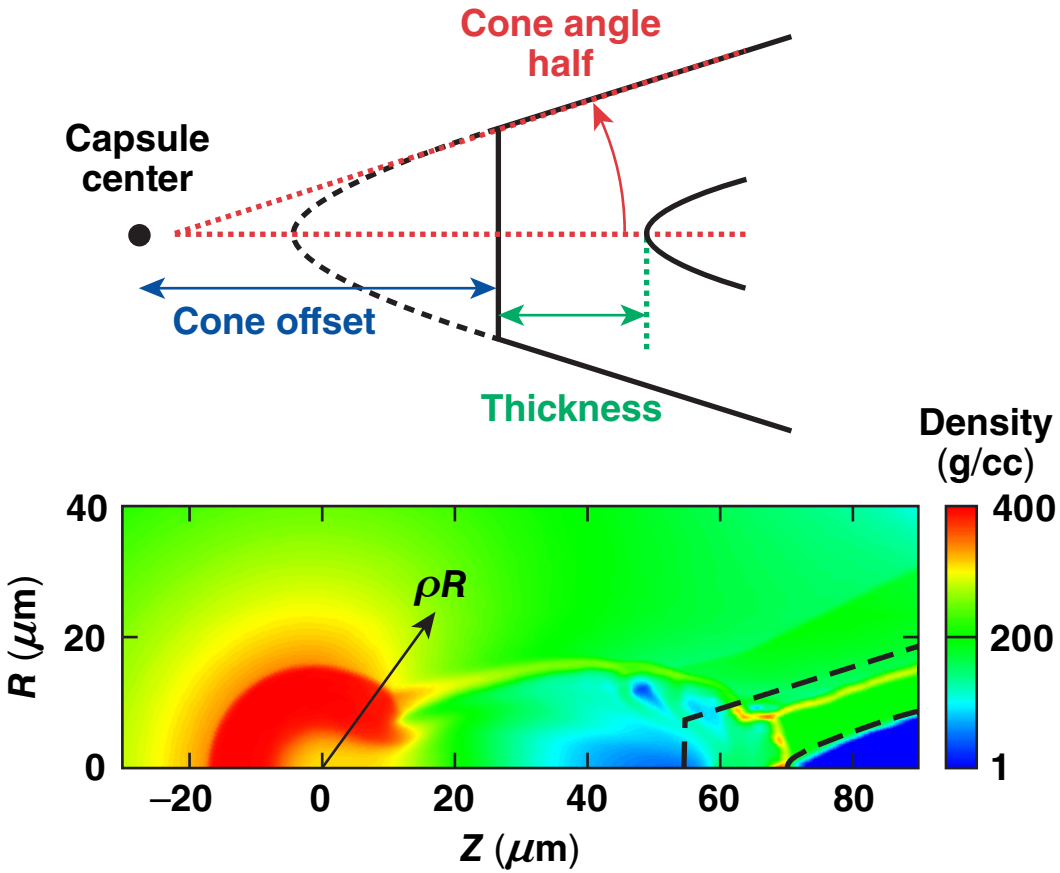
Parametric Study of Direct-Drive Fuel-Assembly Simulations of Fast-Ignition Cone-in-Shell Targets



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Summary

The performance of cone-in-shell fuel-assembly implosions is sensitive to cone geometry

FSC

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- The temporal difference between cone-tip shock-breakout time (t_{sb}) and the time of 90% peak ρR (t_{90}) provides a good figure-of-merit for system performance ($\Delta t = t_{90} - t_{sb}$)
  - insensitive to cone opening angle (±20 ps)
  - sensitive to cone-tip offset (±50 ps)
  - very sensitive to cone-tip thickness (±100 ps)

- Optimal cone geometry will be determined by integrated *DRACO-LSP** simulations

*A. A. Solodov (YI1.00002).

Collaborators

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Multiparameter studies characterized the performance of OMEGA CD implosions for various cone-tip geometries

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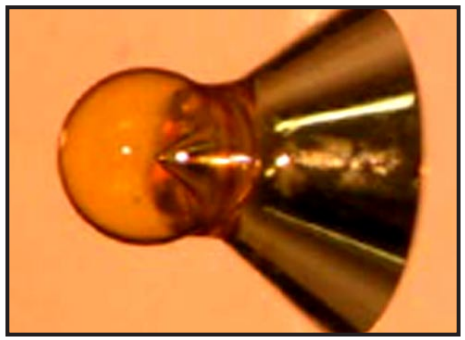
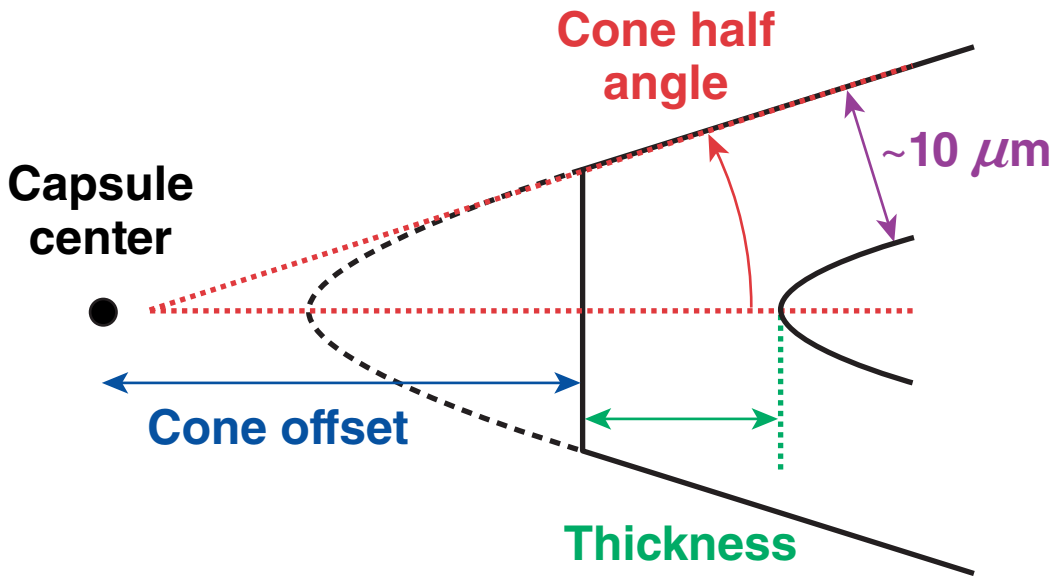
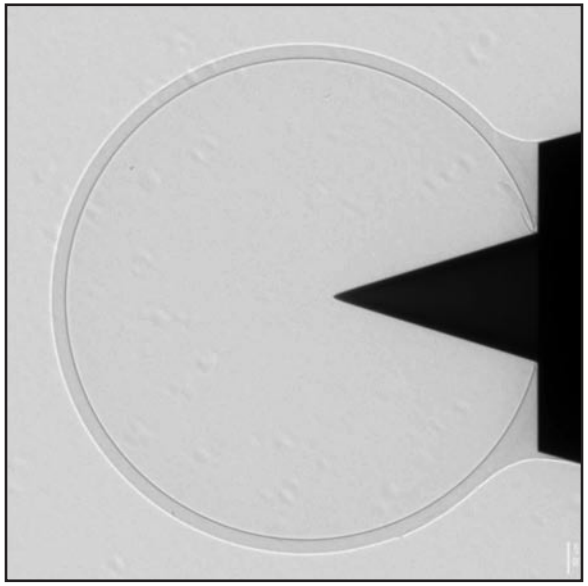
- Parameters
  - cone angle (12° to 35° half angle)
  - cone-tip offset from target center (40 to 70 μm)
  - cone-tip thickness (5 to 25 μm)



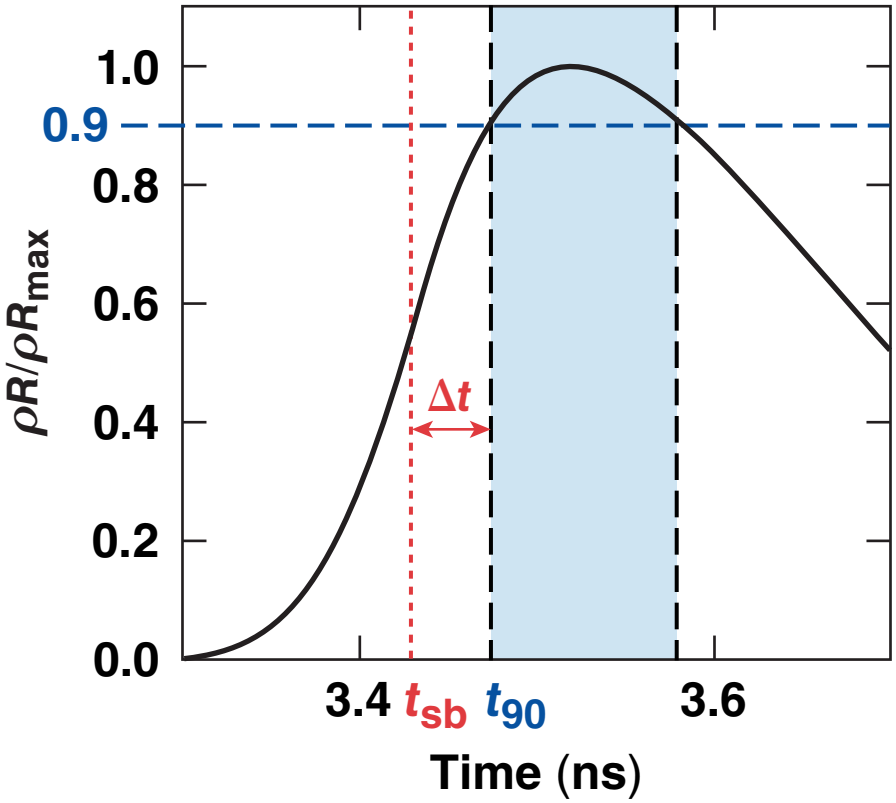




Radiograph of target

TC8276

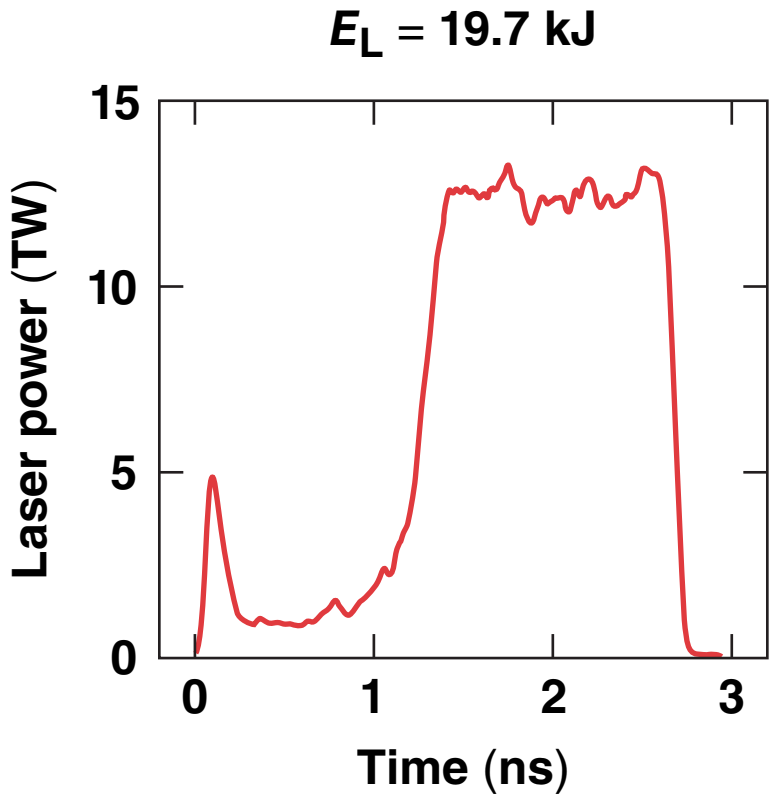
The temporal difference (Δt) between the shock breakout on the inside of the cone tip (t_{sb}) and the time of 90% peak ρR (t_{90}) provides a good figure-of-merit for system performance ($\Delta t = t_{90} - t_{sb}$)

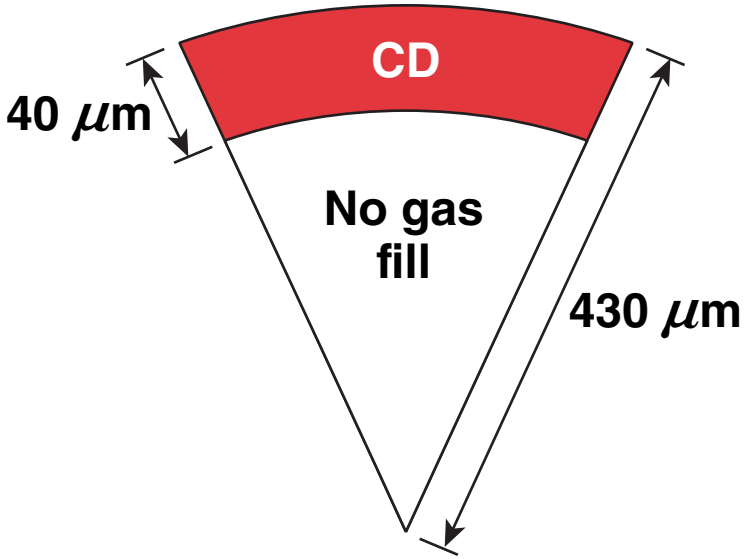


- Fast-electron beam should be injected before t_{sb}
- Variations in Δt in the parameter space show the effect of cone geometry on timing

TC8279

Studies examine warm mass-equivalent targets emulating ignition-scaled OMEGA cryogenic cone-in-shell capsules

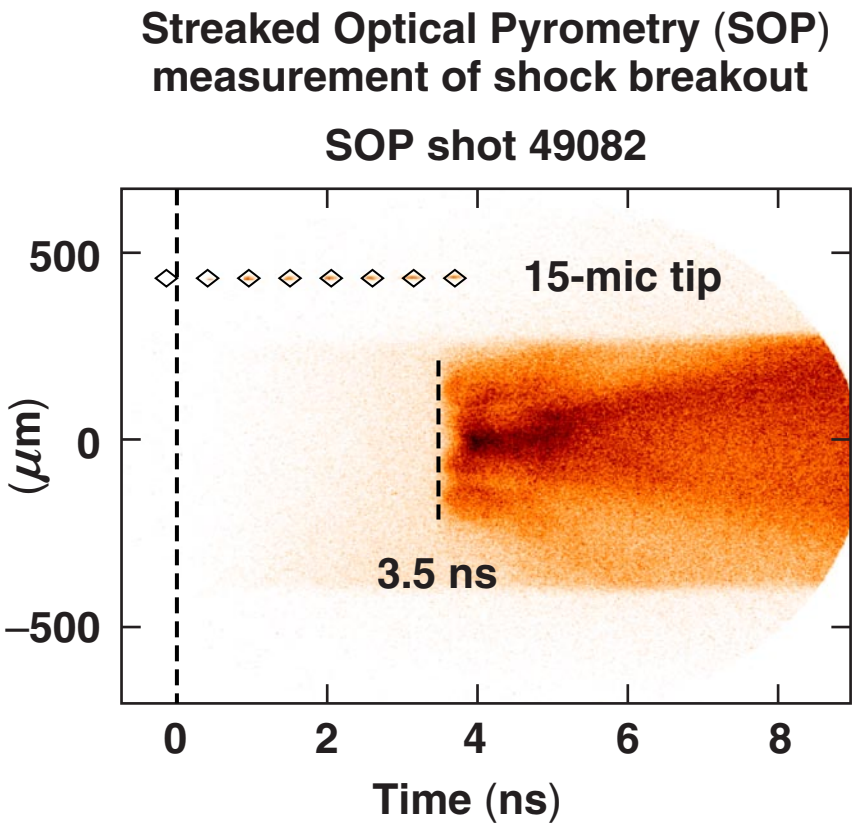


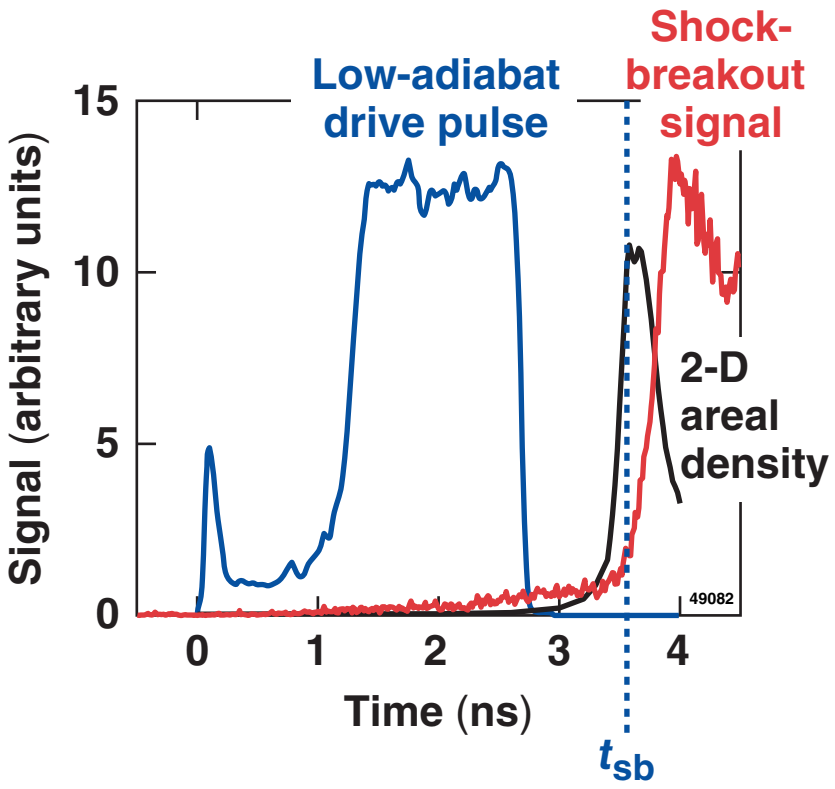


Adiabat, α = 1.2

TC8277

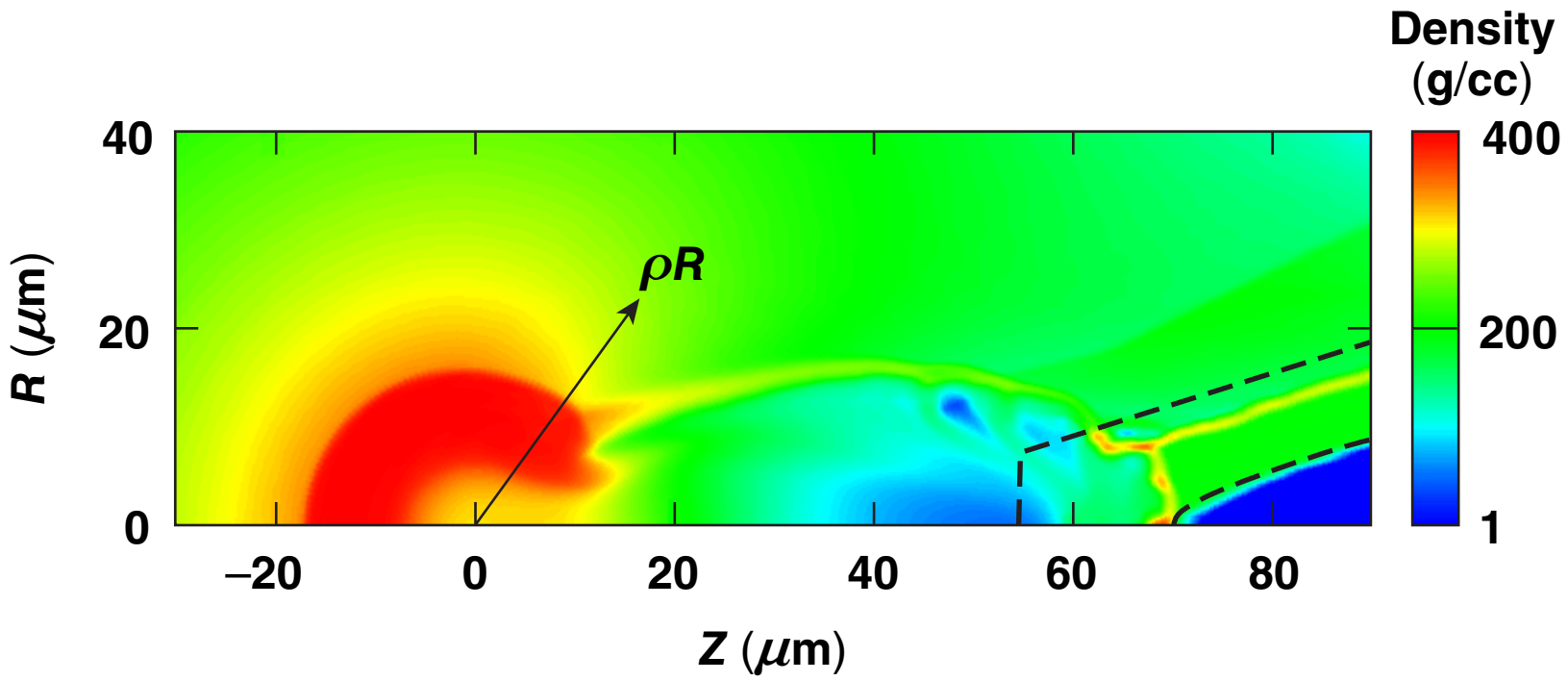
The shock-breakout time inside the cone tip has been measured experimentally





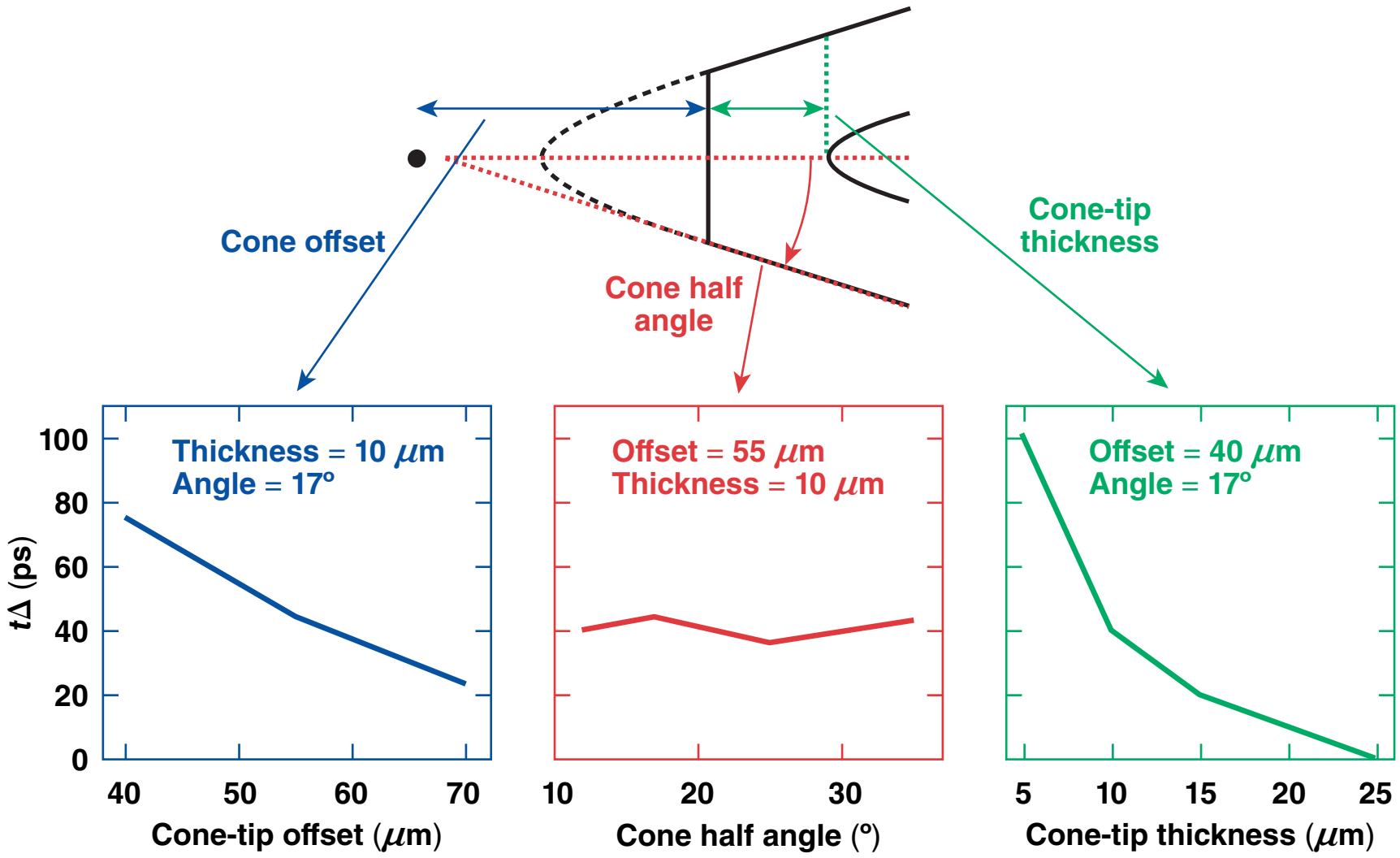
TC8380

Target performance is evaluated by measuring the delay between the shock-breakout time in the cone tip and the time of 90% of peak ρR



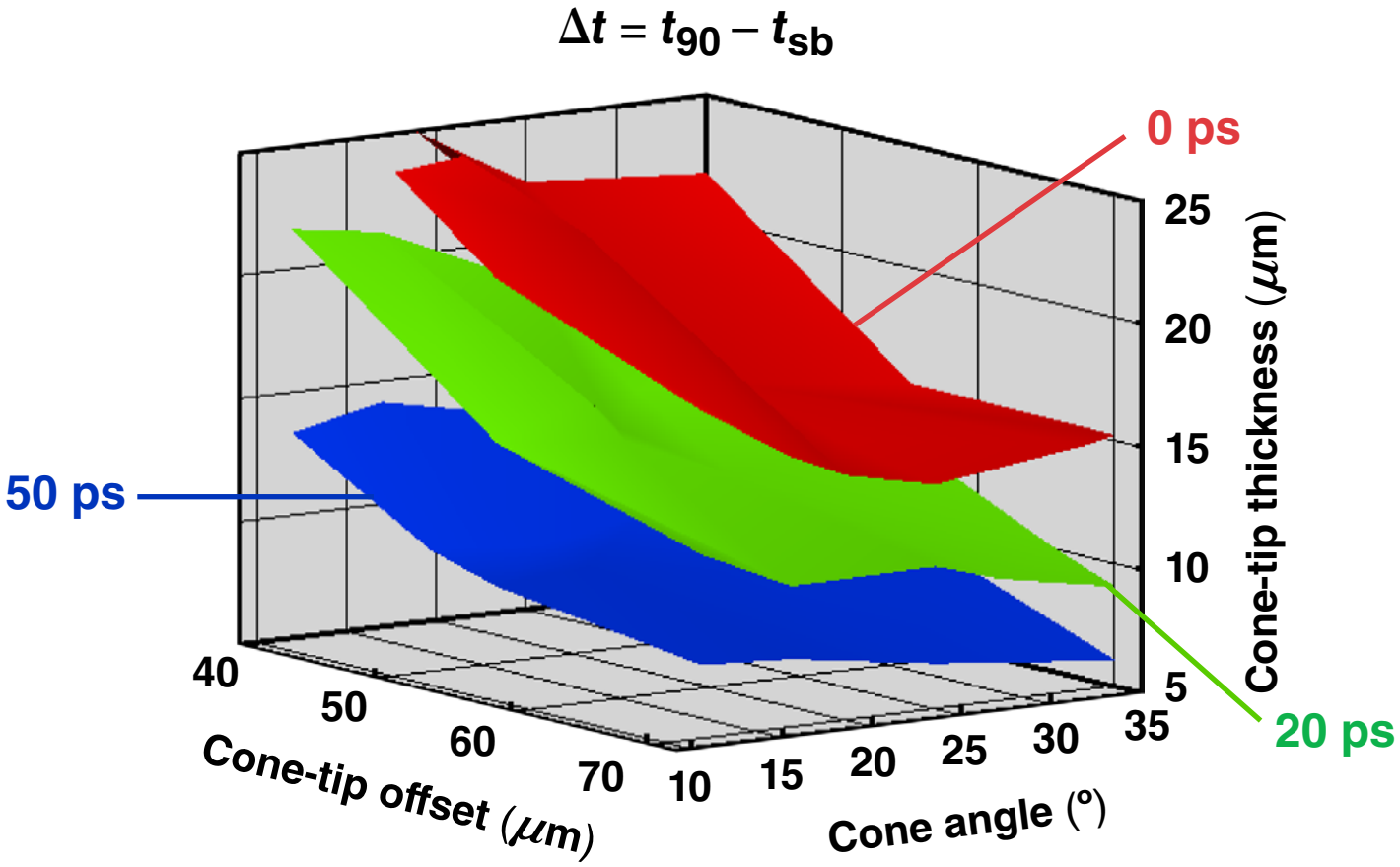
$t = t_{sb}$ represents the time the cone interior begins filling with plasma.

The shock-breakout time (t_{sb}) depends highly on cone-tip thickness, but only moderately on tip offset



TC8381

The shock-breakout time (t_{sb}) depends highly on cone-tip thickness; moderately on tip offset



Integrated *DRACO-LSP* simulations* indicate significant coupling of hot-electron energy to the fuel assembly

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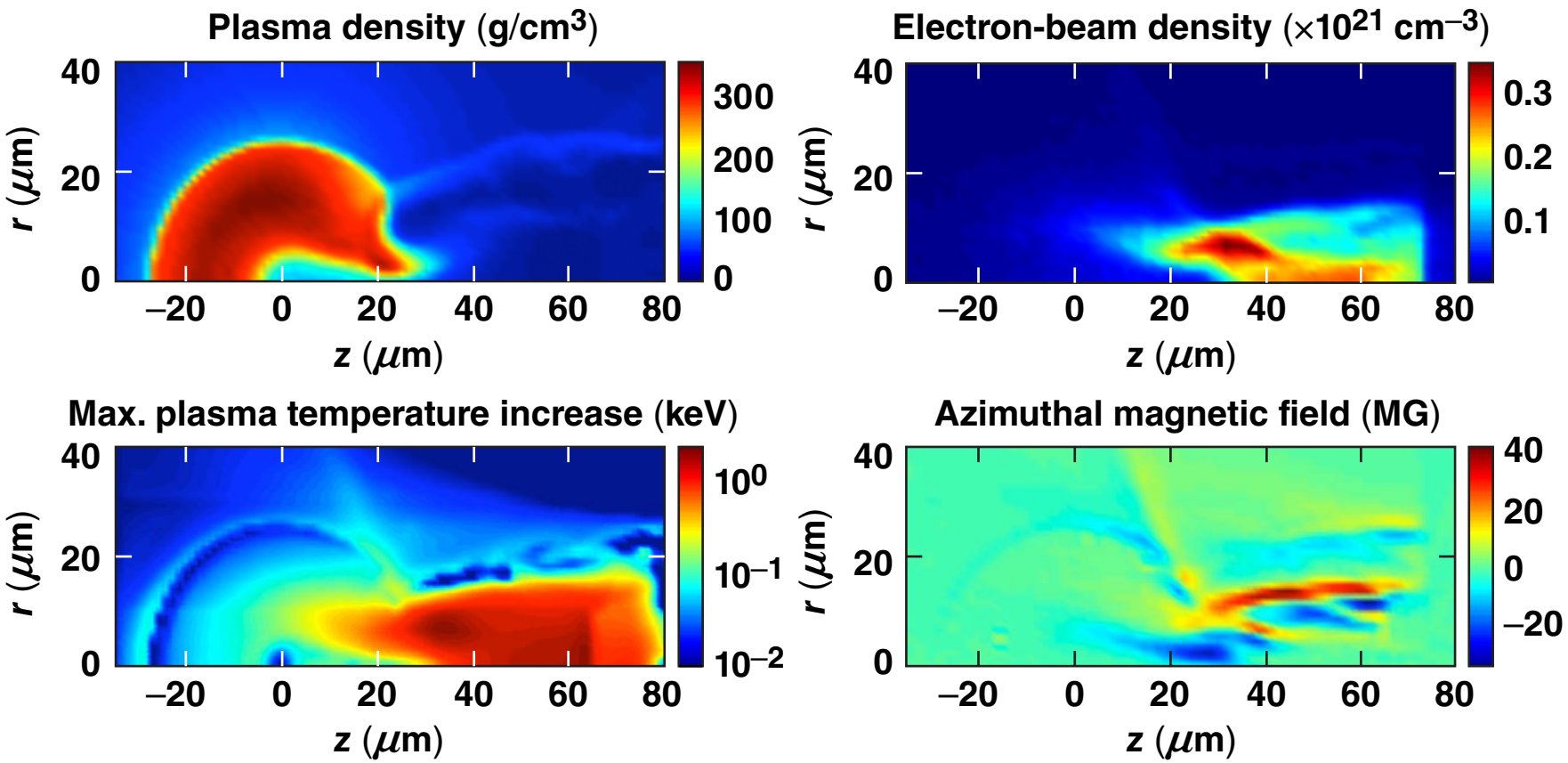
Snapshots at t = 6 ps after the beginning of the e-beam



55% of hot-electron energy couples to fuel assembly at density greater than 80 g/cc.

TC8382

*A. A. Solodov (YI1.00002).

Summary/Conclusions

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  - insensitive to cone opening angle (±20 ps)
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- Optimal cone geometry will be determined by integrated *DRACO-LSP** simulations

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Future Work

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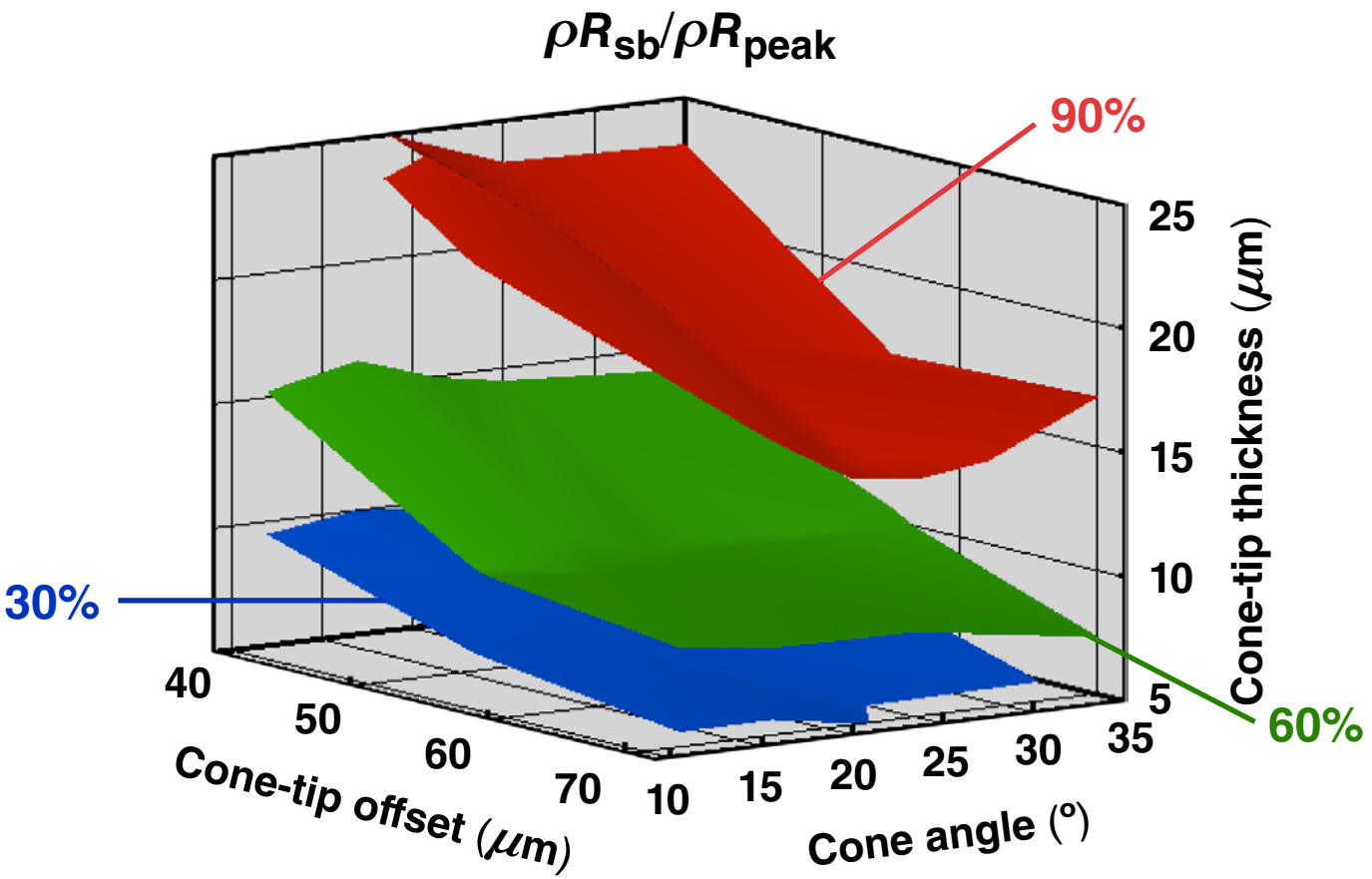
- **Optimization of beam configuration with 3-D ray trace (in progress)**
- **Optimization of yield with integrated fast-electron transport on integrated *LSP-DRACO* simulations**
- **Cryogenic and ignition design studies**

Target performance is highly dependent on the cone-tip thickness

ρR_{sb} = areal density at time of shock breakout in cone tip

ρR_{max} = maximum areal density



TC8289