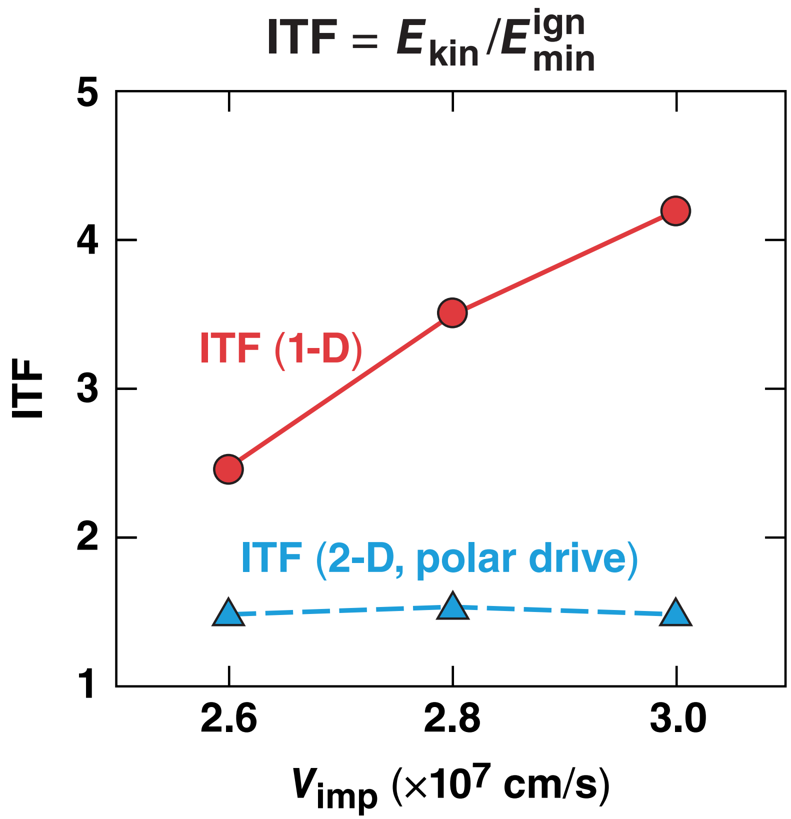
An Implosion-Velocity Survey for Shock Ignition on the NIF



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Summary

A survey of implosion velocity for shock ignition at the National Ignition Facility (NIF) indicates best performance and stability at velocities below 3×10^7 cm/s

- A parameter study was performed varying the implosion velocity and quantifying target robustness in 1-D and 2-D for plastic-ablator cryogenic capsules
- This study used polar-drive beam geometry to evaluate long-wavelength perturbations and laser imprint to study short wavelengths
- The target margin in 2-D with polar drive was relatively constant with implosion velocity
- Low-velocity capsules showed less sensitivity to laser imprint

Collaborators

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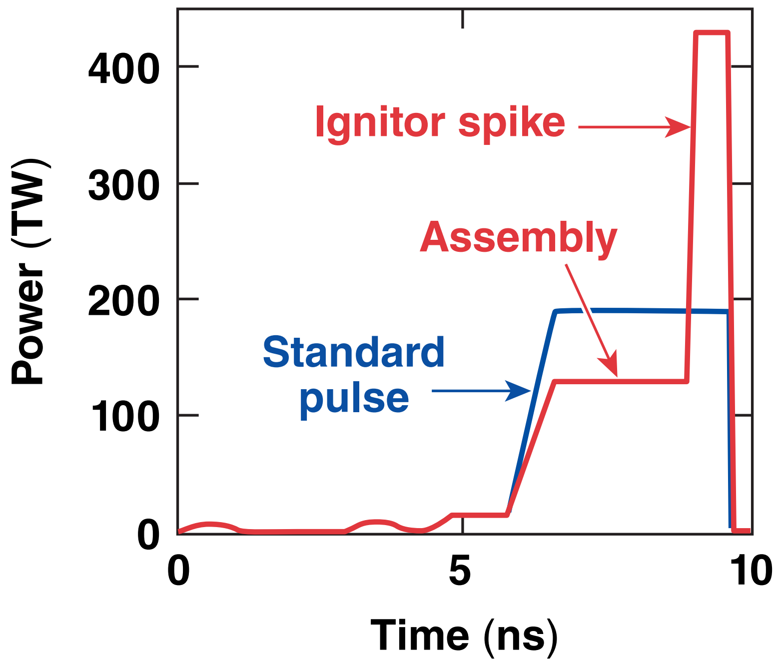
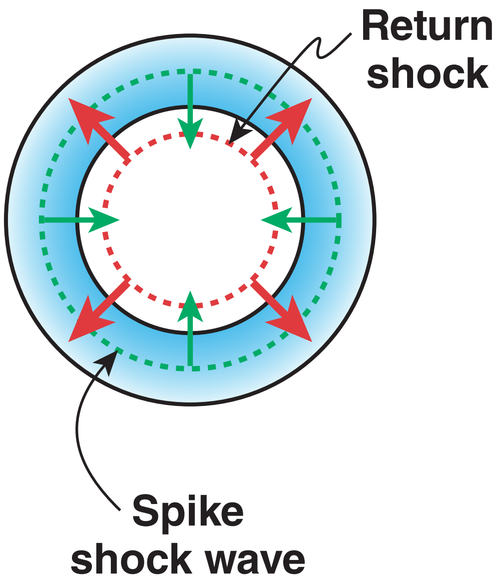
Shock ignition separates the fuel-assembly phase from the ignition phase using a single laser system





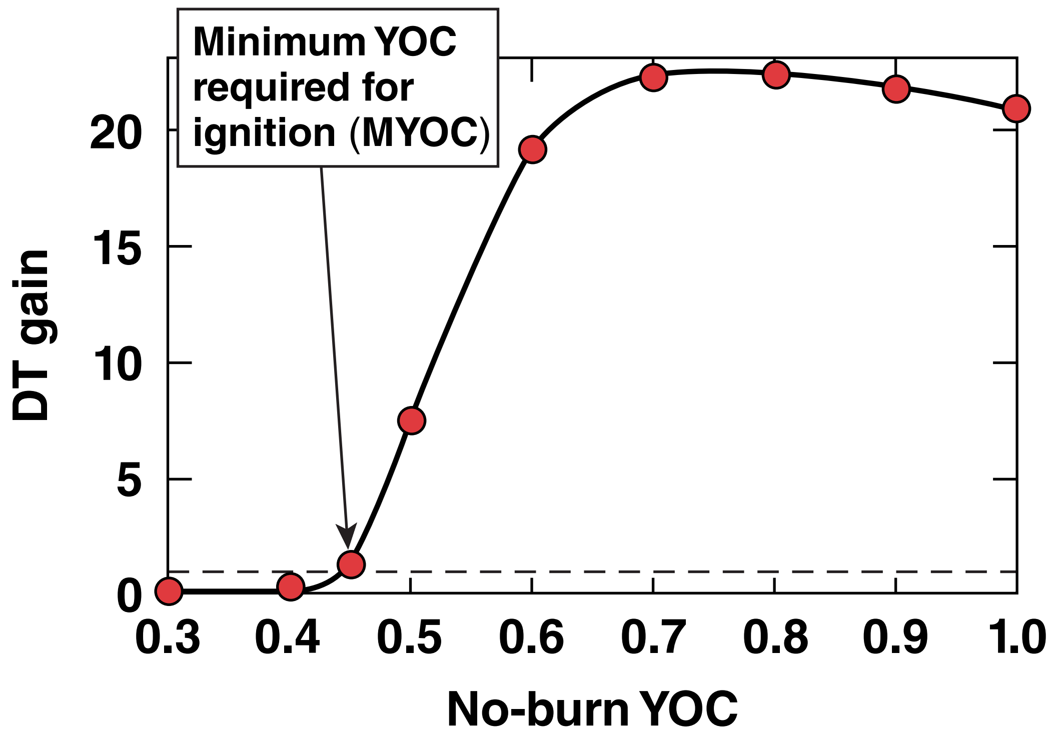
The late-time shock amplifies the hot-spot pressure.

TC10153c

R. Betti *et al.*, Phys. Rev. Lett. 98, 155001 (2007).

The target margin is quantified using the ignition threshold factor (ITF)*

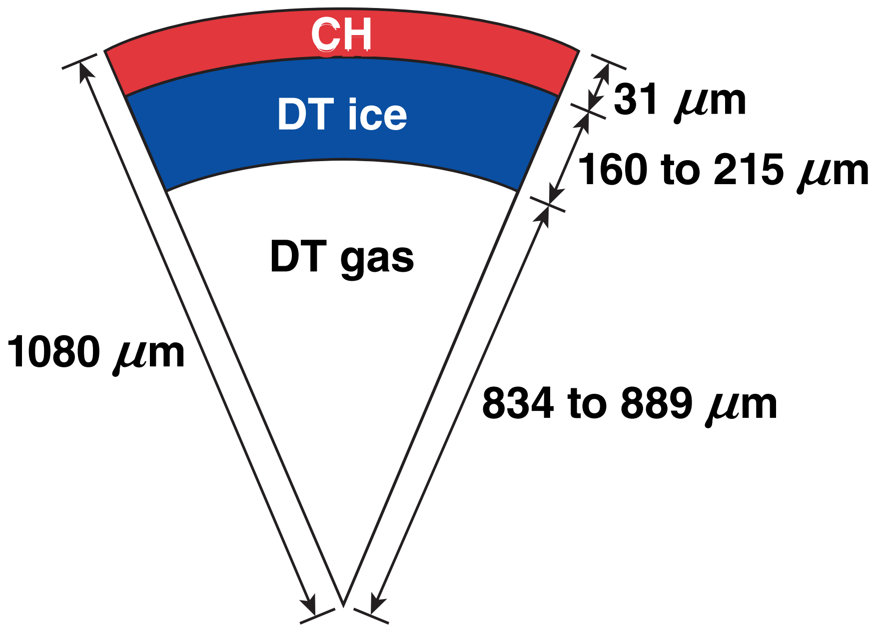
$$\int_{V_{\text{clean}}} \langle \sigma\nu \rangle \, dV \approx \int_{V_{\text{1-D}}} \langle \sigma\nu \rangle \, dV \frac{V_{\text{3-D}}^{\text{clean}}}{V_{\text{1-D}}} \approx \int_{V_{\text{1-D}}} \langle \sigma\nu \rangle \, dV \times \text{YOC}$$

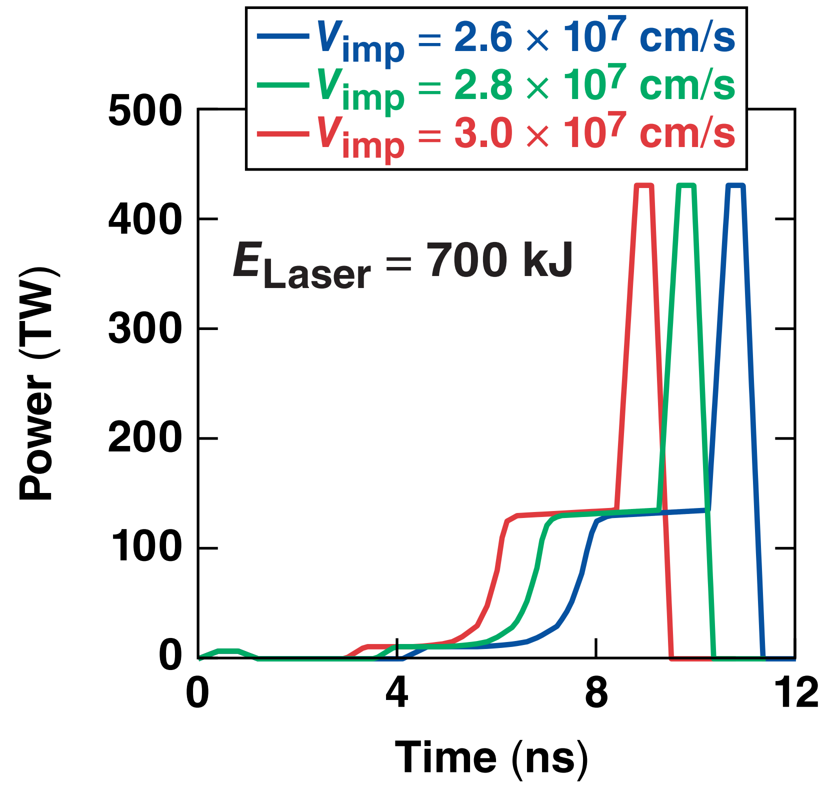


ITF; $\text{MYOC}^{-1.5}$

*D. S. Clark *et al.*, Phys. Plasmas 15, 056305 (2008);
P. Y. Chang *et al.*, Phys. Rev. Lett. 104, 135002 (2010);
B. K. Spears *et al.*, Phys. Plasmas 19, 056316 (2012).

Three targets were analyzed; the velocities were varied by changing the target thickness



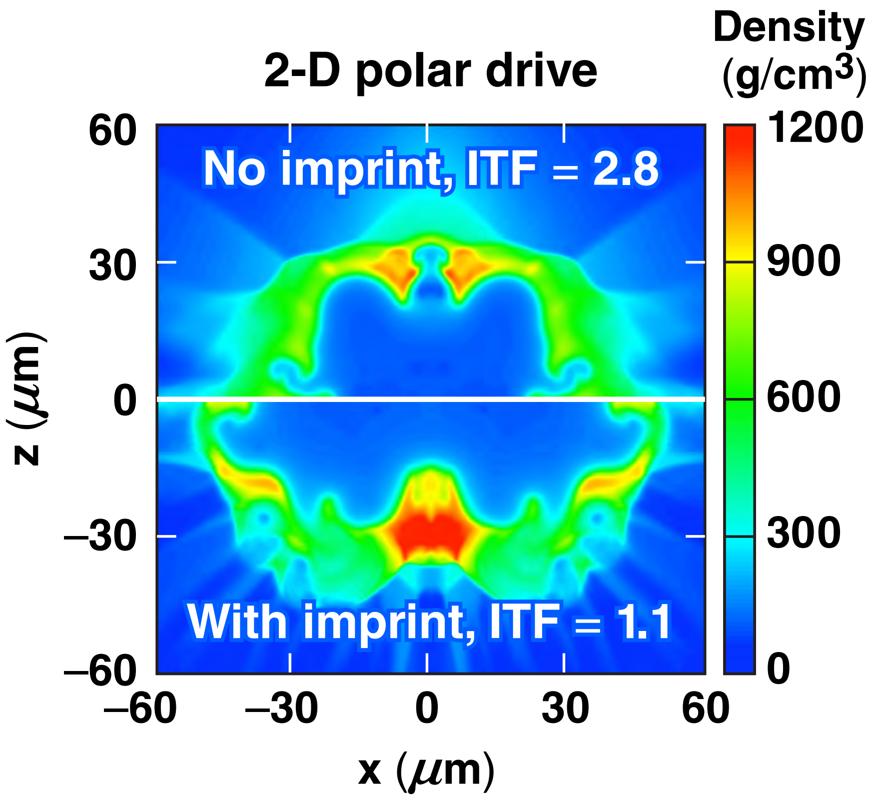


Velocity (cm/s)	2.6×10^7	2.8×10^7	3.0×10^7
Gain (1-D)	69	62	58
ITF (1-D)	2.5	3.5	4.2
$IFAR_{2/3}$	14	17	20

TC10739

The previous shock-ignition* design for the NIF showed the highest sensitivity to polar-drive beam geometry and laser imprint

$v_{imp} = 3.1 \times 10^7$ cm/s
ITF (1-D) = 4.1
IFAR = 22



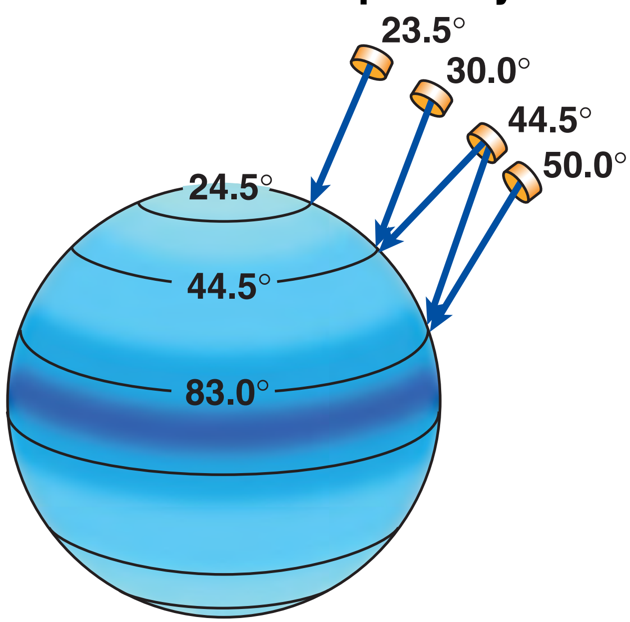
*K. S. Anderson *et al*., Phys. Plasmas 20, 056312 (2013).

TC10738

Robustness to long-wavelength modes was evaluated using polar-drive nonuniformities and to short-wavelength modes using laser imprint

Polar drive

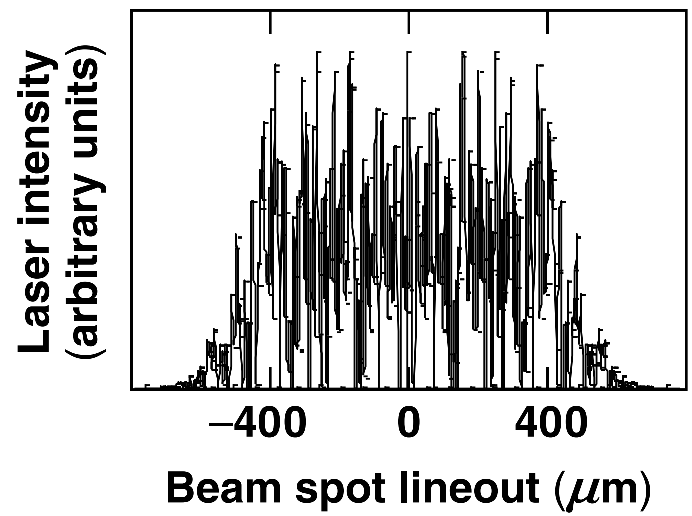
Beams are repointed toward the equator to ensure adequate symmetry



Generates long-wavelength perturbations, $\ell \leq 20$

Single-beam speckle from phase plate

Radial lineout of laser intensity



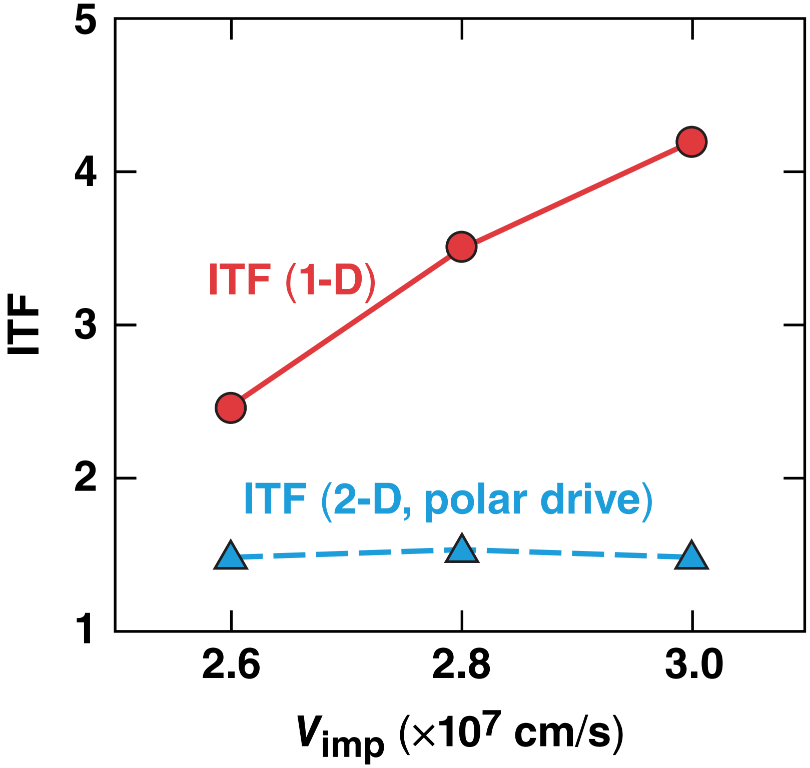
Generates short-wavelength perturbations, $\ell > 20$

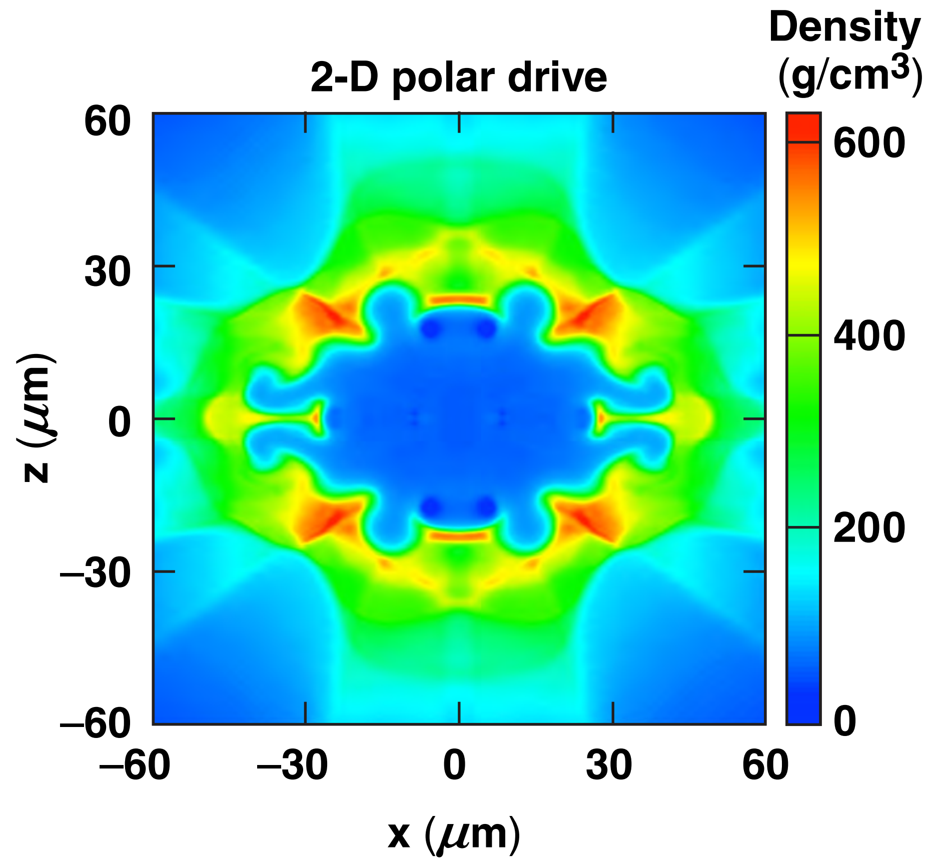
Laser imprint modeled using multi-FM SSD*

TC11002

*A. Shvydky *et al.*, YO4.00006; M. Hohenberger *et al.*, YO4.00007, this conference.

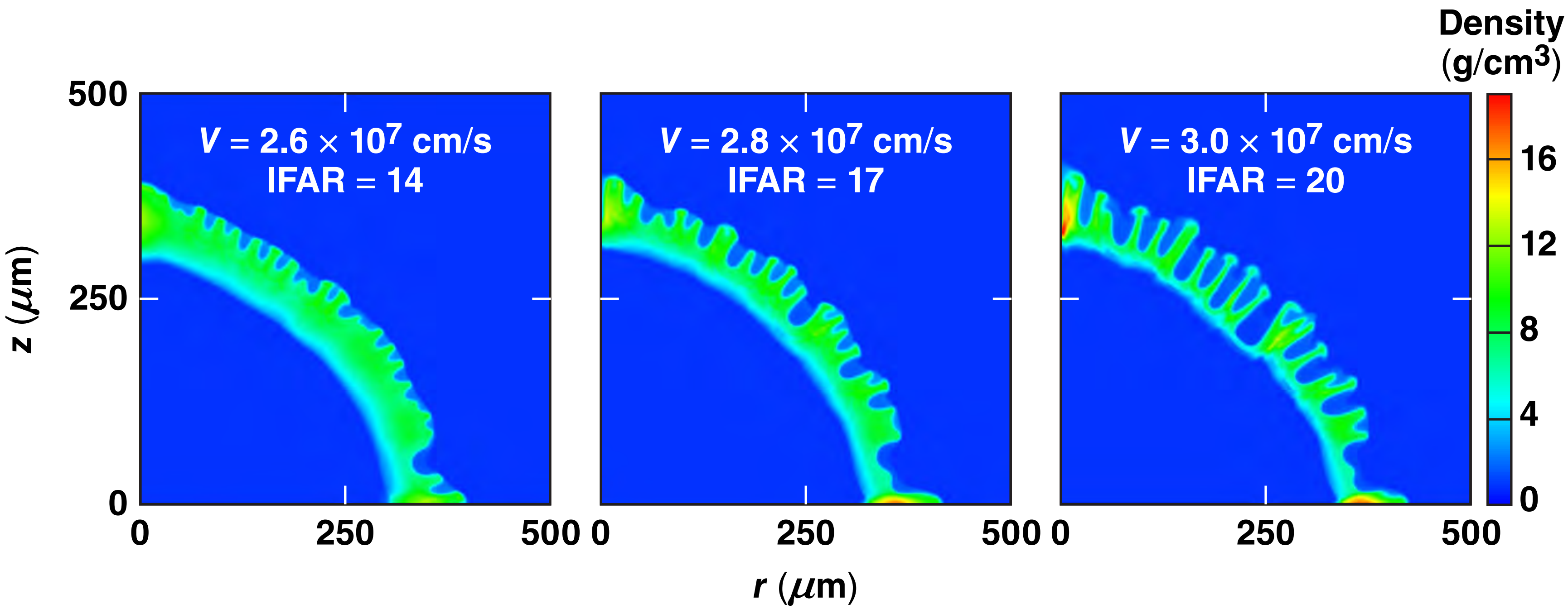
The margin in 2-D polar-drive simulations was relatively independent of implosion velocity





TC10740

Low-velocity, low-IFAR targets show less susceptibility to imprint



ITF analysis with laser imprint is in progress.

Summary/Conclusions

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