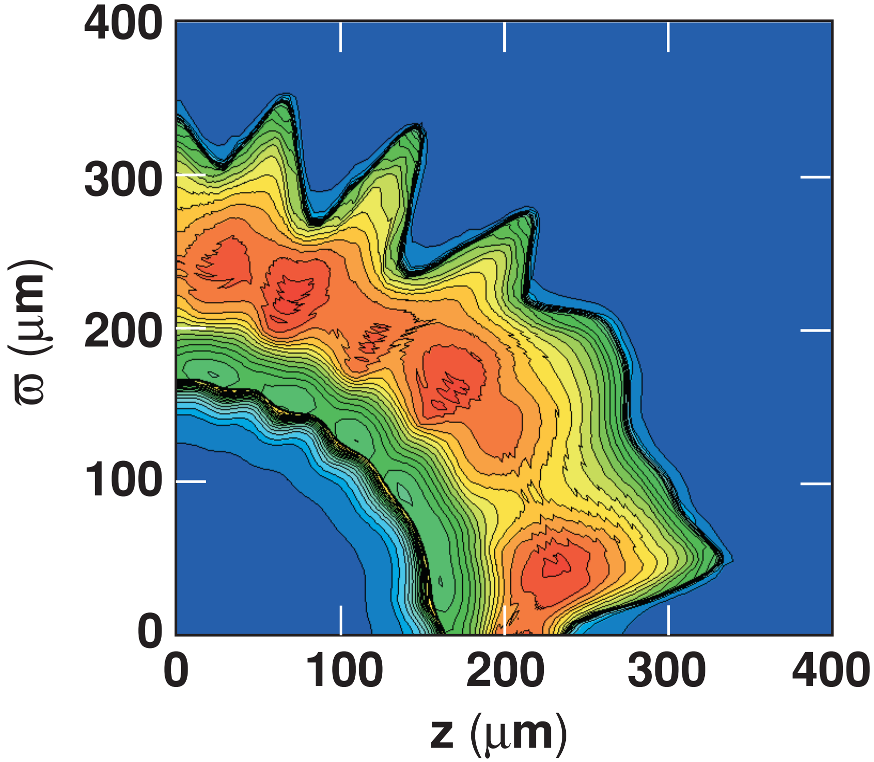
High-Gain, Direct-Drive Foam Target Design for the NIF



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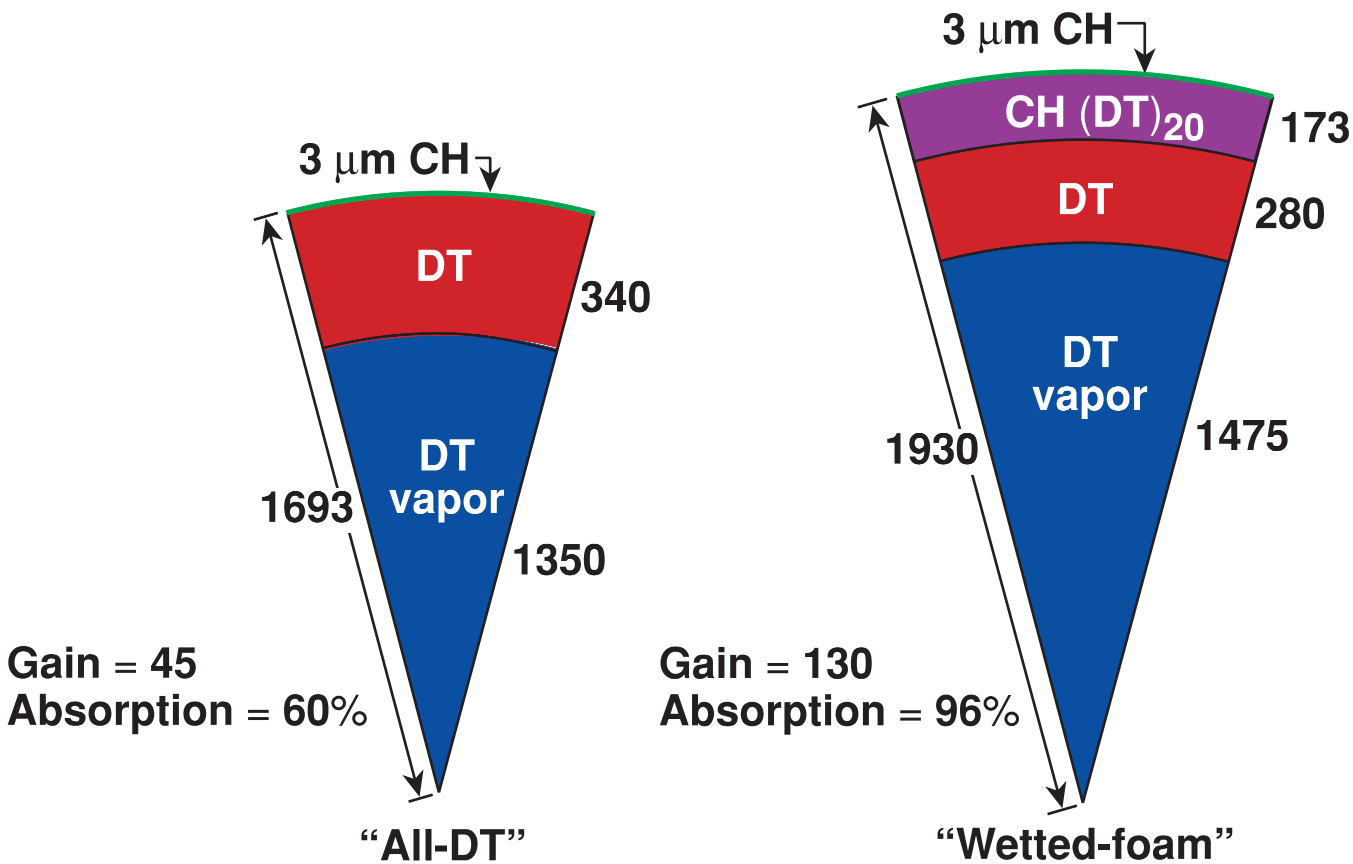
Summary

The high-gain, wetted-foam NIF target design shows good hydrodynamic stability during acceleration

- Wetted foam is used to increase both absorption and fuel mass, resulting in a gain of ~130.
- A picket is used to decrease target instability.
- 2-D linear growth-factor simulations show a peak of 6.4 e-foldings at $\ell = 60$.
- 2-D multimode simulations suggest that, during the acceleration phase, imprint dominates over energy imbalance.

Wetted-foam targets have higher laser absorption than DT, allowing more fuel and higher gain

- Foams have been used previously to selectively radiatively preheat the ablator.[1]



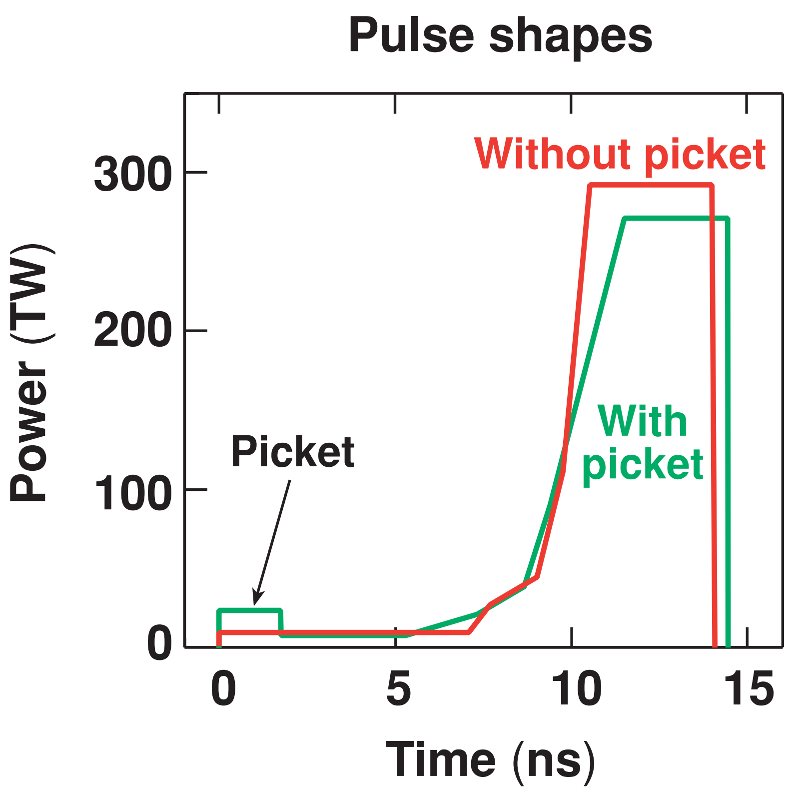
- The foam also protects the fuel from preheat due to radiation from the CH.
- A lower-gain (G = 80), more-stable target with $CH(DT)_4$ foam has also been designed.

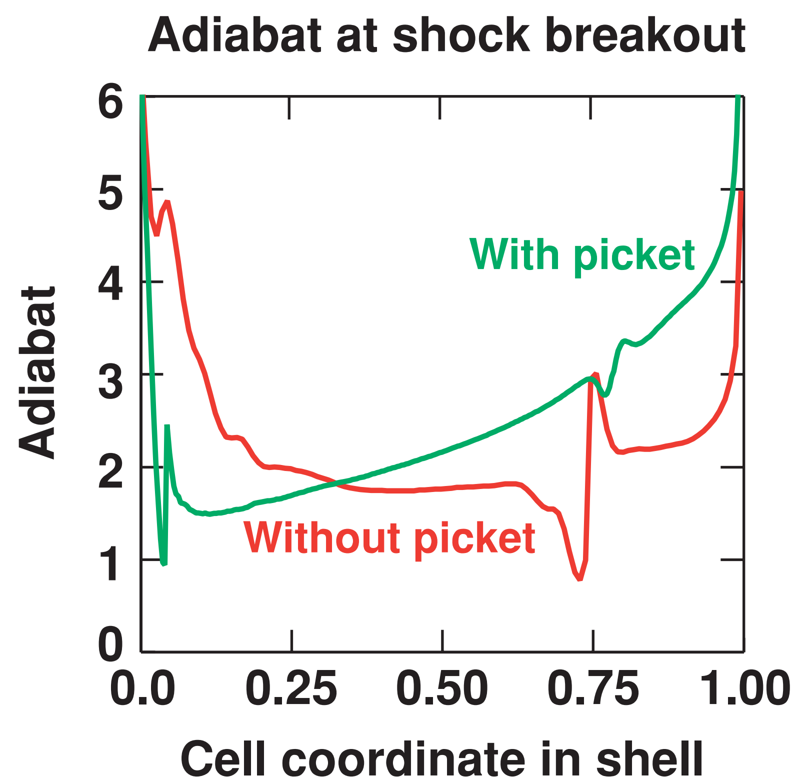
[1] D.G. Colombant *et al.*, Phys. Plasmas 7, 2046 (2000).

TC5787c

A "picket" prepulse provides increased stability

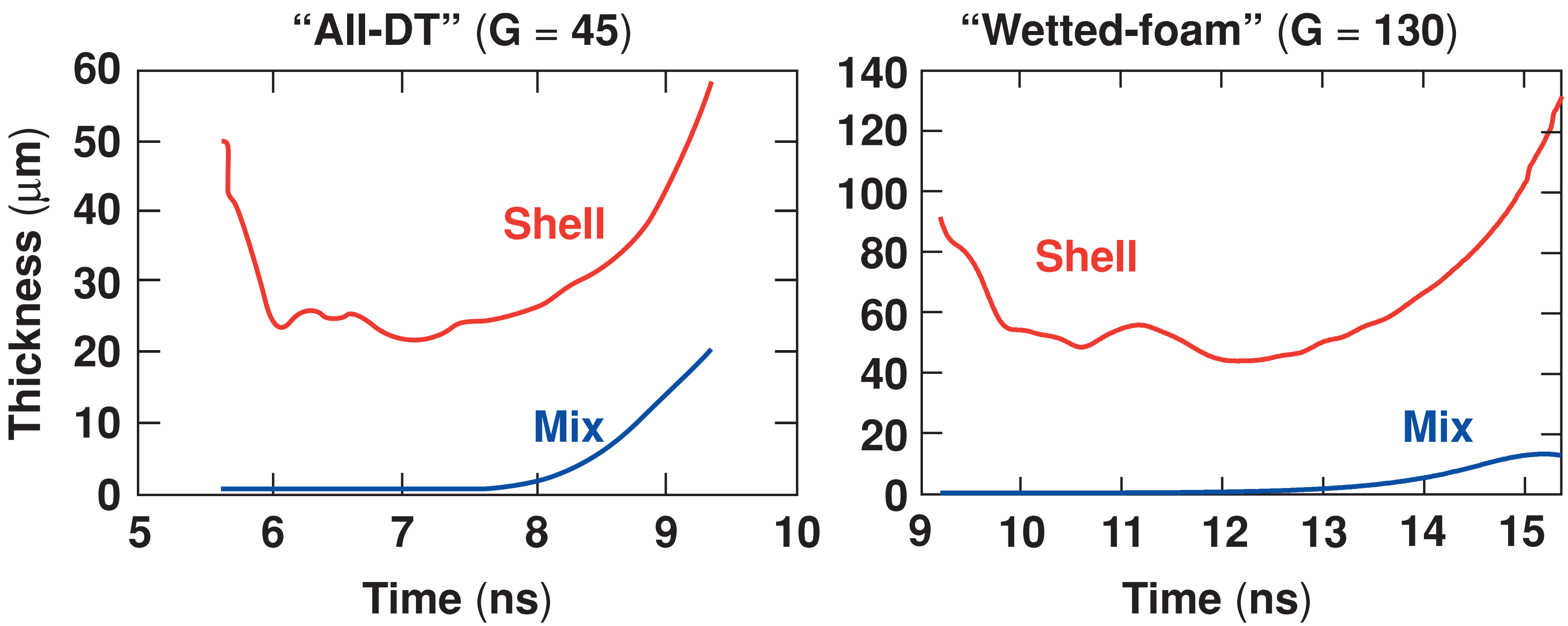
- **A high-intensity picket results in a decaying shock.**
- **This results in an adiabat that decreases throughout the shell, stabilizing the outer surface without preheating the fuel.**





TC6052

A preliminary analysis shows less hydrodynamic instability during acceleration for the "wetted-foam" and "all-DT" designs



Assumptions:

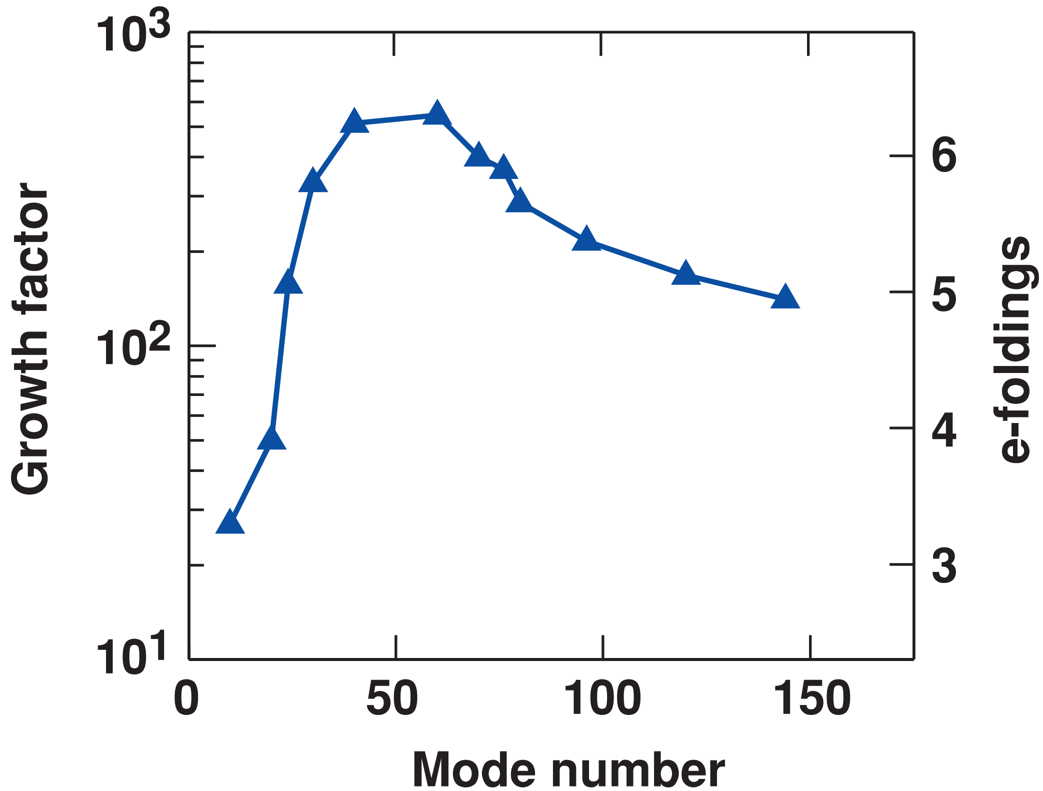
- "Wetted foam" has the same laser imprint as the "all-DT" design (1 THz).
- "Wetted foam" is treated as a homogeneous mixture.
- Inner-surface roughness = 1 μm.

TC5610b

V. N. Goncharov *et al.*, Phys. Plasmas 7, 5118 (2000).

2-D linear growth-factor calculations show a peak of 6.4 e-foldings at ℓ = 60

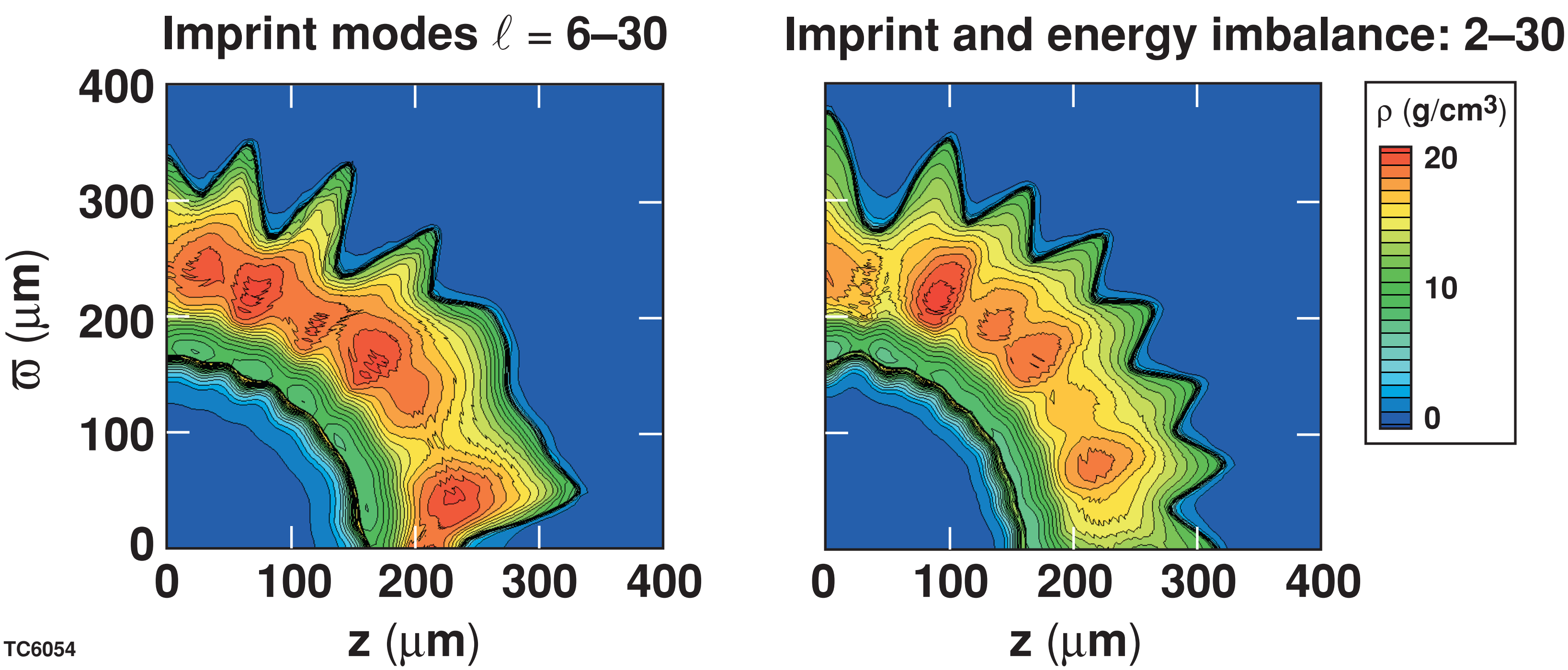
- **Each point represents a 2-D simulation of the foam target with a single imposed surface modulation.**
- **The growth factor is the ratio of the surface-mode amplitude at the end of the acceleration phase to the initial amplitude.**



Beam-to-beam energy imbalance does not significantly affect acceleration-phase target stability

UR LLE

- Energy imbalance is modeled by an 8% beam-to-beam rms imbalance, constant in time, in modes 2 and 4.
- The DPP and DPR spectra are modeled, smoothed by 1-THz SSD.
- Imprint has a greater effect because of the greater Rayleigh–Taylor growth rate during the acceleration phase for $\ell \geq 6$.



TC6054

The classical foam/DT interface does not jeopardize the acceleration-phase target performance

- A "classical" (non-ablative) interface exists between the DT and the wetted foam, with a density ratio ~1.05 and an Atwood number of 0.023.
- The interface is seeded by shock nonuniformities originating at the outer surface.
- The interface grows first due to the Richtmyer–Meshkov instability, then, after the rarefaction-wave return, the Rayleigh–Taylor instability.
- In simulations including imprint and power balance, the σ_{rms} of the interface remains below 1 μm.

Summary/Conclusions

The high-gain, wetted-foam NIF target design shows good hydrodynamic stability during acceleration

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- Wetted foam is used to increase both absorption and fuel mass, resulting in a gain of ~130.
- A picket is used to decrease target instability.
- 2-D linear growth-factor simulations show a peak of 6.4 e-foldings at $\ell = 60$.
- 2-D multimode simulations suggest that, during the acceleration phase, imprint dominates over energy imbalance.
- Deceleration-phase simulations modeling burn are underway.

TC6050