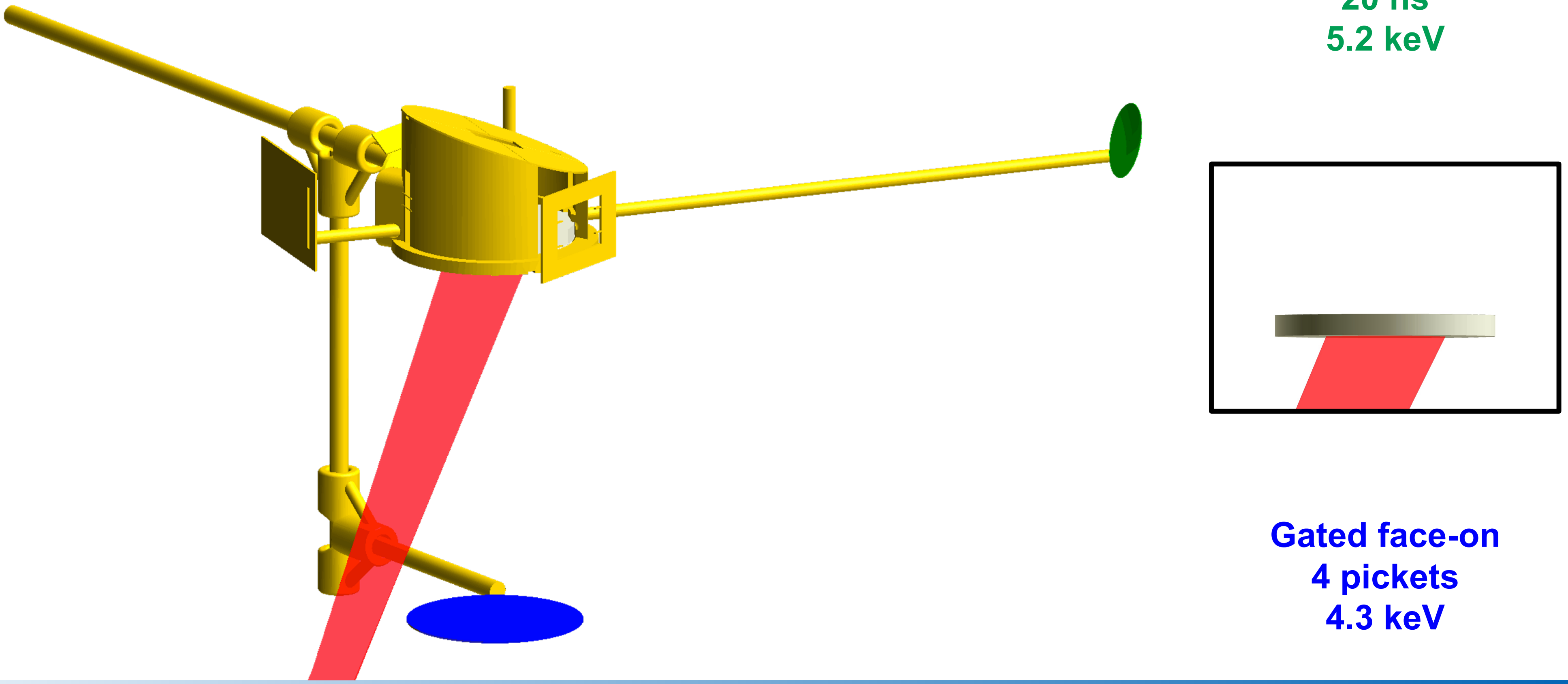


SSD: Smoothing by Spectral Dispersion

Target was driven for 44 ns to displace it to similar distances as before, allowing the results to be directly compared

Gated side-on
4 pickets
8.8 keV

Streaked side-on
20 ns
5.2 keV

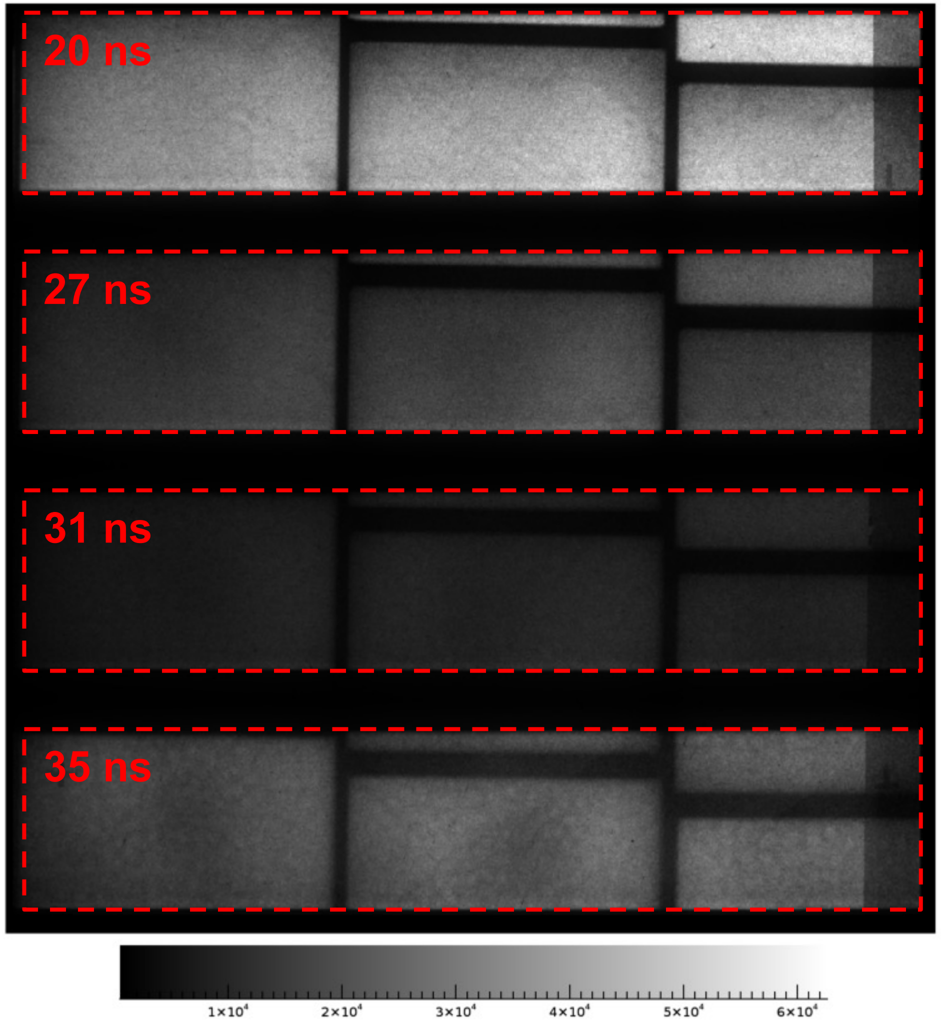


Main drive
480 kJ, 44 ns
1.75 mm Ø

Gated face-on
4 pickets
4.3 keV

High-quality face-on radiographs were obtained

N211020-002



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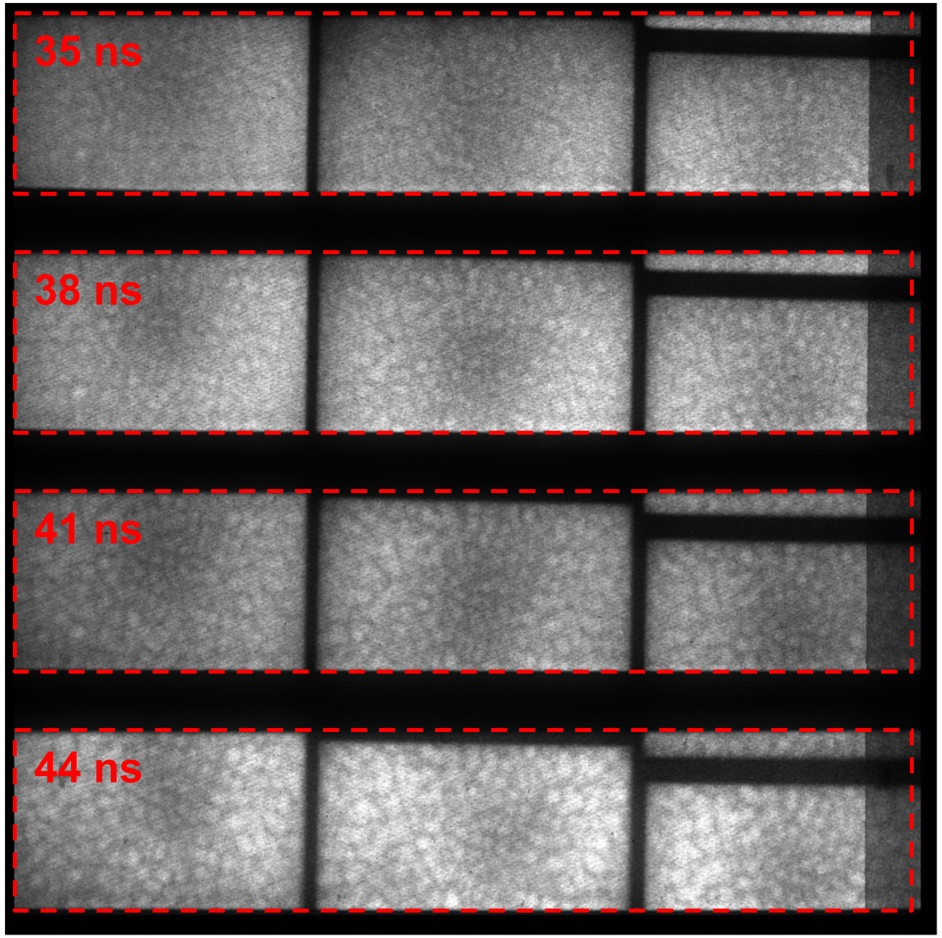
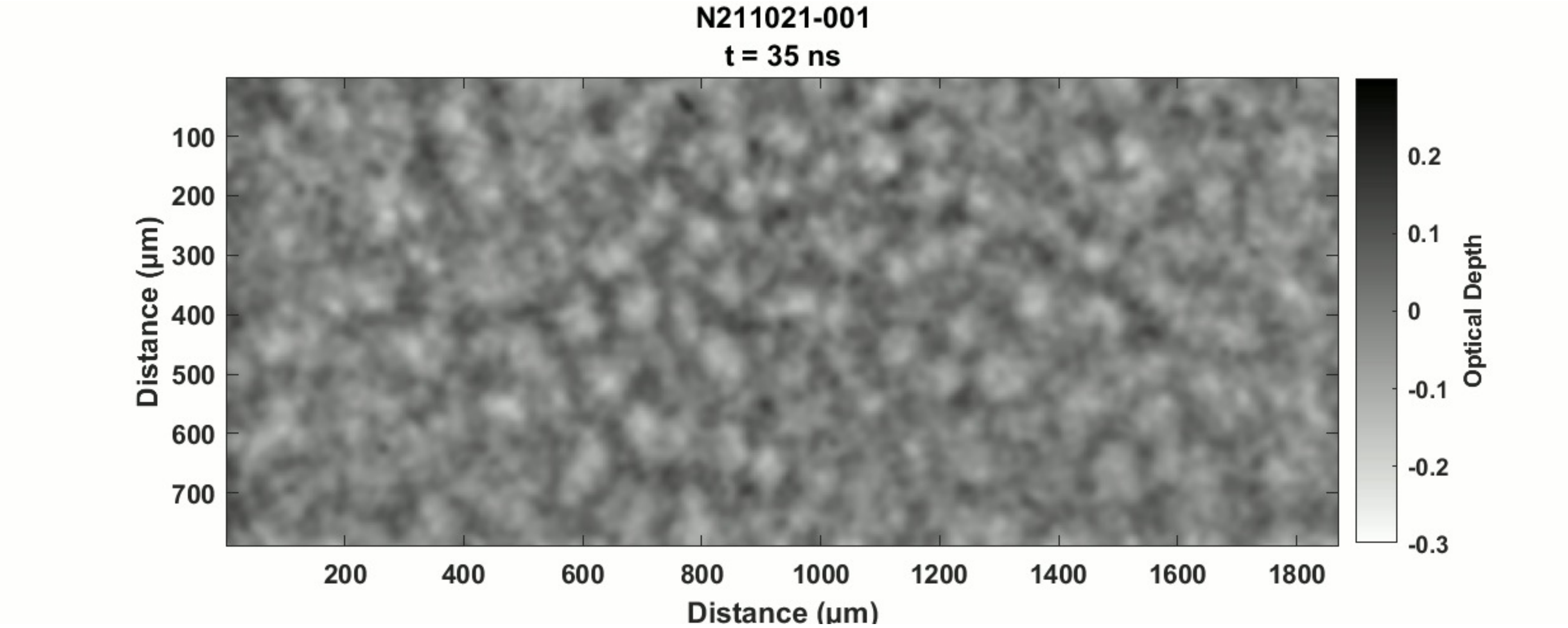
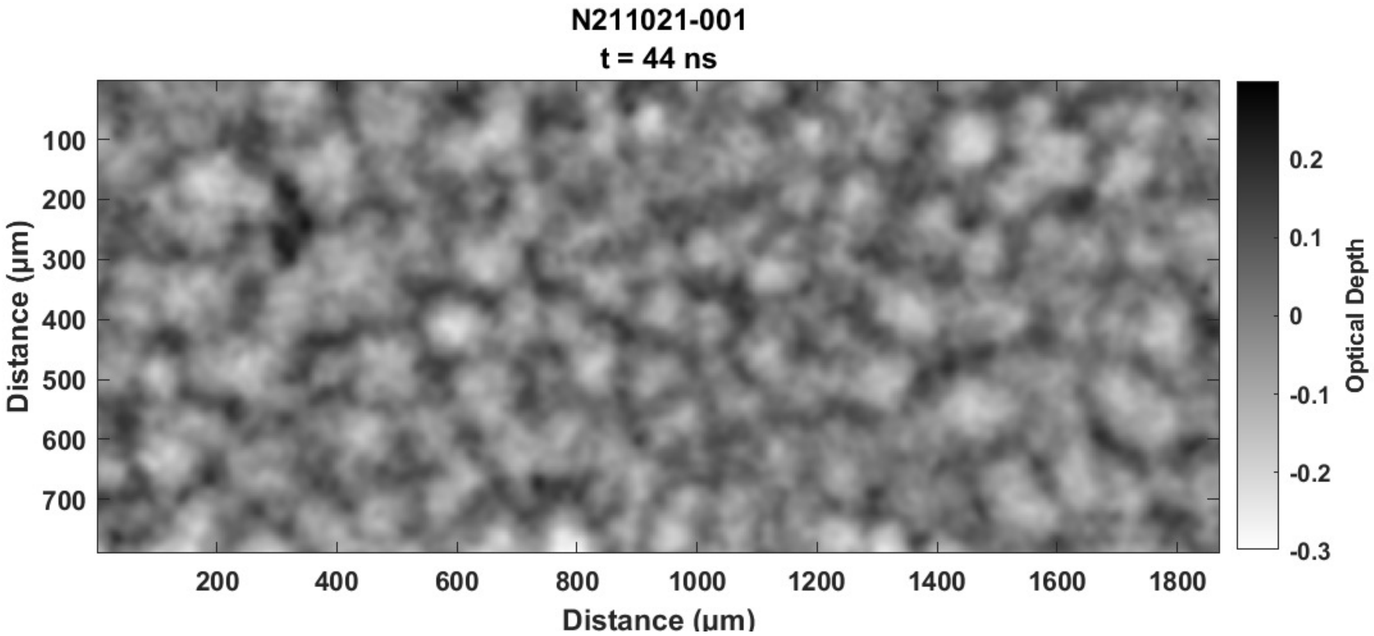
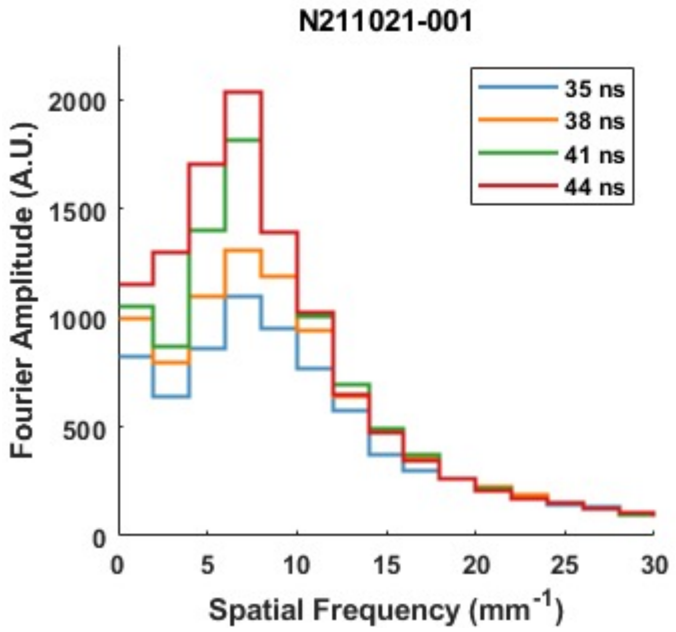


Analysis has begun



Analysis has begun, and early results suggest stagnation still exists





Stagnation continues despite increased thickness!

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UR LLE

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Side-on images were obtained for late times