Experimental Results from Cryogenic D$_2$ Implosions on the OMEGA Laser

High-adiabat ($\alpha \sim 25$) square drive pulses

Pre-shot characterization

D$_2$ inner surface rms ($\mu$m)

YOC (1-D)

Measured offset ($\mu$m)

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Summary
Cryogenic capsule alignment accuracy and stability at the OMEGA TCC have improved dramatically

- Alignment accuracy and stability at shot time requires control of both static (offset) and dynamic (vibration) sources.
- Stable alignment (<10-μm goal) has required considerable re-engineering and careful attention to “tolerance buildup.”
- Performance with high-adiabat (α ~ 25) pulses approaches 1-D when the capsule is well-layered and properly aligned at TCC.

Full analysis of recent shots will be presented by P. W. McKenty in session F12.022 (tomorrow morning).
All of the *identified* alignment issues have been addressed

- Static offset sources include
  - optical alignment,
  - docking rigidity, and
  - collet yield.
- Dynamic offset sources include
  - static vibrational coupling, and
  - induced vibrational coupling.
At shot time, the state of the capsule is determined using a suite of imaging diagnostics.

1. X-ray pinhole cameras
2. CTCD (cryogenic target characterization diagnostic)
3. Cryo-vibe
4. 500-ps fast video cameras

Shot 26479 (stalk)
Shot 26477 (cryo)

Note core offset
TCC defined by stalk-mounted target (26479)
Capsule center

Measured offset:
\[ r = 85 \ \mu m \]
\[ (\theta, \phi) = 99^\circ, 251^\circ \]
The fast camera data showed significant coupling between the MCTC and the C-mount target.

A new four-axis control unit was developed to reduce coupling up the stalk; in addition, the stalk was redesigned to damp the primary modes.
Recent CTCD measurements show that the vibrational amplitudes are now very small (~6 μm or less)

The TED illuminators remain on during the ~2-ms readout of the CTCD image, creating a trace that maps target motion.

Capsule offset from TCC by 108 μm at t₀

No vibration

Cryogenic capsules on C-mounts are now as stable as stalk-mounted TPS2 capsules!
Cryogenic D$_2$ target quality on OMEGA has improved with time as has alignment accuracy and stability.

Data points represent OMEGA target shots and pre-shot ice-layer characterization.
High-$\alpha$ ($\sim$25) performance is excellent when well-layered cryogenic capsules are close to TCC.