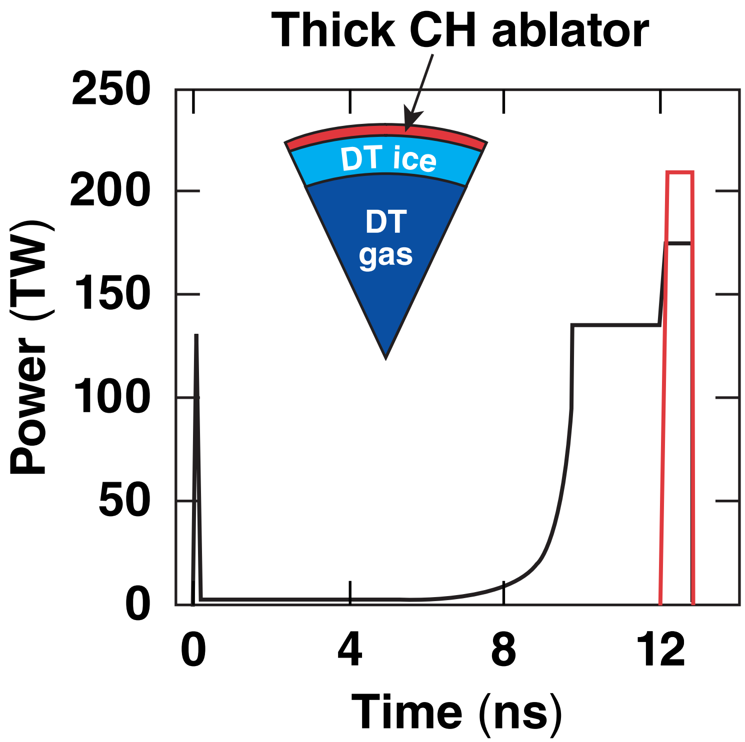
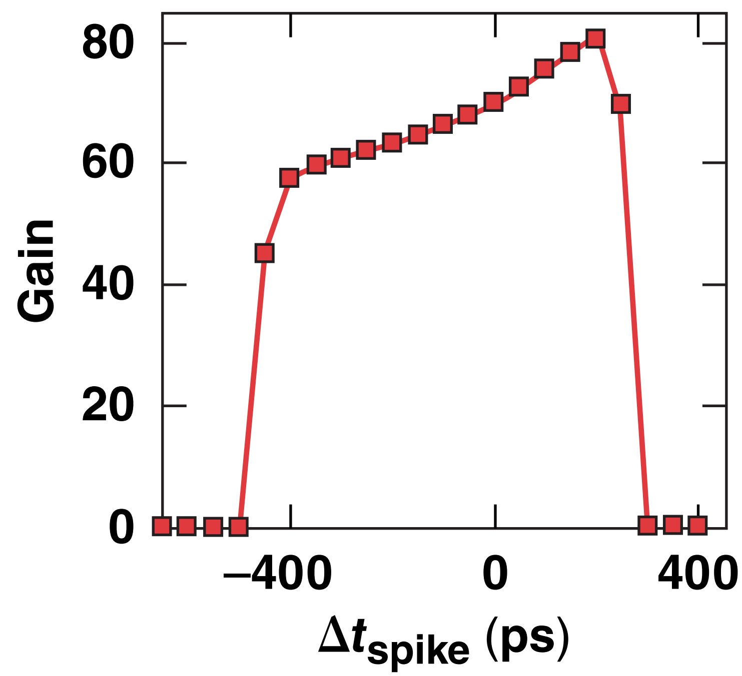
A Plastic-Ablator Cryogenic Shock-Ignition Design for the NIF





K. S. Anderson, *et al*.
University of Rochester
Laboratory for Laser Energetics

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Summary

Plastic-ablator cryogenic shock-ignition designs for the NIF are predicted to be robust at sub-MJ energies

- Cryogenic targets with thick plastic ablators have higher two-plasmon-decay (TPD) thresholds than DT ablators and, therefore, may avoid preheat from TPD hot electrons
- Targets are tested for robustness using a 1-D, clean-volume model to determine the minimum yield-over-clean (MYOC) required for ignition
- Implosions at 600 to 700 kJ are predicted to be robust to
  - spike pulse mistiming of 700 ps
  - hot-electron energy deposition in the shell
  - an ignition-threshold factor (ITF) of 3.0 for this target
- 2-D *DRACO* simulations indicate robustness to rms ice roughness up to 3.5 μm

Collaborators

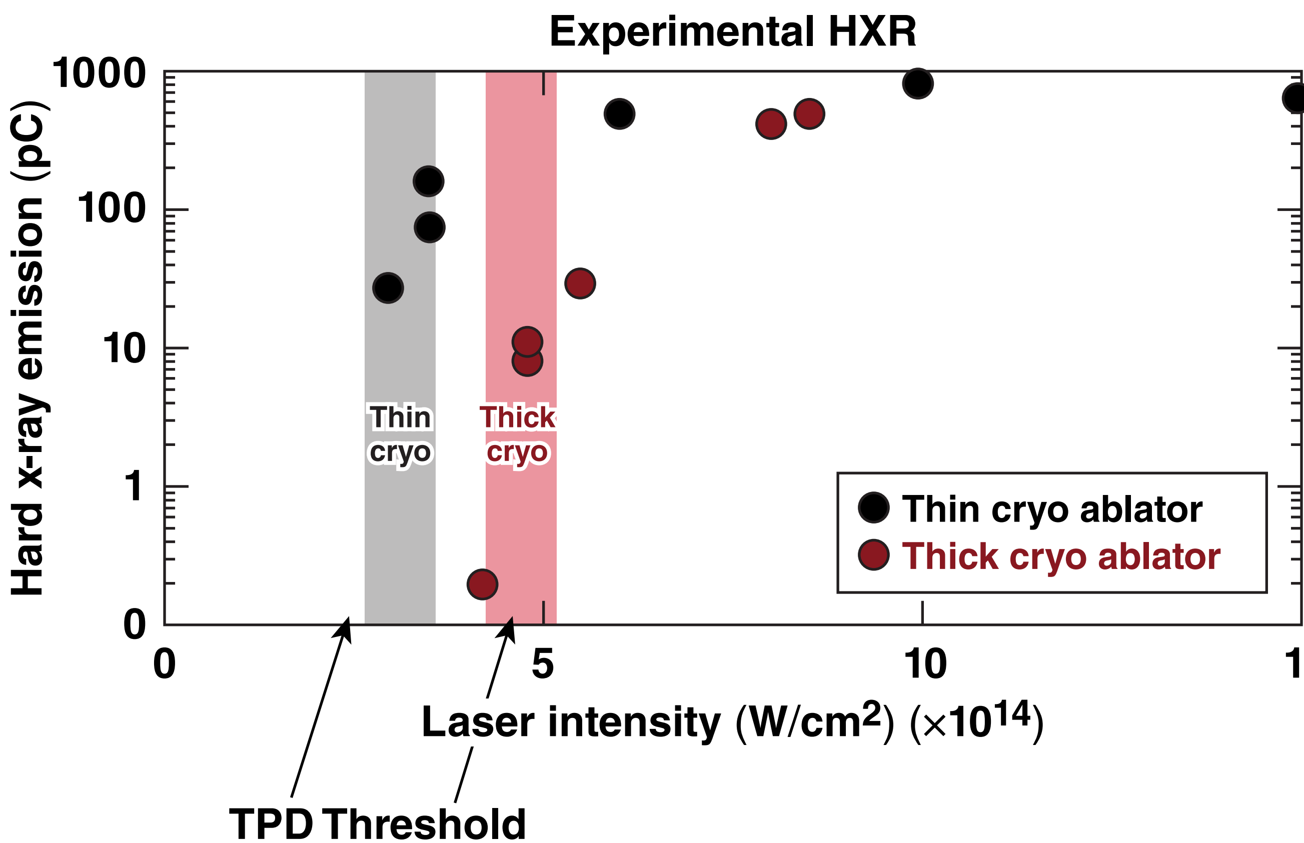
R. Betti,[†] R. S. Craxton, R. Nora[†], and A. A. Solodov

University of Rochester
Laboratory for Laser Energetics
[†]also Fusion Science Center for Extreme States
of Matter and Fast Ignition

L. J. Perkins

Lawrence Livermore National Laboratory

Large hard x-ray signals in OMEGA experiments may indicate preheat from LPI-generated hot electrons

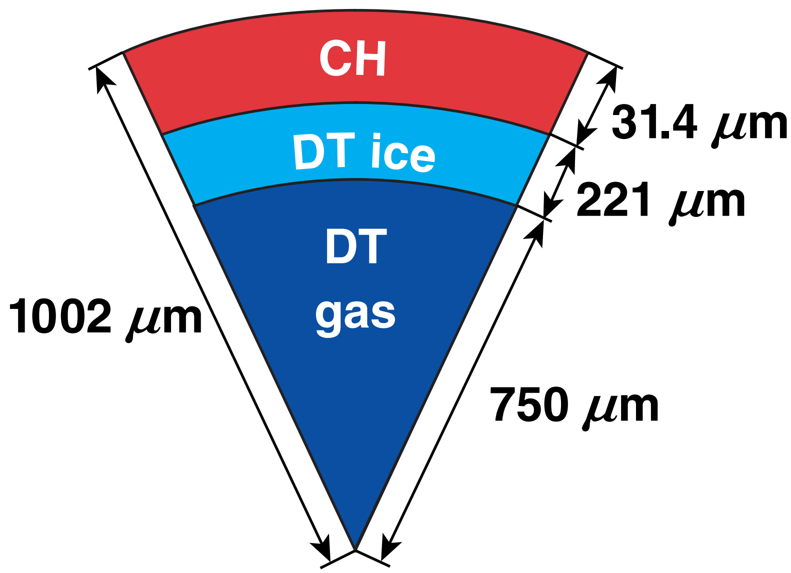


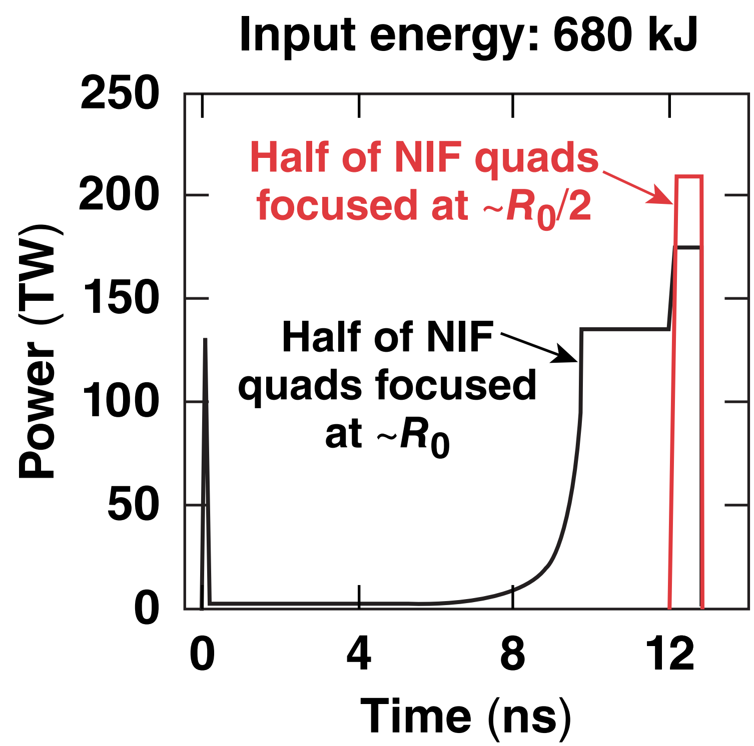
OMEGA implosions with thick plastic ablators produce fewer hard x rays from hot electrons.

TC8036f

A. V. Maximov *et al.*, Bull. Am. Phys. Soc. 52, 195 (2007).

A thick plastic-ablator shock-ignition target for the NIF has been designed using existing NIF phase plates





Gain (1-D)	70
ρR (g/cm^2)	2.6
V_{imp} (μm/ns)	300
IFAR$_{2/3}$	30

1-D beam profiles approximate polar drive.*

$$\text{IFAR}_{2/3} = \frac{R}{\Delta R} \text{ at } R = \frac{2}{3} R_0$$

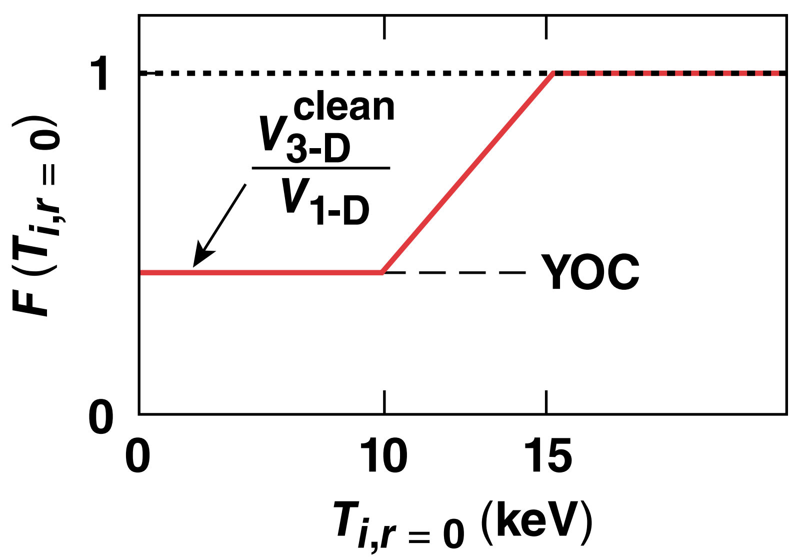
TC9109

*cf. R. S. Craxton (BO5.00008).

A 1-D clean-volume model* is used to evaluate target robustness for design purposes

- The fusion rate is modified at sub-ignition temperatures by the ratio of clean volume to the 1-D hot-spot volume; this ratio is approximately the yield-over-clean (YOC)

$$\langle \sigma v \rangle_{\text{mod}} = F\left(T_{i,r=0}\right)\langle \sigma v \rangle$$



*K. S. Anderson *et al*., Bull. Am. Phys. Soc. 54, 306 (2009).
P. Chang, K. Anderson, and R. Betti, Bull. Am. Phys. Soc. 54, 260 (2009).

TC8571a

The 1-D ignition-threshold factor (ITF) can be calculated from the minimum yield-over-clean (MYOC) required for ignition

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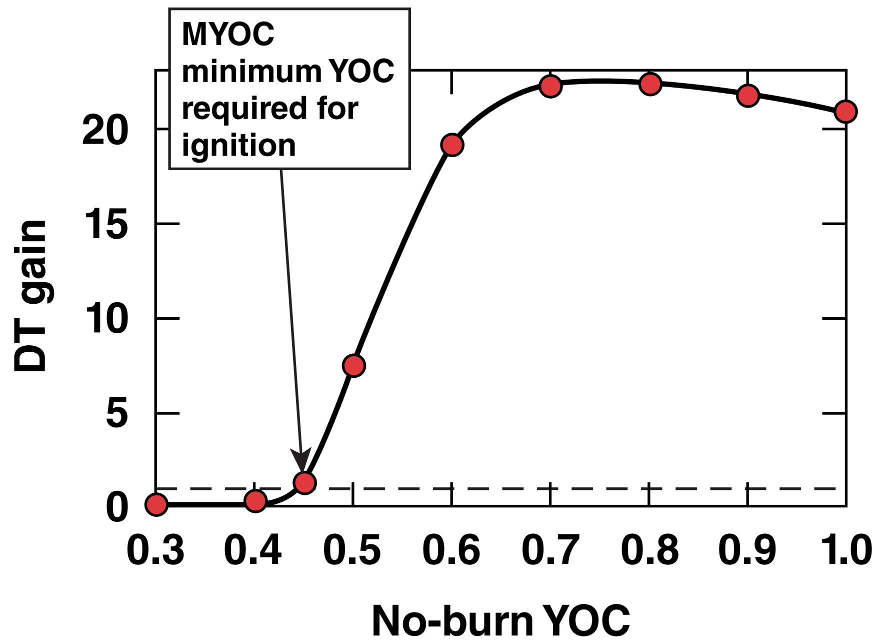
- Varying the YOC as an input parameter, one finds the minimum YOC required for ignition



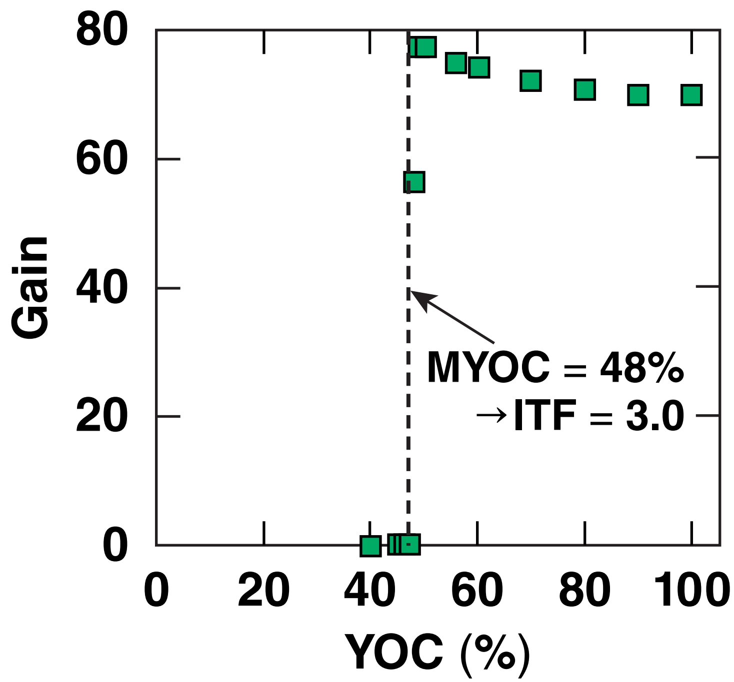
$$\text{ITF (1-D)} = \frac{1}{\text{MYOC}^{1.5}}$$

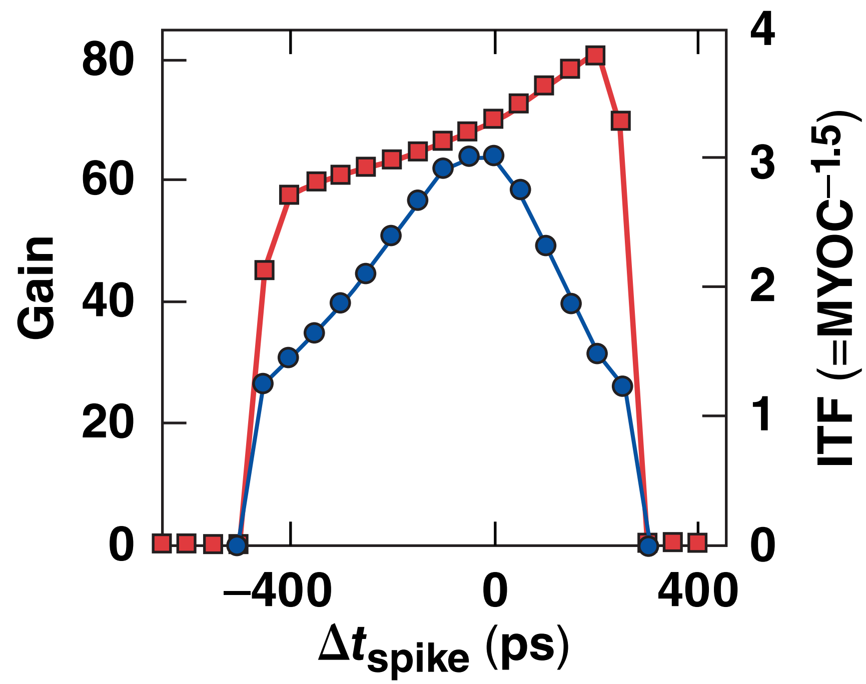
- 2-D *DRACO* simulations have validated this model for other designs*

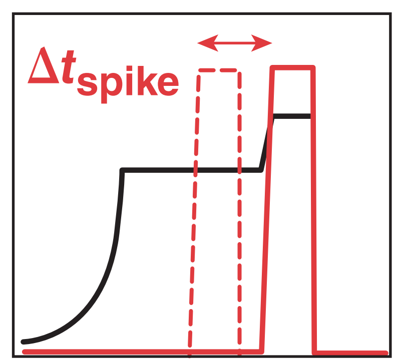
*K. S. Anderson *et al.*, Bull. Am. Phys. Soc. 54, 306 (2009).
P. Chang, K. Anderson, and R. Betti, Bull. Am. Phys. Soc. 54, 260 (2009).

TC8570a

Plastic-ablator shock-ignition targets are robust to shock timing and reduced clean volumes







ITF for indirect-drive point design* is ~5.3 (MYOC = 33%) at 1 MJ.

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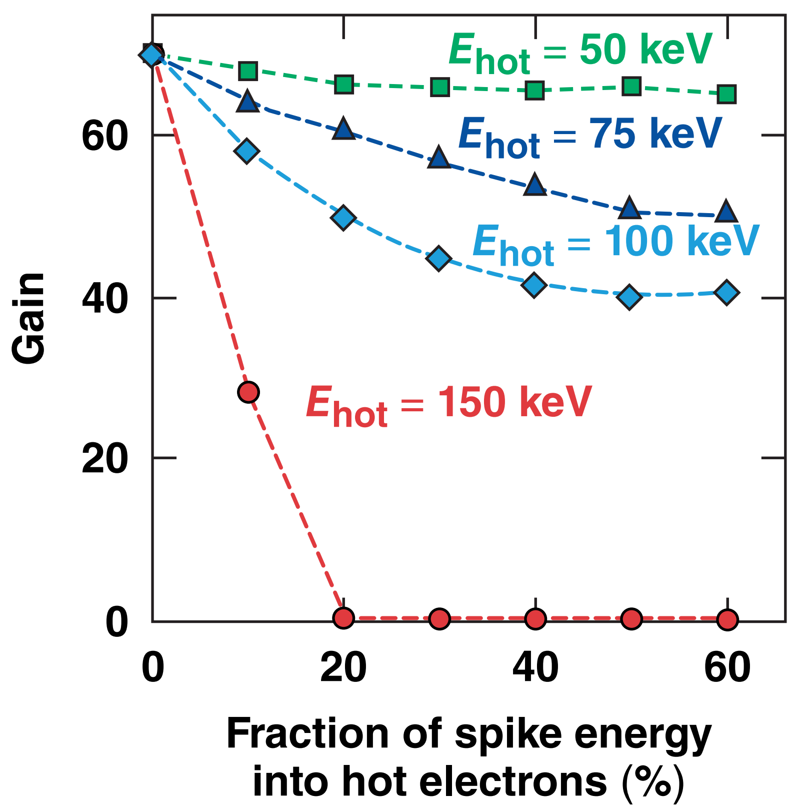
*J. Lindl, presented to the JASON Review Committee Study #JSR-09-330, San Diego, CA, 14–16 January 2009.

TC9110

The plastic-ablator SI design is robust to hot electrons up to 100 keV at 60% of laser energy during the spike pulse



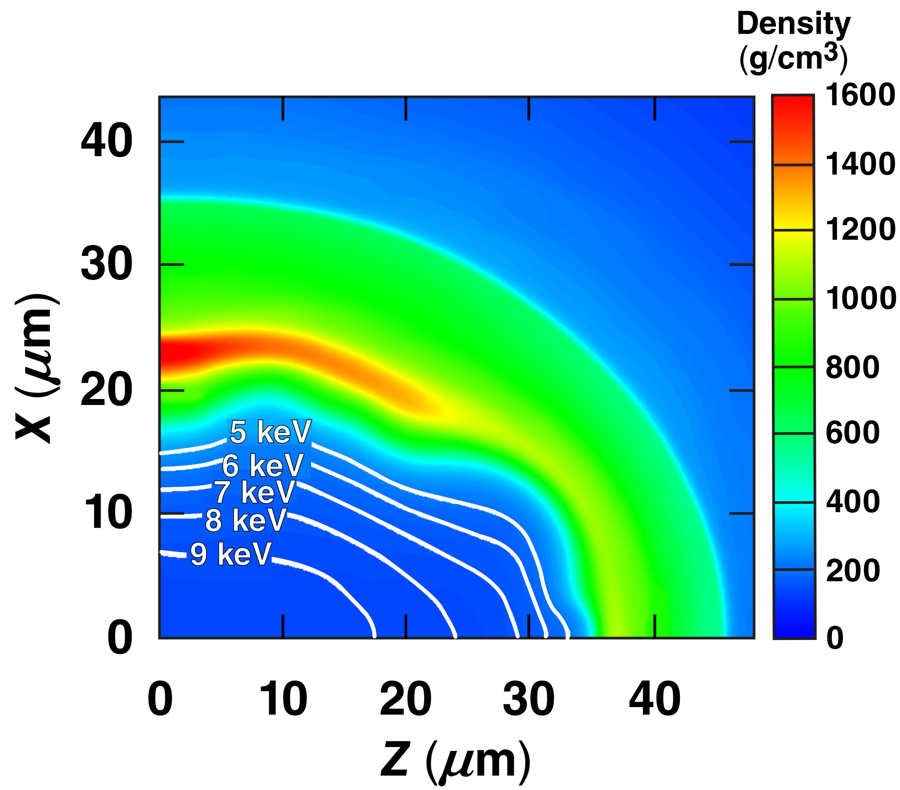
- Straight-line hot-electron-transport model by A. A. Solodov
- Future work will investigate hot-electron transport during the main pulse

M. Hohenberger, BO5.00011 (2010);
M. Lafon, XP9.00044 (2010).

TC9111

Symmetric 2-D *DRACO* simulations performed with similar targets indicate robustness to ice roughness >3.5-μm rms

- Symmetric laser irradiation
- *DRACO* simulations with 3.5-μm-rms roughness in modes $\ell = 2$ to 50
- Target ignites with full gain
- Upper limit on robustness to ice modes not yet explored
- Other nonuniformity studies to follow (imprint, target offset, polar drive, etc.)



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