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X-ray Conversion Efficiency in Low-Z and Mid-Z Lined Hohlraum Targets

39th Annual Anomalous Absorption Conference

Bodega Bay, CA, June 14-19, 2009

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X-ray Conversion Efficiency in Low-Z and Mid-Z Lined Hohlraum Targets

Presented at
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Institutions and staff contributing to this effort include:

R. Olson, R. Leeper, G. Rochau

T. Boehly, W. Seka

L. Suter, E. Dewald

In cryogenic vacuum hohlraum experiments, it is observed that the Tr(t) is degraded.

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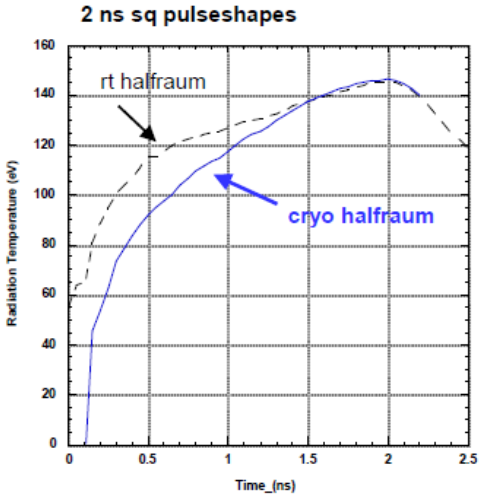
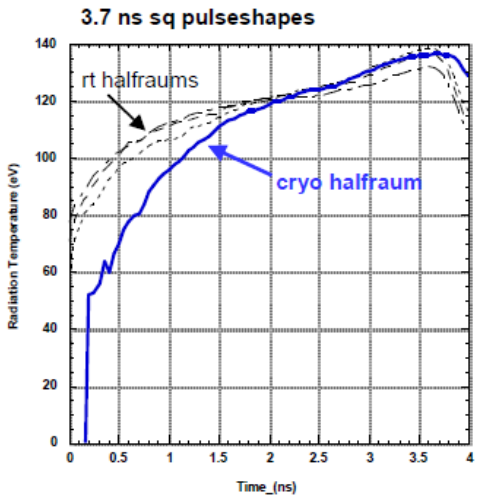
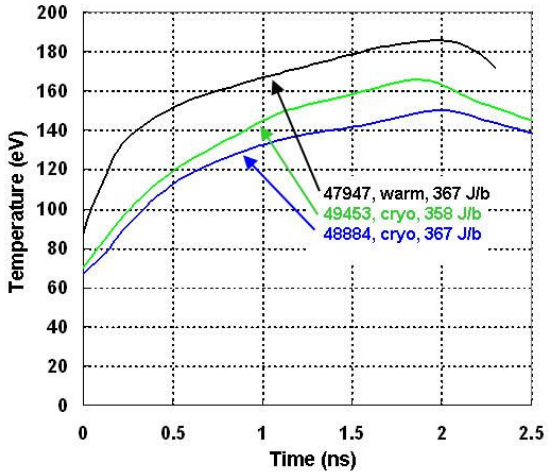
Tr(t) unfolds of Omega Dante data.







Our hypothesis is that condensates are, in effect, a low-Z liner on the hohlraum interior.

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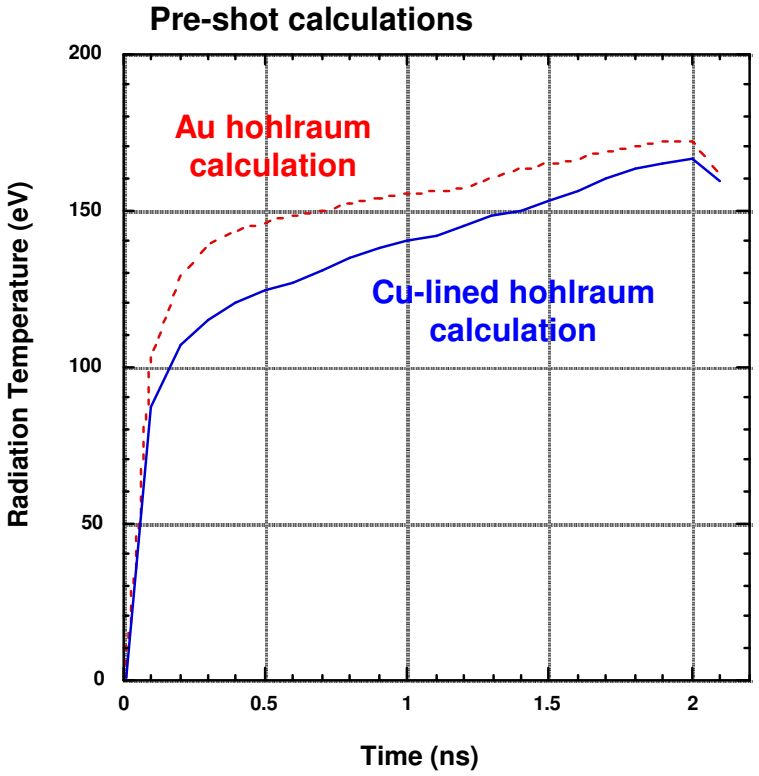
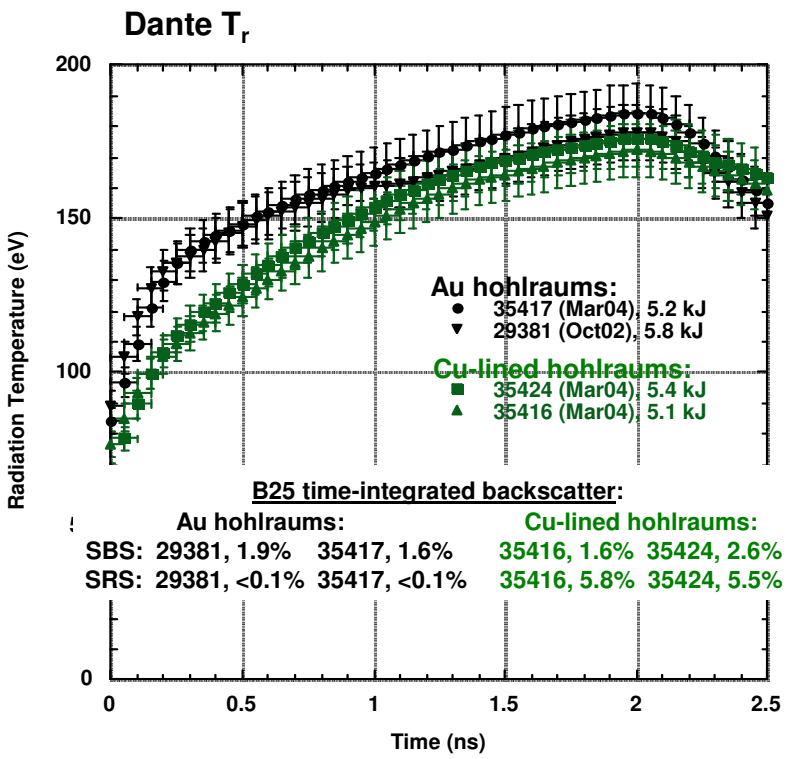
Our previous experience with Cu-lined halfraums* supported the condensate hypothesis.





*Modification of a Laser Hohlraum Spectrum via a Mid-Z Wall Liner",
Bull. Am. Phys. Soc. 49, 24 (2004).

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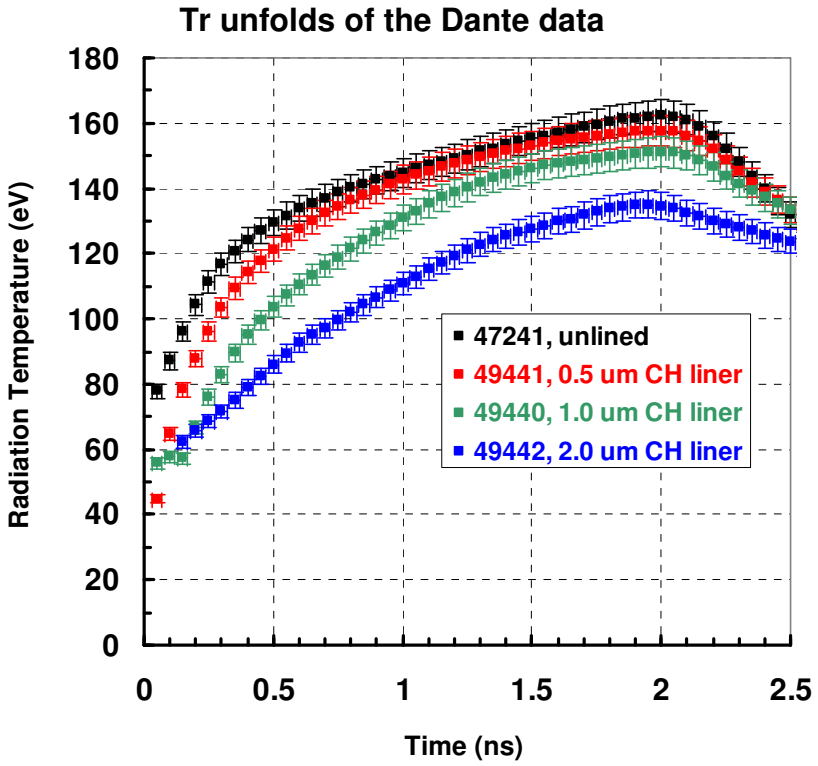
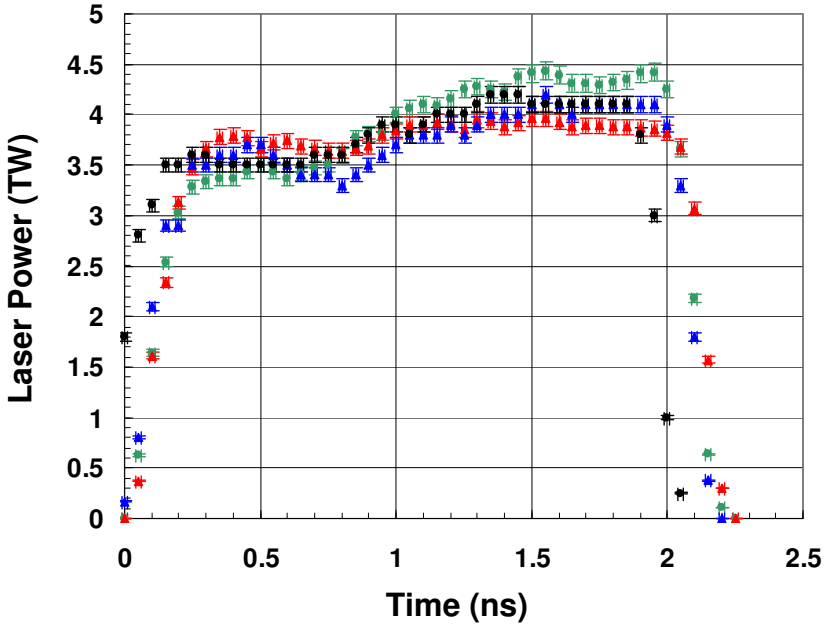
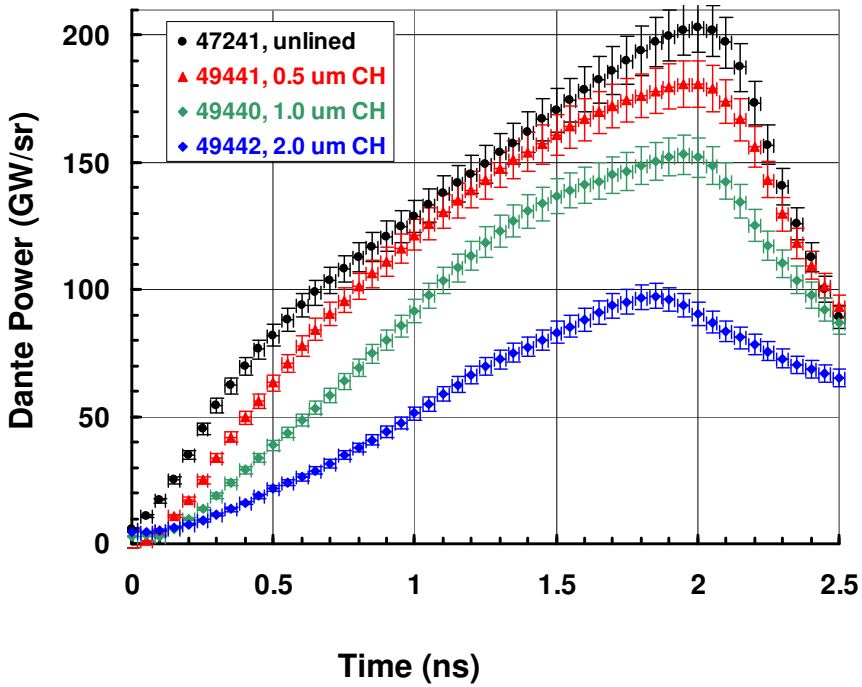
The hypothesized condensates are low-Z, so the idea was tested with a series of CH-lined hohlraums.



The degradation of X-ray output appears to be correlated to liner thickness .





A simple hohlraum model suggests three possible explanations...

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$$P_{Labs\ x\text{-}ray} = (1-)A_w\ T^4 + A_{LEH's}\ T^4$$

1 2 3

1) Increased backscatter will reduce absorbed laser power.

2) Laser absorption in low-Z plasma will have reduced x-ray conversion efficiency.

3) A low-Z wall will have a reduced x-ray albedo.

$$P_{las} = P_{bs} + P_{xr} + P_w + P_{pl}$$

These three quantities are measured.

P_w can be estimated from A_w (1-)T^4

Hypothesis is that a large P_{pl} leads to the extremely inefficient CH lined hohlraums.

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An integrated Lasnex simulation was done for each of the CH-lined and unlined hohlraum experiments.

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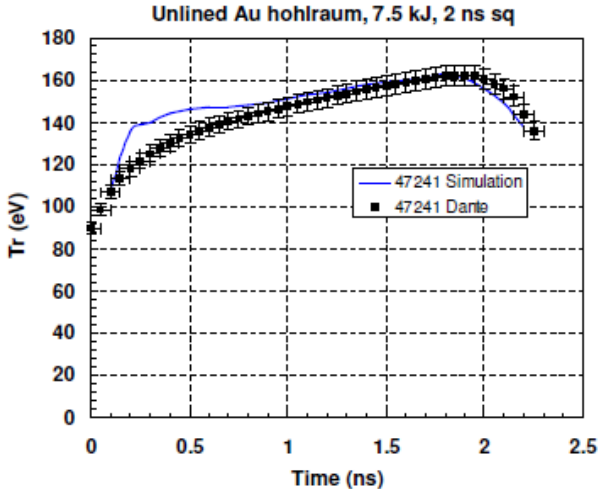

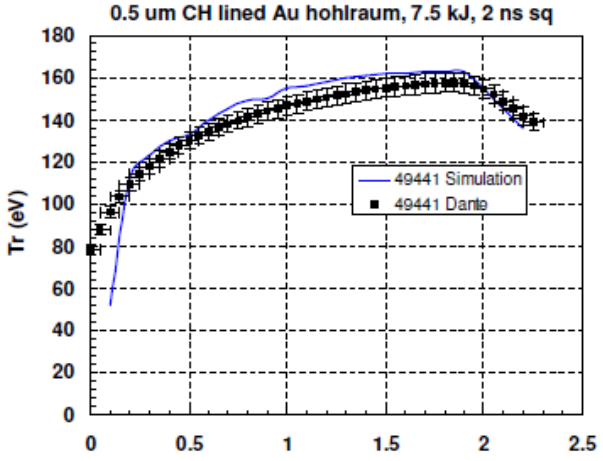

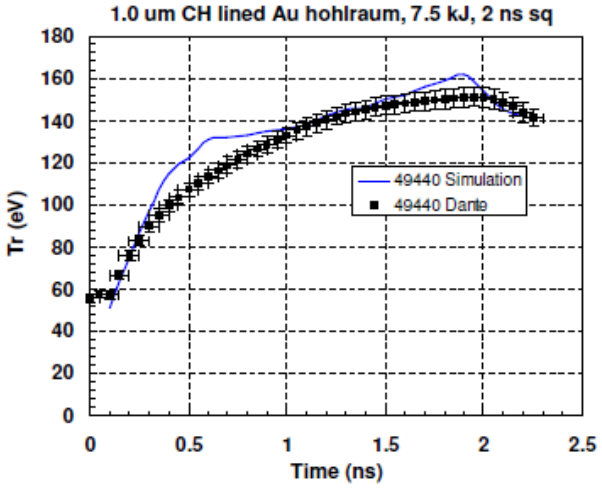

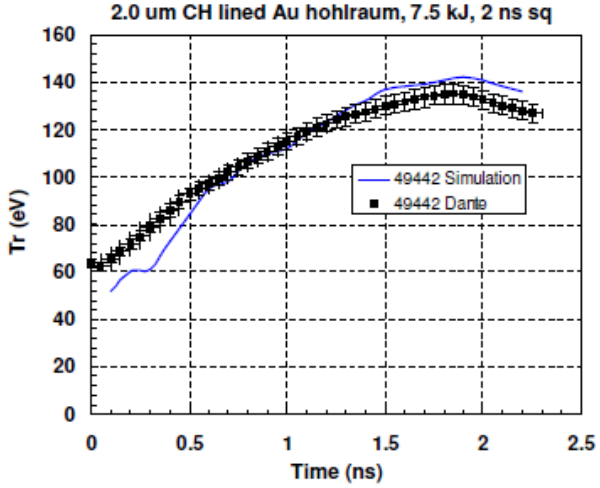

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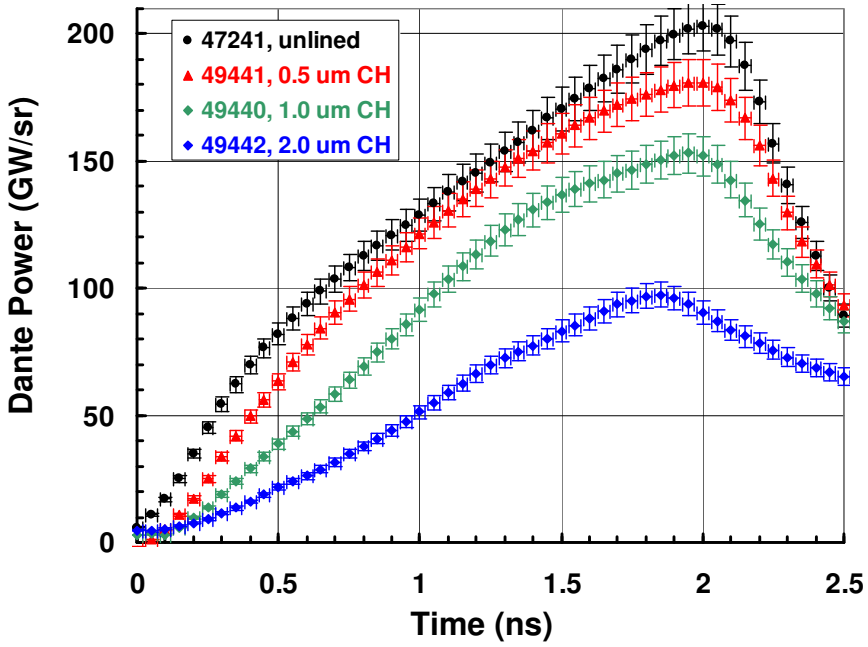
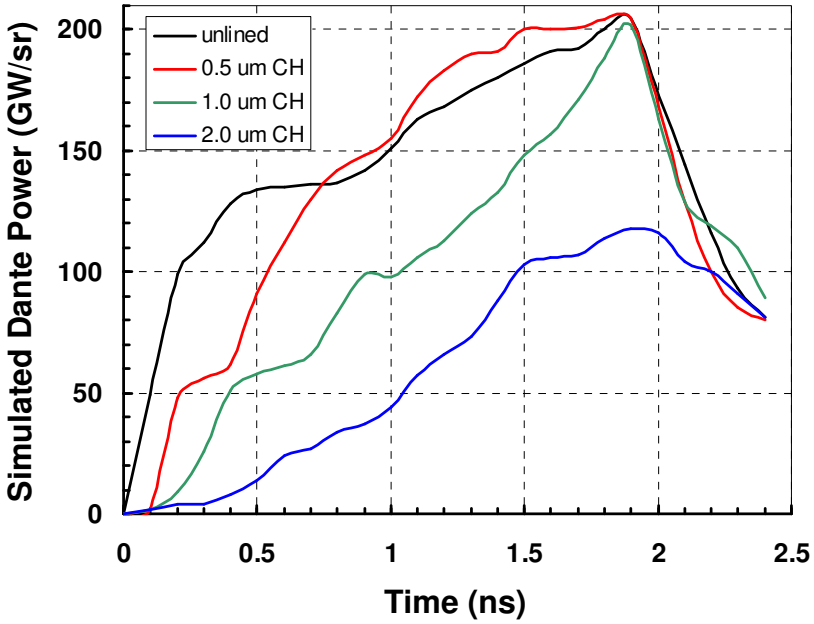
The simulations capture the basic trend in the Dante data.





The simulations indicate that the CH-lined hohlraums have increased levels of blowoff plasma.

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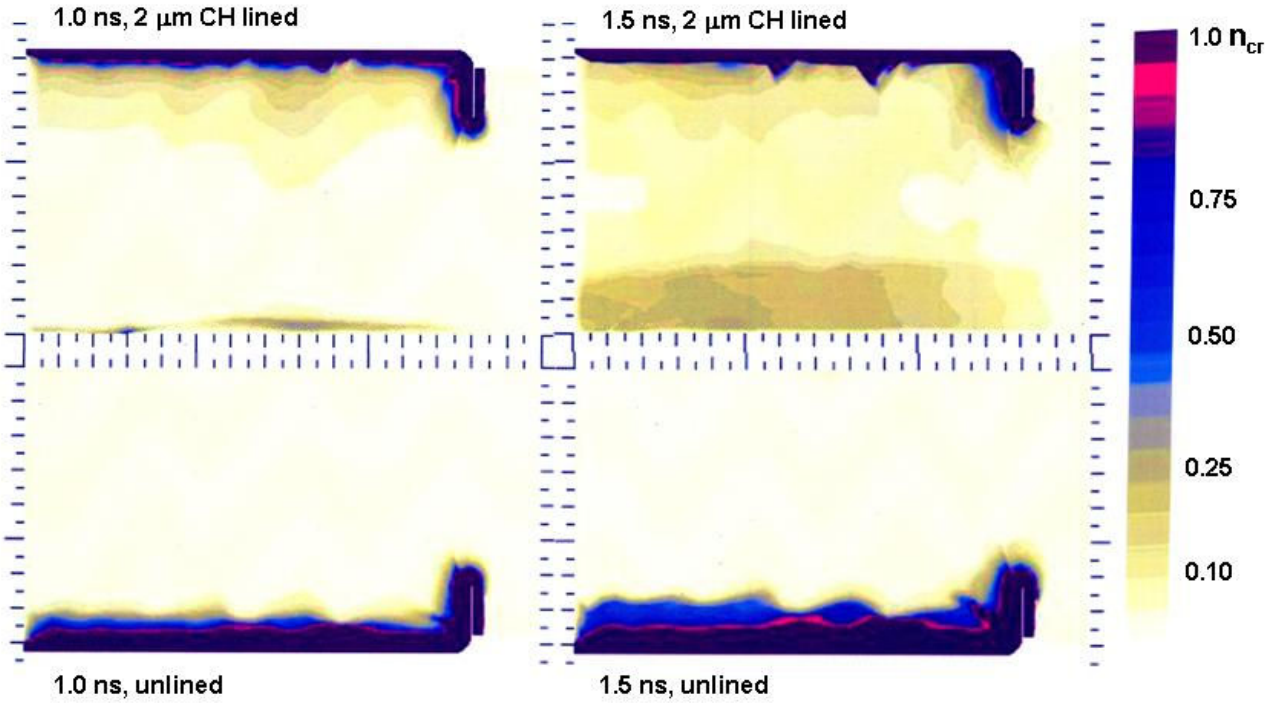

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The simulations indicate that excessive energy is in the blowoff plasma in the CH-lined hohlraums

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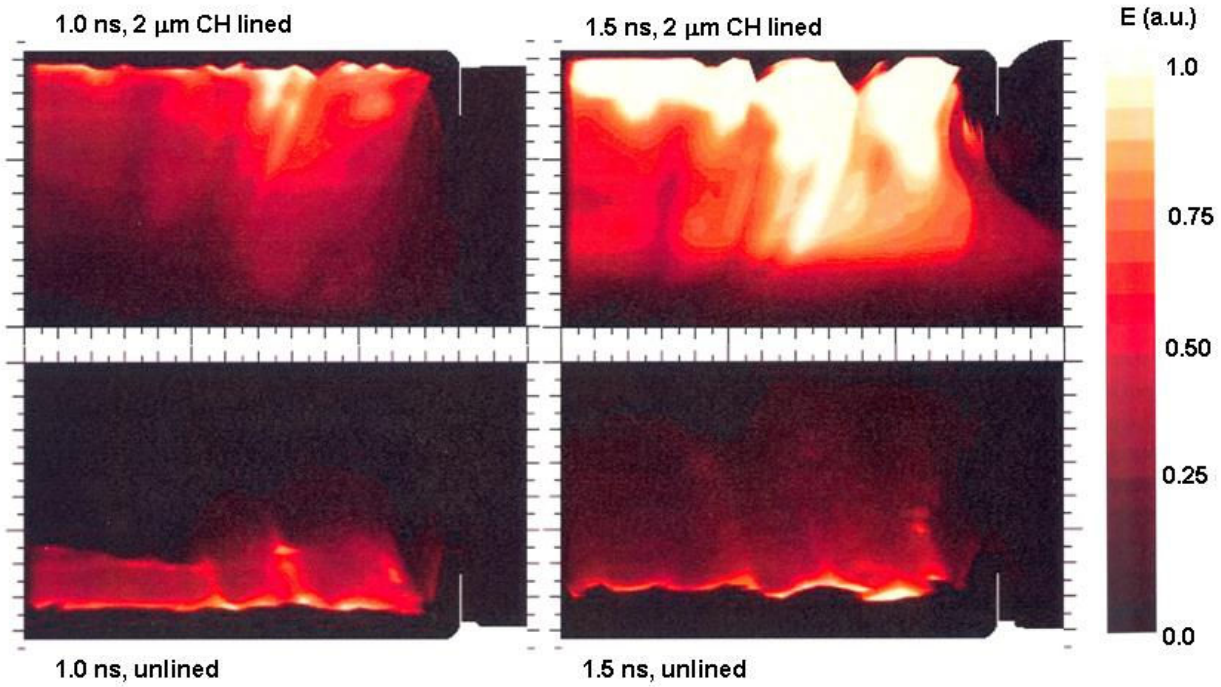

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The total energy in the blowoff plasma in the CH-lined hohlraums is ~2-3x greater than in the unlined hohlraum.

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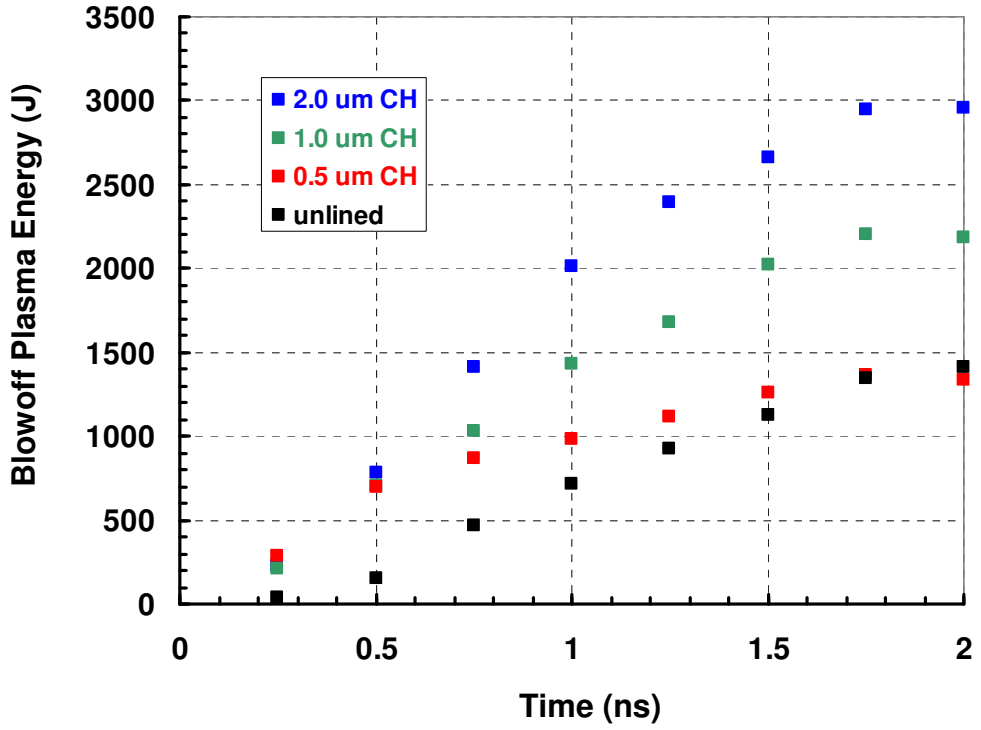

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Summary

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In cryogenic vacuum hohlraum experiments, it is observed that the $T_r(t)$ is degraded.

Our hypothesis is that condensates form a low-Z liner on the cryogenic hohlraum wall.

A series of Omega experiments shows that X-ray output is correlated with the thickness of the CH wall liner.

Although laser backscatter is increased with the CH, the SRS and SBS measurements are only ~10% greater.

Integrated Lasnex simulations of the experiments indicate that the significant energy loss into low-Z blowoff plasma can result in very inefficient hohlraums.