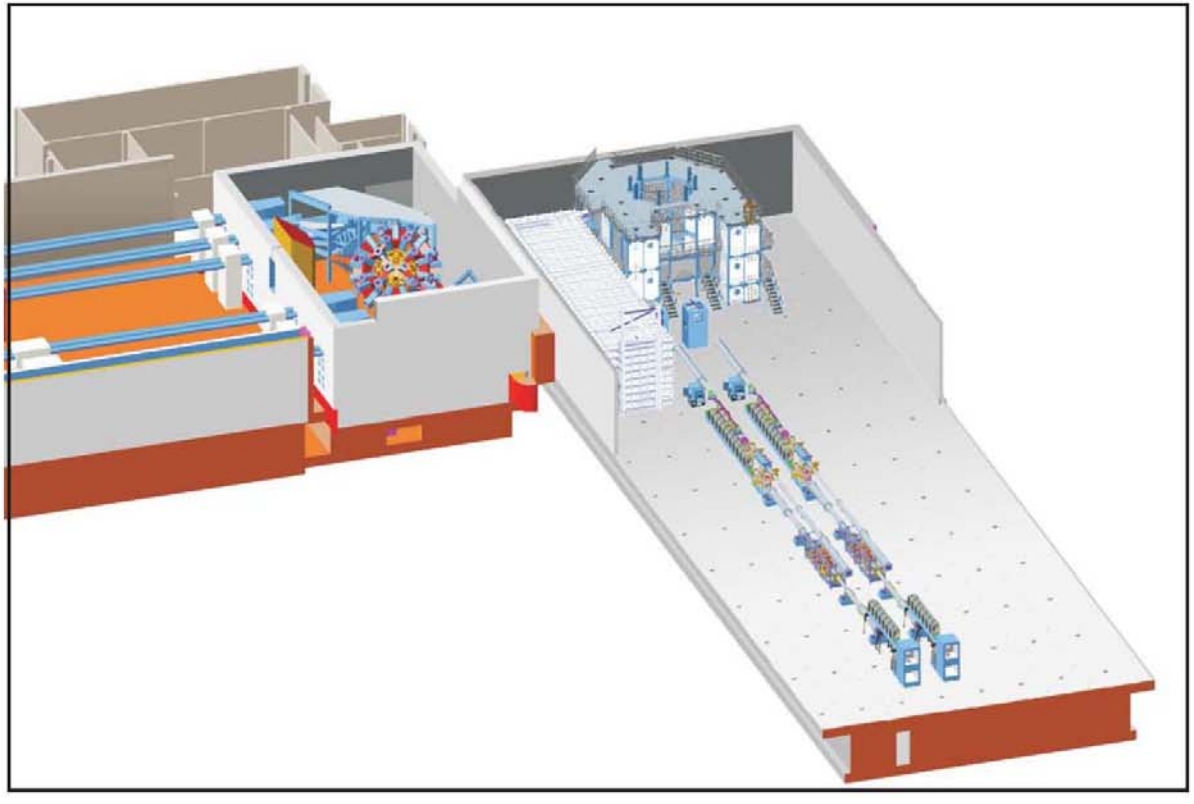
University of Rochester FSC Workplan for FY2005



David D. Meyerhofer
University of Rochester
Laboratory for Laser Energetics

FSC Meeting
Cambridge, MA
24 Oct. 2004

UR's FSC workplan includes simulations, experiments, and diagnostic development

- There are four major parts to UR's FY05 workplan:
  - Development of hydrodynamic simulation capability for spherical targets with embedded cones,
  - Development of hybrid code capability (LSP and models for hydrodynamic codes) for high density, compressed cores of imploded cryogenic targets,
    - Comparison of LSP and OSIRIS,
    - Begin optimization of
  - Fuel assembly experiments with spherical plastic shells with embedded gold cones,
  - Development of diagnostics for integrated (PW plus implosion) experiments planned to begin on OMEGA/OMEGA EP in FY07,
    - Experiments on Vulcan, Gekko(?), others(?).

We welcome FSC member collaboration in these activities

The UR's FSC team includes UR faculty and students, LLE scientists, and FSC postdocs

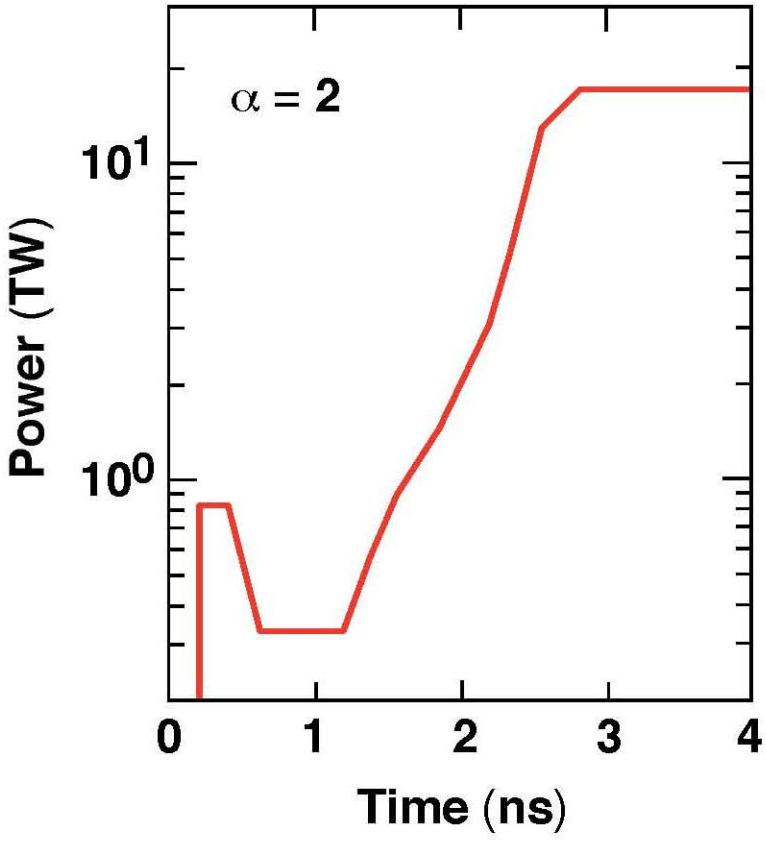
- UR faculty – R. Betti, D. Meyerhofer, C. Ren (thanks Warren)
- UR students – M. Storm, plus additional
- LLE scientists:
  - Experimental – C. Stoeckl, W. Theobald
  - Theoretical – J. Myatt, J. Delettrez
- An experimental and a theoretical postdoc will be hired through the Center.

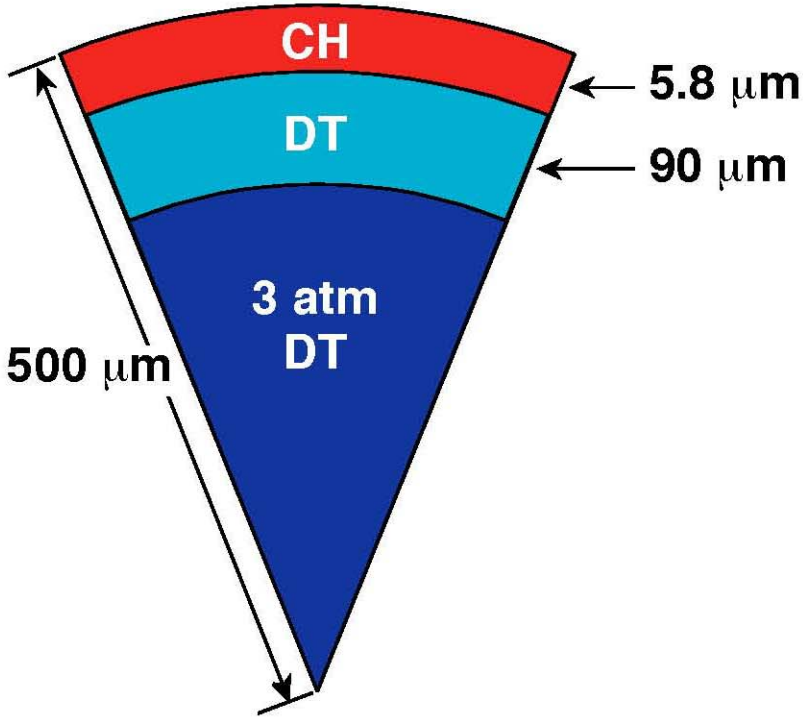
The FSC members will need to develop benchmarking experiment

- **Two types of validation experiments are required:**
  - **Theoretical benchmarking of different simulation tools and development of an understanding of how to model FI interactions, transport, and deposition, in relevant targets**
  - **Experiments that test specific code predictions,**

Both direct and indirect drive targets can be designed to produce a high density compressed core

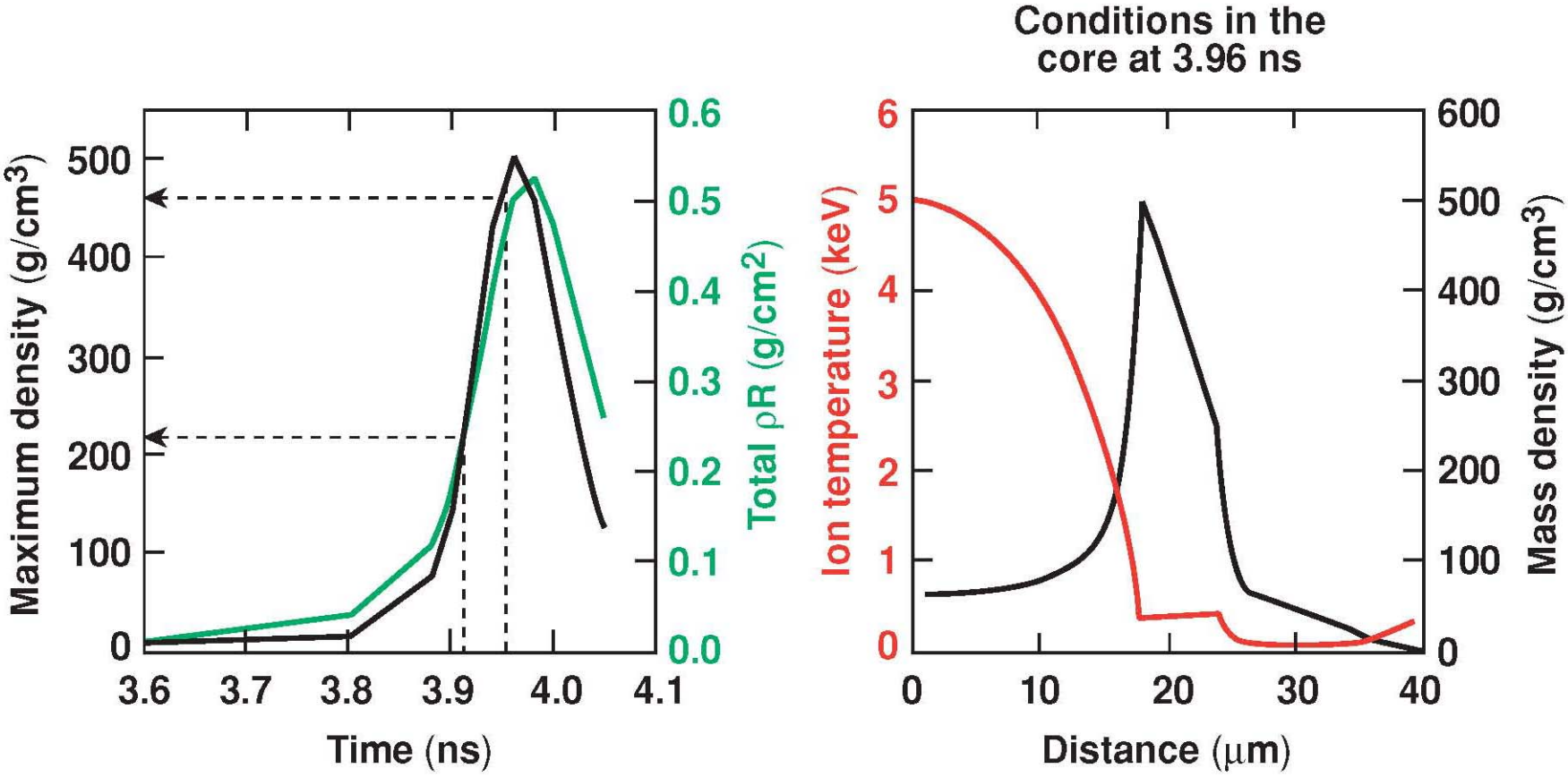
Example: Direct-drive cryogenic target for OMEGA that has a predicted compressed density approaching 500 g/cm^3





TC6195

Densities approaching 500 g/cm^3 are predicted for OMEGA cryogenic implosions



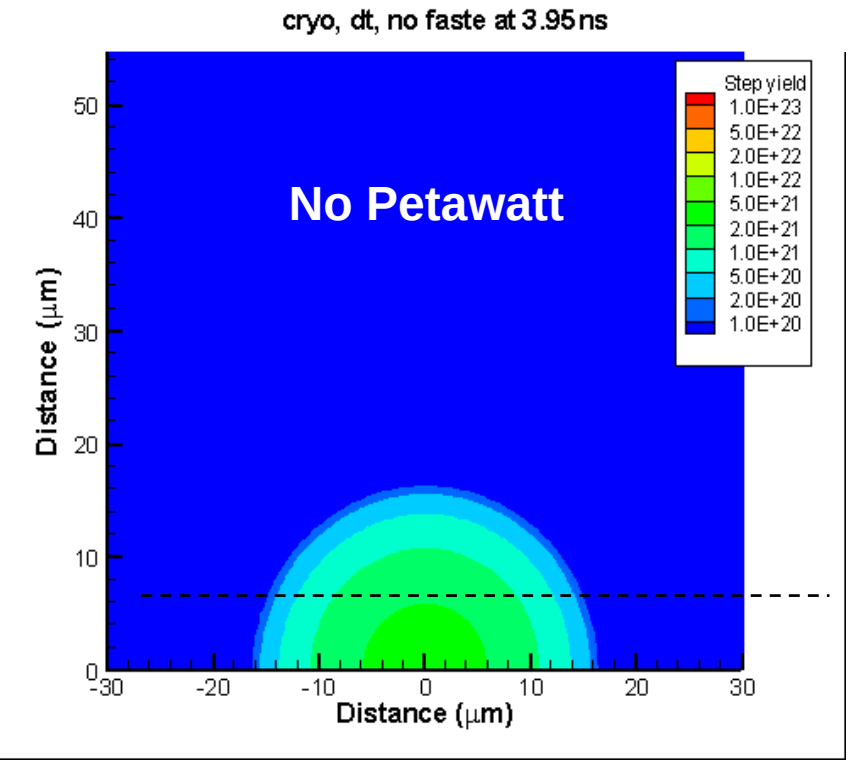
A 1-MeV electron has a range of about 0.4 g/cm^2.

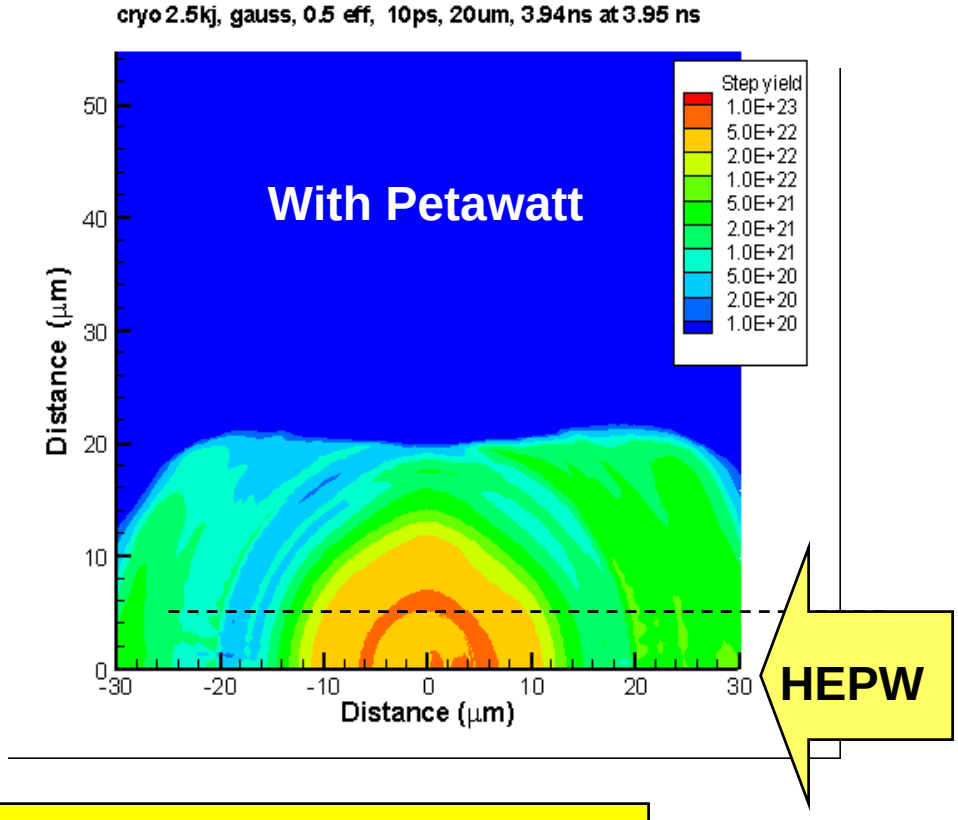
TC6196

Adding a 2.5 kJ HEPW laser pulse increases the predicted neutron yield by close to an order of magnitude

- Integrated Fast Ignition simulations are in their infancy.
- Here a 2.5 kJ beam is incident on a compressed target.

Neutron production rate (n/cm^3/s)





This was the simplest treatment of the electron beam, we need to improve the modeling

Routine cryogenic target implosions have required significant engineering and development

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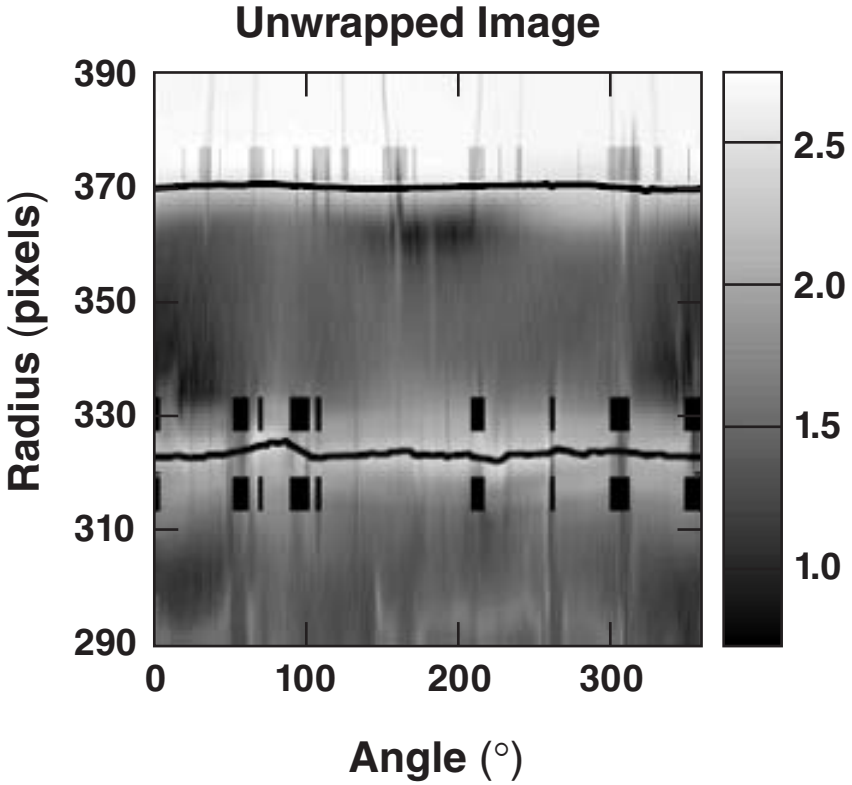
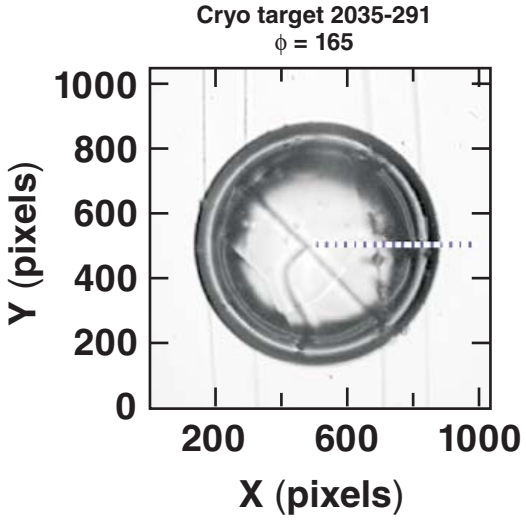
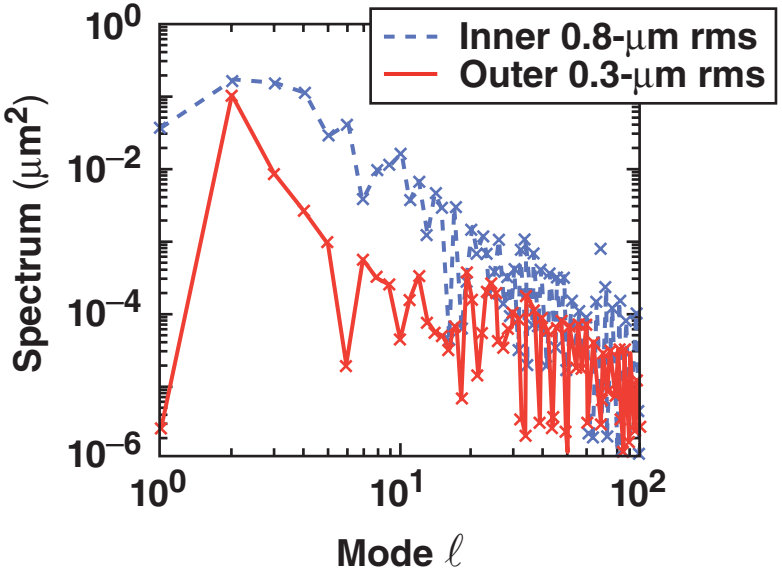
- Cryogenic implosions have been carried out on OMEGA for ~3 years.
- Significant obstacles have been overcome
  - cryogenic target transport
  - target survival
  - target layer survival
  - target vibration at shot time
- Recently, 8 cryogenic targets were shot in a single week.

Submicron rms ice layers were demonstrated; the smoothest layers were confined to localized regions of the target

- 24 views every 15° in "x" and "y"
- 0.8 to 1.4 μm over 1/4 of target's surface

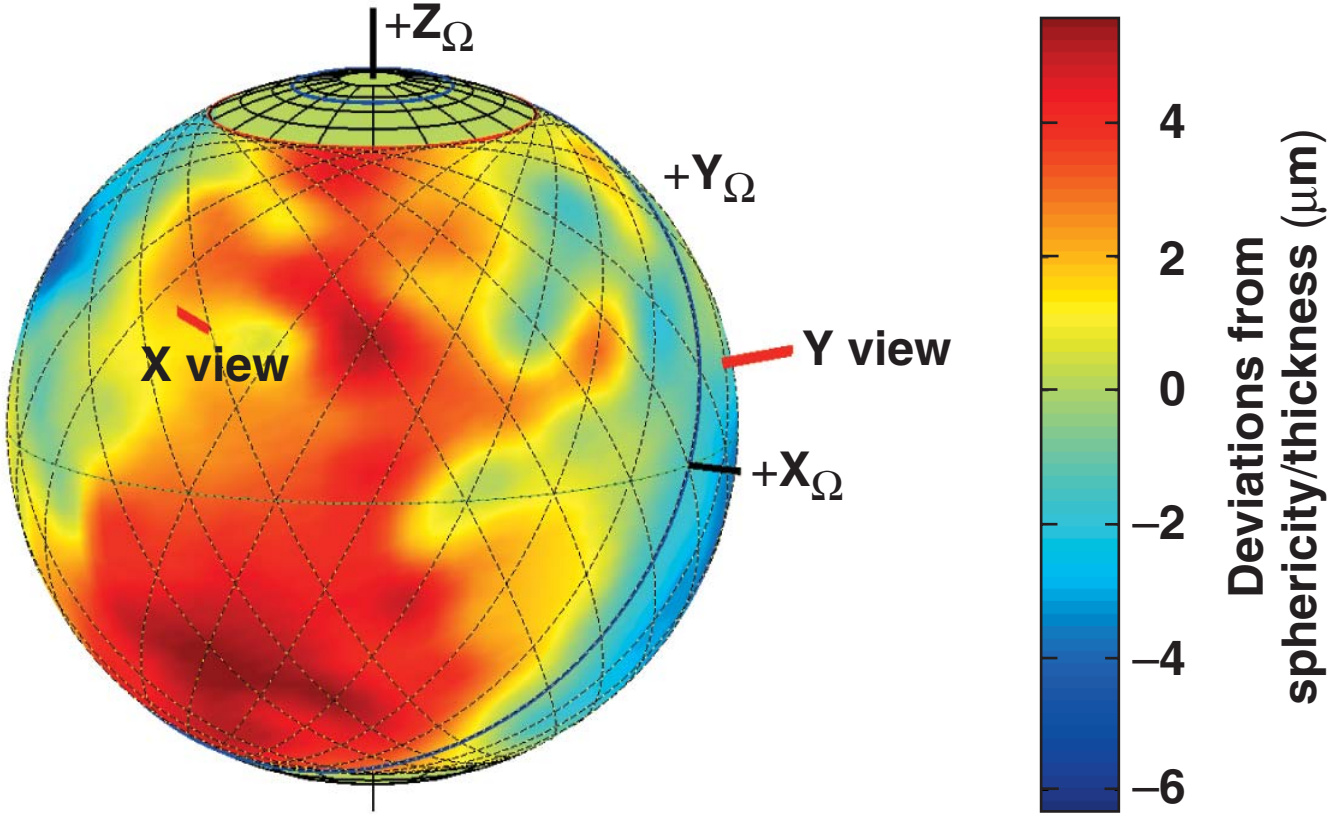






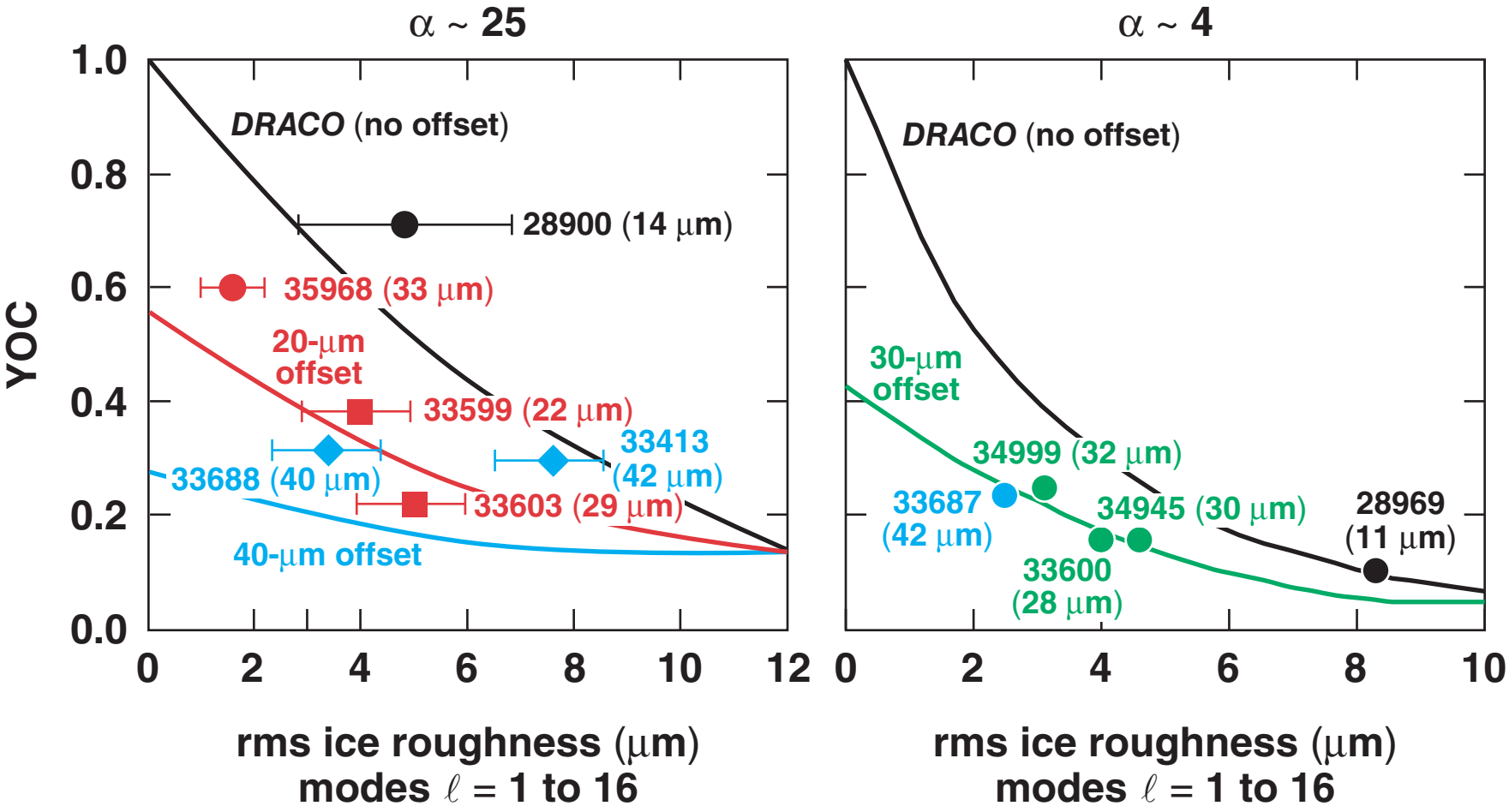
T1905a

Low-order ℓ and *M* modes can be extracted from a 3-D reconstruction of the inner-ice surface



Structures in the ice correlate with known asymmetries in the layering sphere and are consistent over repeated layering/melting cycles.

Hydrodynamic simulations are consistent with the data over a wide range of ice roughness and target offset



E13085a

Gas-tight fast-ignition targets were developed for fuel-assembly experiments

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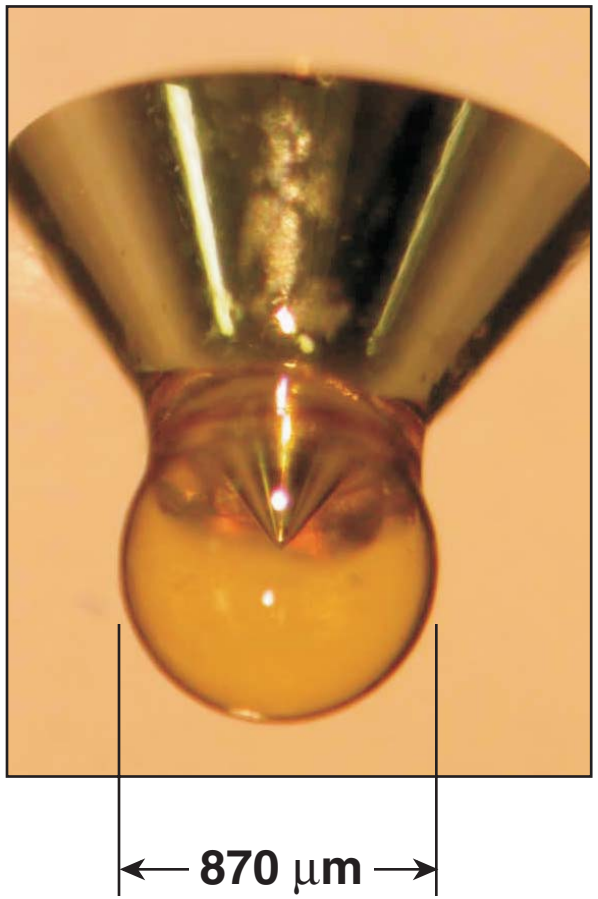
GENERAL ATOMICS

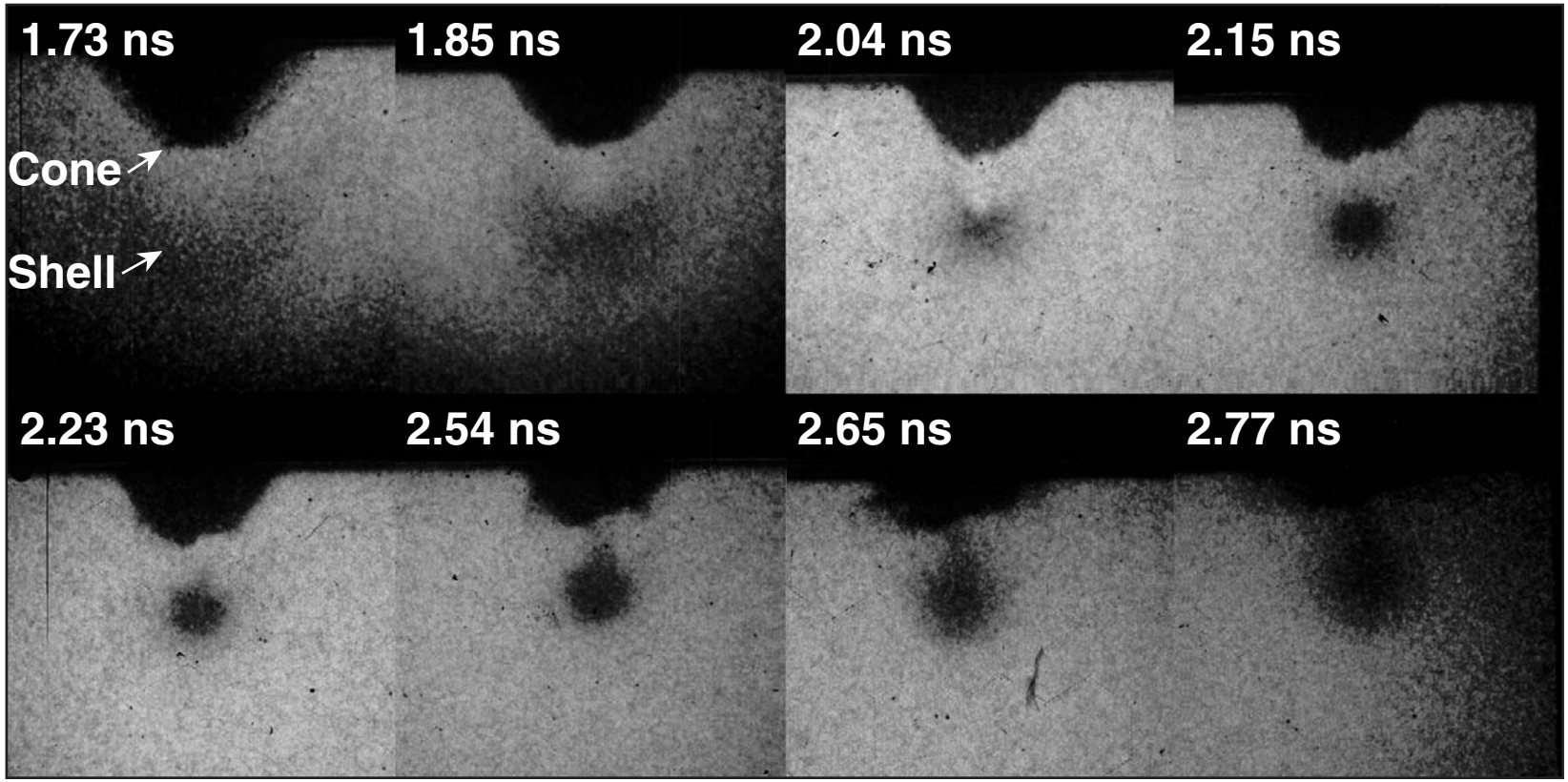
- 870-μm OD shell
- 24-μm wall
- ~10 atm D_2 or D^3He fill
- 35° half-angle gold cone
- Backlighting
  - 35 beams, 12 kJ, 1 ns on target
  - 15 beams, 6 kJ, 1 ns on backlighter
- Areal-density measurements
  - 55 beams, 22 kJ, 1 ns on target



The backlit framing-camera images show the core assembly and cone reaction in great detail

UR LLE

GENERAL ATOMICS



Shot 32381, V backlighter,
D_2 fill, yield = 6×10^6,
$\rho R \sim 60$ mg/cm^2 (D^3He proton dE/dx)

E12558d

LLE collaborates with IC, RAL, and LLNL on HEPW experiments using the Vulcan laser system

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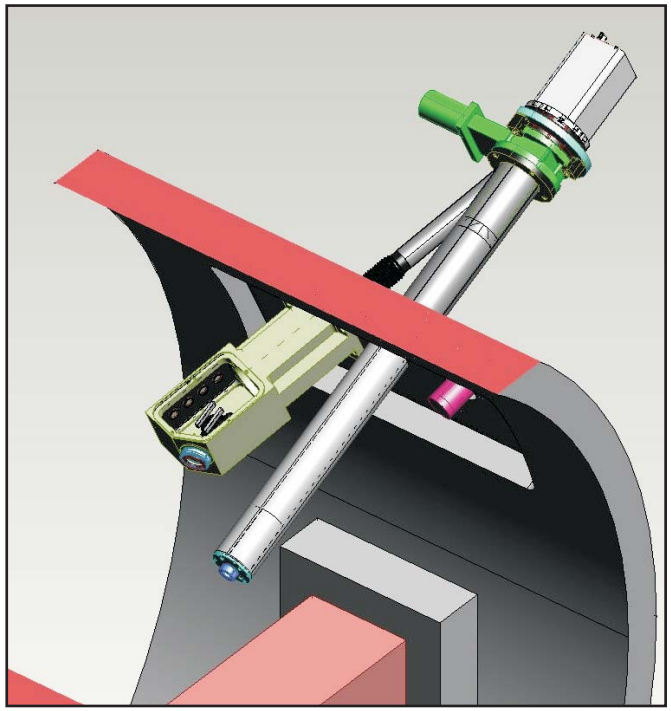
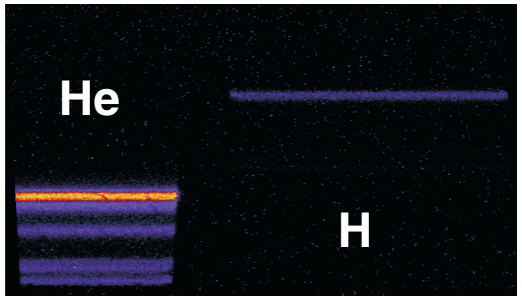
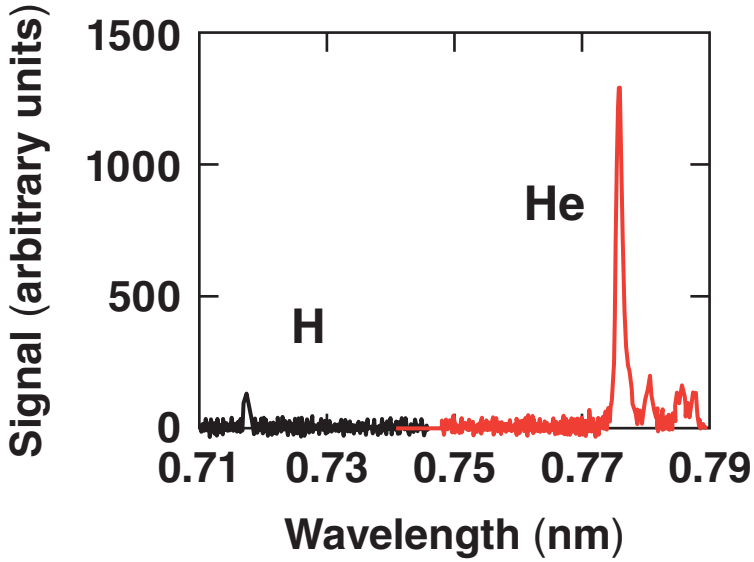
LLE fielded an x-ray spectrometer to measure Al conversion efficiency.



Al spectrum





Shot 0406031, Al flag target, laser intensity ~10^{16} to 10^{17} W/cm^2

E13238