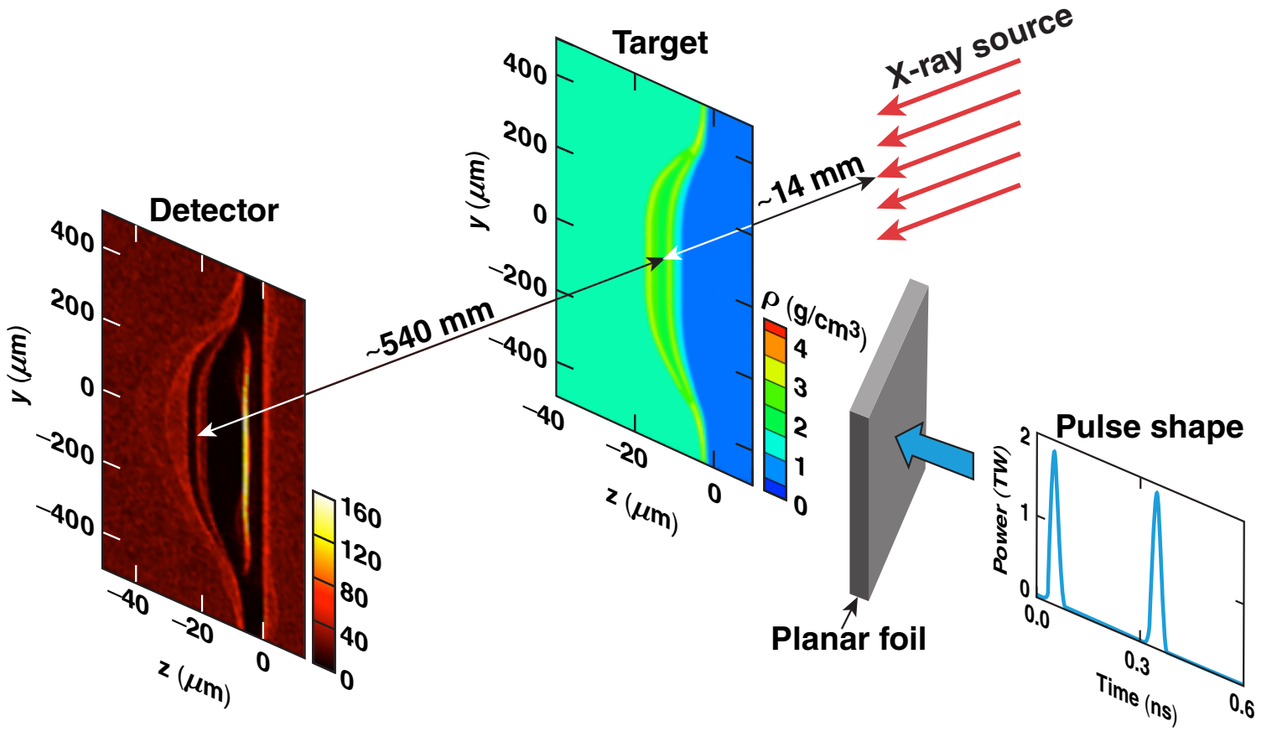
X-Ray Radiography of Laser-Driven Shocks for Inertial Confinement Fusion



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Summary

An x-ray postprocessor to the hydrodynamic code *DRACO* that images shocks has been developed

- The ray-tracing–based postprocessor includes refraction and attenuation of the x rays
- Refractive indices and opacities *specific to the shock conditions* obtained through first-principles equation-of-state (EOS) calculations* are used in the postprocessor
- Multiple shocks and shock breakouts can potentially be imaged using radiography

*S. X. Hu *et al.*, Phys. Rev. B 96, 144203 (2017).

Collaborators

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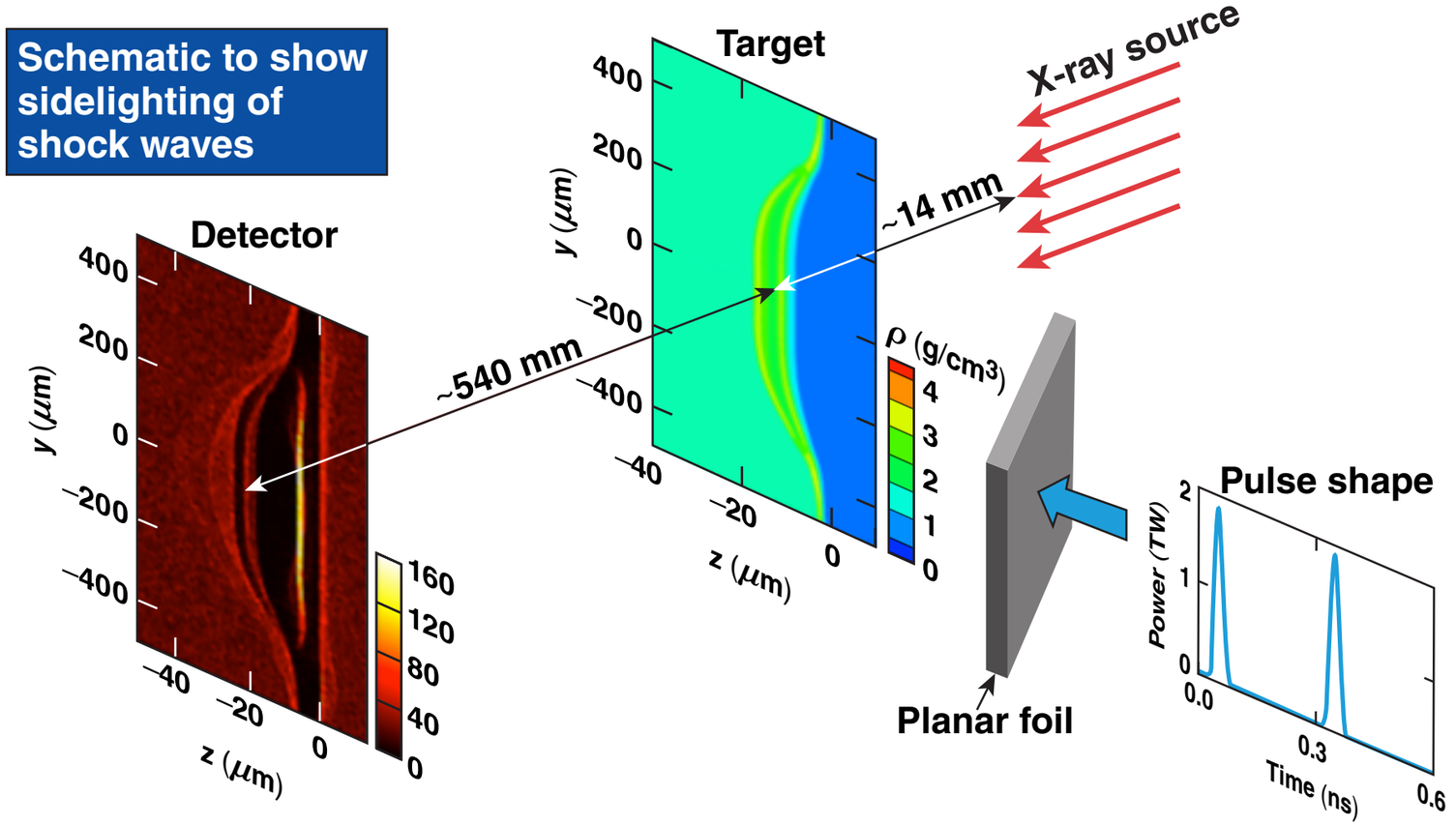
Refraction of light across sharp density gradients is used to image shock fronts



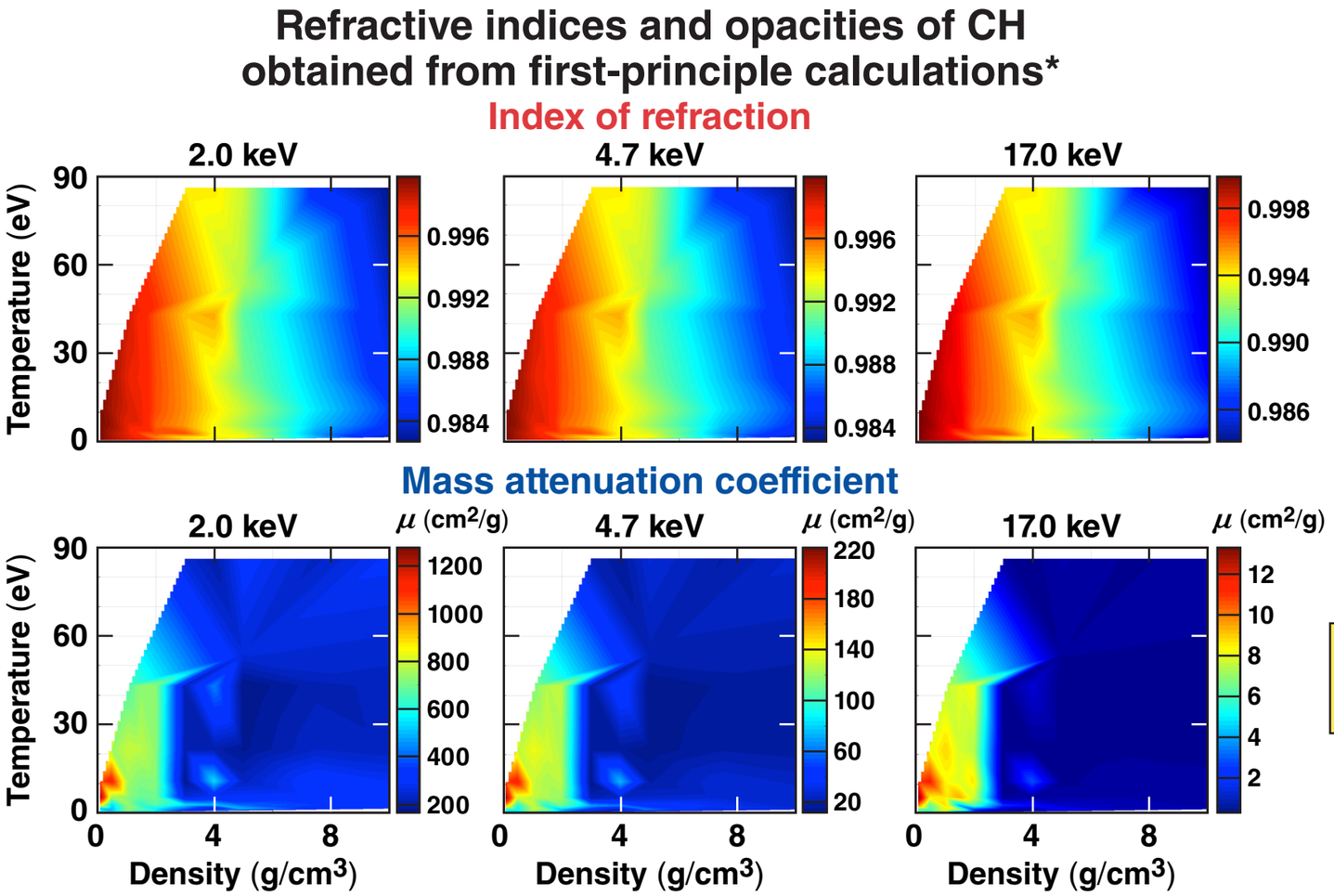
- An x-ray postprocessor to the hydrodynamic code *DRACO* that images the shock front has been developed

VISAR* and OHRV do not provide any information about the axial spatial location of shocks.**

*VISAR: velocity interferometer system for any reflector
**OHRV: OMEGA high-resolution velocimeter

TC13586a

Both refraction and attenuation affect the intensity of x rays as they travel through a medium



- Refractive index of a medium

$$n = (1 - \delta) + i\beta$$

Refraction Attenuation

- They scale as

$\delta \propto E^{-2}$, $\beta \propto E^{-4}$

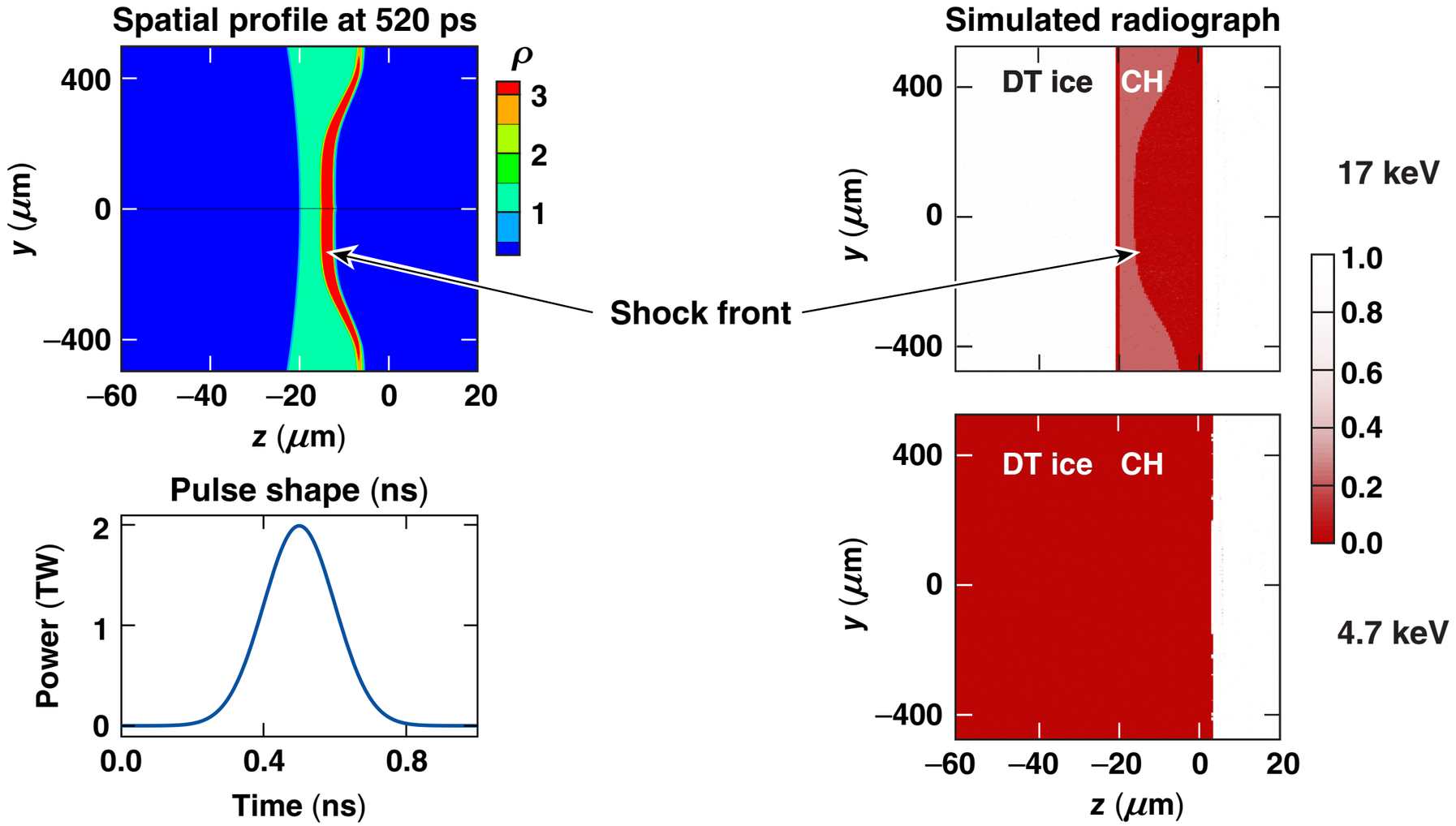
for x rays with energy E**

High-energy x rays: early time (high ρ)
Low-energy x rays: late time (low ρ)

*S. X. Hu *et al.*, Phys. Rev. B 96, 144203 (2017).
**S. C. Mayo *et al.*, J. Microsc. 207, 79 (2002).

TC13776

Simulated radiographs suggest that high-energy x rays are required to image shocks at earlier times when the shock is being supported

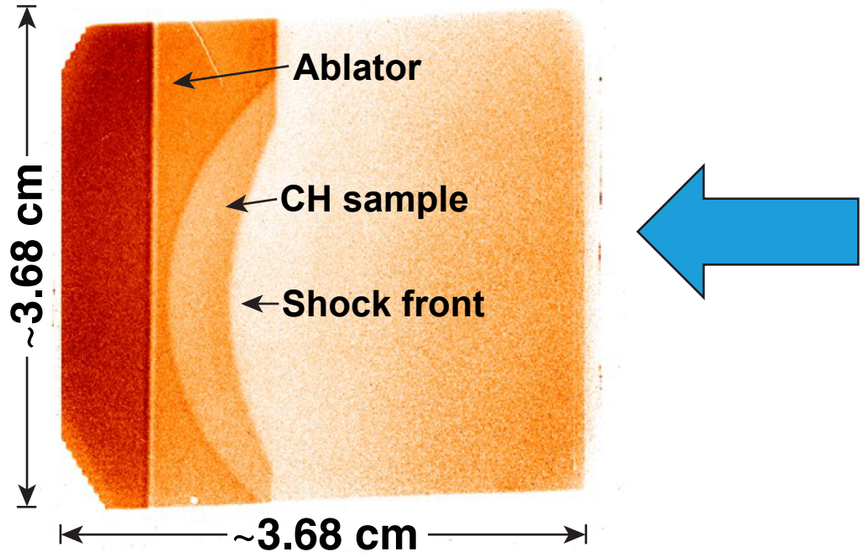


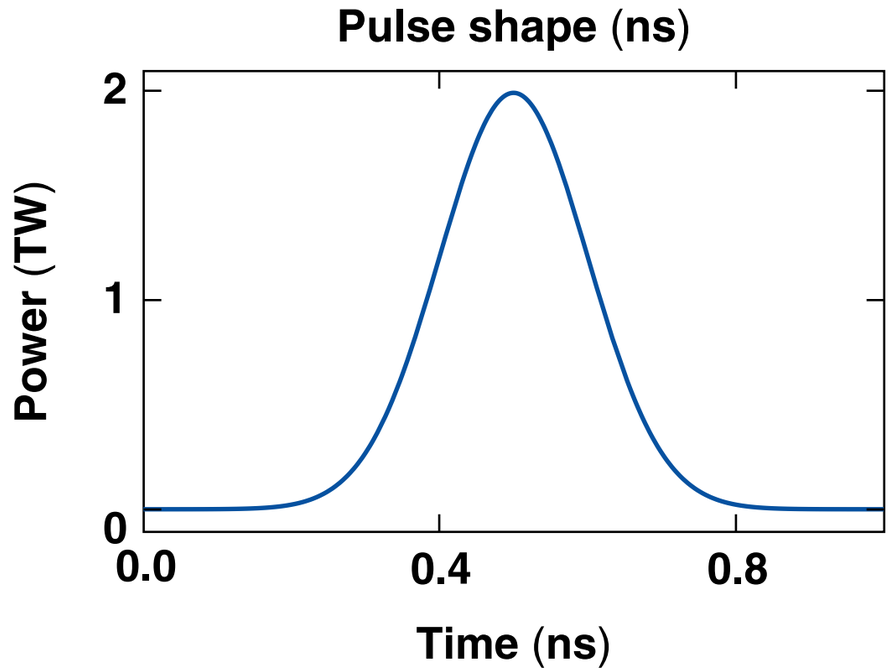
TC13777

A proof-of-concept experiment has previously been performed on OMEGA for 4.7-keV x rays

Experiment

Ablator: 20 μm CH
Sample: 1.5 × 0.4 × 0.25 mm CH





Shot 38808
February 2005
Radiograph taken at late time (~8 ns)

TC13801

Summary/Conclusions

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