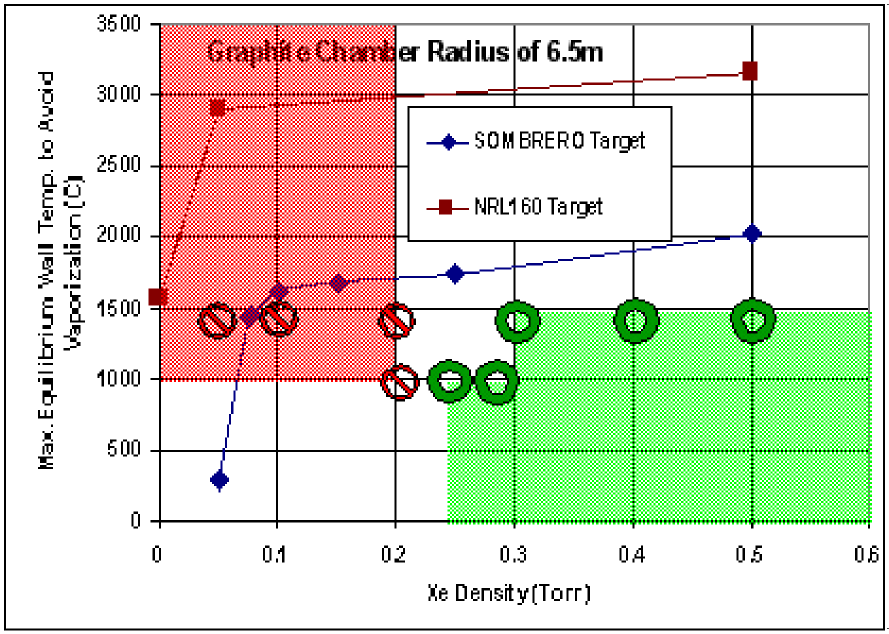
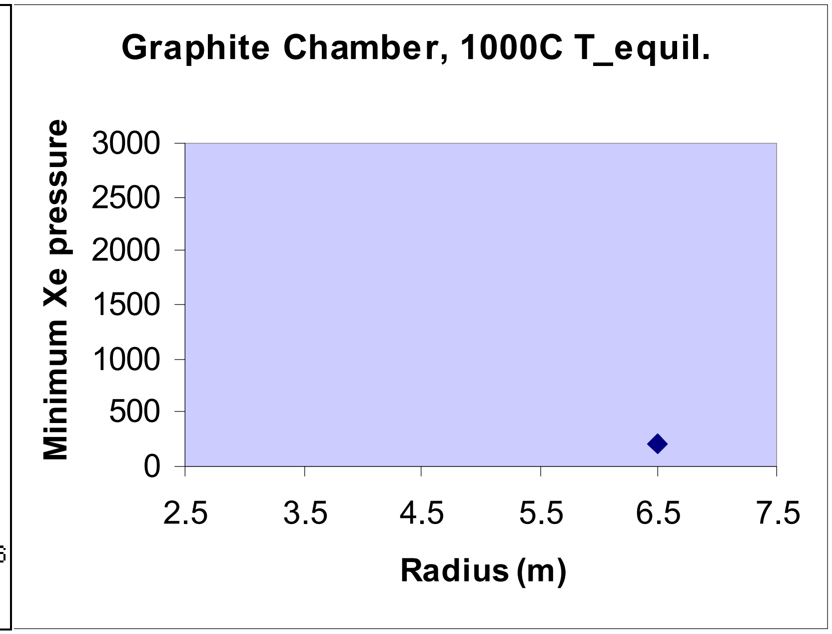
Dry Wall Response to the HIB (close-coupled): Refinement of T-Xe and R-Xe operating windows

Operating windows as of June's meeting:





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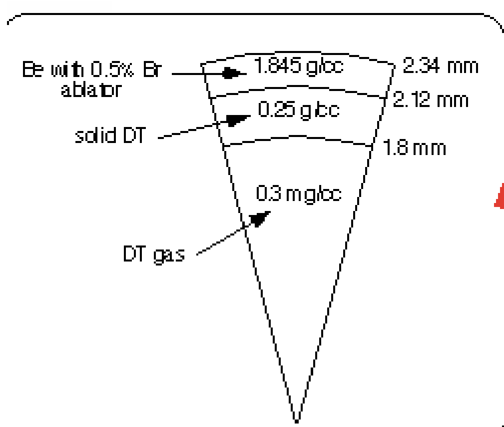
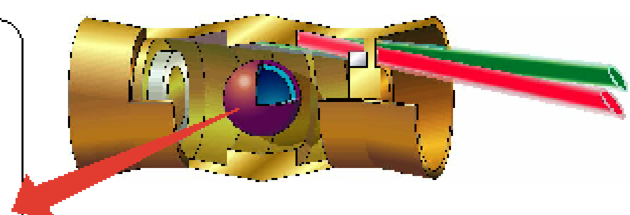
Summary/Outline

Further BUCKY calculations of first wall response to the Closely-coupled HIB target output in a gas protected dry wall graphite chamber have refined operating windows in two planes of parameter space: **Xe density vs. equilibrium temperature** for a fixed (6.5m) radius chamber, and **radius vs. Xe density** for a fixed (1000C) equilibrium temperature.

- The curvature of the boundary in the density vs. T_{eq} is less marked than that for the direct drive targets we have studied.
- Minimum Xe density varies greatly between 3m and 6.5m.
- Hot gas remnant issue.

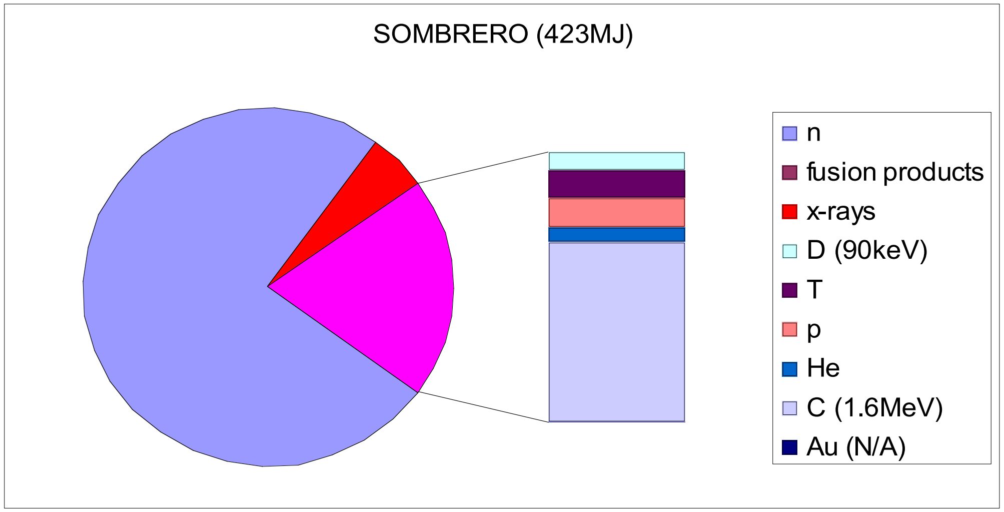


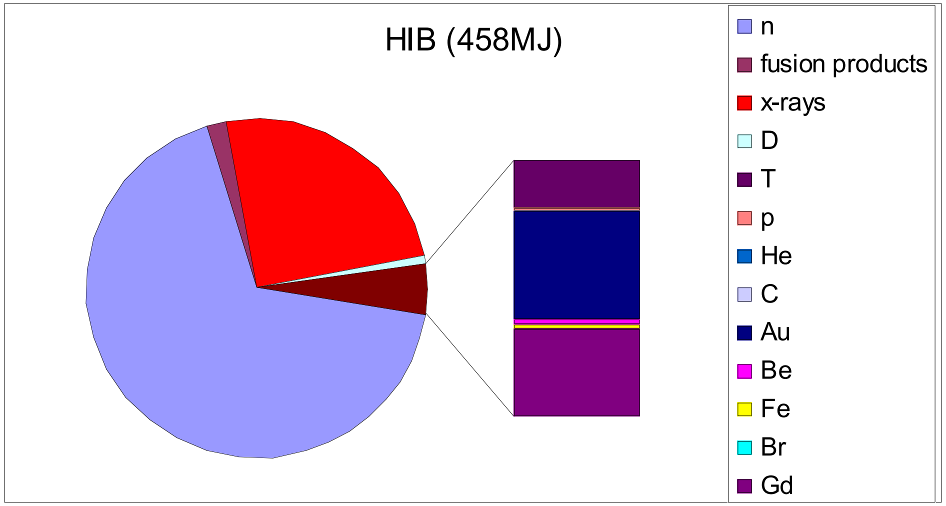


Ion beam characteristics:
3.5 GeV Pb+ ions
3.3 MJ input energy
1.7 mm effective radius spot

Though the total yields of the SOMBRERO and high yield closely-coupled HIB targets are similar, the partitioning and spectra of the non-neutronic output differ significantly.

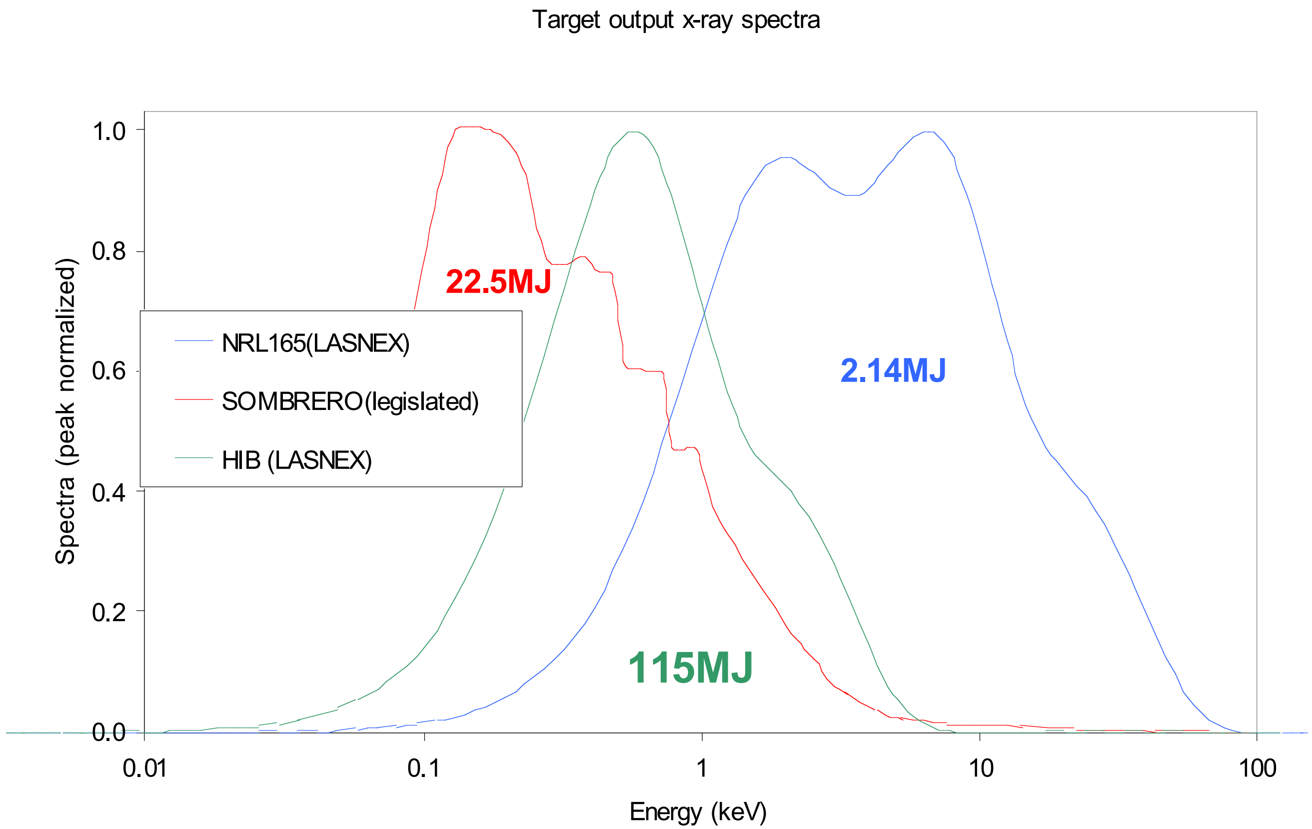
- Over 25% of the yield from this target is in x-rays, compared with 5% of SOMBRERO's, or 1% of the NRL Au-coated targets'.





X-ray Spectra

- The x-ray spectrum of the HIB target is harder than that of the SOMBRERO, but not so hard as the NRL Au-coated target.
- "Quantity has a certain quality all its own."

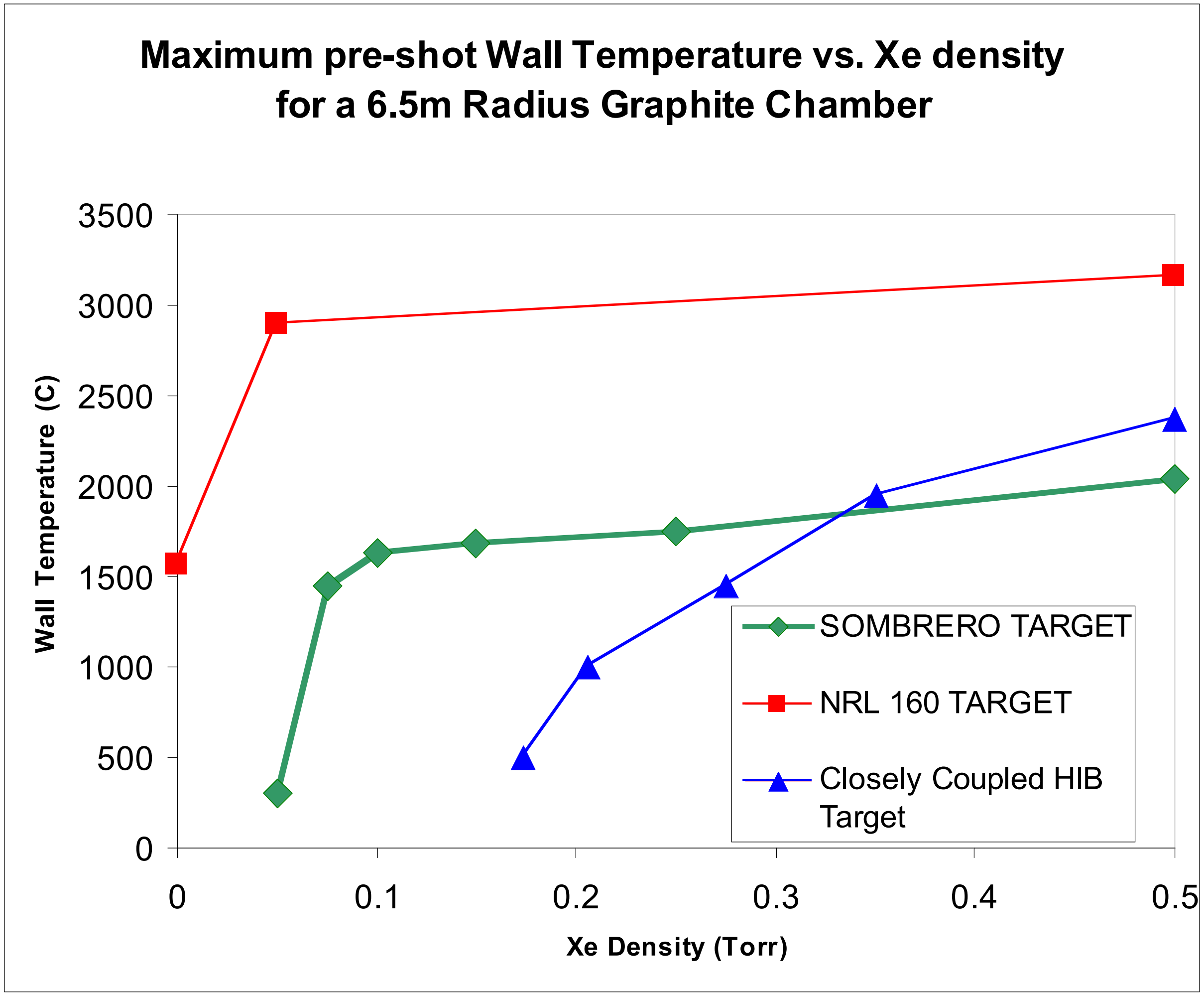


If our goal is to prevent vaporization in a 6.5m chamber, we must include a buffer gas at pressures above those required for SOMBRERO.

6.5m Graphite chamber results:

Chamber survives at 1000C, at 210mTorr, 1450C at 300mTorr, up to 10^{-4}s after target implosion.

- The gas density and equilibrium wall temperature have been varied to find the highest wall temperature that avoids vaporization at a given gas density.
- Vaporization is defined as more than one mono-layer of mass loss from the surface per shot.
- The use of Xe gas to absorb and re-emit target energy increases the allowable wall temperature substantially.



1000C Graphite chamber results:

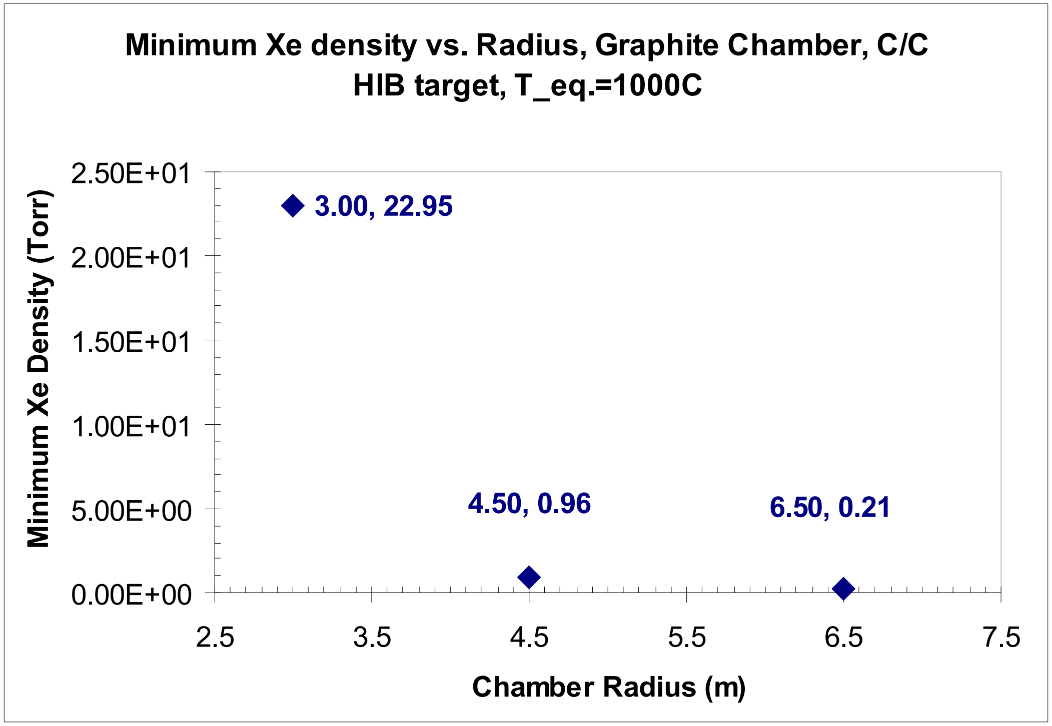
The minimum Xe density required to protect the first wall varies strongly between 3m and 6.5m chamber radius, and the dependence is not well fit by assuming that a constant areal density is required.

•3m simulation run out to 0.5ms. The wall survives flash from x-rays, and initial re-radiation.

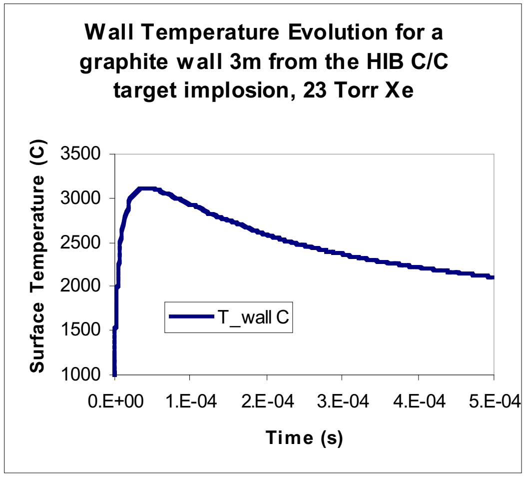
•However, chamber gas is still <u>very</u> hot (>1eV out to 2.4m) and continues to slowly heat the wall after the shock wave reaches it. 60MJ is remains in the gas.

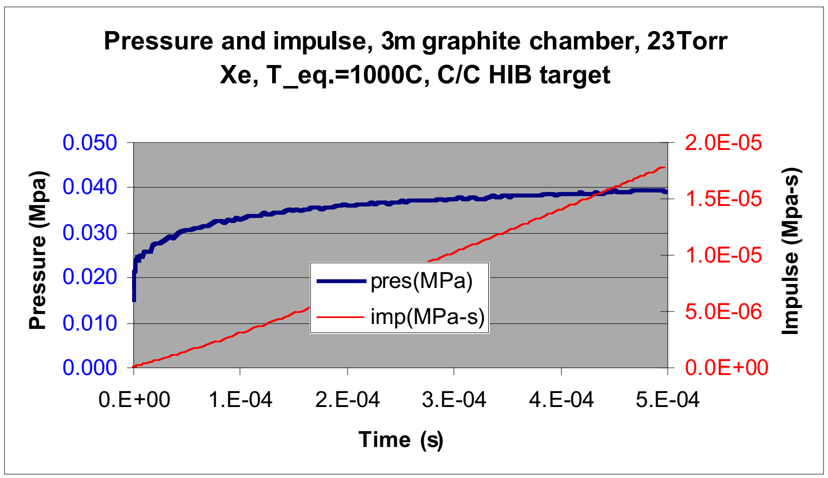
•At the end of the simulation, the wall surface temperature is still above 2000C.

• However, the wall is cooling, and, <u>if one cared to extrapolate</u>, the wall would return to the coolant temperature by the next shot.



At the minimum Xe pressure required to protect a graphite first wall at 3m from the closely-coupled HIB target implosion, the peak pressure on the first wall is ~0.04 MPa, and the total impulse > 18 Pa-s.





- The chamber gas is still very hot (over 12,000K), and continues to bake the wall for as long as I have run the calculation (0.5ms). By this time the shock has rebounded from the spherical wall of the BUCKY simulation, and the applicability of this type of calculation has to be assessed.
- Is chamber clearing necessary to flush the hot gas?

Conclusions/Summary

- Gas protection of the first wall is effective in stopping the prompt x-rays and the effects of immediate re-radiation from the excited, ionized gas.
- However, even with the lowest amount of Xe required to prevent flash vaporization, we are left with a very hot gas (>1eV for 3m chamber) at the end of the BUCKY simulations.
- **We still need to consistently connect the times of post-shot "flash" and next-target injection.**