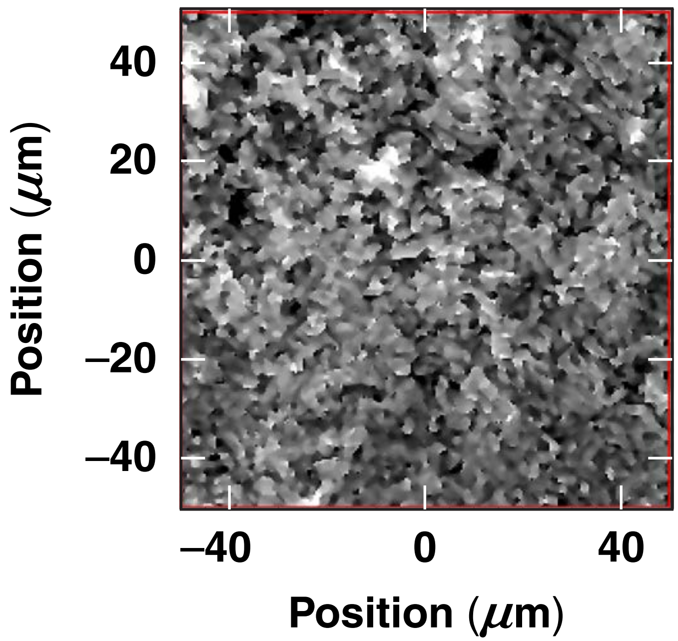
Measurements of Laser Imprinting Using 2-D Velocity Interferometry

Shock-velocity perturbations



$$\left\langle \frac{\delta v}{v} \right\rangle$$

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Summary

Velocity interferometry is used to study imprinting by observing modulations in the shock velocity

UR LLE

- **Laser-beam nonuniformities produce modulations in shock pressure that create density modulations; these can seed Rayleigh–Taylor (RT) growth**
- **Two-dimensional velocity interferometry directly measures shock velocity and the perturbations caused by imprinting**
- **We observed shock-velocity perturbations in CH and CH/D_2 targets driven by multiple beams**
- **We obtained expected results for known increases in uniformity and results correlate well with x-ray radiographic data**
- **Experiments with cryogenic D_2 show the beneficial effects of beam smoothing and multiple beams**

Collaborators

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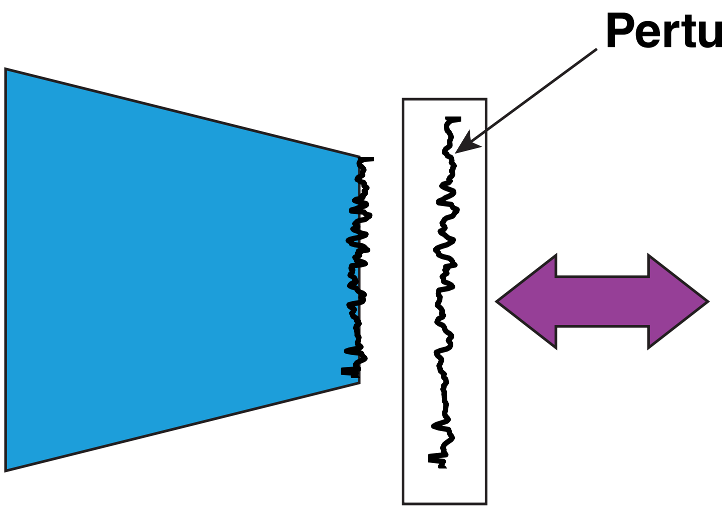
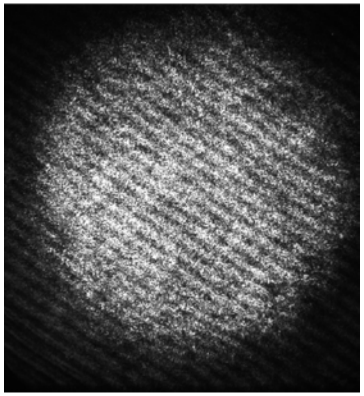
Velocity interferometry is used to directly measure shock perturbations caused by imprinting



2-D high-resolution VISAR*

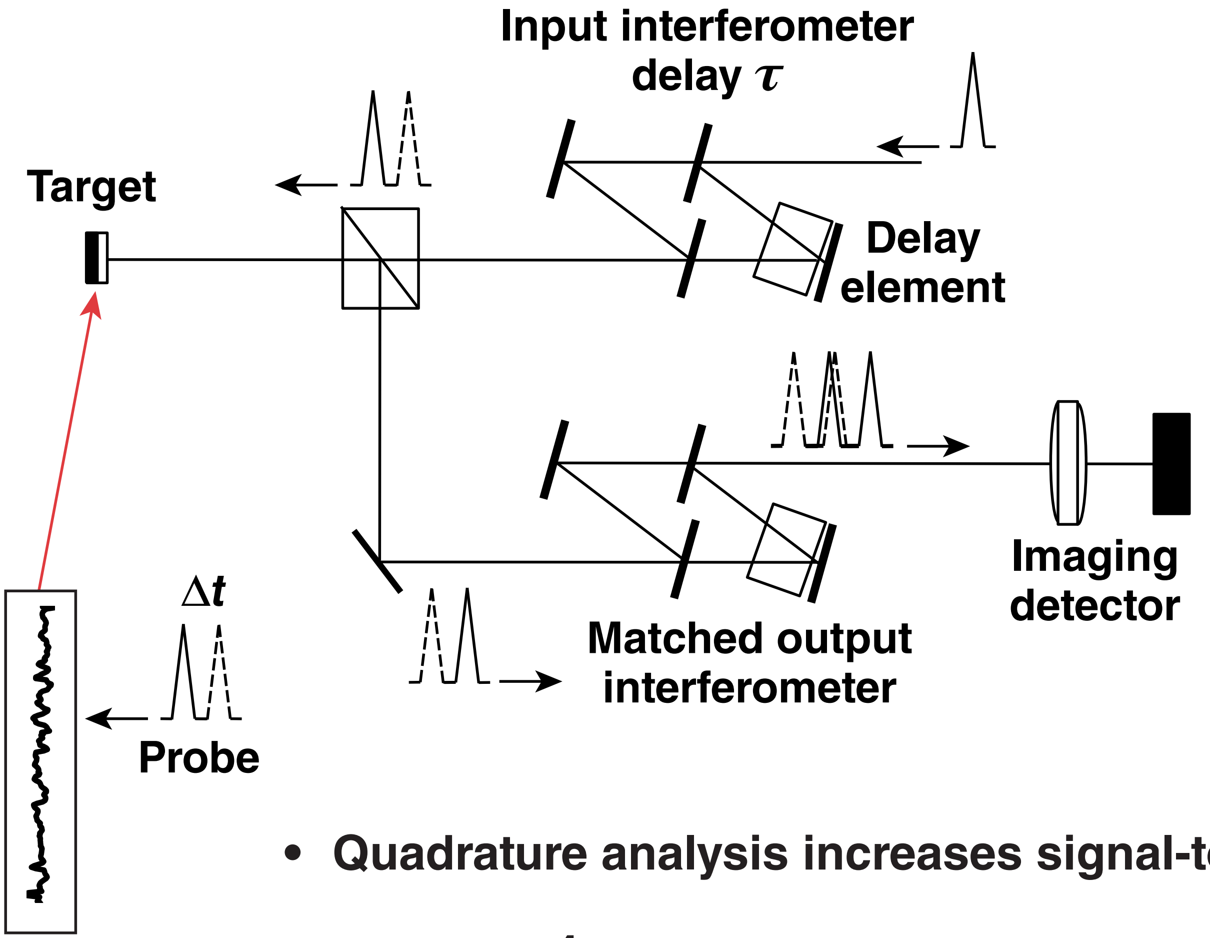
Velocity

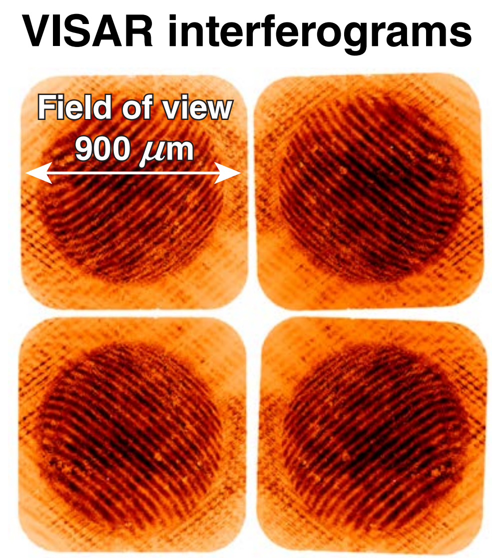


$\delta v/v$
2-ps snapshot

*Velocity interferometer system for any reflector

VISAR measures velocity by comparing the phases of a doppler-shifted probe beam at two different times





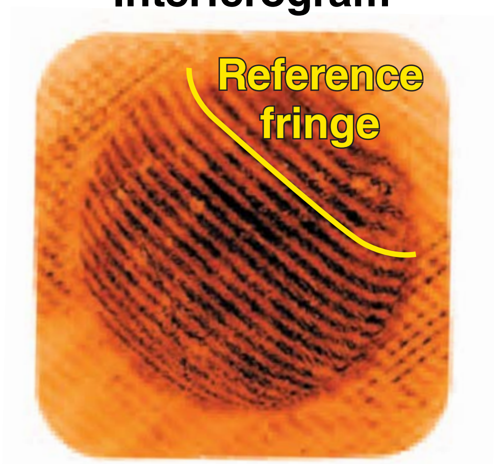
- Quadrature analysis increases signal-to-noise ratio
- $\delta v/v \sim 10^{-4}$ at 2-μm resolution

P. M. Celliers *et al.*, Rev. Sci. Instrum. 81, 035101 (2010).

Data comprise an *interferogram* of two images (at t and $t + \delta t$), providing a 2-D map of velocity

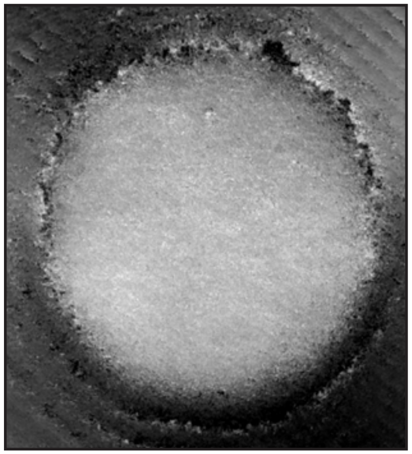
- The 2-D velocity map is Fourier analyzed

Interferogram

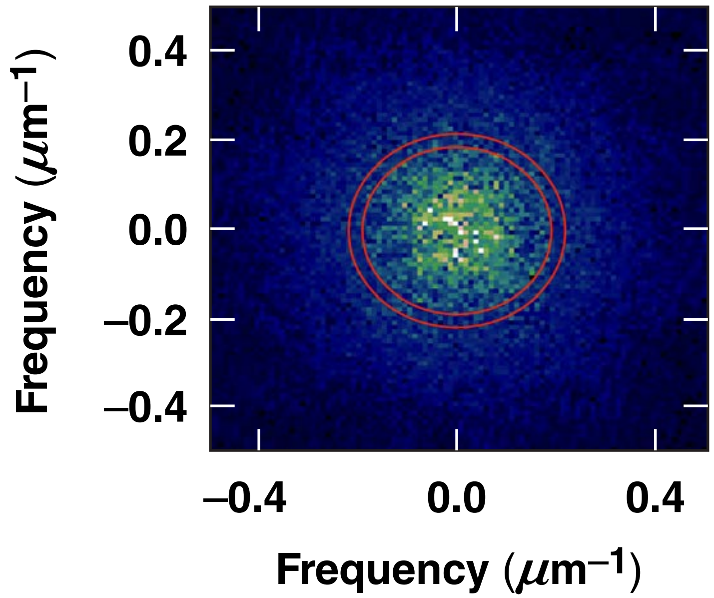


δv's reside in deviations from reference fringe

$\delta v/v$

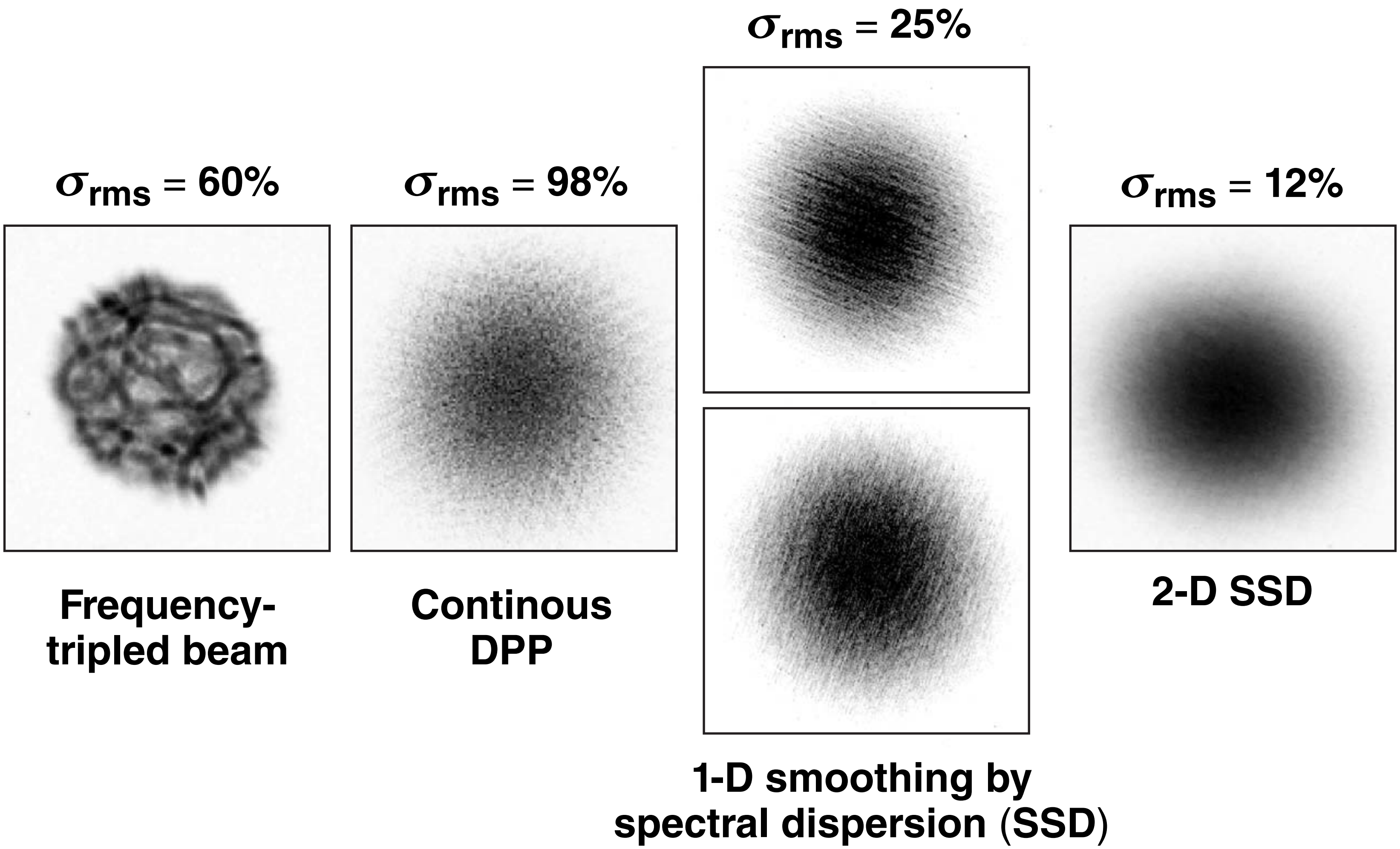


Fourier transform

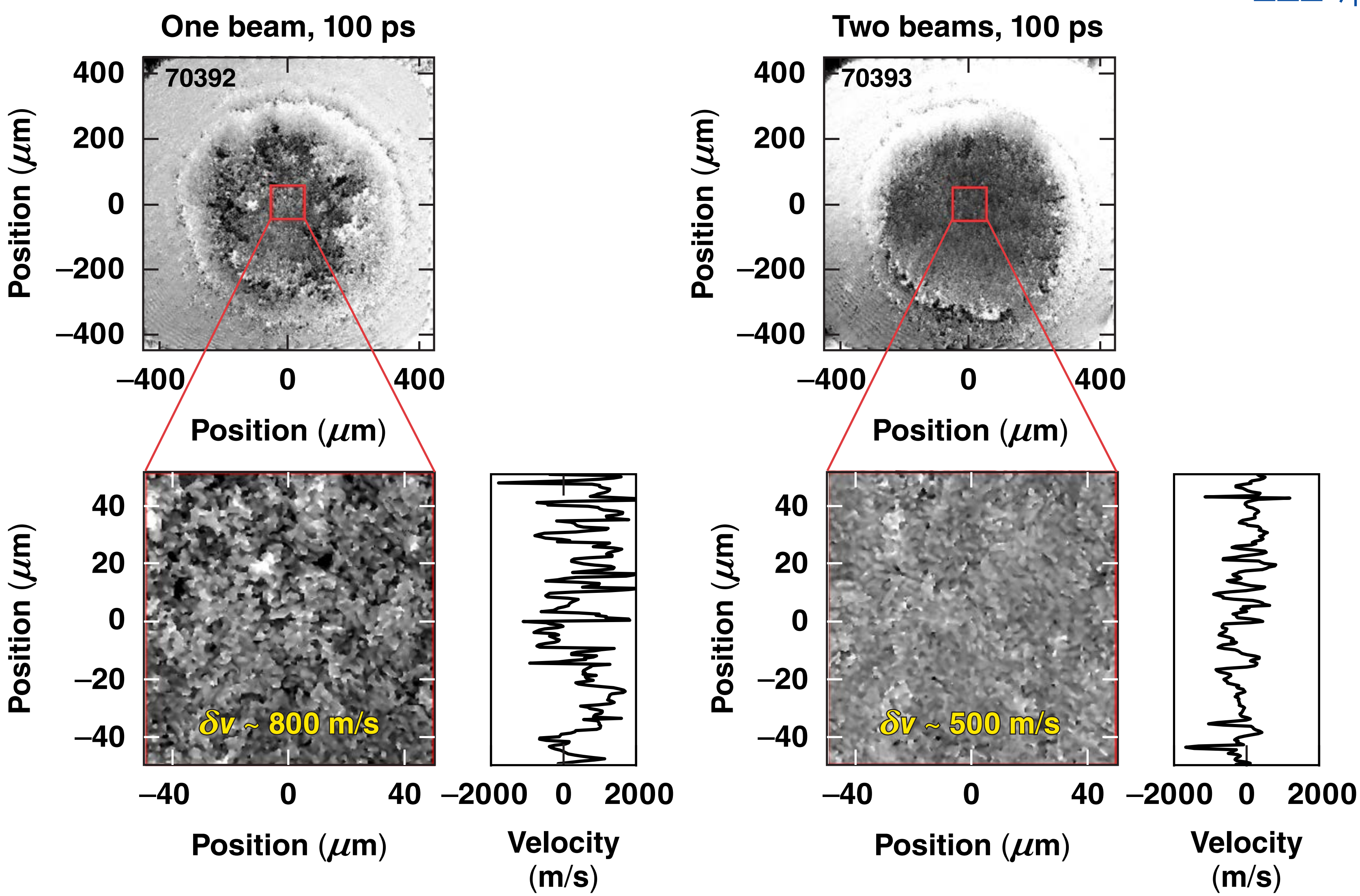


E23598

Drive-beam nonuniformites are caused by high-frequency speckle from distributed phase plates (DPP's)

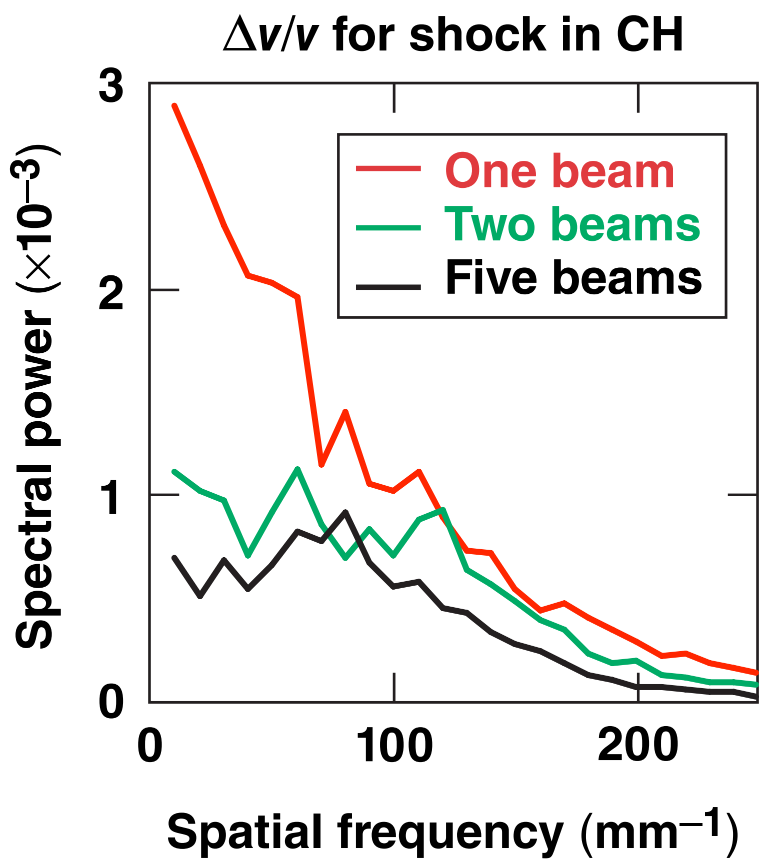


Velocity interferometry shows distinct patterns that are correlated to laser nonuniformities (speckle)



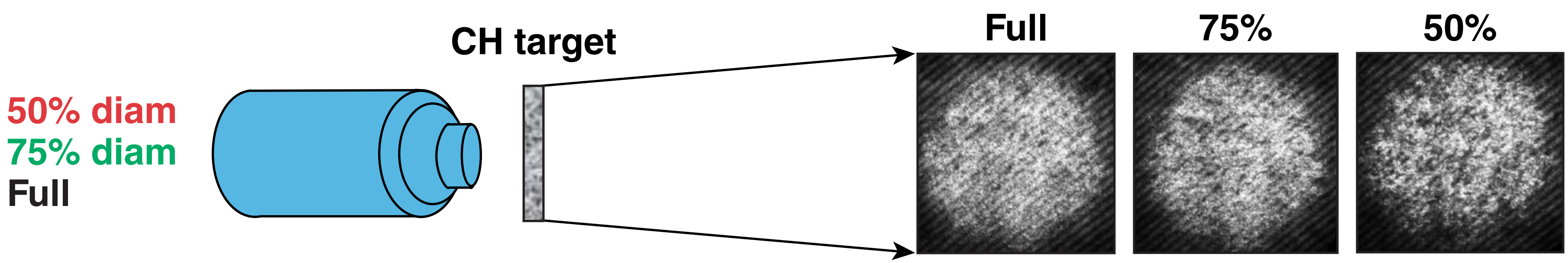
E23600

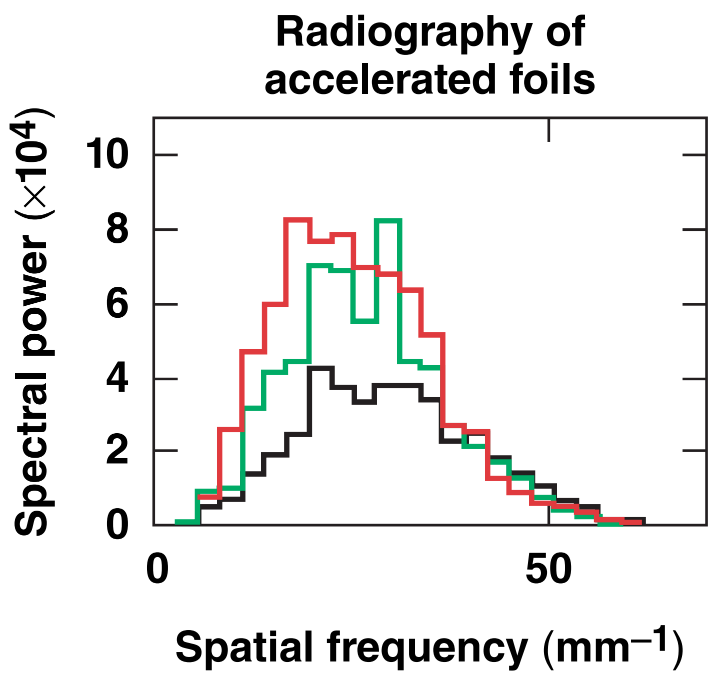
For 100-ps pulses, multiple beams with no SSD produce the expected decrease in imprint level

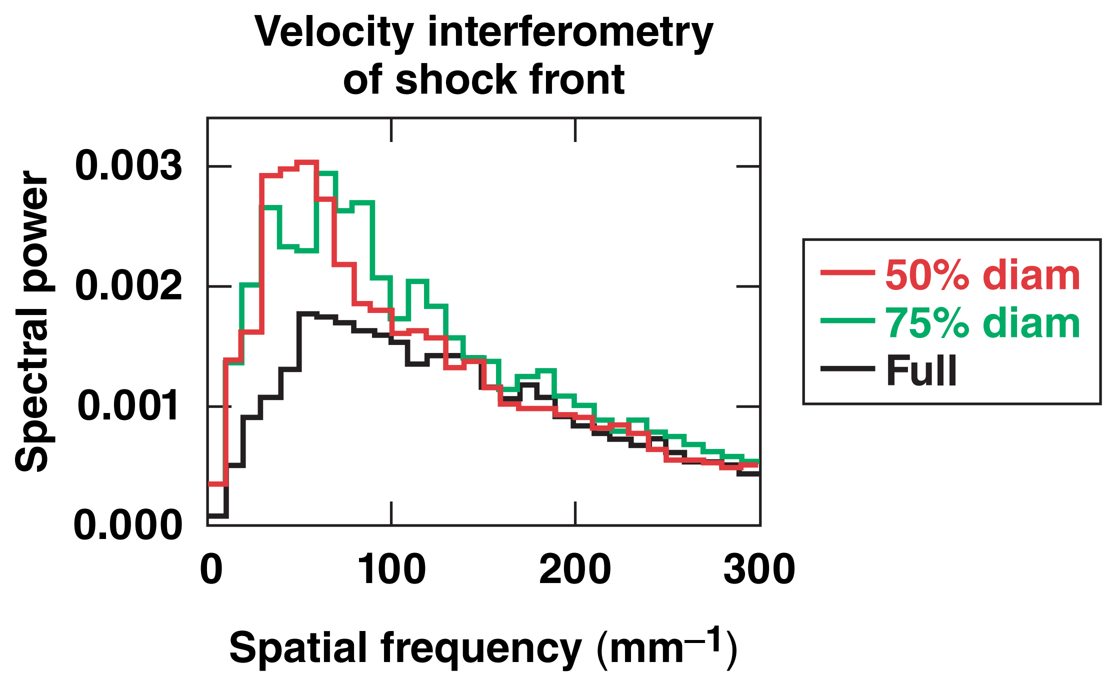


Drive uniformity increased by beam (speckle) overlap.

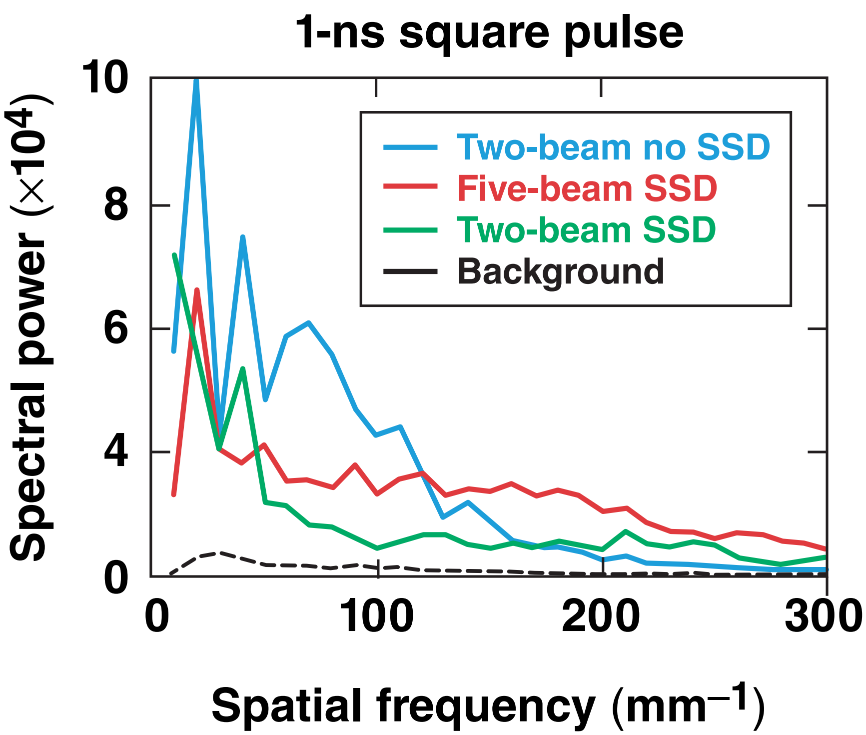
Imprint measurements using radiography and interferometry show qualitative agreement



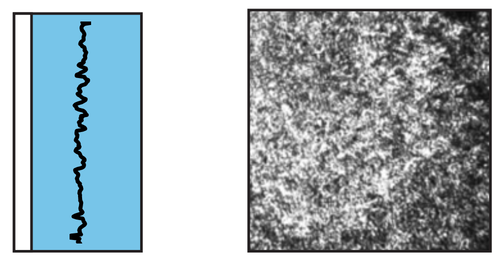




Imprint measurements in cryogenic D_2 show the benefits of beam smoothing and multiple beams



10 μm CH/D_2



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