Hohlraum Radiation Field Characteristics

sample orientation at the midplane and DANTE vs. sample T_R conditions

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Orientation of a sample at midplane

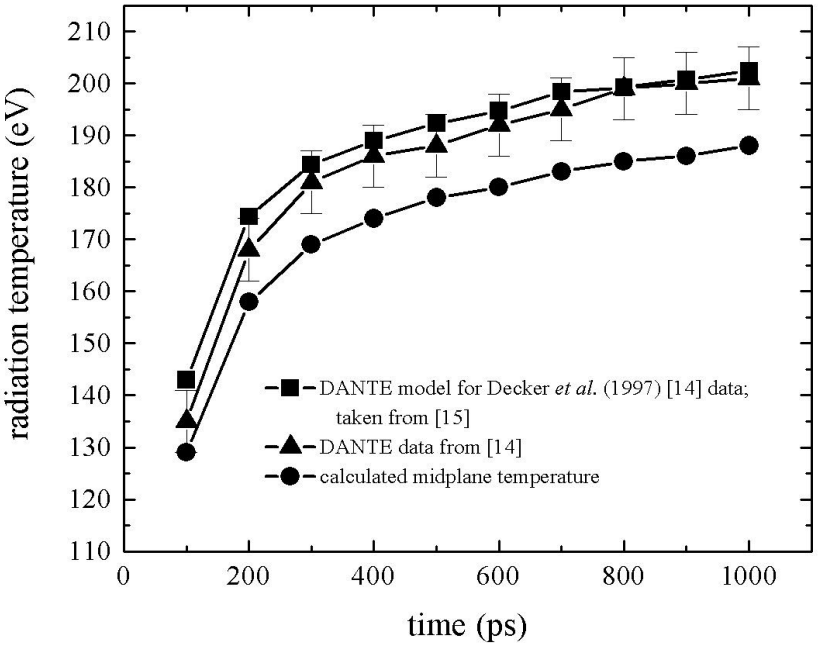
Our starting point is the data from Decker *et al.* PRL (1997):

A study of DANTE-through-the-LEH diagnostic

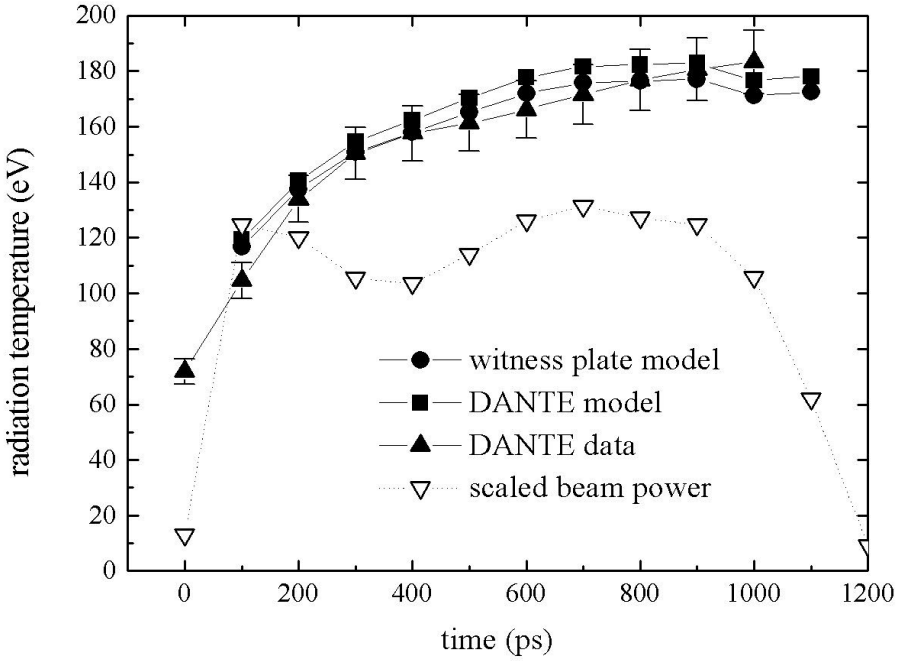
The proximate motivation is to explore the $T_{\text{dante}}/T_{\text{sample}}$ difference between hohlraum and halfraum configurations--the value of this ratio is much closer to unity for halfraums, and is significantly >1 for hohlraums.

Could this be due to the *orientation* (and/or position) of the sample (LEH-facing in the case of a halfraum and wall-facing for a hohlraum)? …the essential difference between a hohlraum and a halfraum is the orientation of the sample.

Hohlraum (left) vs. halfraum (right) - Figs. 5 & 6 from our Physics of Plasmas paper: calculated DANTE temperature is significantly higher than sample temperature in hohlraum, but they're more similar in halfraum



Difference is 14 eV at 0.1 ns and 14 eV at 1.0 ns



Difference is 2 eV at 0.1 ns and 5 eV at 1.0 ns

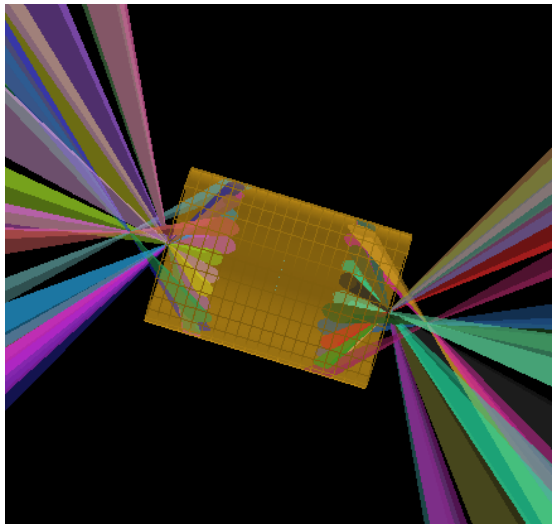
The parameters used in the hohlraum calculations shown here are taken from Decker *et al.*:

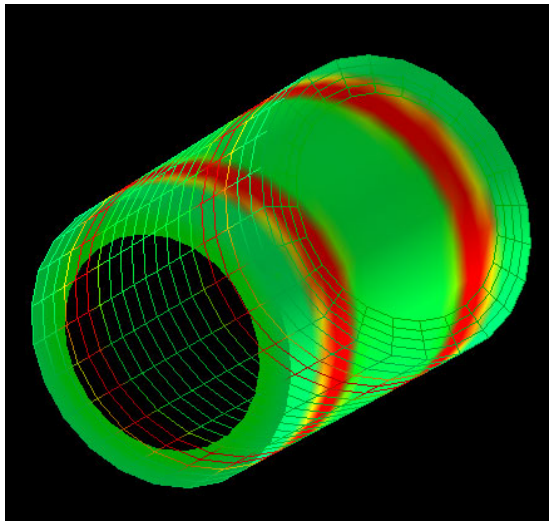
1600 X 2300 micron gold hohlraum with 600 micron radius LEHs;

OMEGA P6-P7 axis with 30 cone 2 and cone 3 beams, pointed to make a single ring on each side (cone 2 beams are pointed about 400 microns outside of the LEH);

1 ns square pulse (power assumed per beam is 0.5 TW);

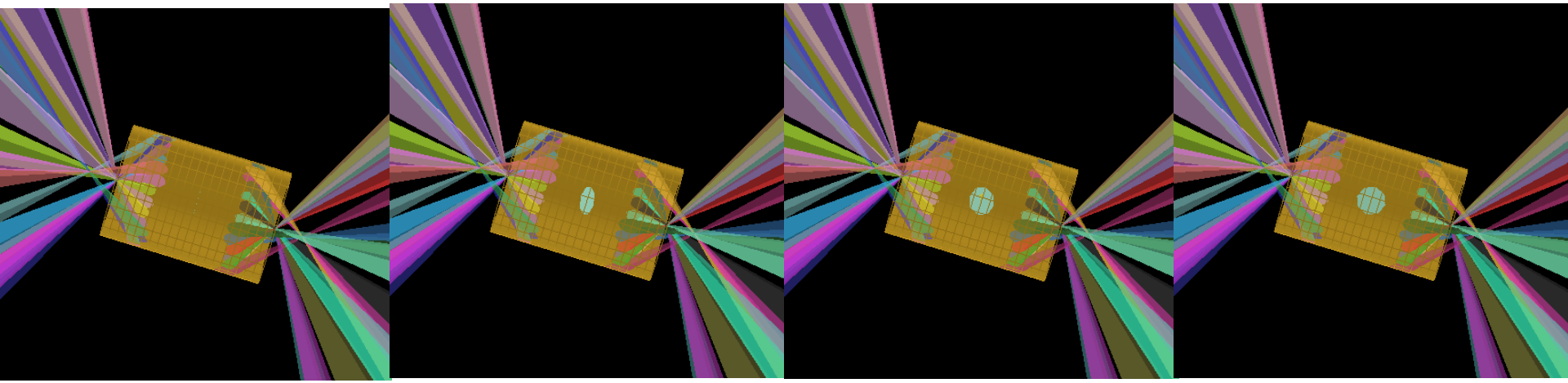
A realistic XCE and gold albedo model were used.





First, we investigate the dependence of the sample temperature on its orientation and position at the midplane of a hohlraum

A flat "sample" disk at the hohlraum center (TCC); it can be rotated from 0º (LEH-facing) to 90º (wall-facing)



0º 30º 60º 90º

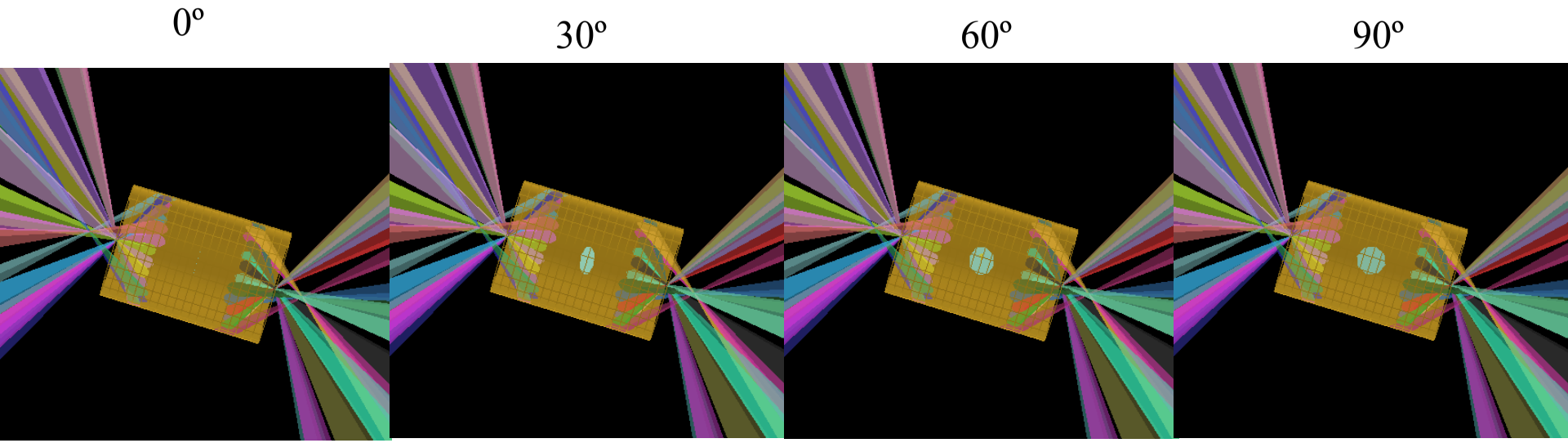
Note: the size of the sample is exaggerated by a factor of 10 in these images. In the calculations, it was 20 microns in diameter.

And the sample is seen edge-on in the first image on the left above.

We report on two representative times from our model (0.1 and 1.0 ns)

These two times have xce=0.275 and albedo=0.184 for t=0.1 ns

And xce=0.55 and albedo=0.73 for t=1.0 ns

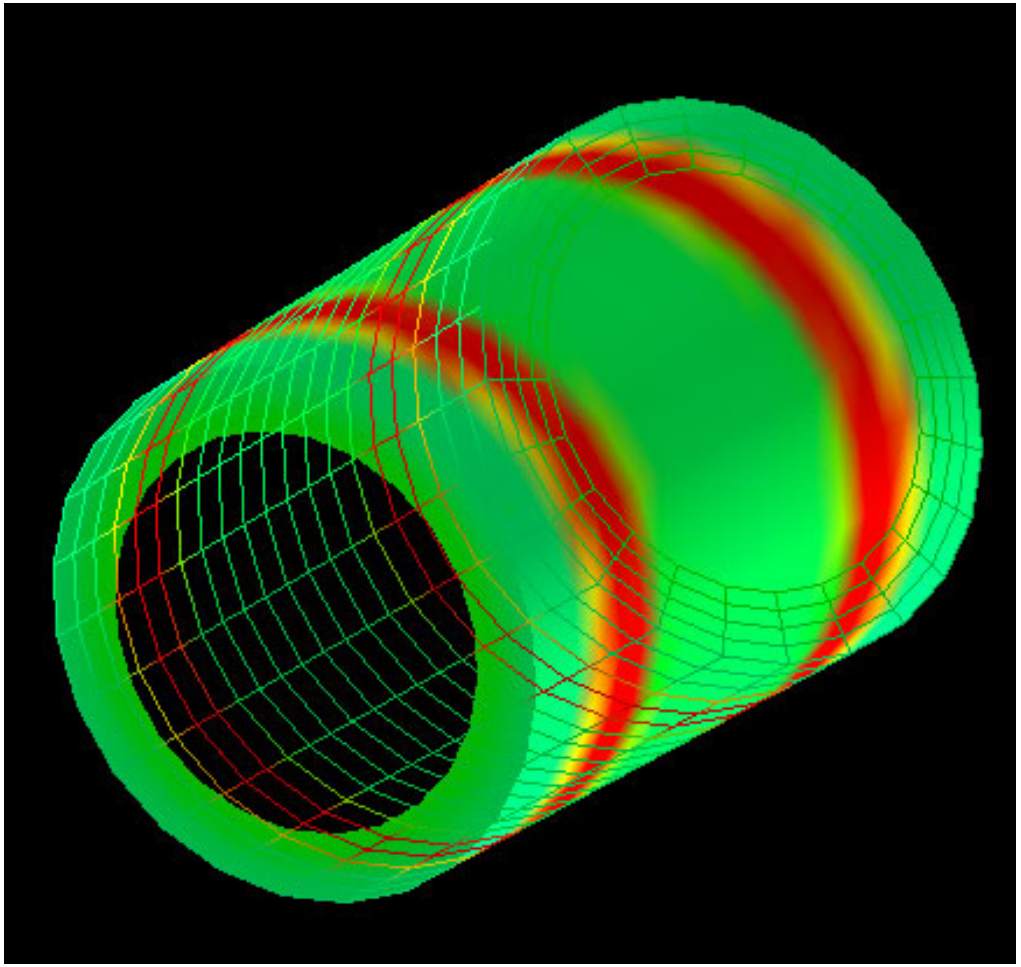


Radiation temperature on the sample

0.1 ns	135 eV	131 eV	128 eV	129 eV
1.0 ns	190 eV	188 eV	189 eV	191 eV

There is no clear or significant trend of T_R with sample orientation.
Although, with the low albedo (t=0.1 ns) there is a slightly higher T_R for the LEH-facing sample.

For comparison, the DANTE temperature was 143 eV and 202 eV, at t=0.1 ns and t=1.0 ns, respectively



Emission temperature on a 140 to 220 eV color scale range (same range used in all the hohlraum images in this presentation)

Even the wall-facing sample (90º) in the previous slides is not identical to a wall-mounted midplane package on a hohlraum, or even directly related to a wall reemission measurement through a diagnostic hole, because the sample in these calculations was at the *center* of the volume of the hohlraum (*i.e.* not against the wall).

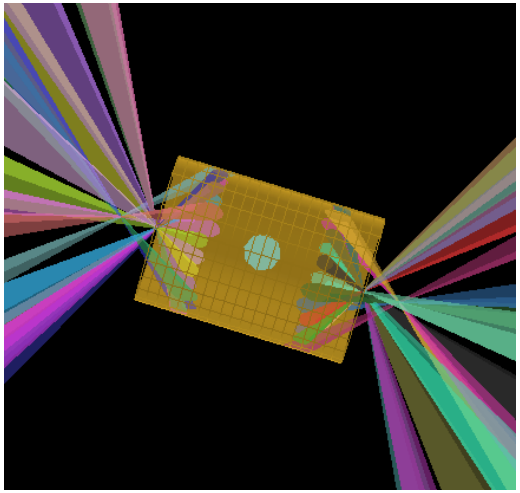
So, we next moved the sample from the center of the hohlraum toward the wall, in two steps, to see if the T_R on the sample would decrease with this different view (the LEHs should fill more of the sky, I would think).

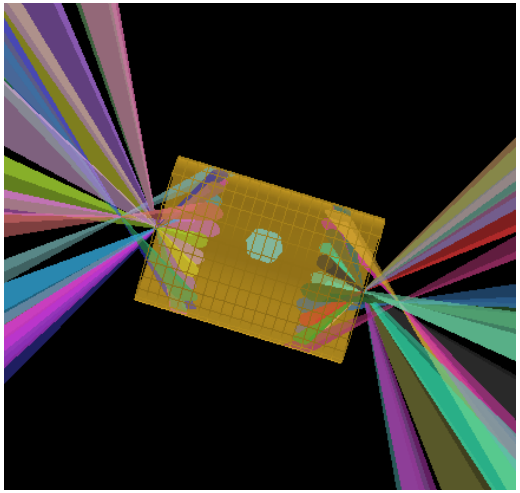
These two calculations should be compared to the 90º case from the previous slides.

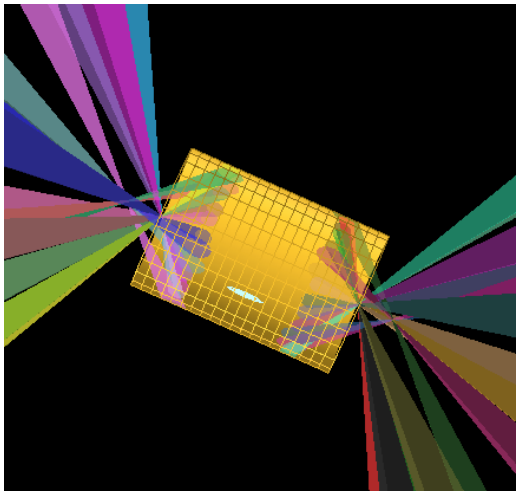
For 90º we had T_R = 129 eV, 191 eV

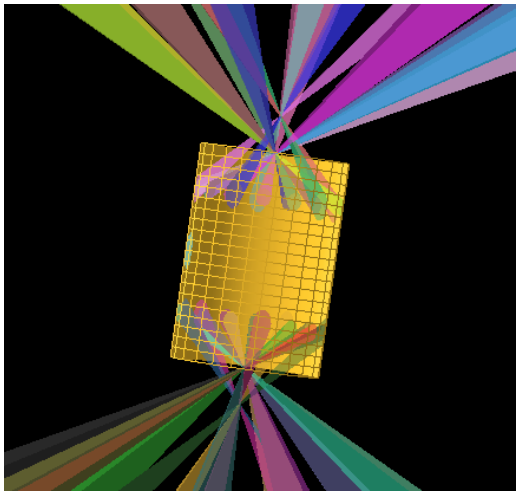
Sample is still wall-facing (90º), but is now *half way* between the center of the hohlraum and the wall (400 microns from each).

Here the sample is against the wall. Drive temperatures on the sample at the two times are shown below.









t=0.1 ns	131 eV	(compare to 129 eV)	129 eV
t=1.0 ns	191 eV	(compare to 191 eV)	188 eV

Conclusions

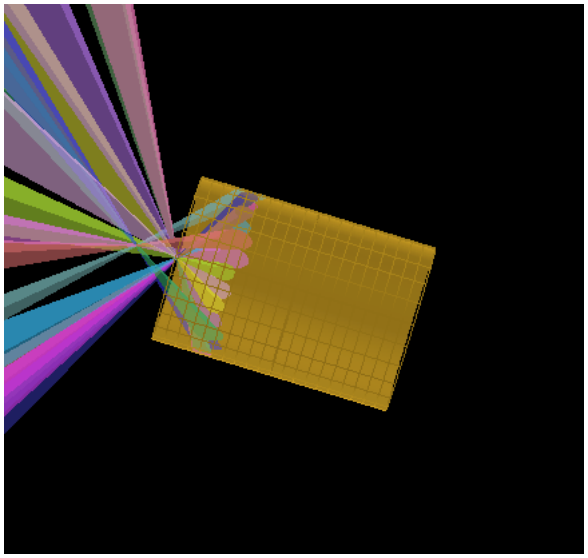
There is very little temperature advantage--if any--in having a midplane sample face the LEH (it seems to me that this should already be known from spherical capsules (reemission balls?)).

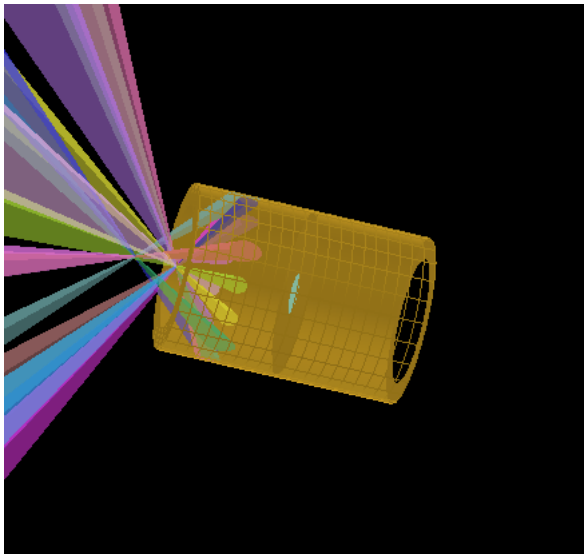
There is no significant dependence on position (center of hohlraum vs. against the wall) for a wall-facing sample's radiation temperature.

Small variations, like what we've found, should have an effect on capsule symmetry, at some level.

If sample orientation and position do not have a significant effect, then could the presence of the “back wall” in a halfraum make a difference in the sample temperature - in either an absolute sense or relative to the DANTE temperature?

To make this hohlraum into a halfraum, I added a circular disk at the midplane, and used only the 15 beams from one side. The sample is in the middle of the disk

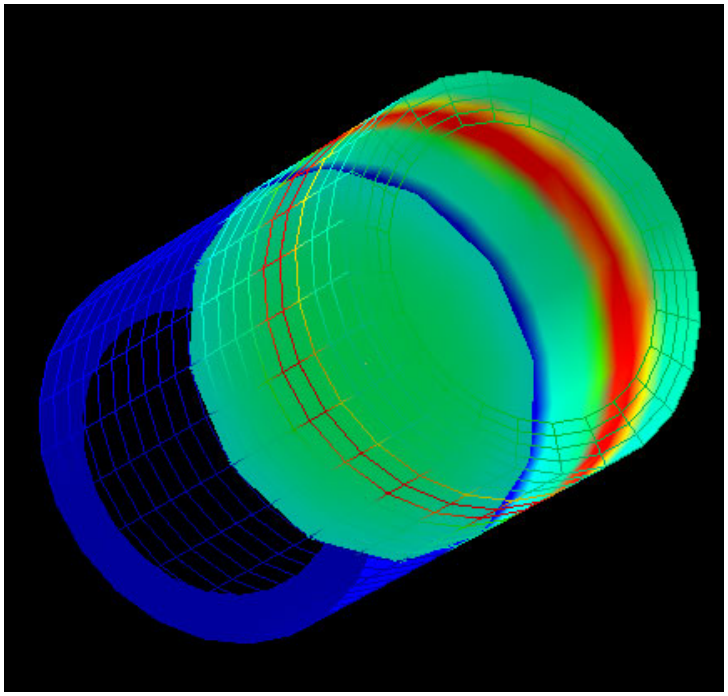


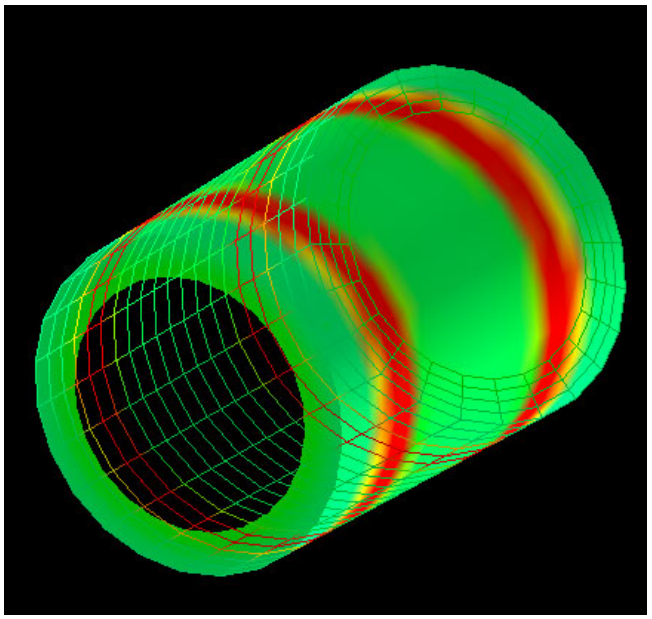


0.1 ns	134 eV
1.0 ns	186 eV

Note that these temperatures are very similar to the corresponding hohlraum simulation: 135 eV and 190 eV. If anything, the disk/back wall/halfraum configuration makes the sample *cooler*.

The DANTE view





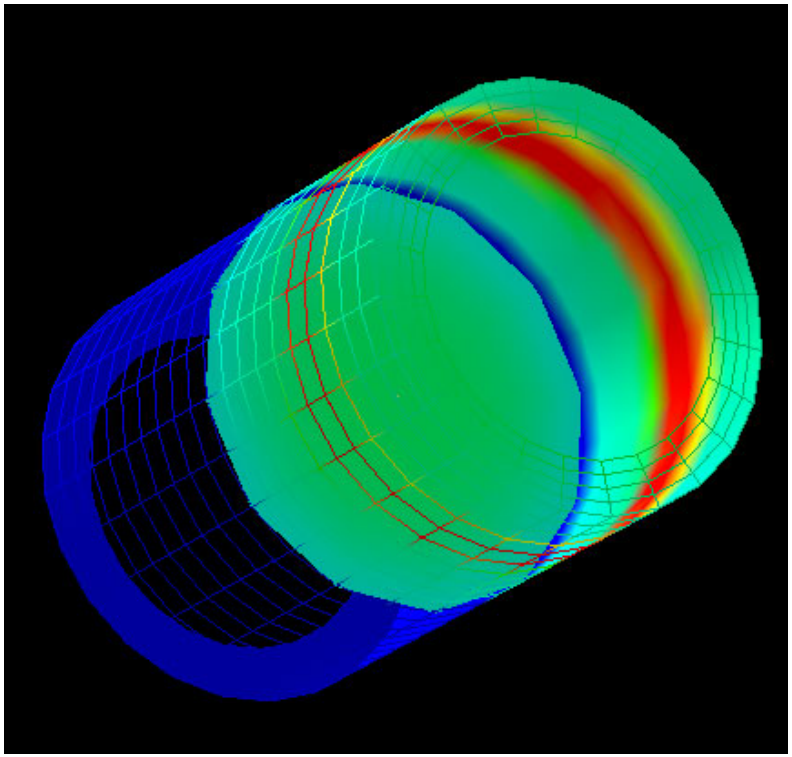
Compare with standard hohlraum

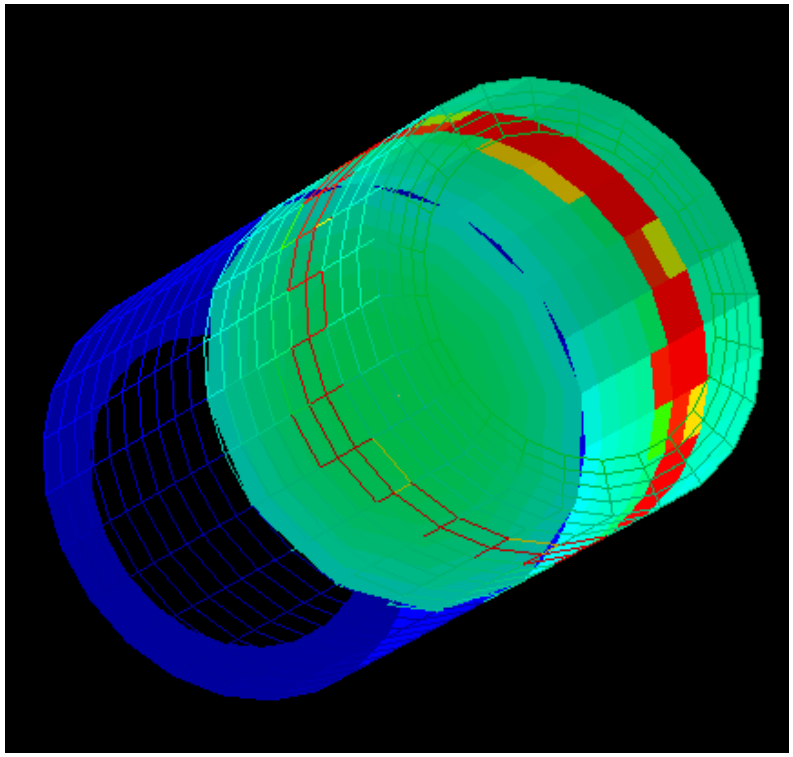
0.1 ns	137 eV	143 eV
1.0 ns	193 eV	202 eV

The DANTE temperatures are significantly cooler in the halfraum case; the back wall is cooler than the hohlraum sidewall and edge of the far ring of hot spots whose view is ‘blocked’ by the back wall.

The area where the back wall meets the wall of the hohlraum looks cooler in this image, but that is an artifact of the color assignment and smoothing.

If we turn off the smoothing, this region of lower temperature looks better, and any remaining lower temperature areas are simply edge-effects and averaging effects; the radiosities of the surface elements are *not* affected.





Same simulation, but without any smoothing of the color image

With the back wall, the hohlraum configuration has a DANTE temperature that exceeds the sample temperature by only 3 eV at 0.1 ns and 7 eV at 1.0 ns.

This is similar to what's seen in Fig. 6 of our paper, but it's not identical, as the beam powers were a little lower and not identical to each other and that halfraum is a little bit longer in the calculations for the paper.

Main Conclusions

1. The DANTE/sample temperature discrepancy is bigger in the hohlraum configuration than the halfraum configuration because the DANTE temperature is higher in the hohlraum, because DANTE sees some of the hot spots on the far side of the hohlraum. The DANTE temperature is lower in an equivalent halfraum (while the sample temperature is similar or slightly lower).
2. Drive temperature onto a sample at the midplane of a hohlraum is basically unaffected by the sample's lateral position or orientation. In a low-albedo environment, a LEH-facing sample is slightly hotter than a wall-facing sample.

   It might be fruitful to explore the effects of varying the beam pointing in the hohlraum simulations.