Rayleigh–Taylor Measurements in Planar Cryogenic D$_2$ Targets Using X-Ray Radiography on OMEGA

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50th Annual Meeting of the American Physical Society
Division of Plasma Physics
Dallas, TX
17–21 November 2008
Summary

Preliminary Richtmyer–Meshkov and Rayleigh–Taylor experiments have been performed on OMEGA using planar cryogenic D₂ targets

- X-ray radiography is used to measure modulation growth in D₂ indirectly.

- Modulations grow in D₂ and feed through to the back CH₂ window of the target and are detected by x-ray radiography.

- First proof-of-principle experiments demonstrated our ability to measure Richtmyer–Meshkov and Rayleigh–Taylor (RT) growth.
Collaborators

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Planar D₂ cryogenic targets are equivalent to OMEGA spherical D₂ targets

Modulations grow in D₂ and feed through to the back CH₂ window of the target and are detected by x-ray radiography.
**DRACO** simulations show how modulations growing in D$_2$ are related to modulations on the back CH$_2$ window.

\[ a_{CH_2}^{(k)}(t) = a_{D_2}^{(k)}(t) \times e^{-kd(t)} \]

where \( a \) is the modulation amplitude, \( k \) is the wave number, and \( d \) is the distance from CH$_2$ to the D$_2$ ablation front.

- \( d(t) \) is approximately constant, simplifying the interpretation of results.
X-ray radiography can be used to measure the modulation amplitude on the rear CH window of the target.

Achieving high sensitivity requires a transmission of ~10%.

Approximately 1 to 2 keV x rays can be used to image CH windows, but they are not useful for directly imaging D$_2$. 
Planar cryo targets with 2-D modulations are driven by 10 to 12 drive beams while an x-ray backlighter is used to determine modulation growth.
Richtmyer–Meshkov modulations were measured during the foot of the shaped drive pulse.
60-\(\mu m\)-wavelength 2-D modulation oscillates during shock transit time due to ablative RM instability*

Up to \( \sim 2 \) ns, observed modulations grow due to RM instability and after \( \sim 2 \) ns due to RT instability.

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**Modulation growth in front window due to RM and RT.**

**Modulations in D\(_2\) due to RT are detected on back CH\(_2\) window.**
Rayleigh–Taylor experiments were designed using DRACO 2-D simulations.

Targets with a 50-μm D₂ layer have been designed to increase the imprint on the back CH₂ window.
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