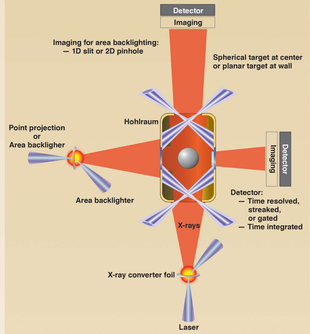
Horizontal and Vertical Axis Radiography Platforms on the National Ignition Facility

Radiography Platform Overview

Experimental Configurations

We have performed a variety of radiography measurements using area and point projection backlighting techniques

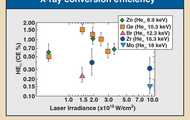


Imaging	1D	2D
Trade offs	Larger collection solid angle than 2D, but only 1D information	2D Spatial information, but smaller gated temporal window

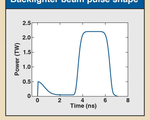
Detector	Gated	Time integrated
Pros	Resolve temporal dynamics Rejection of drive background	Improved signal to noise at higher backlighter energies
Cons	Limited detection area	Requires extensive shielding Time resolution limited by backlighter duration Single image

Technique	Point projection	Area backlighting
Trade offs	Field of view vs. source distance to target Limited pointing range	Field of view vs. energy in backlighter source

X-ray conversion efficiency

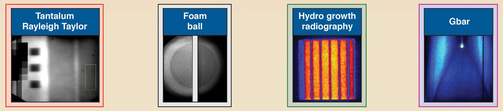


Backlighter beam pulse shape

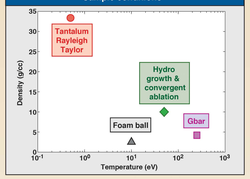


Parameter Space

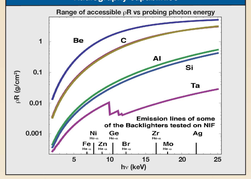
Radiography has enabled density measurements over a large material phase space for basic science, inertial confinement fusion and high energy density experiments



Sample conditions



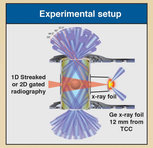
Radiography capabilities



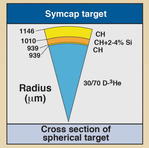
Convergent Ablation Platform

Area backlighting is applied to record the convergence of ICF capsules by streaked and gated imaging

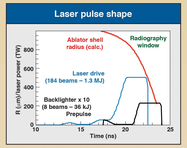
Experimental setup



Symcap target

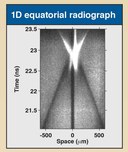


Laser pulse shape

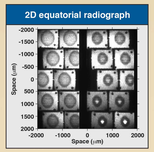


1-D and 2-D time resolved imaging of the compressed ablator is used to determine the implosion velocity, symmetry, and ablator density profile

1D equatorial radiograph



2D equatorial radiograph

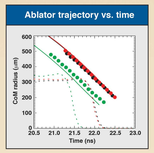


- Each strip covers 200 ps, with time progressing from top to bottom
- Strip on the left precedes strip on the right by 250 ps

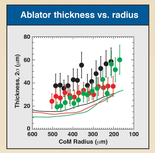
Results

Ablator radius vs time and thickness vs radius were extracted from the streaked radiograph image

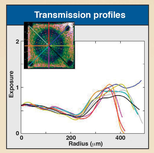
Ablator trajectory vs. time



Ablator thickness vs. radius



Transmission profiles



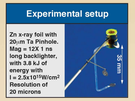
Current parameters of 1D streaked and 2D gated radiography techniques

Technique	1D Streaked	2D Gated
Magnification	12	8
Objected plane field of view (mm)	1.6	0.8
Spatial resolution (μm)	17	25
Temporal duration (ns)	1-10	0.25 per strip, up to 4 strips, with 8 ns total coverage
Temporal resolution (ps)	15-50	80
Solid angle of collection (steradians)	7.08 x 10^{-8}	4.91 x 10^{-8}

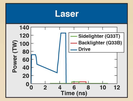
Foam Ball Platform

Simultaneous dual axis point projection radiography is used to measure drive symmetry with a foam ball surrogate capsule

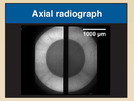
Experimental setup



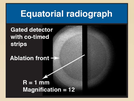
Laser



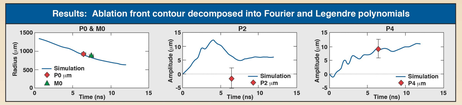
Axial radiograph



Equatorial radiograph



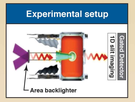
Results: Ablation front contour decomposed into Fourier and Legendre polynomials



Hydrodynamic Instability Growth Platform

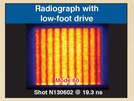
An area backlighter is used to measure instability growth in a convergent geometry at the center of a hohlraum

Experimental setup

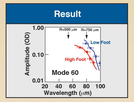


Axial target view

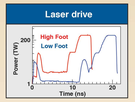
Radiograph with low-foot drive



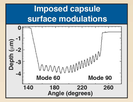
Result



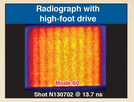
Laser drive



Imposed capsule surface modulations



Radiograph with high-foot drive

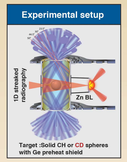


Growth factors were reduced by ~2 times at mode 60, and ~10 times at mode 90 with High-foot drive

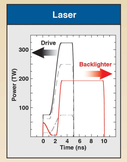
Gbar Platform

Extreme pressures can be accessed with convergent shocks in a solid plastic spherical capsule

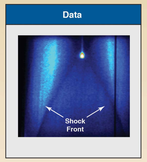
Experimental setup



Laser

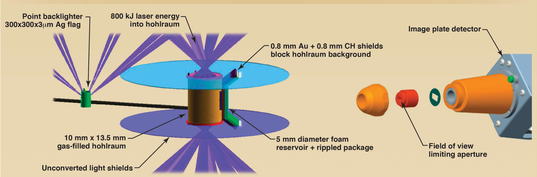


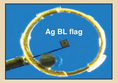
Data

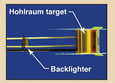


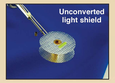
Planar Rayleigh-Taylor Platform

A high energy point projection backlighter is used to record the RT growth of a planar package using an image plate detector



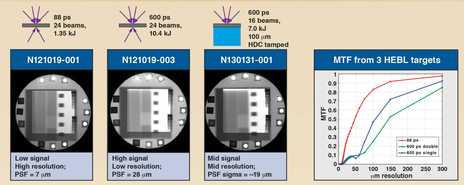




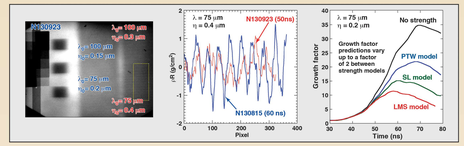


- A 195 eV drive temperature is created in a gas-filled hohlraum
- Foam reservoir unloads across a vacuum gap to provide a ramp pressure drive at 5 Mbar
- A 22 keV high-energy backlighter is used for face-on radiography of the ~50 μm thick tantalum sample
- The image is recorded with time-integrating image plate detector
- Time resolution is provided by the duration of the backlighter laser pulse

Spatial resolution and brightness has been tested using the High Energy Backlighter (HEBL) platform with a surrogate resolution pattern



First experimental results show the ripple growth was about 50% of preshot predictions indicating Ta strength under compression at 5 Mbar pressure



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