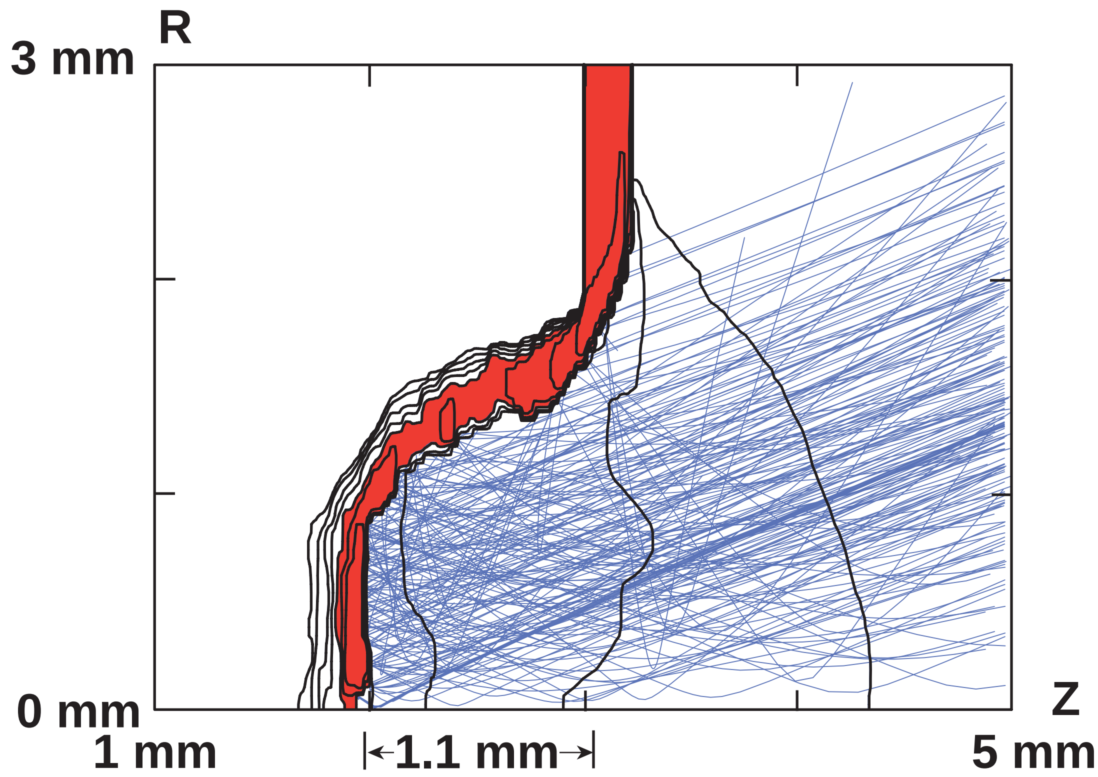
Two-Dimensional Simulations of Cryogenic Deuterium Foil Acceleration for NIF Instability Experiments



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Summary

Preliminary 2-D *SAGE* simulations indicate that cryogenic DD instability experiments are feasible using four NIF quads

- **The spatial beam profiles and focusing conditions are critical.**
- **At I_{las} = 3 × 10^{14} W/cm^2, accelerations of ~6 × 10^{15} cm/s^2 are experienced for ~4 ns over a flat region of diameter $\gtrsim$1.5 mm.**
- **The behavior of the center of the target can be modeled quite accurately in 1-D.**

Outline

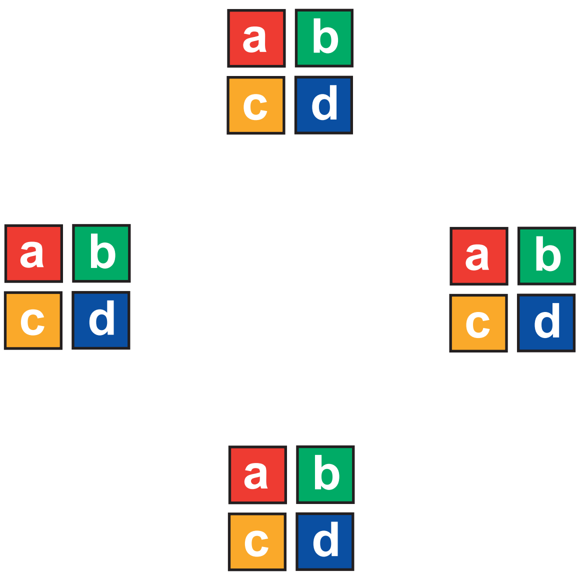
- Experimental concept
- 2-D *SAGE* simulations
  - staggered focusing
  - common focusing
- Enhancements to *SAGE* ray-tracing package (nonuniform deposition $\rightarrow$ target breakup)
- Predicted target trajectories

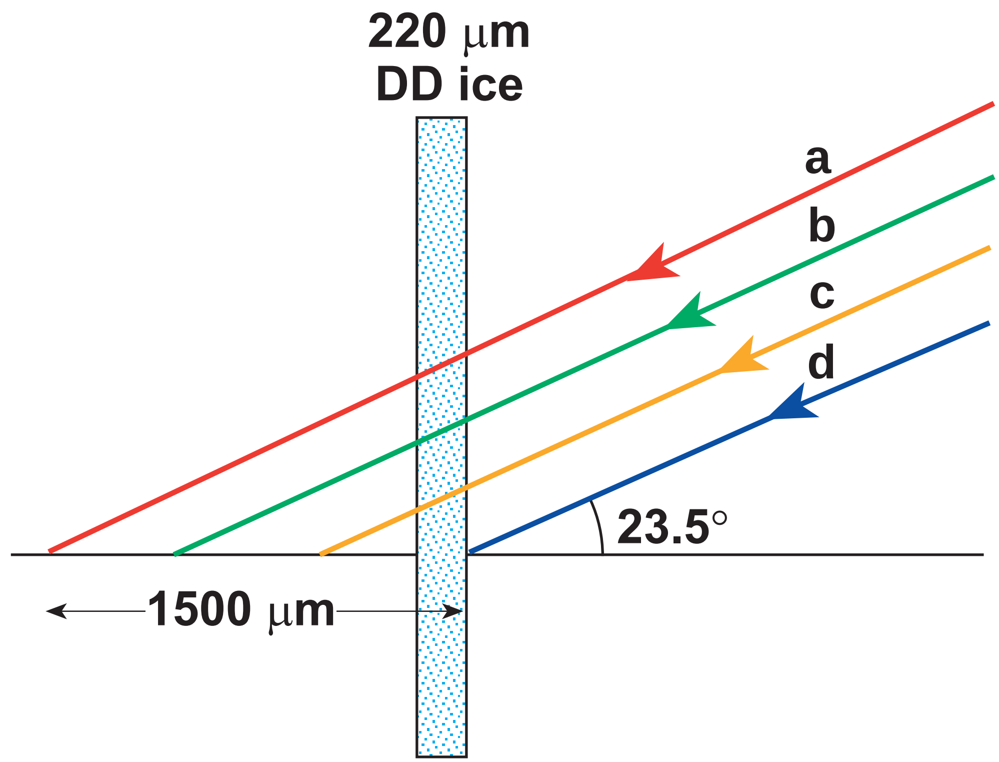
  $v \rightarrow 3$ to 4×10^7 cm/s

  $\triangle z \approx 1$ mm

  $a \approx 6 \times 10^{15}$ cm/s^2
- Comparison between 1-D and 2-D

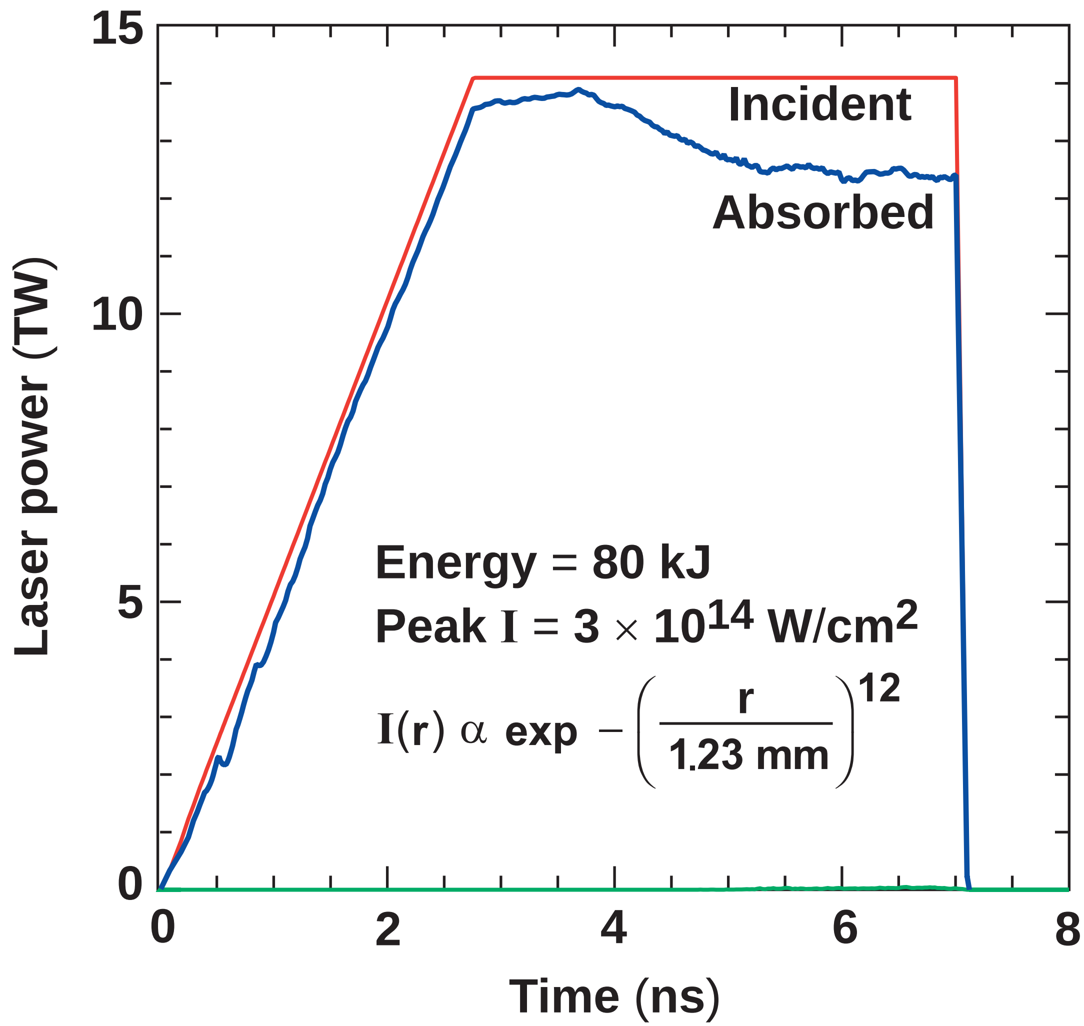
A cryogenic DD target is accelerated by four groups of NIF beams with staggered focusing





TC5369

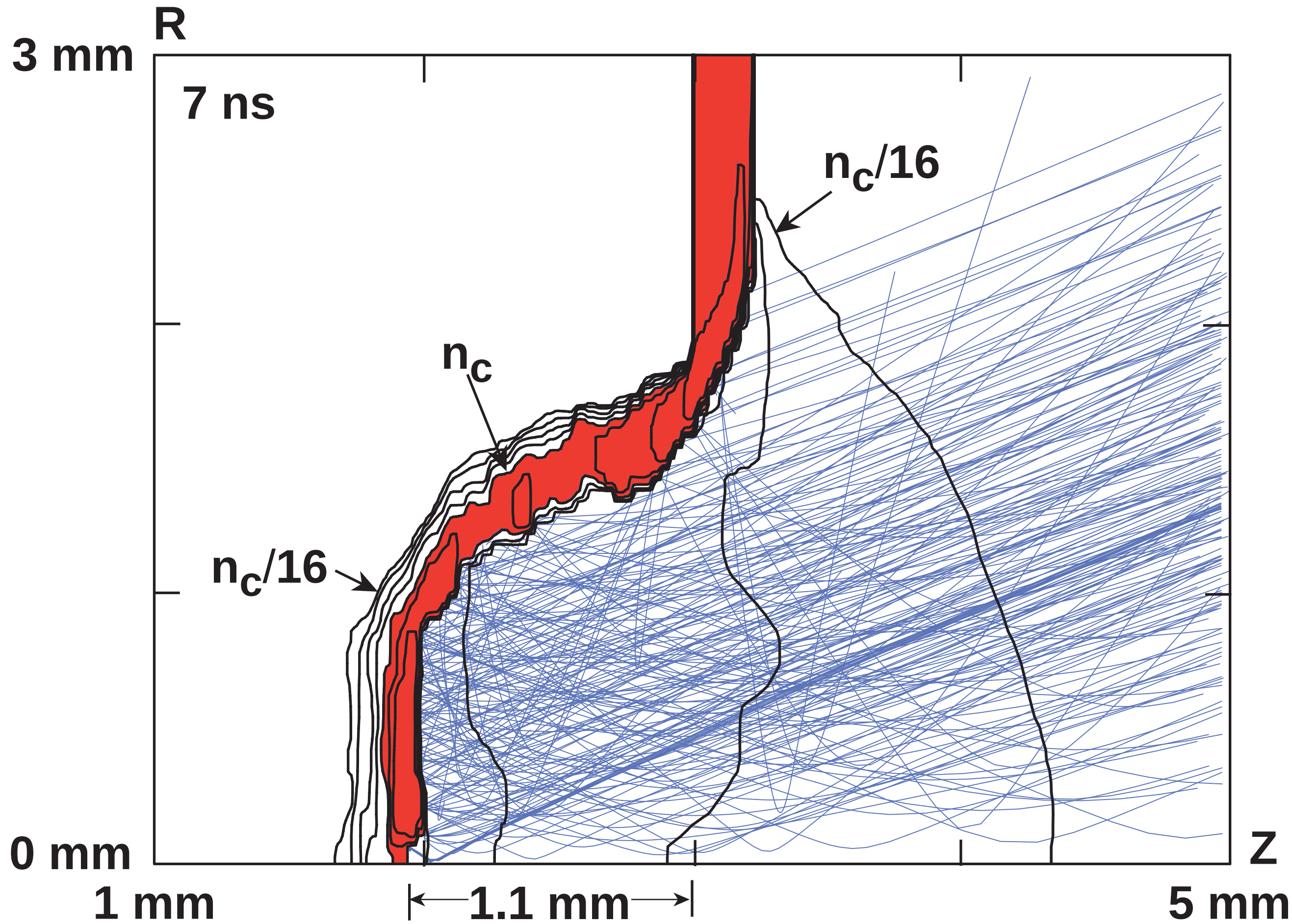
The experiment uses four NIF quads at 5 kJ/beam



Run 3160
TC5370

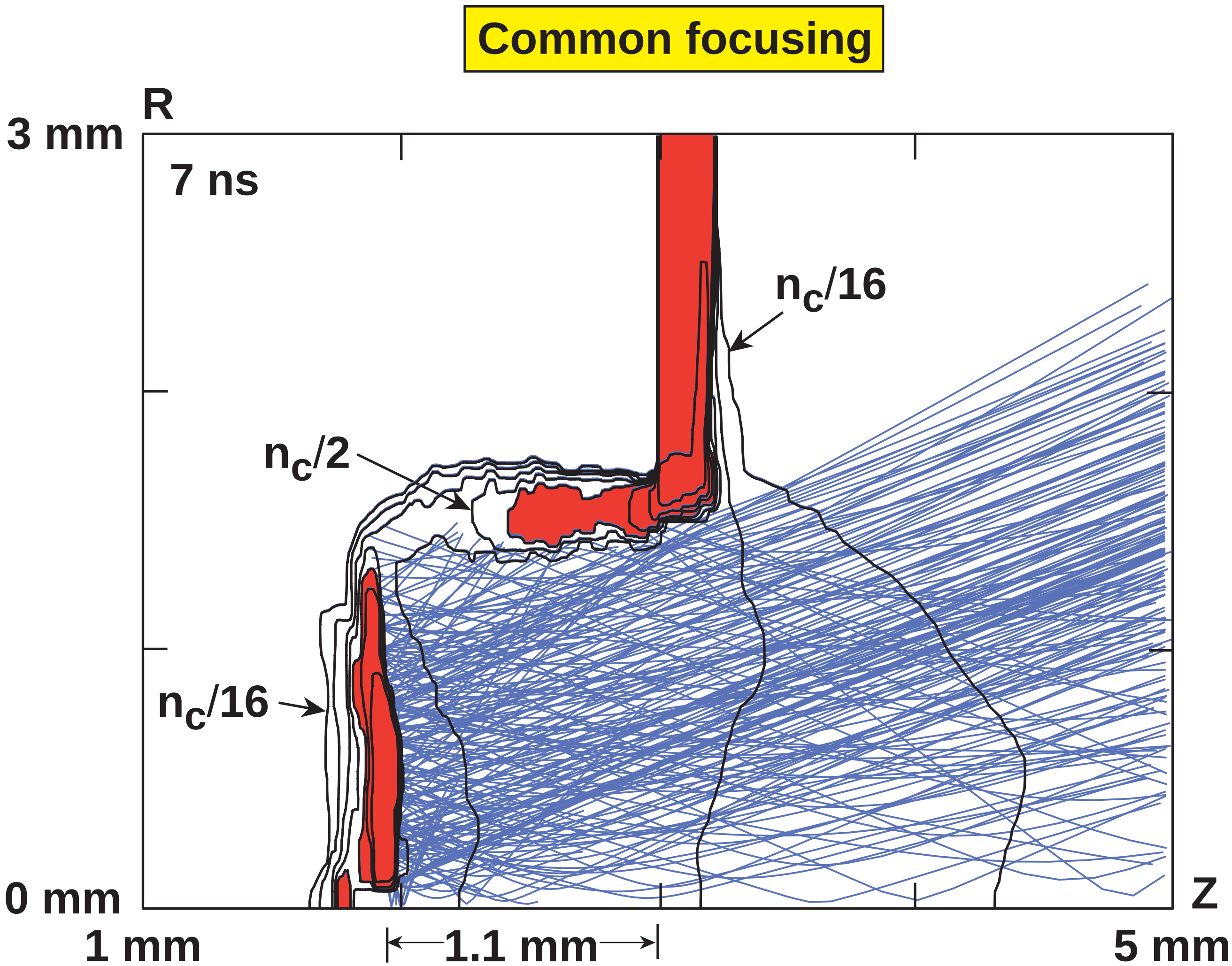
At the end of the laser pulse, the central portion of the target has moved 1.1 mm and is fairly flat

Staggered focusing



Run 3160
TC5371

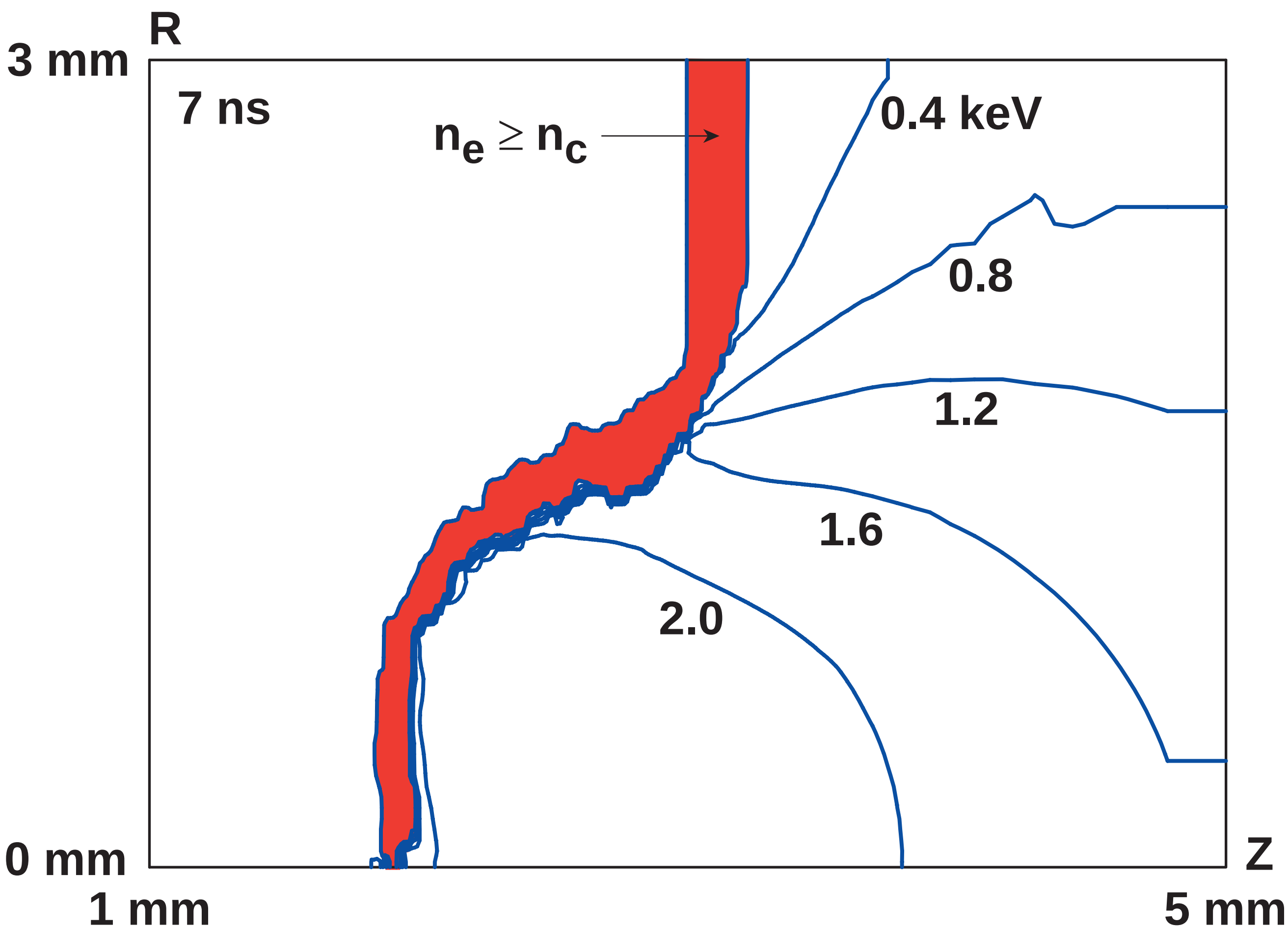
With all beams focused to the same point, the edge of the accelerated target becomes underdense



Run 3152
TC5372

The high temperatures are confined to the region heated by laser rays

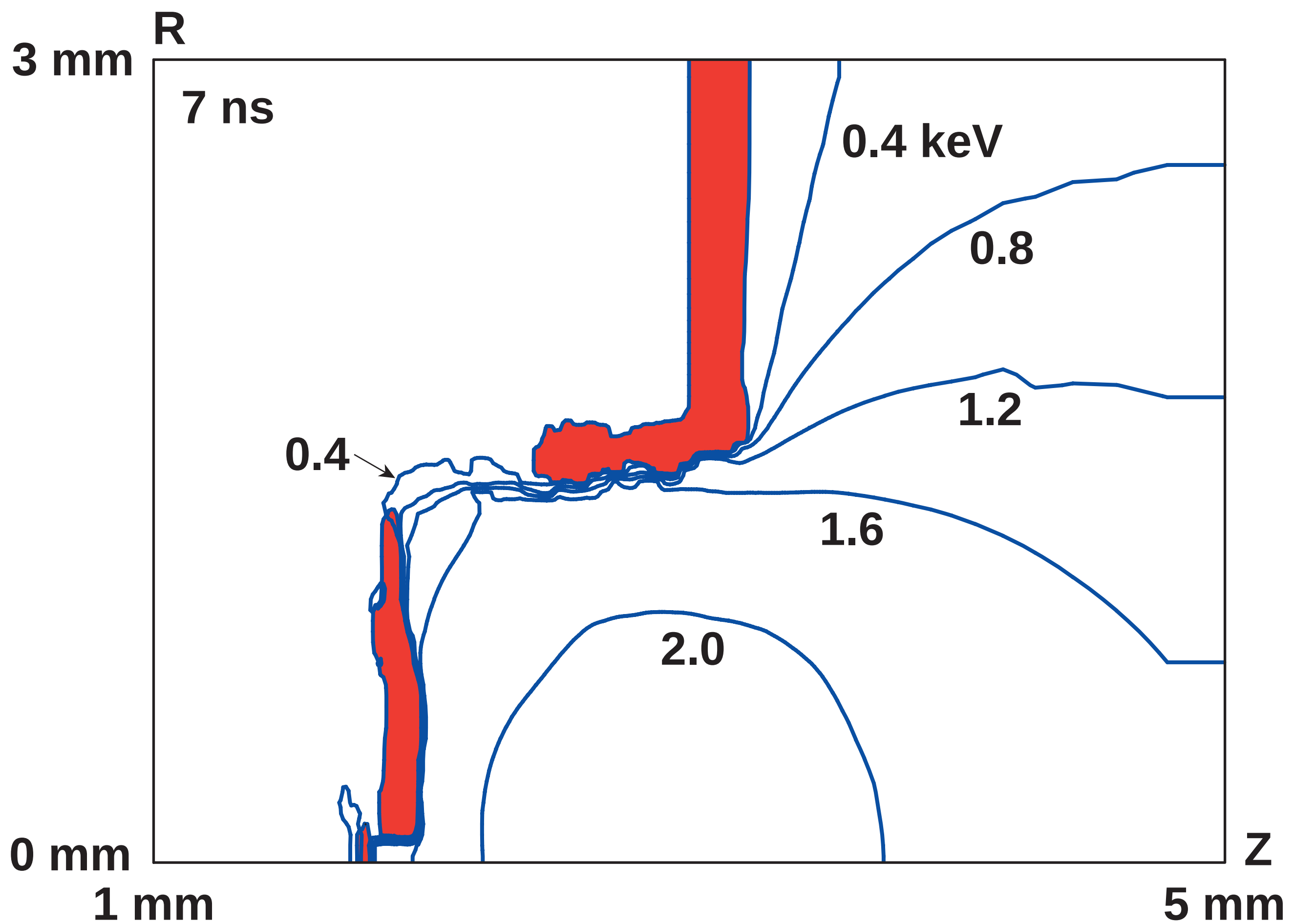
Staggered focusing



Run 3160
TC5373

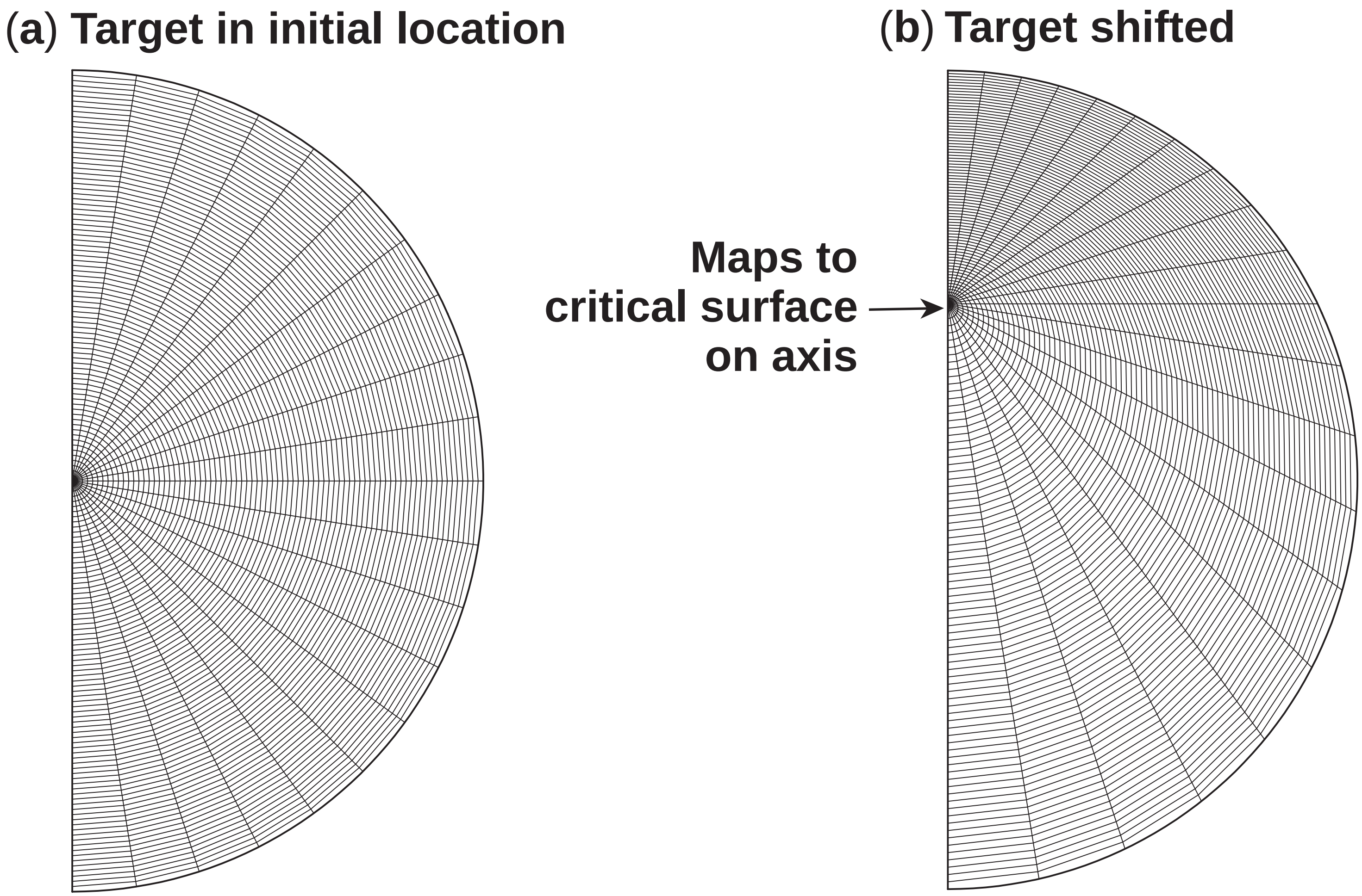
In the target that has become underdense, high temperatures penetrate to the rear

Common focusing



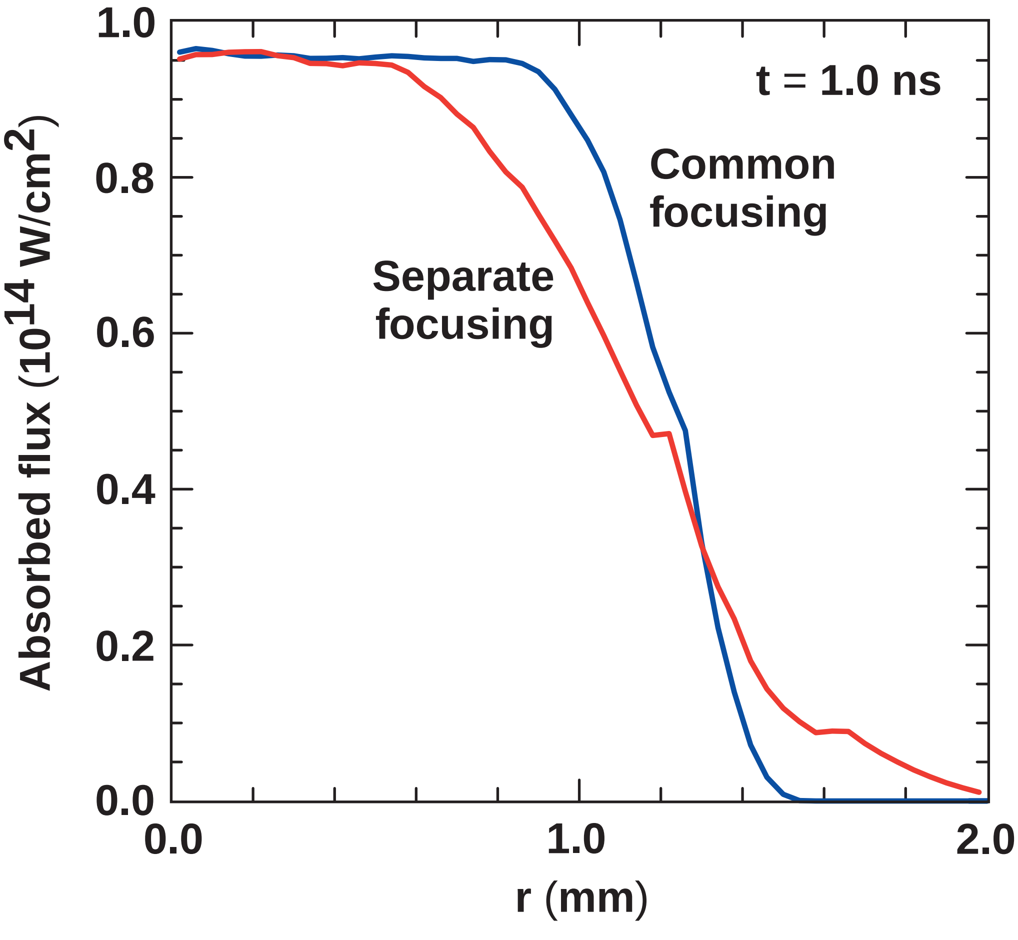
Run 3152
TC5374

To improve deposition uniformity, the (r, θ) grid of starting ray positions changes with time



Run 3160 – sub 26
TC5375

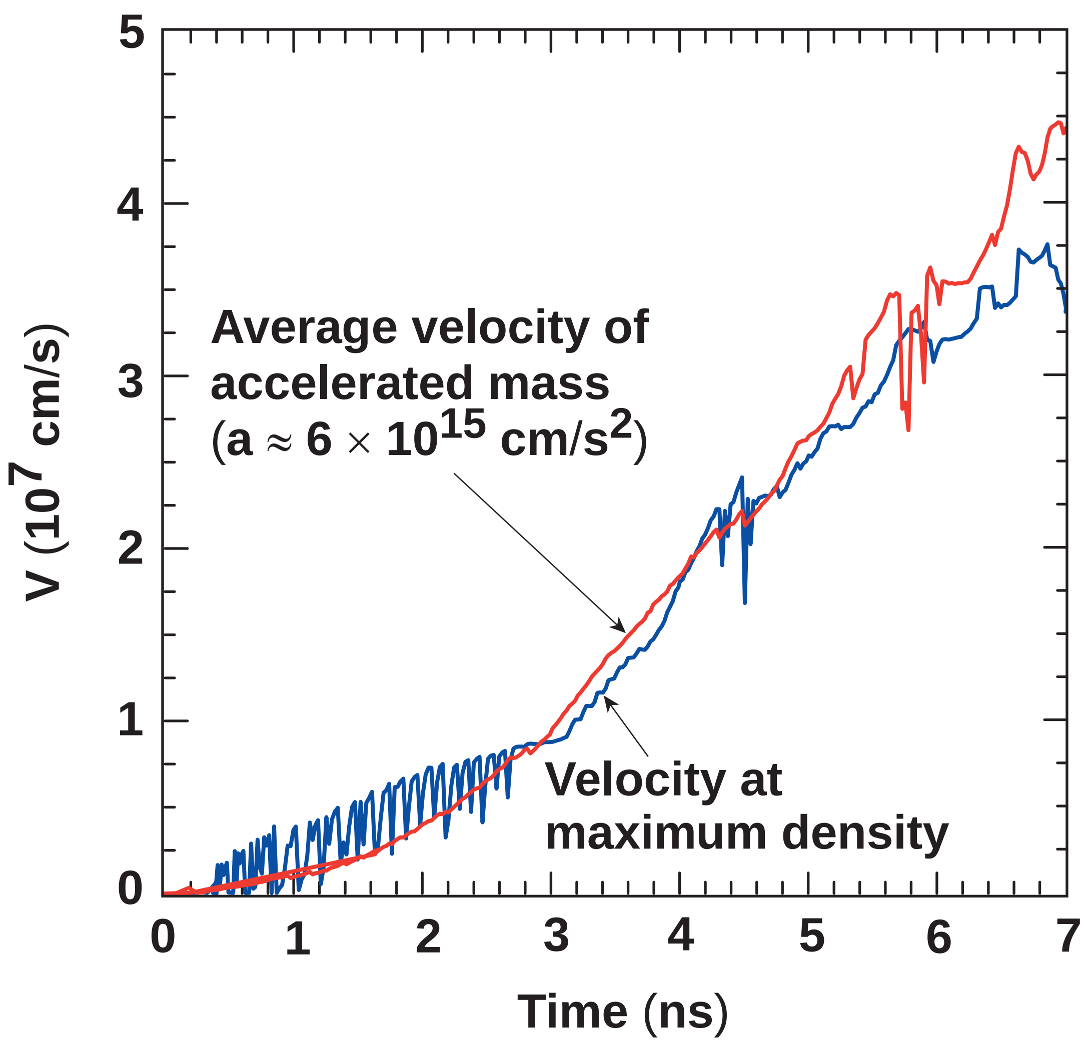
Uniform deposition is found for both focusing conditions in the central region



- Absorbed flux is integrated over Z.

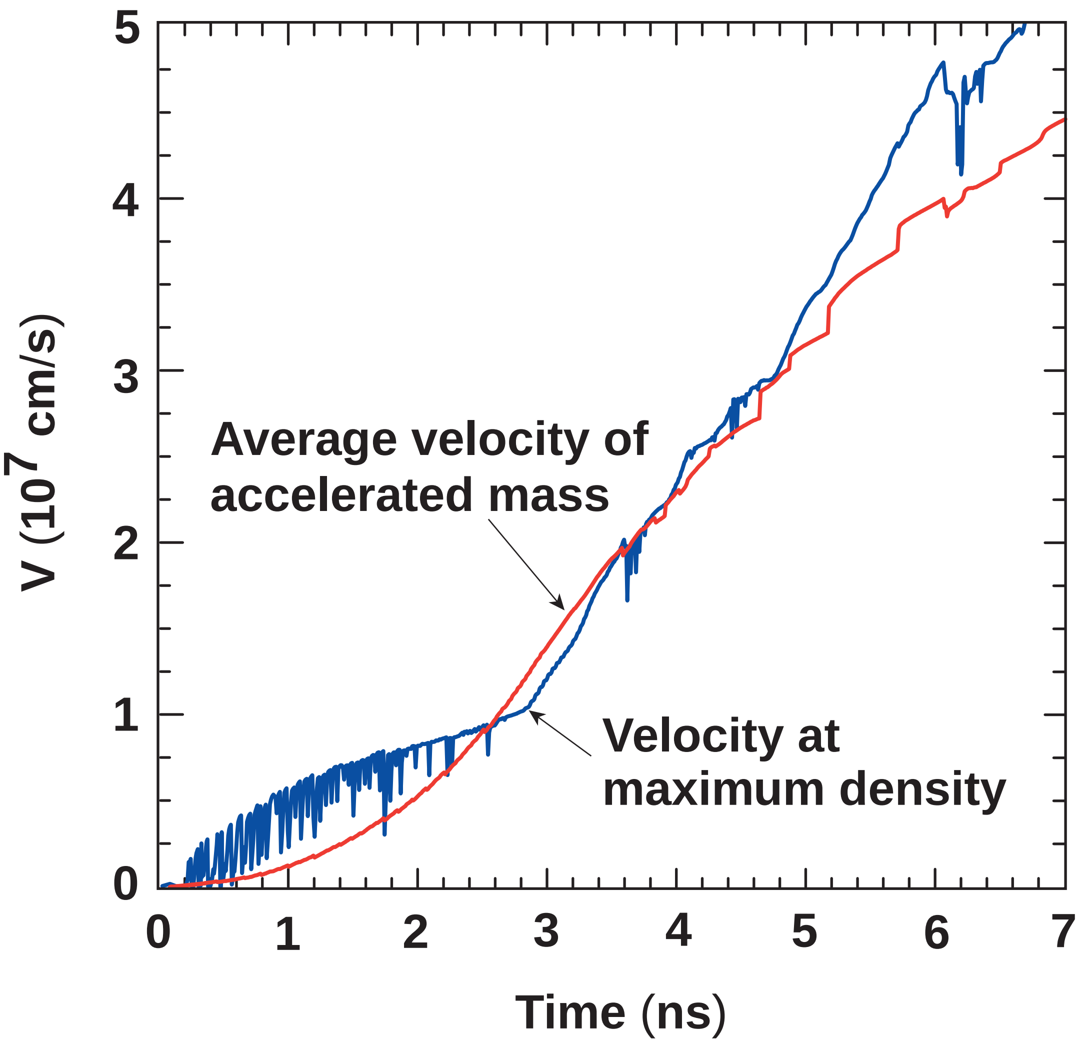
Run 3160, 3152
TC5376

On the flat portion of the laser pulse, a steady acceleration of 6×10^{15} cm/s^2 is achieved in the center of the target



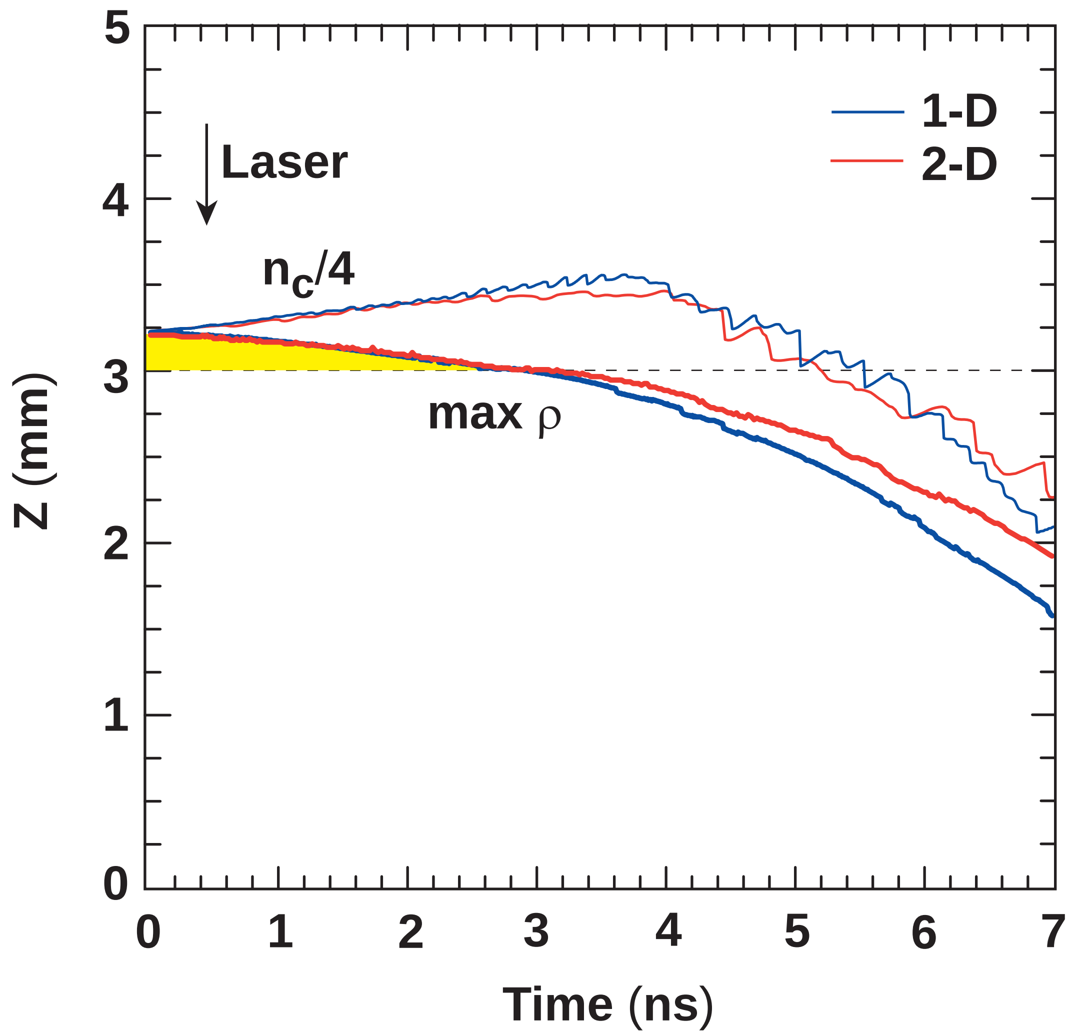
Run 3160
TC5377

The acceleration for an equivalent 1-D calculation is a little higher (~10^{16} cm/s^2)



Run 3168
TC5378

Similar target trajectories are found for 1-D and 2-D runs



Run 3160, 3168
TC5379

Summary/Conclusion

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