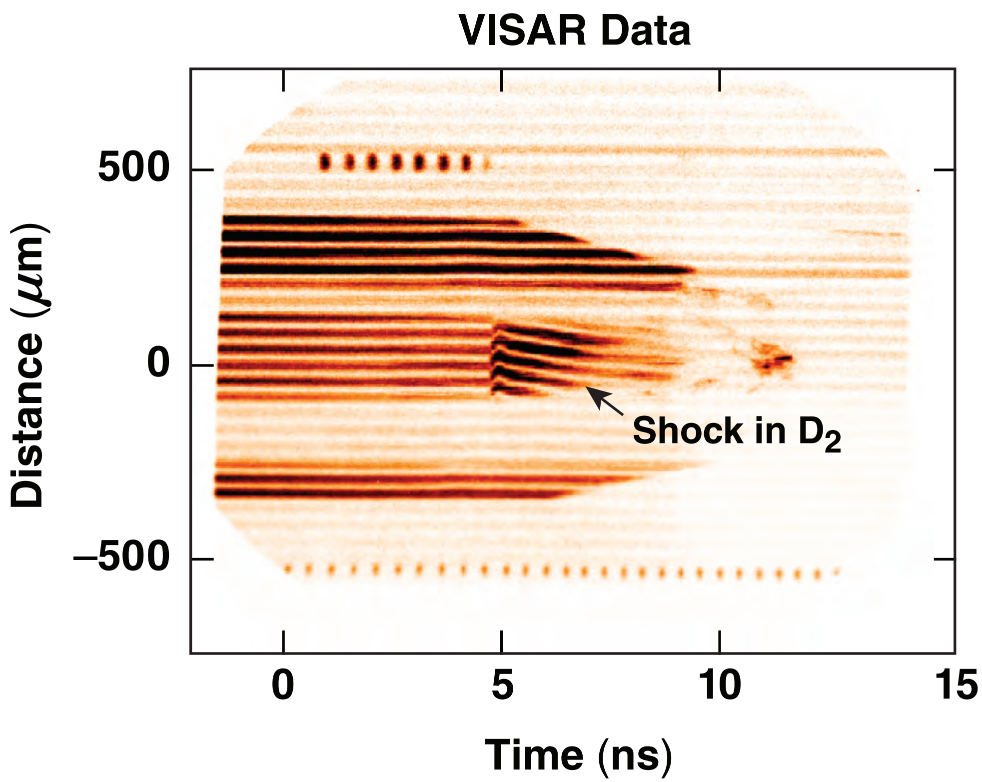
Development of Shock-Timing Techniques for the National Ignition Facility



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Summary

OMEGA experiments have validated the shock-timing technique planned for the NIF

- Ignition targets require precise timing (±50 ps) of the first three shocks for optimal performance
- Optical measurements (VISAR and self-emission) can readily achieve that precision when T_{rad} = ~170 eV and I_{wall} = 100 TW/cm^2
- OMEGA experiments have demonstrated that optical shock-timing measurements can be performed at and above NIF-relevant x-ray loading (at 1.5 to 4 keV)
- Cryogenic hohlraum experiments on OMEGA have validated the shock-timing technique under NIF-like conditions

Collaborators

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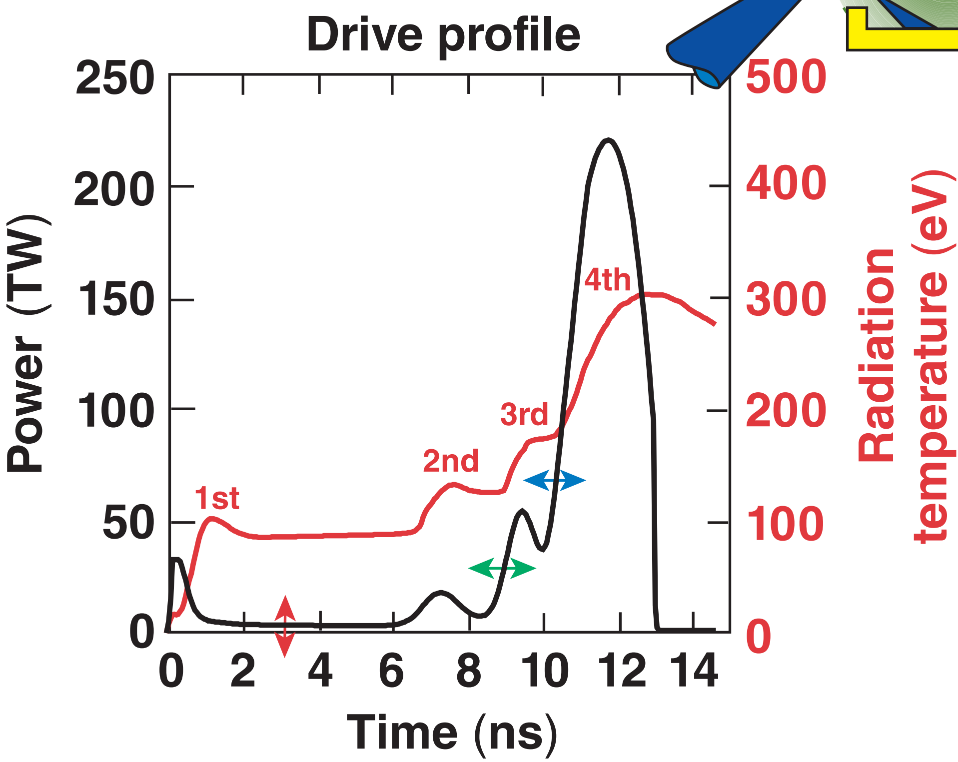
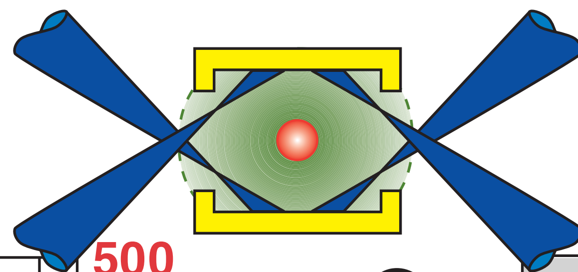
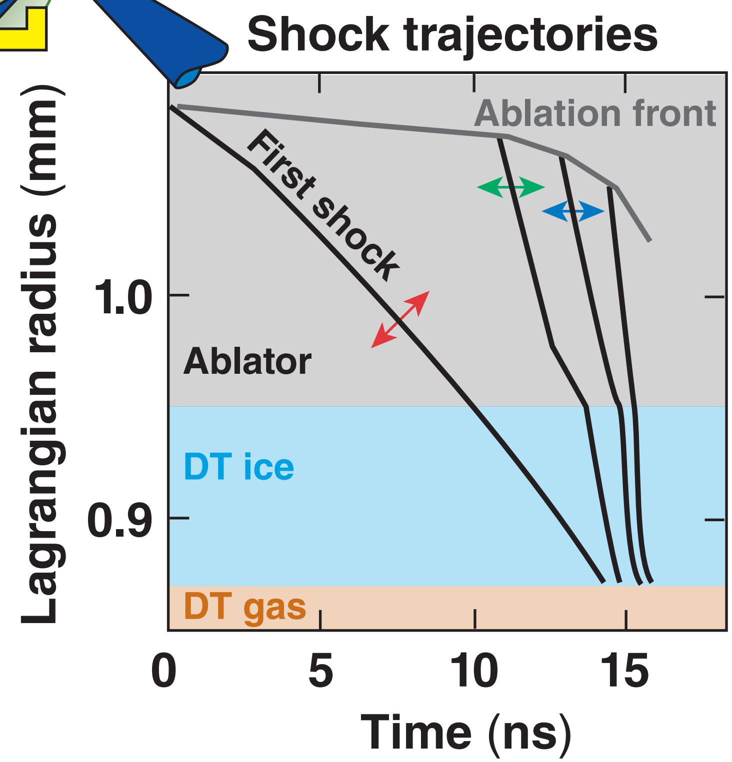
Indirect-drive-ignition capsules use four shocks to achieve ignition







- First three shocks ±50 ps
- Fourth shock ±100 ps

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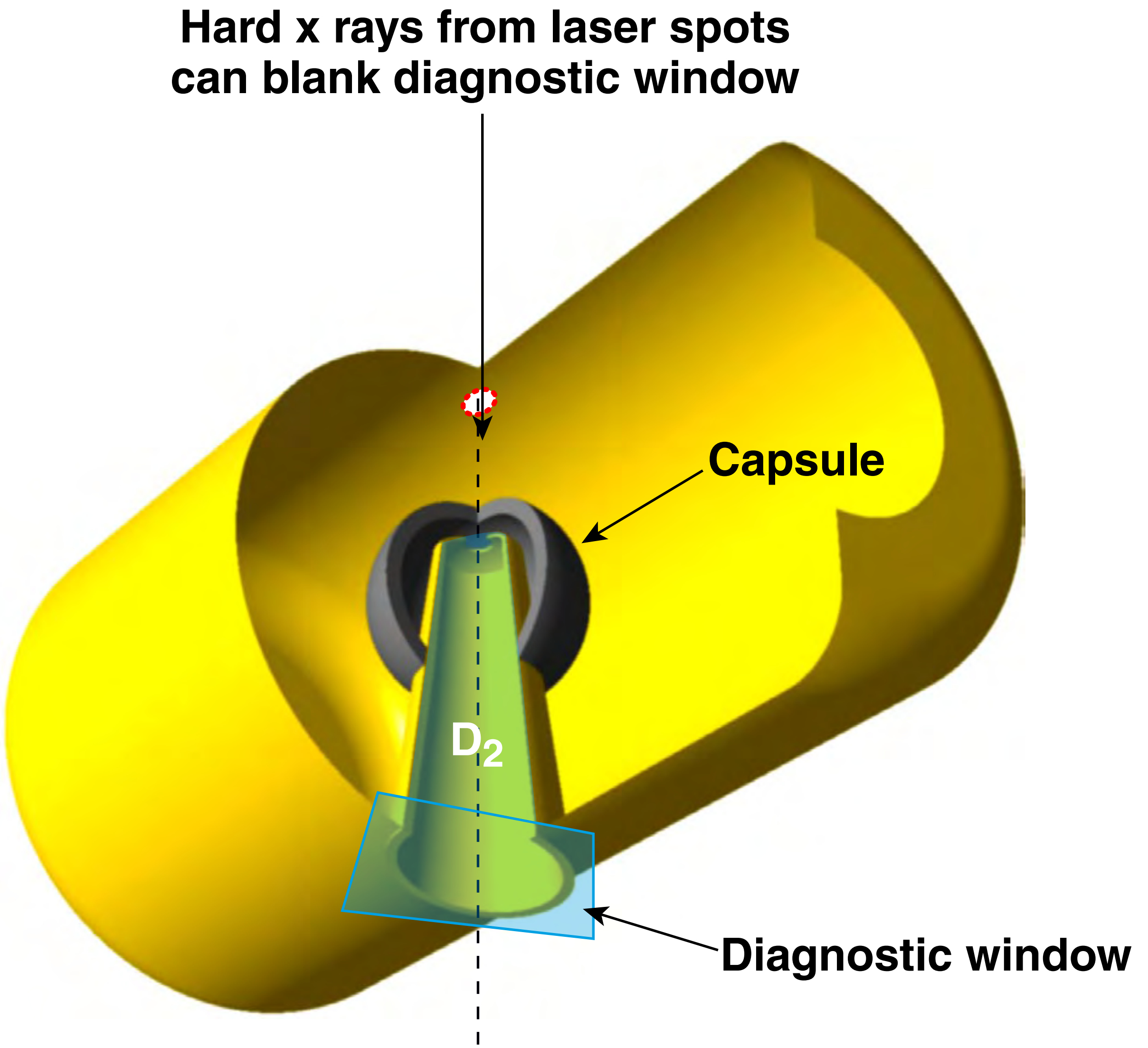
NIF shock timing will be measured through a cone that penetrates the hohlraum and the sphere inside



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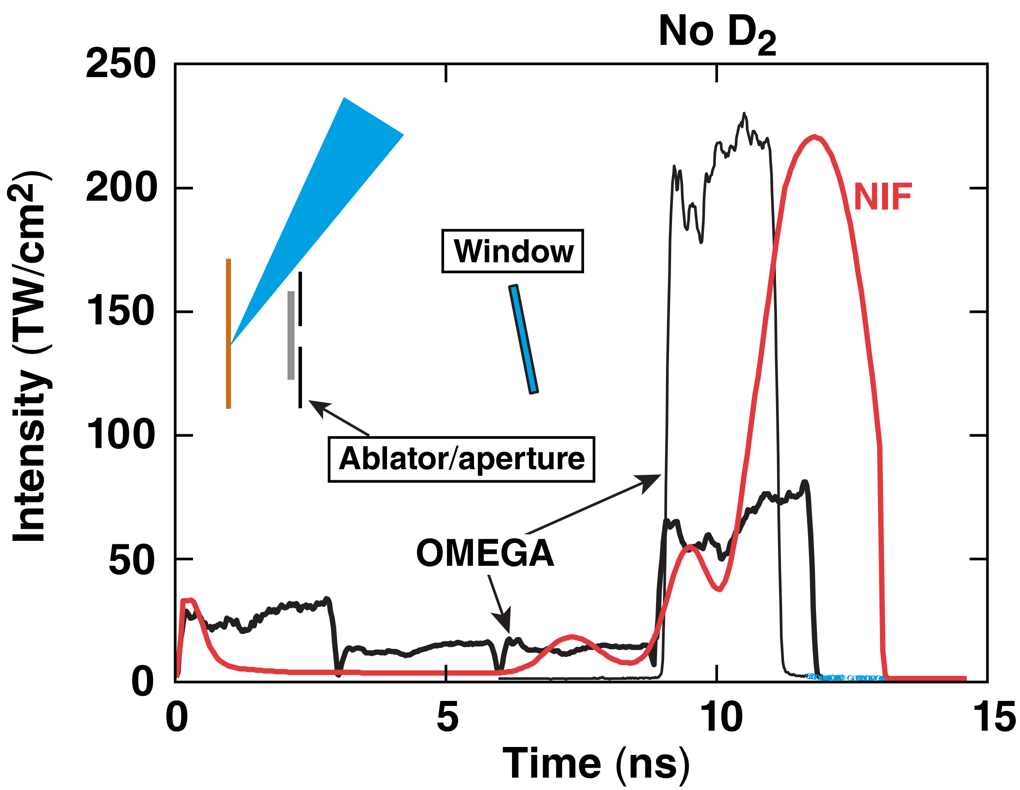
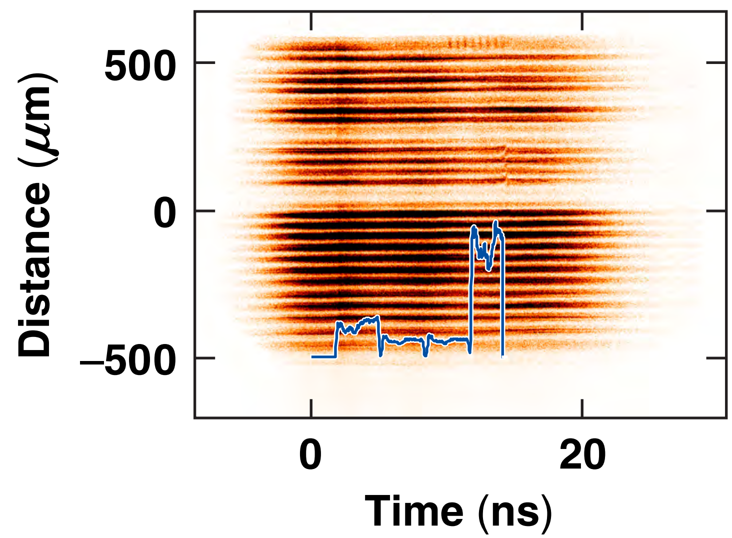
Stacked-pulse experiments show that neither instantaneous nor integrated flux are expected to be problems





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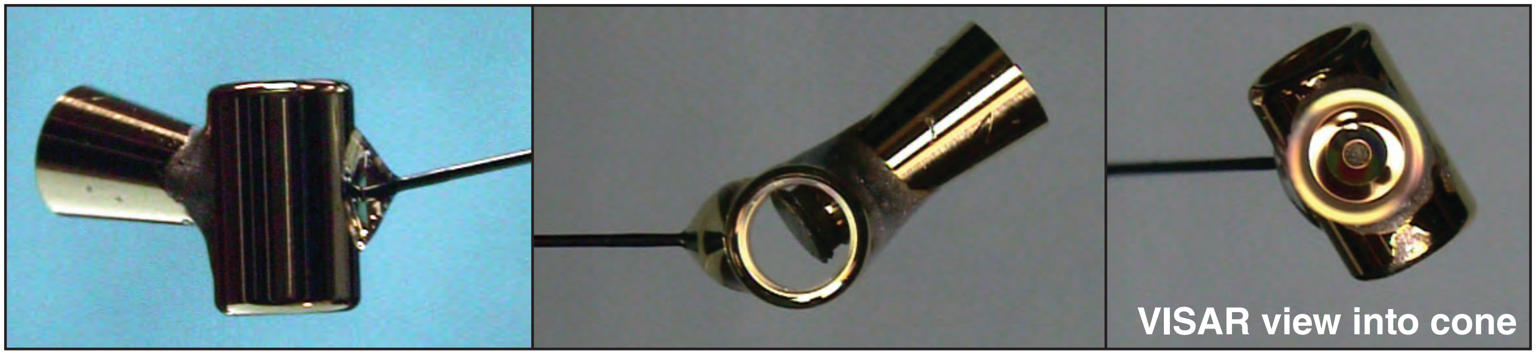
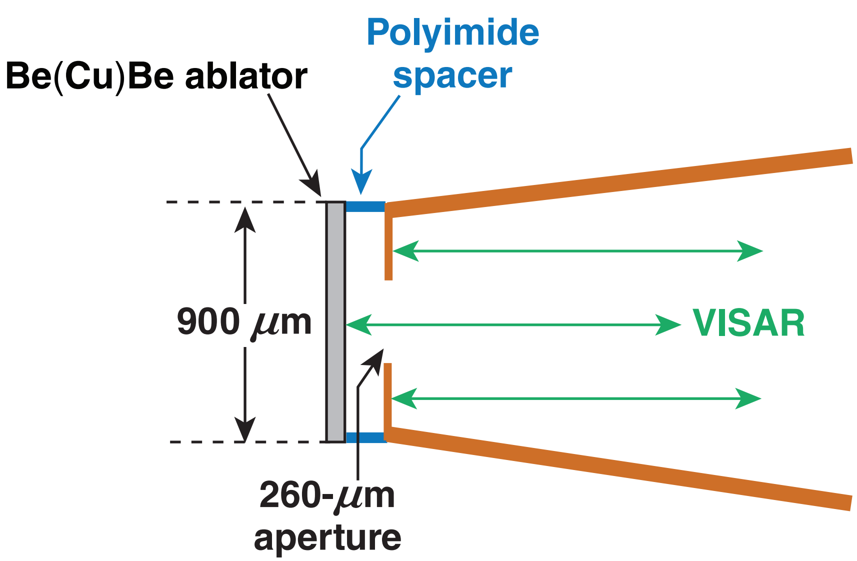
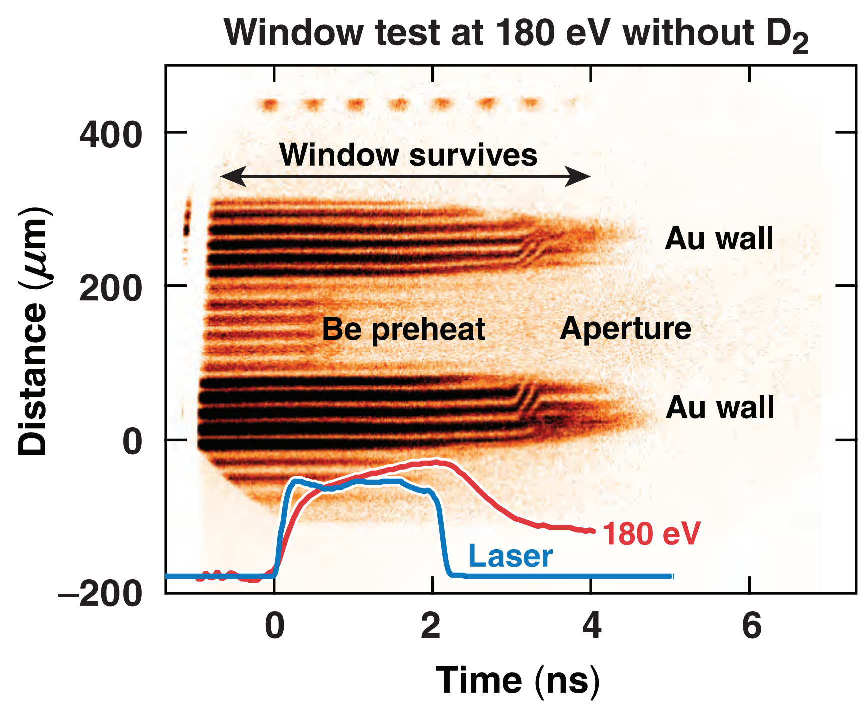
Hohlraum experiments with NIF-sized re-entrant cones demonstrate success at 180 eV







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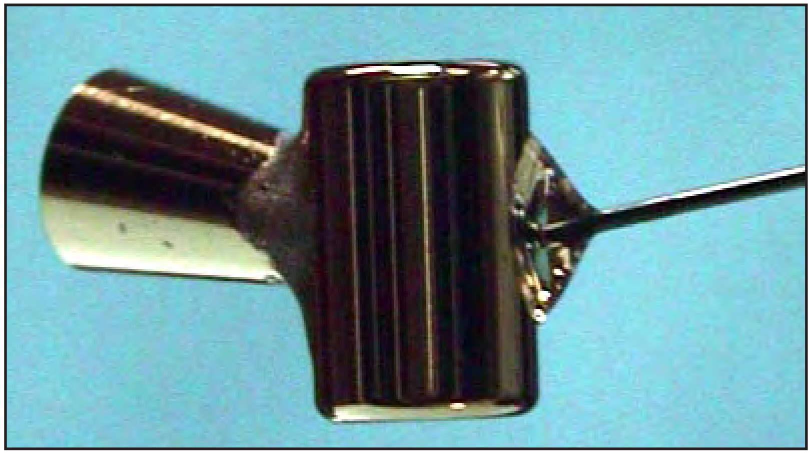
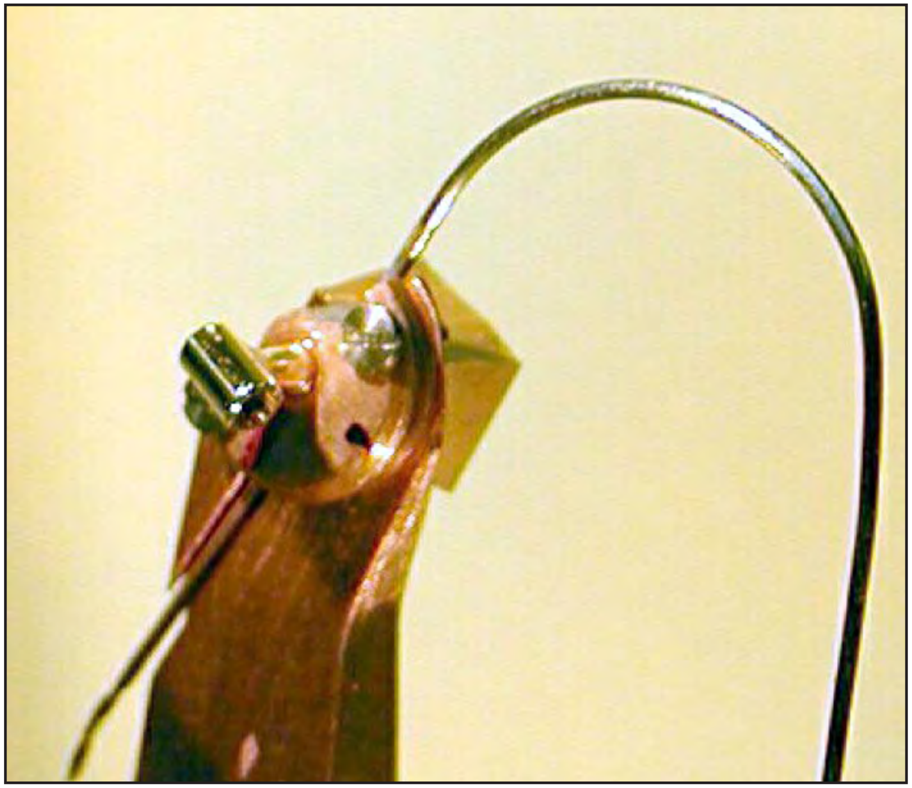
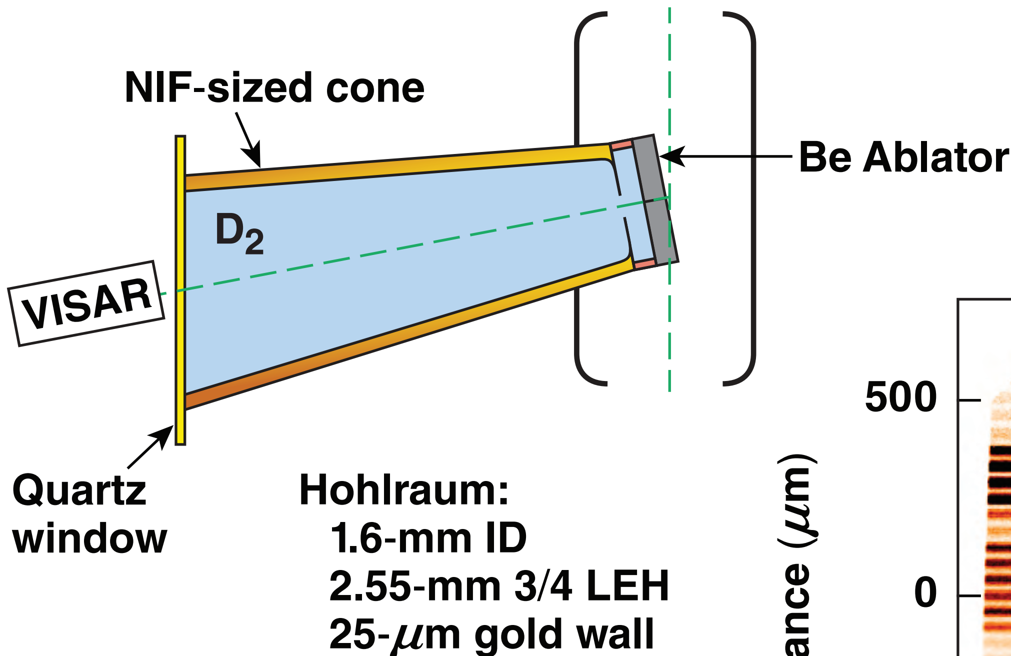
The success of these experiments resulted from a collaboration of four labs for design, construction, fielding

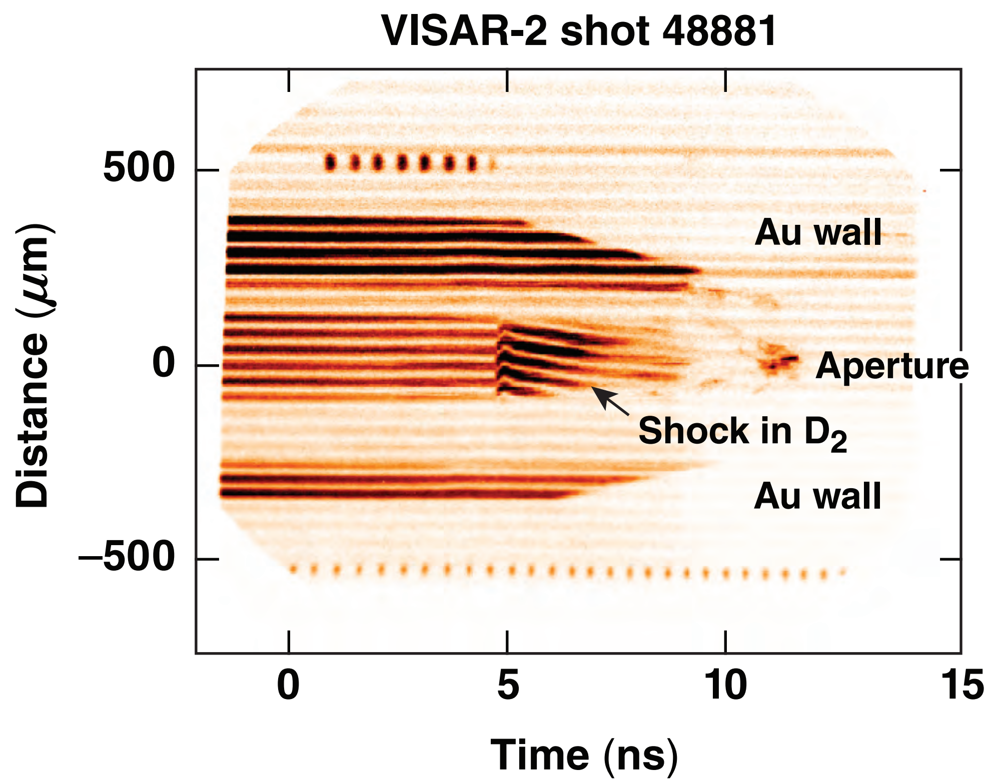


- Parts from GA and LLNL
- Hohlraum-cone assembly at SNL
- Shields and cryo mount at LLE



Cryogenic keyhole target with "thick" ablator succeeded at 135 eV





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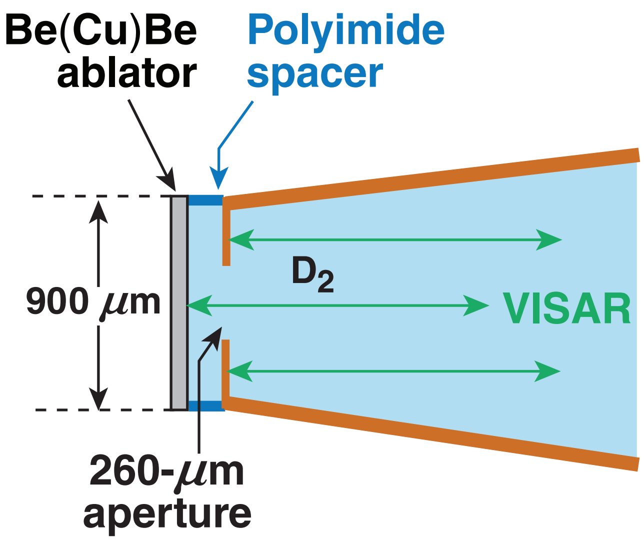
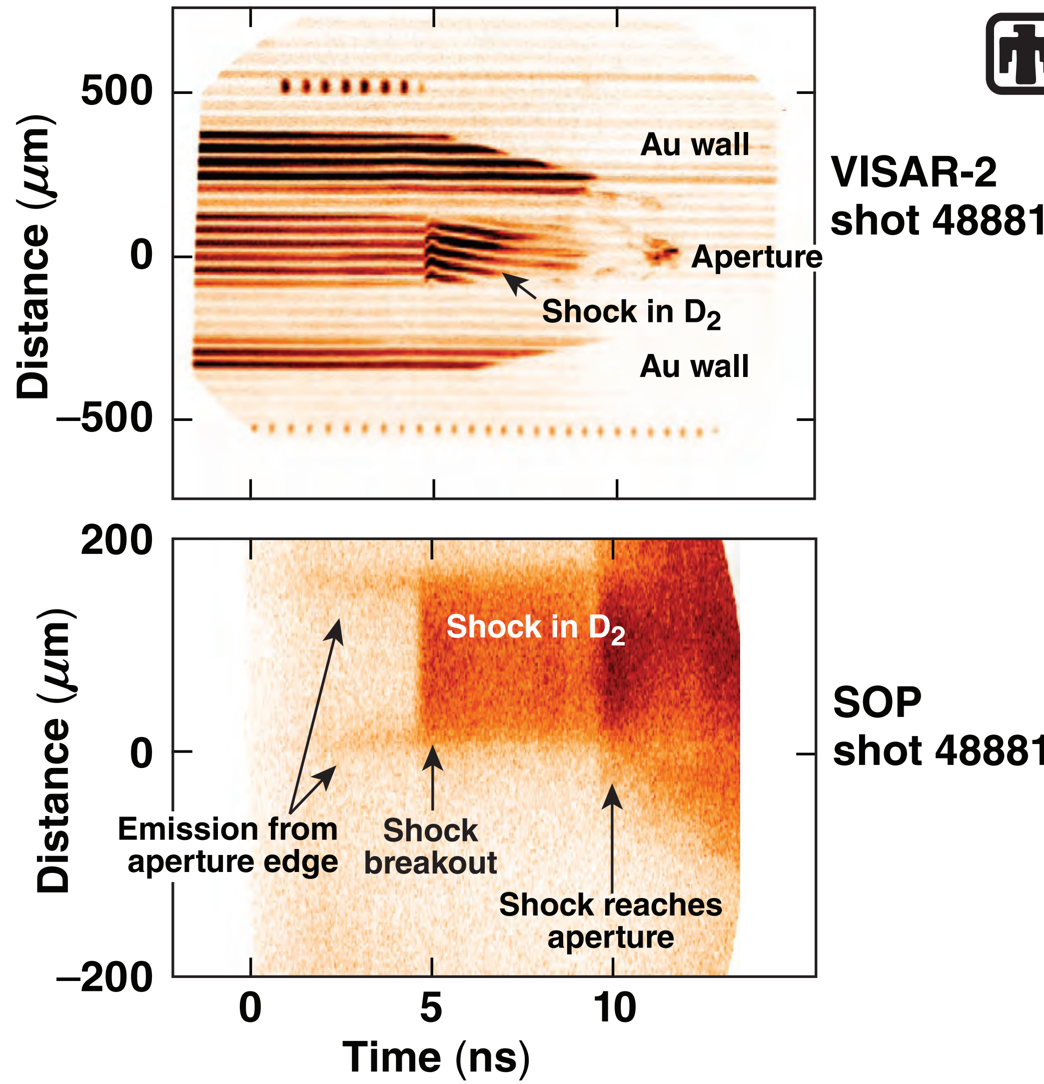
Self-emission agree well with the VISAR shock breakout time—shock arrival at the aperture is also observed





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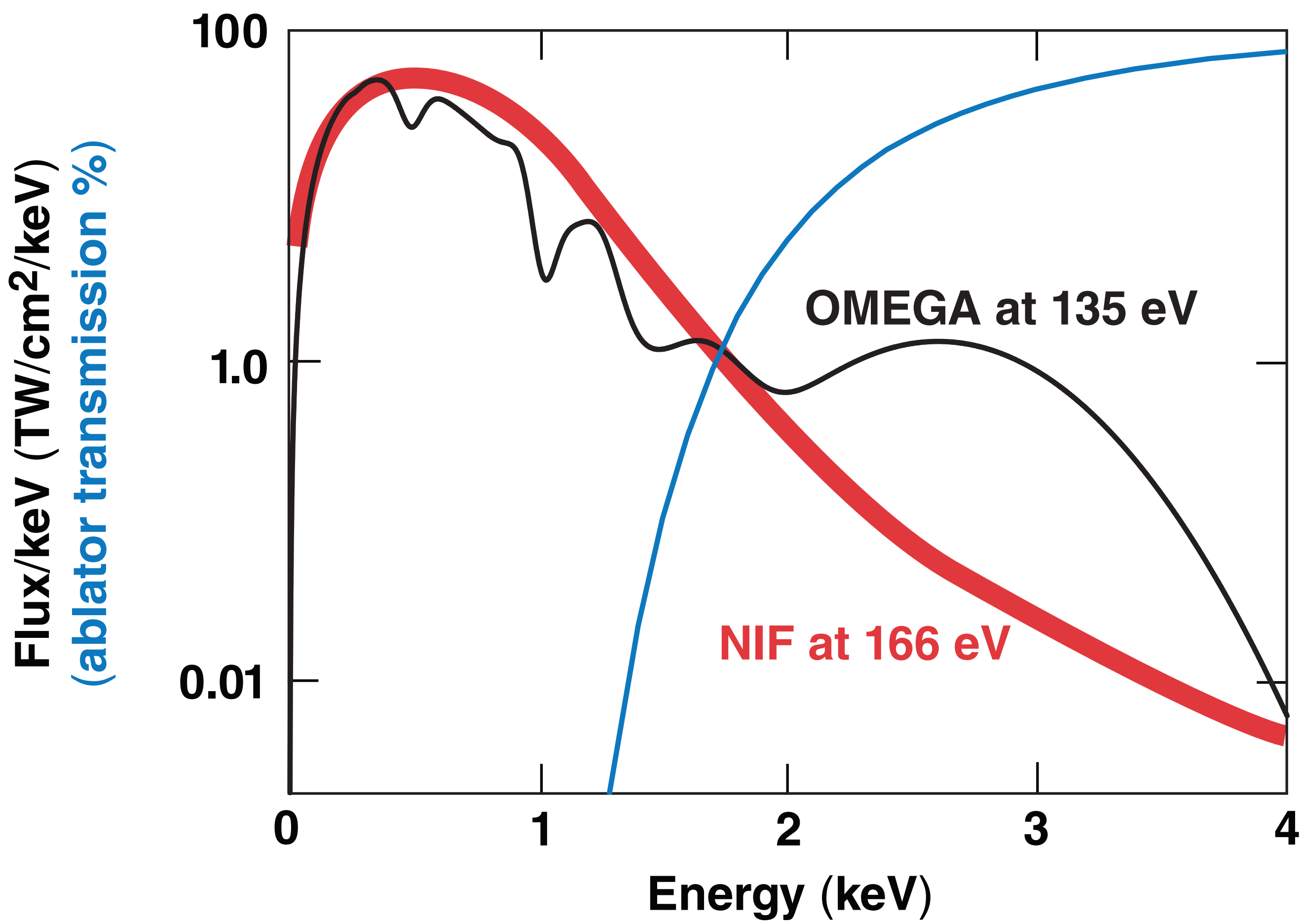
OMEGA hohlraums produce "hard" x-ray fluxes that are relevant to (or exceed) those expected on the NIF



OMEGA-scale hohlraums have higher laser-spot intensities than the NIF

Summary/Conclusions

OMEGA experiments have validated the shock-timing technique planned for the NIF

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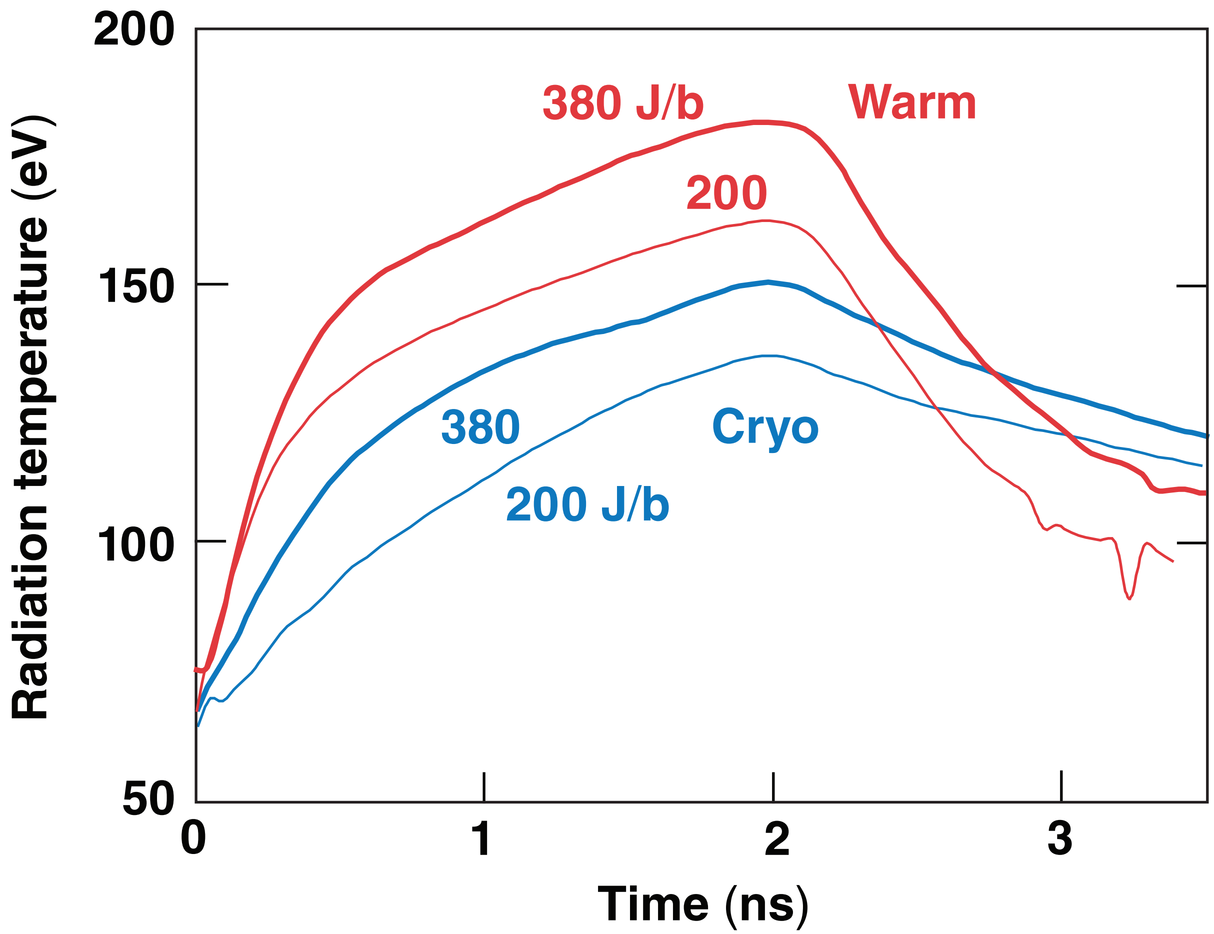
The cryogenic vacuum hohlraum exhibits decreased radiation temperatures compared to warm ones



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