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Title:	LANL C10.2 Projects in FY13
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LANL C10.2 Projects in FY13

Steven H. Batha

James Fincke and Mark Schmitt

June 12, 2012

ICF Execs Meeting

Washington, DC

LANL has two projects in C10.2

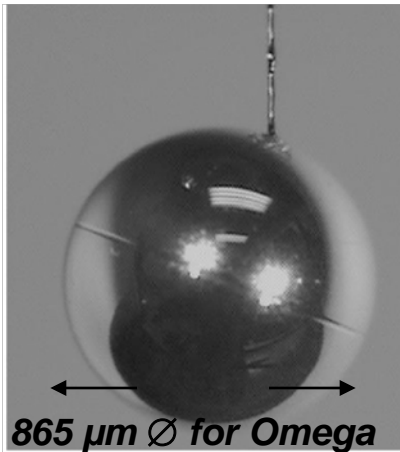
- **Defect-Induced Mix Experiment (DIME)**
 - Ongoing, several runs at Omega
 - NIF shots this summer
- **Shock/Shear**
 - Tested at Omega for two years
 - NIF shots in second half of FY13
- **Each project is jointly funded by C10.2, other C10 MTEs, and Science Campaigns**

•DIME is investigating 4π and feature-induced mix in spherically convergent ICF implosions by using imaging of the mix layer

- Measure mix in perturbed and unperturbed ICF capsules
- Determine the effects of mix on DT burn

•DIME capsule

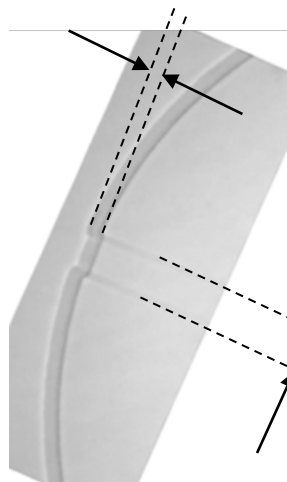
5-atm DT/D₂ fill



865 μm \varnothing for Omega

2.2mm \varnothing for NIF

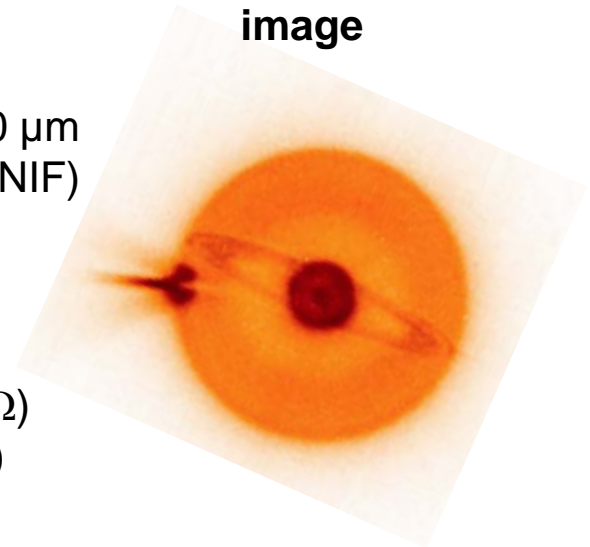
•Equatorial defect



Depth: 10 μm
(Ω /NIF)

Width: 30 μm (Ω)
80 μm (NIF)

Omega DIME x-ray image



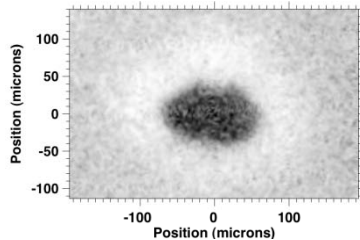
- 2 μm thick mid-Z doped layers at different depths are used to assess mix

•DIME prepared for NIF by demonstrated its PDD mix platform on Omega including imaging mid-Z doped layers and defects

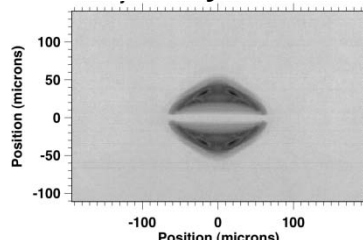
- Hydra calculations show excellent agreement with implosion trajectory (as determined by simulated x-ray self-emission)
- Spectral imaging has revealed pentagonal laser imprinting of mix in the imploded core (from the pole)
- DIME on NIF will baseline PDD CH capsules with dopant imaging this year

•DIME Omega x-ray images

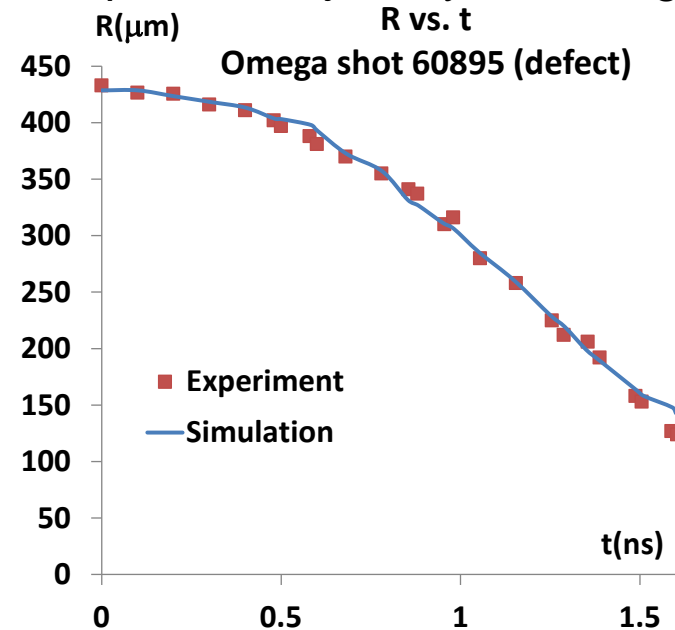
• Shot 62813



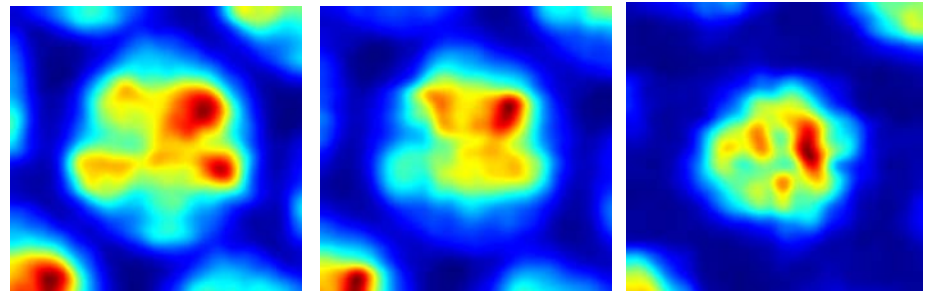
Hydra simulation



•Implosion trajectory for Omega DIME



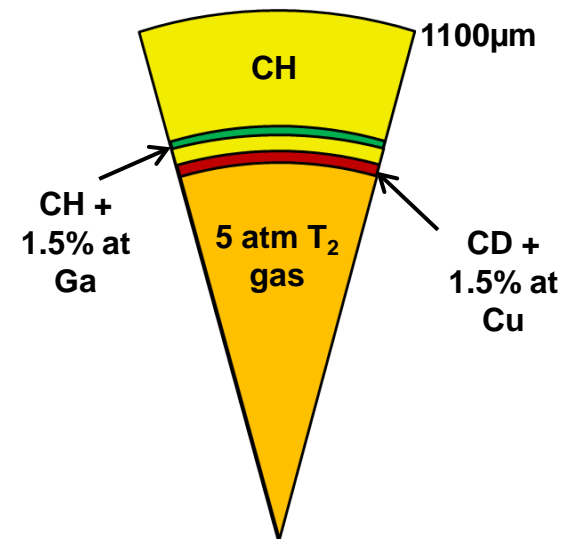
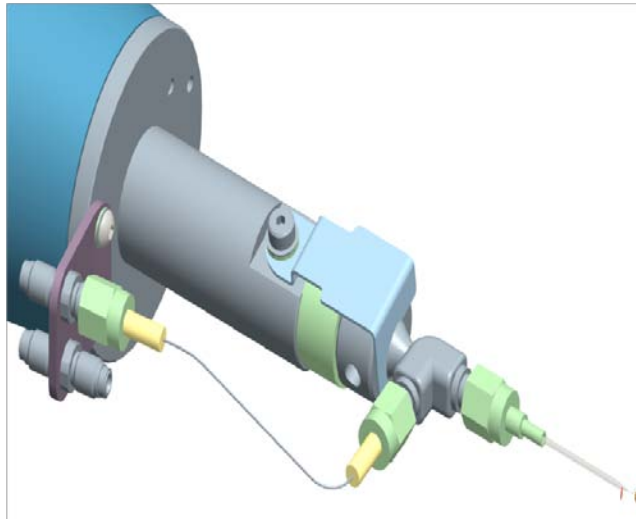
•Post-processed DIME Omega He_α images



• Postprocessed images courtesy of Roberto Mancini, UNR Analysis Team

•DIME in FY13 will focus on PDD symmetry-dependent mix and moving burn into the mix region for validation of mix/burn models

- Measure polar angle symmetry versus laser power and pointing tuning
- Measure symmetry dependent 4π mix uniformity and depth using new MMI diagnostic
 - Imaging of spectral dopants provides uniformity, temperature and density
- Measure spatially dependent 4π mix and burn in CD/ T_2 capsules/gas targets
 - Separated nuclear reactants burn mainly in the mix layer
- Measure defect induced mix and its spatially dependent effects on burn



Re-Shock and Shear are two laser-driven experiments designed to study the turbulent mixing of materials.



▪ **Experimental Objective:** Perform experiments to study the physics of re-shock and shear-driven mix under HED conditions.

Project Motivation:

- **ICF:** Shock waves traverse capsule defects and initiate mix between shell and fuel, degrading yield.
- **Astrophysical jets:** Supernova remnants, young stellar objects, and planetary nebulae are subject to complex evolution involving shock and shear.



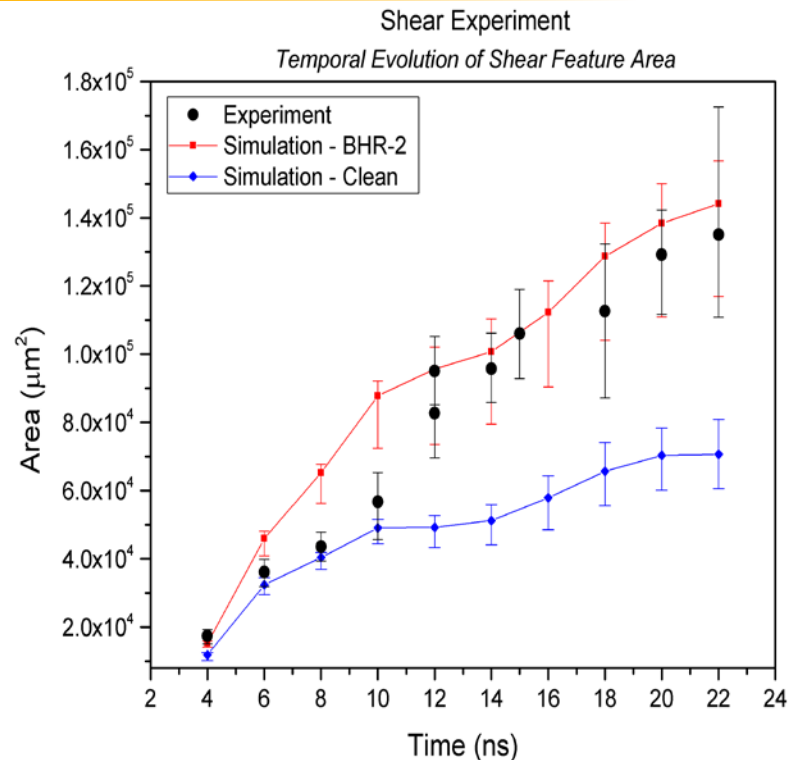
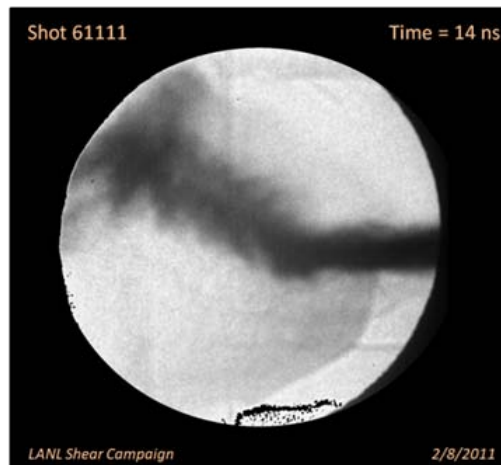
- **Project Objective:** Provide detailed quantitative data to validate and improve the BHR-2 mix model in the RAGE hydrodynamic code.
- **Funded by 10.2 and other components of program**

- *Theoretical Design, XTD Division; J. Fincke, L. Welser-Sherrill, F. Doss*
- *Experimental Physics, P Division; E. Loomis, K. Flippo, D. Offermann, P. Keiter*
- *High-Resolution LES Simulations, XCP Division; B. Haines, F. Grinstein*

In FY-2012 43 shear and re-shock experimental shots were executed on the OMEGA laser and a complete time history obtained for both

- Data was compared to both pre-shot and post shot calculations.
- Modeling included both BHR and LES calculations.
- Results are currently being used to examine the relative importance of select model terms.

■ Turbulent K-H structure is evident in radiograph



■ Shear layer evolution, typical radiograph at left, composite growth curve above

The FY-2013 goal is to transition the experiment to NIF where the larger scale will provide a longer time period for mix layer growth

- The HED-Council has recommended 6 -Tier 1 shots on NIF in FY-13
- The counter-propagating shear platform uses shocks to produce flow in opposite directions across a dense plate.
- Observation of late time turbulent growth requires larger targets and longer pulses supporting the shocks and delaying formation of the rarefactions.
- Both the colliding shock and shear experiments use the same basic setup and diagnostics and are virtually interchangeable.
- FY-13 will primarily address platform development and obtain shear data at late time.

