Summary

Imprint and hydrodynamic instability growth experiments have been performed at the National Ignition Facility (NIF)

• Initial experiments examined single-mode modulation growth and showed good agreement with DRACO simulations

• Upcoming spherical imprint experiments examine the growth of broadband imprint and the preimposed surface perturbations

• DRACO simulations of these experiments indicate that the growth of the imprint modes will dominate

• DRACO simulations of the planar imprint experiments predict that multi-FM smoothing by spectral dispersion (SSD) is highly effective in mitigating imprint seeded nonuniformities

Related talk: M. Hohenberger et al., JO4.00006, this conference.
Collaborators


University of Rochester
Laboratory for Laser Energetics
NIF polar-direct-drive (PDD) spherical-imprint experiments employ cone-in-shell CH targets and simultaneous x-ray radiography and side-on self-emission imaging.

The CH shell is driven with 34 quads.

* RGXD4F: rotated gated x-ray detector 4F
** GXD3F: gated x-ray detector 3F
NIF shots N141119 and N141120 used corrugated shells and slotted cones for 1-D imaging of a single-mode modulation growth.
Two-dimensional DRACO simulations predict the initial shell compression and the Rayleigh–Taylor (RT) growth of preimposed surface perturbations.
Upcoming spherical-imprint experiments will use cones with a hole for 2-D imaging of broadband imprint and the preimposed surface-perturbation growth.

Side view

Axial view

Diameter 2200 μm

Diameter 600 μm

Hole

λ = 100 μm
Λ = 0.25 μm

λ = 50 μm
Λ = 0.25 μm
**DRACO** simulations of the spherical-imprint experiments predict short-wavelength imprint modes dominate preimposed shell modulations.

Imprint simulations include all of the single-beam imprint modes.

Simulation time = 2.5 ns

- $\lambda = 50 \, \mu m$
- $\lambda = 100 \, \mu m$
- $\lambda$ = imprint

$rms$ of $\Delta \rho R$ (mg/cm²)

- $\lambda = 50 \, \mu m$
- $\lambda = 100 \, \mu m$

$A = 0.25-\mu m$ corrugation

335-kJ laser pulse

Instrument noise

Power (TW)
To mitigate laser imprint, single-beam smoothing is required for PDD ignition experiments on the NIF

- 1-D multi-FM SSD* has been developed on OMEGA to provide the single-beam smoothing required for PDD ignition on the NIF
- A single quad (Q24B) will be converted to multi-FM SSD by Q1FY16

One-quad multi-FM planar-imprint experiments will be used in Q1FY16 to validate multi-FM SSD on the NIF

Profile view

Face-on view

Imprint target

Backlighter quads (top 45°)

Dysprosium backlighter

Imprint quad Q24B with and without multi-FM

10-μm Au washer

CH washer

20-μm CH foil

λ = 100 μm, A = 2.5 μm acts as known RT seed

Laser power (TW)

Imprint drive (Q24B)

0 2

0 5

Imprint target

10-μm Au washer

CH washer

20-μm CH foil

λ = 100 μm, A = 2.5 μm acts as known RT seed

0 2

0 5

*TCC = target chamber center
Two-dimensional DRACO modeling predicts high effectiveness of multi-FM SSD in mitigating imprint-seeded nonuniformities.

Simulations include all single-beam imprint modes and resolve the speckle size.

*IDI: indirect-drive ignition
Summary/Conclusions

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