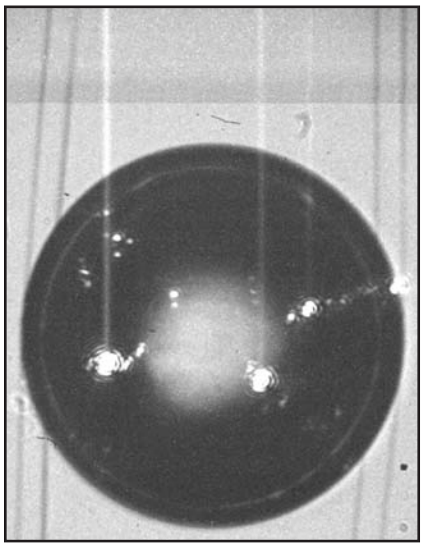
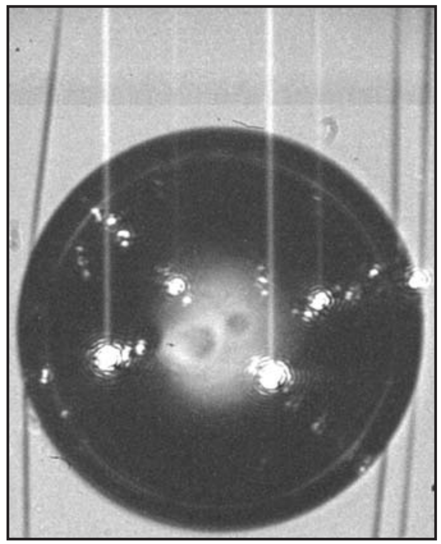
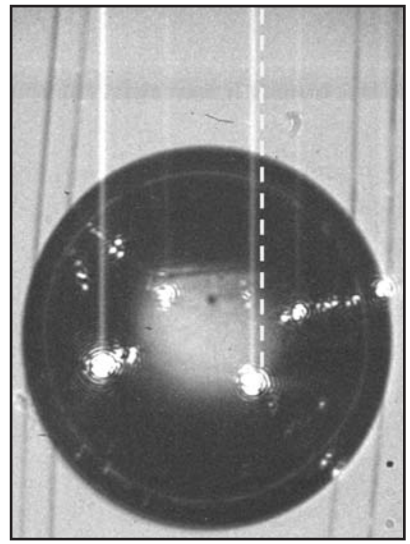
Recent Cryogenic Implosion Results on OMEGA



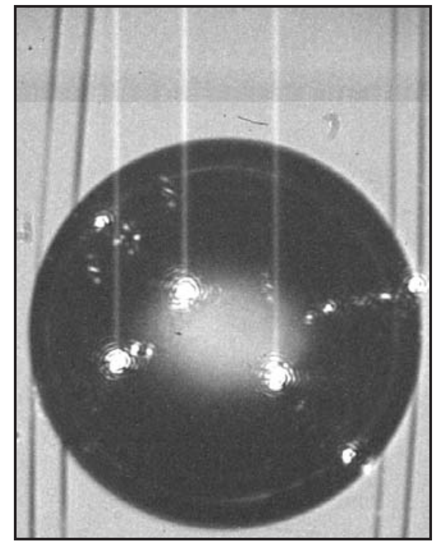
Shot 41095



Shot 41261



Shot 41265



Shot 41357

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Summary

Real progress is being made on spherical cryogenic target-alignment stability and ice-layer quality

UR LLE

- The quality of the fuel ice layer depends sensitively on subtleties in the thermal environment around the capsule.*
- Target-alignment stability has improved by understanding the sources of acoustic energy, minimizing the frequency coupling to the target assembly, and relying on natural damping in the target assembly.
- Tritium will soon be introduced to the OMEGA CTHS.

*D. R. Harding RI2.01

Collaborators

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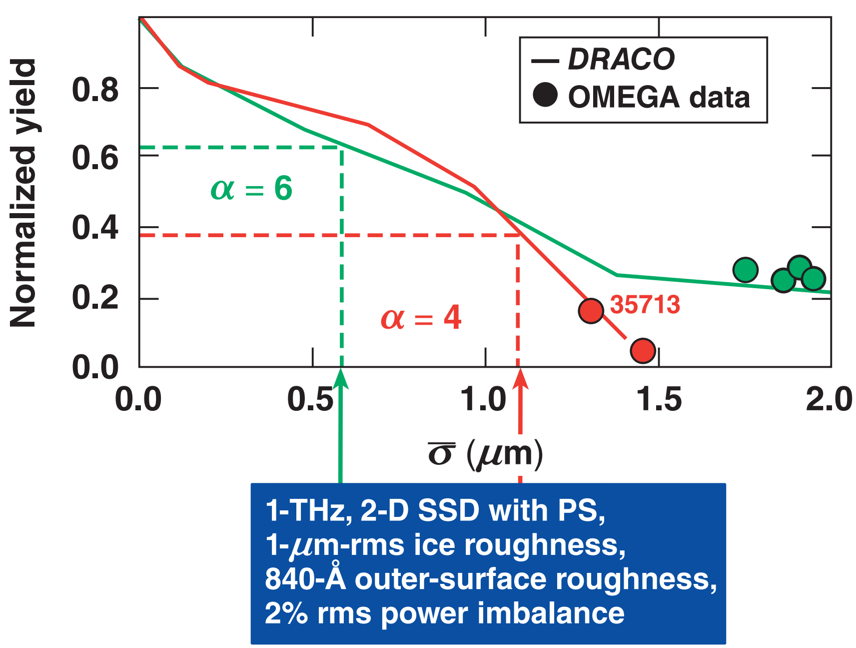
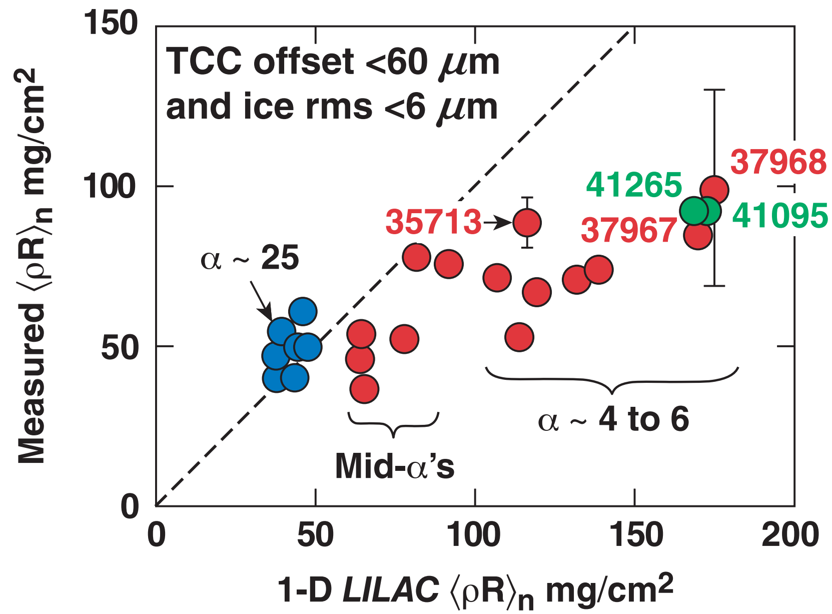
Recent effort has been focused on ice-layer quality and target alignment stability (and tritium readiness)

New $\langle \rho R \rangle_n$ data continue to show good agreement with the hydrocodes...





...while generally poor ice-layer uniformity has limited the number of $\alpha \sim 4$ implosions on the plot

E14140

The ice-layer quality depends on the thermal properties of the target assembly materials*

UR LLE

- Have made ice layers approaching 1-μm rms but not routinely!
- The characterization and analysis tools to fully map the ice layer in 3-D have been developed.**
- The sensitivity of the ice-layer quality on the thermal environment is now being understood with dedicated experiments and a 3-D thermal model.*
- The ice-layering process is quantifiable and repeatable—the target support is primarily responsible for the low-mode variation of the ice thickness around the equator.*
- The 3-D thermal model suggests that temperature gradients on the target can be reduced 10× with straightforward mechanical modifications.*
  - *Impact on target stability is a crucial factor for the final design.*

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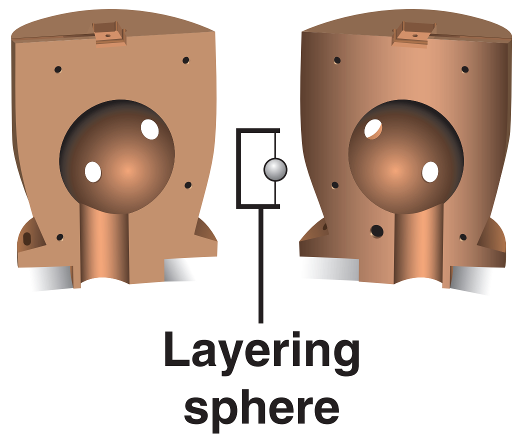
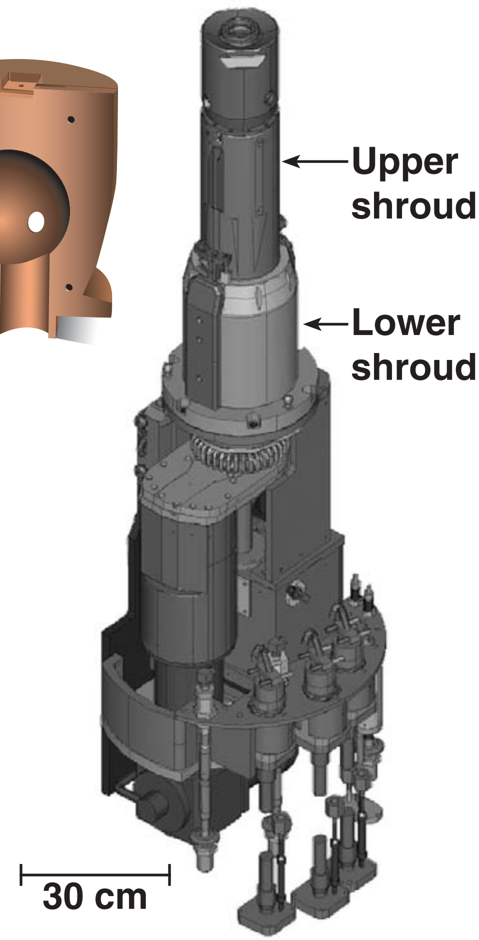
The new hover trajectory reduces the energy coupled into the target assembly at shot time

- At t ~ –6 s, thermal contact between the upper and lower shroud is broken.
- Target remains in a cryogenic environment while local vibrations damp out.
- Shroud acceleration at t ~ 0 s is similar to the original trajectory and exposes the capsule for <90 ms prior to irradiation.
- No adverse affect on the ice-layer quality is expected or has been observed.





E14142

High-speed video (2000 fps) of a cold surrogate shows the differences between a "normal" and the hover trajectories

Target immediately before the shroud separation

Target immediately following the shroud separation (normal)

Target ~3 s after the shroud separation (normal)

The target is always imploded within a few hundred milliseconds of shroud clear!

Target immediately following the shroud separation (hover)

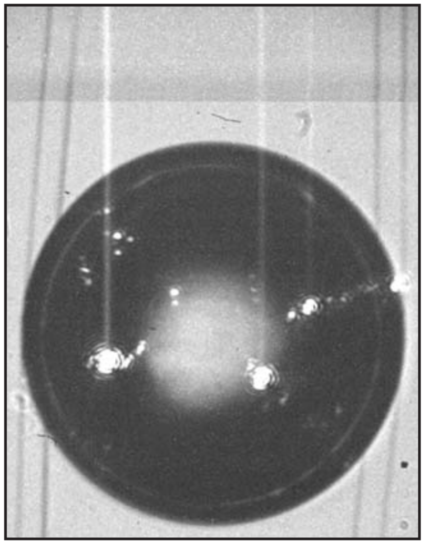
Target ~3 s after the shroud separation (hover)

E14143

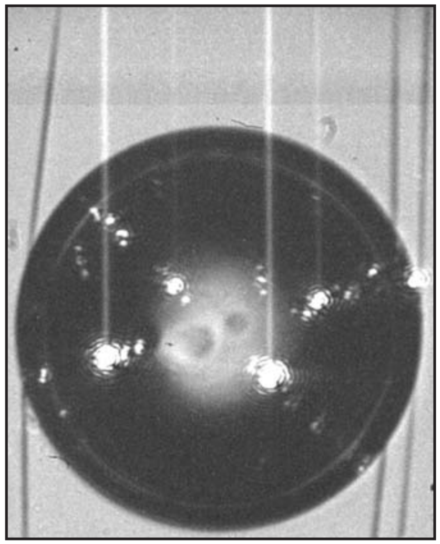
The most recent implosions show virtually no vibration with the new hover trajectory at shot time

Temporal "streak" shows no vibration in CTCD view

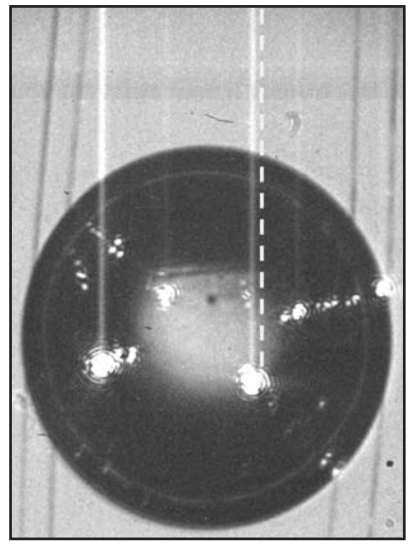
Standard high-speed separation



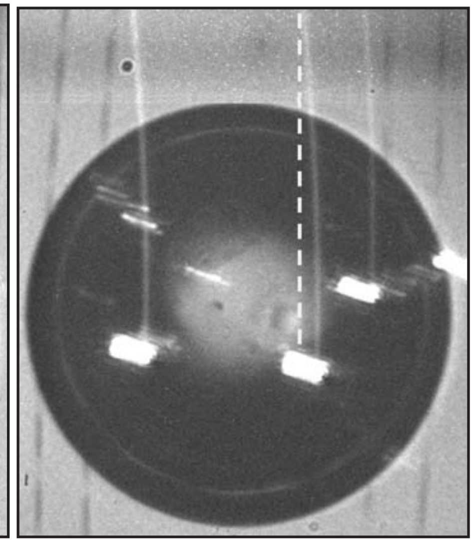
Shot 41095
X = 2 μm
Y = 2 μm
Z = 18 μm
R = 18 μm



Shot 41261
X = –18 μm
Y = –2 μm
Z = 36 μm
R = 41 μm



Shot 41265
X = 18 μm
Y = 10 μm
Z = 7 μm
R = 22 μm



Shot 39891
X = 3 μm
Y = 17 μm
Z = 1 μm
R = 17 μm

...and sometimes you get lucky

Tritium will be introduced into the OMEGA CTHS within a matter of weeks

- **Successful tritium readiness review in June**
- **Second FTS will be complete in 2005 for concurrent D_2 cryogenic target production**
- **Single MCTC will be dedicated to DT operations—one DT implosion per shot day (up to 24/yr)**
- **Initial tritium fraction will be 0.1% and raised incrementally (10×) to reach 50:50 DT in Q2FY06**
  - ***β layering studies can begin with ~10% tritium***

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