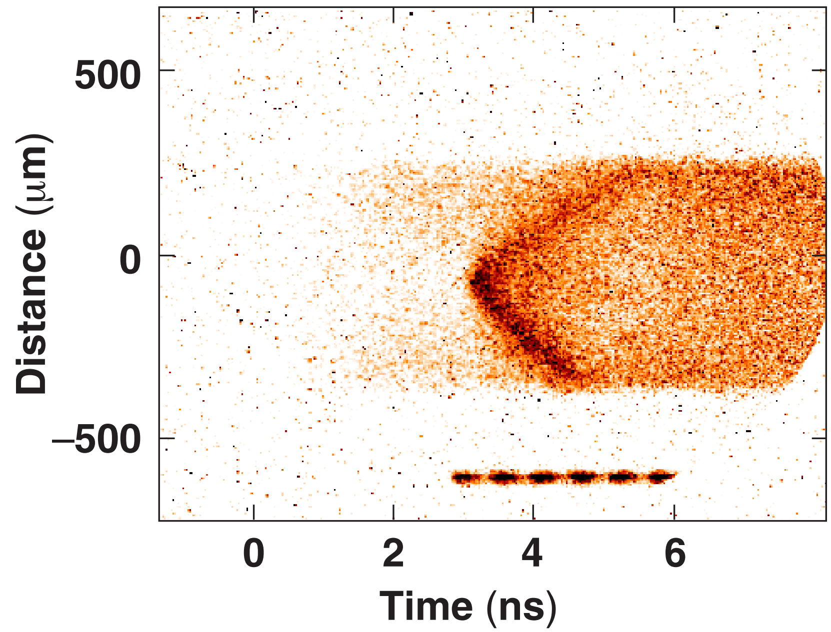
Measurements of Plasma Filling Inside a Fast-Ignitor Cone Target Using Streaked Optical Pyrometry



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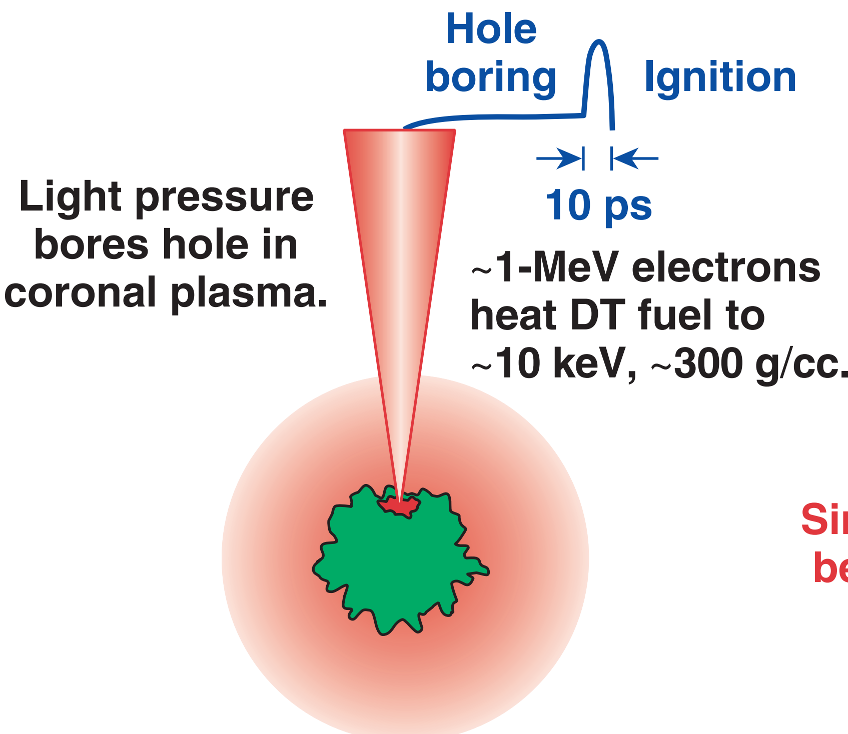
Summary

With the current target design plasma filling of the interior of the cone starts after peak compression

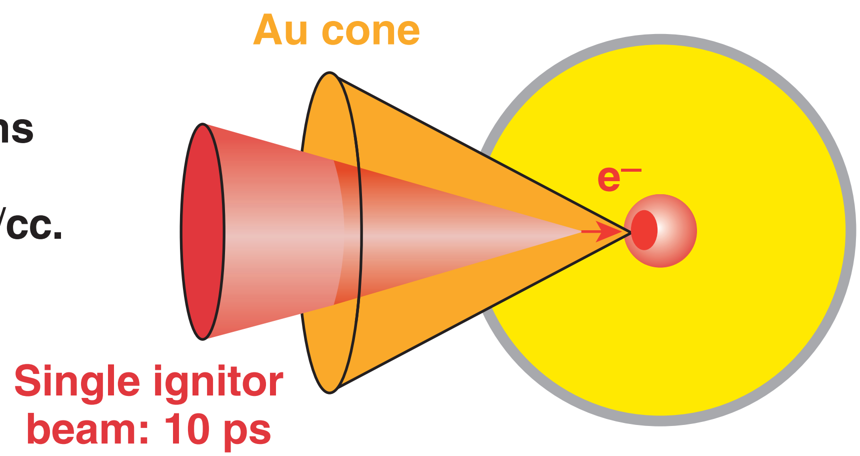
- Experiments were performed with cone-in-shell fast-ignitor targets in laser direct-drive geometry to explore the filling of the interior of the cone where the ultrafast laser has to propagate.
- Backlit x-ray images show the creation of hot, dense core plasma, which erodes the tip of the cone and drives a shock wave through the cone tip, creating plasma when it breaks out.
- The shock breakout was observed using a streaked optical pyrometer (SOP) in the visible spectrum at 660 nm wavelength.
- The shock temperature was estimated to be of the order of 10 eV.

The two viable fast-ignition concepts share fundamental issues: hot-electron production and transport to the core

Channeling Concept

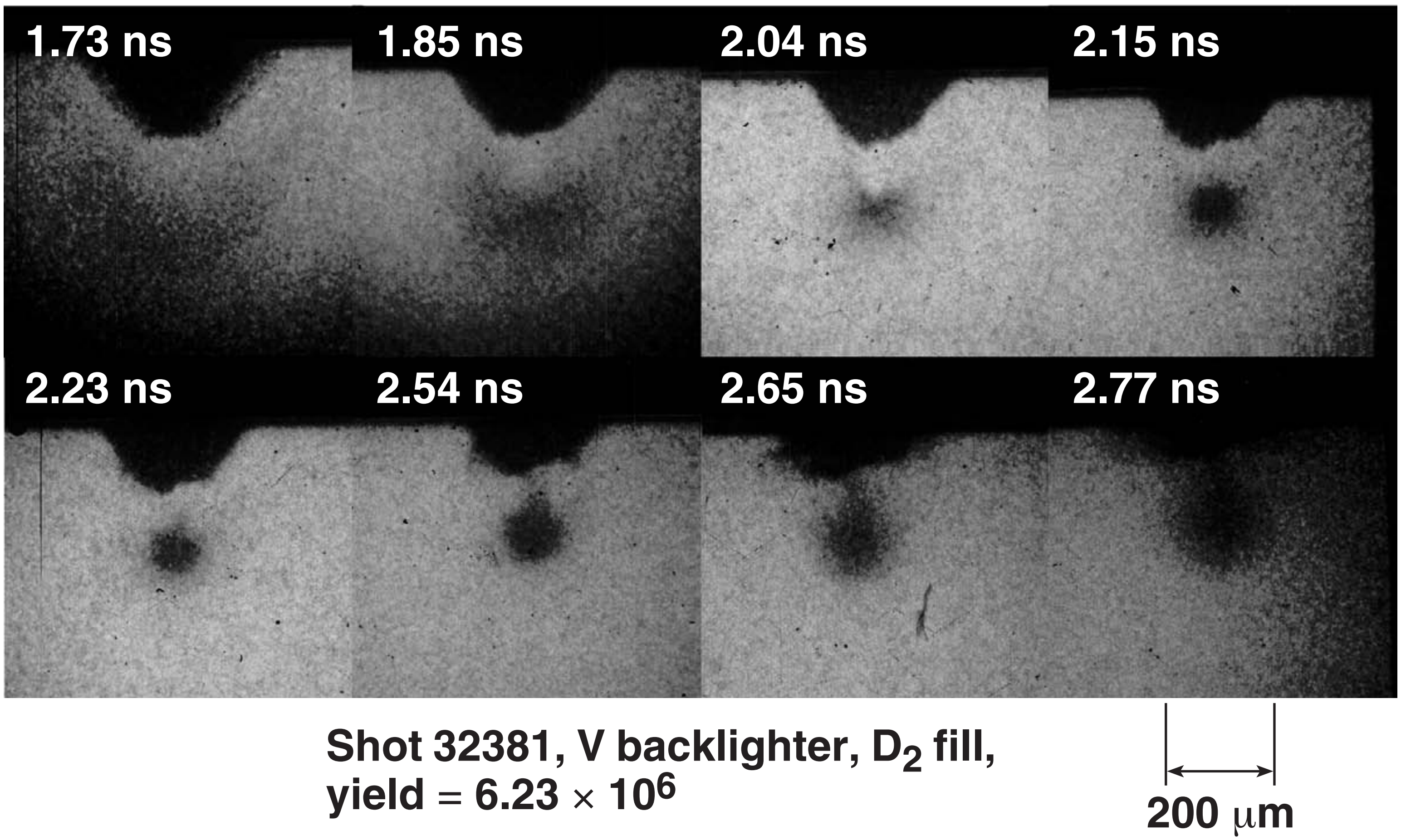


Cone-Focused Concept



E11710d

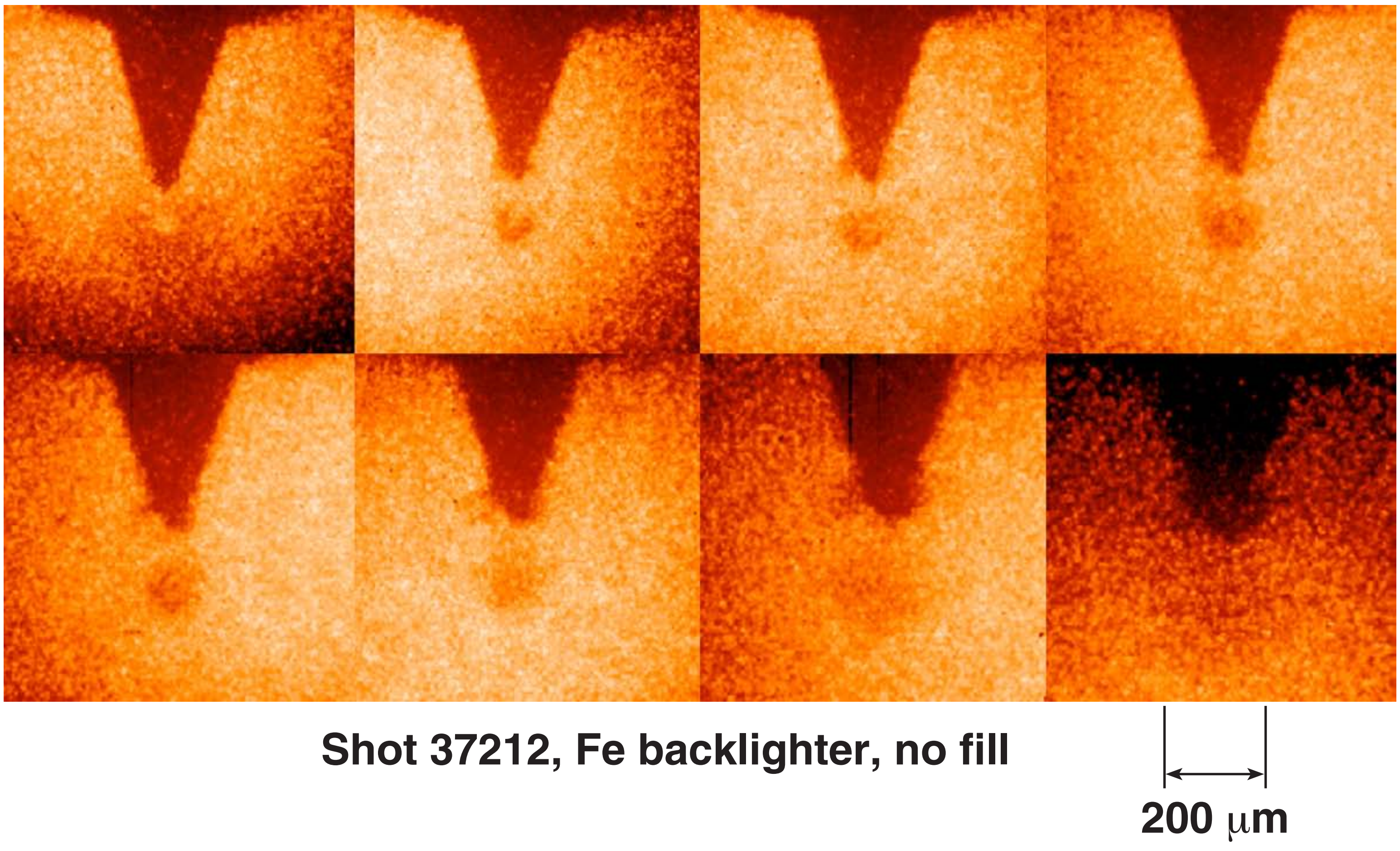
The backlit framing camera images show the core assembly and cone reaction in great detail



Shot 32381, V backlighter, D_2 fill, yield = 6.23×10^6

E12558

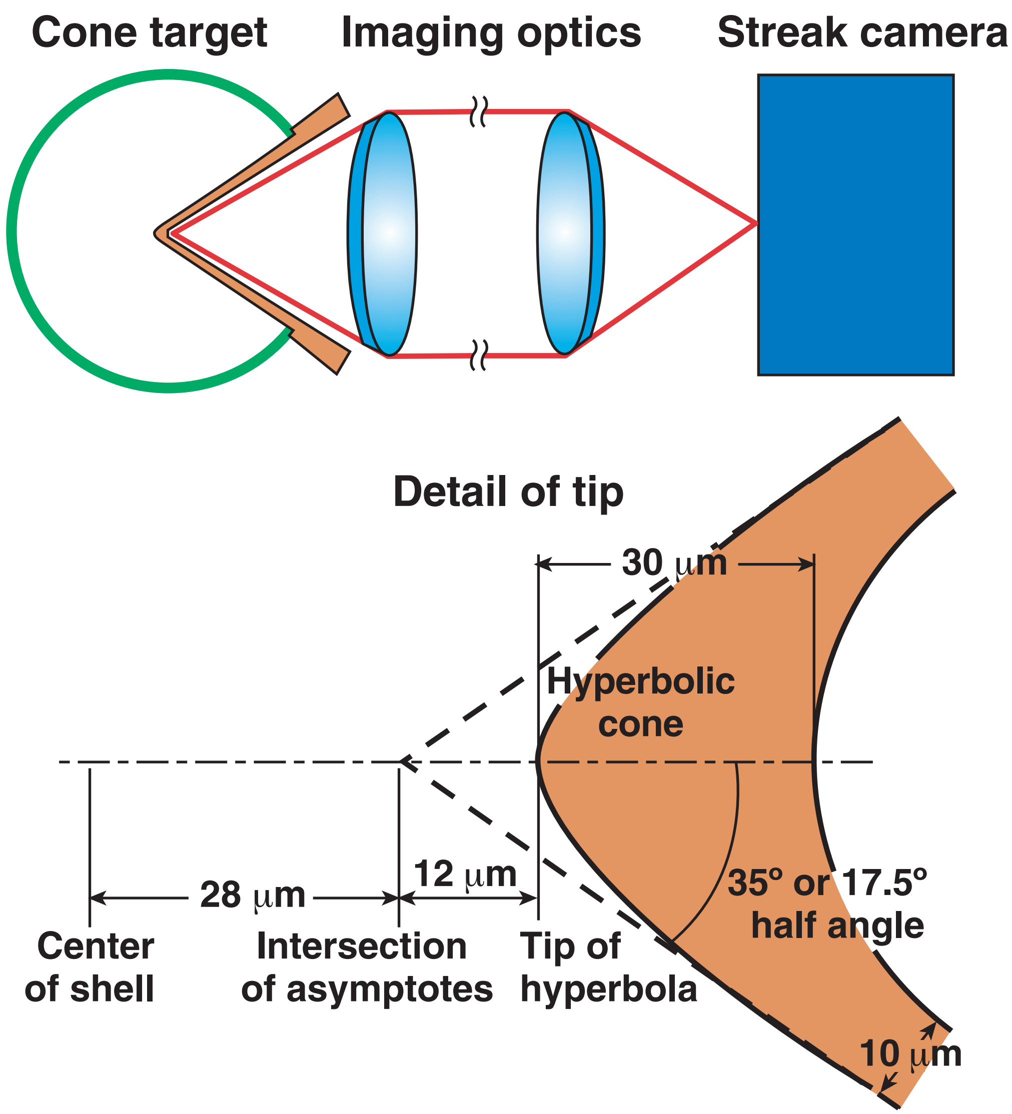
The hydrodynamic evolution of the 35° cones shown in the backlit images is very similar to the 70° cones



Shot 37212, Fe backlighter, no fill

E13817a

Streaked optical pyrometry (SOP) is used to observe the cone filling with plasma



E13821a

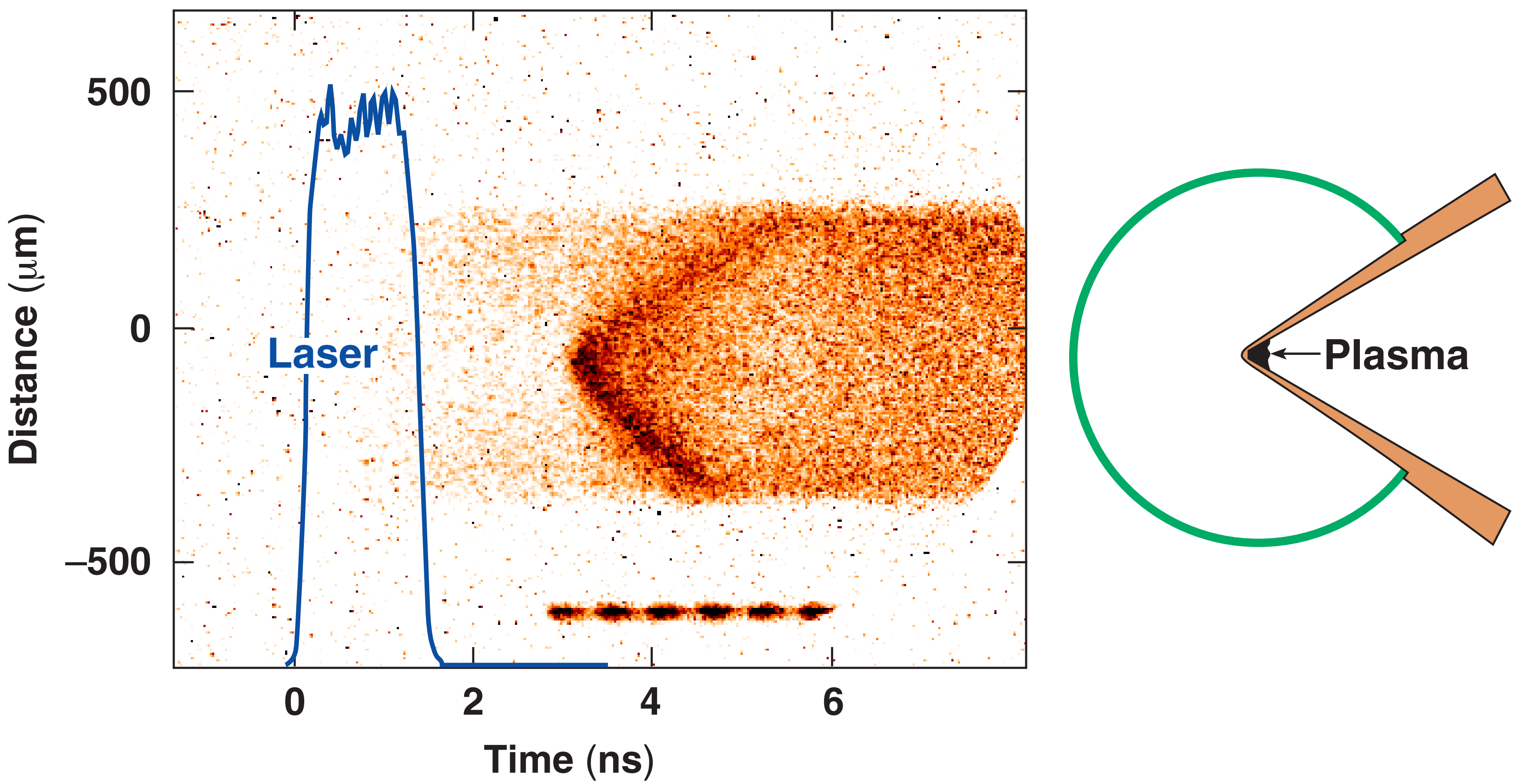
Big cones were necessary to shield SOP from the hot laser plasma driving the shell

1 mm

1 mm

E13822

The 70° cone shows a clean shock-breakout signal at the tip of the cone

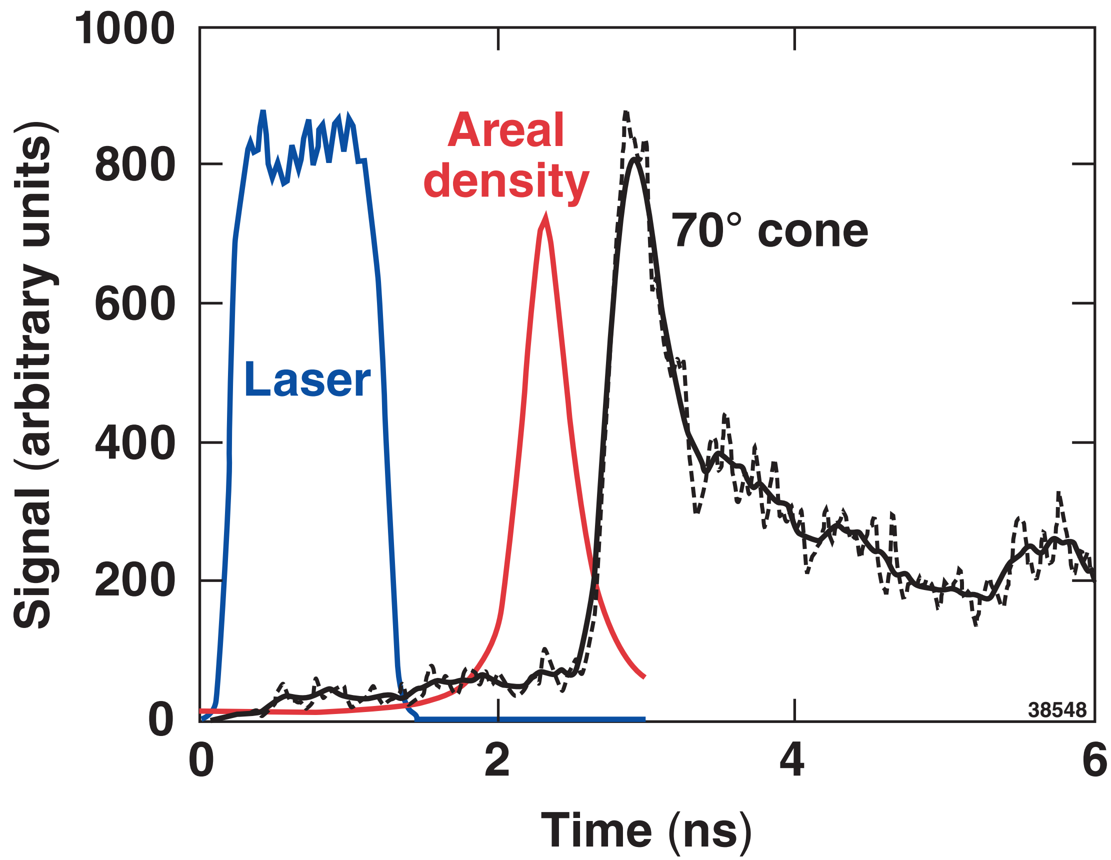


- Shot 38548, 1 ns pulse, 18 kJ, 48 beams, 24 μm CH shell

E13823a

The emission inside the 70° cone starts after the time of peak compression (~2.2 ns)

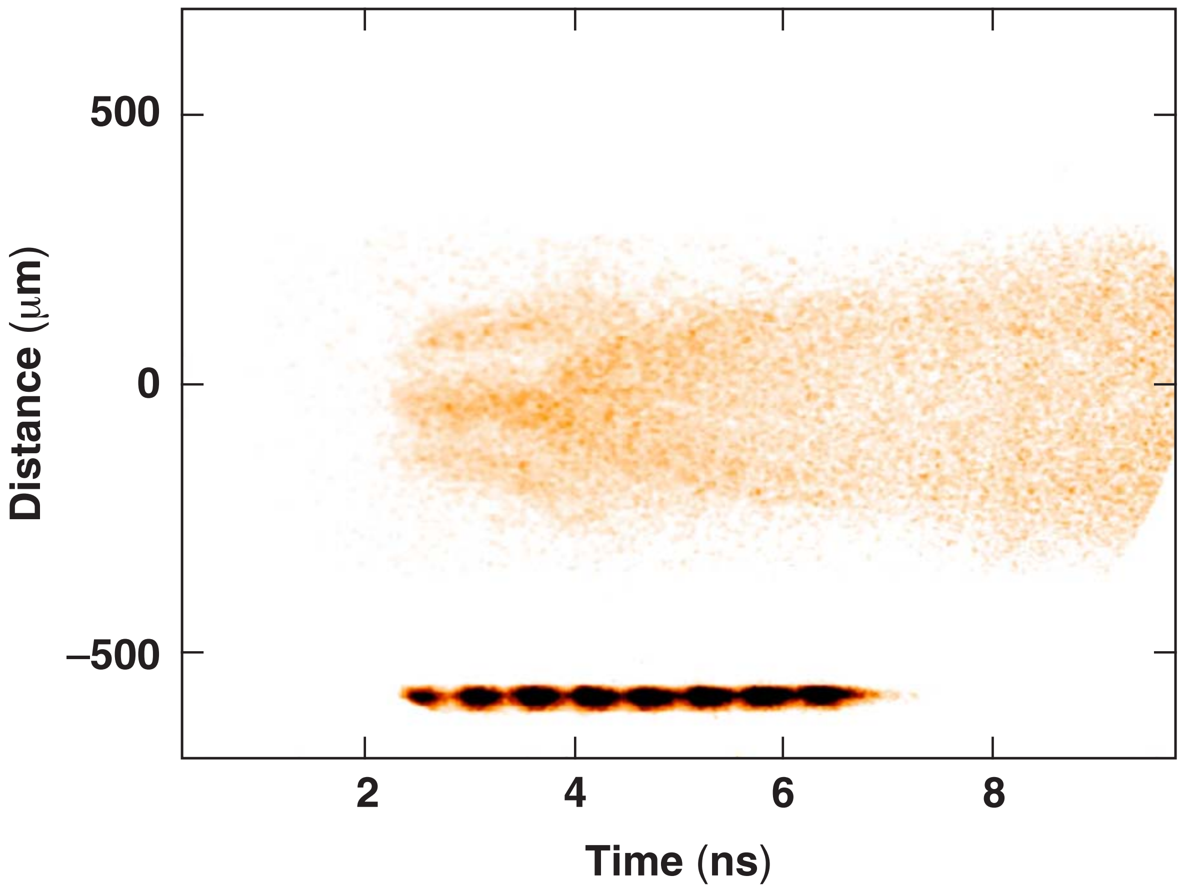
UR LLE

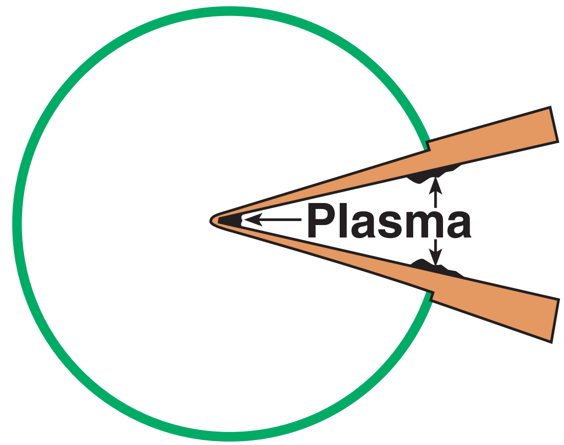


- Lineouts through the tip of the cone in the center of the SOP streak
- Areal density from 1-D hydrocode simulations
- Shock temperature ~10 eV

E13825

The signal from the 30° cone is compromised by a shock breaking out from the shell–cone–joint region

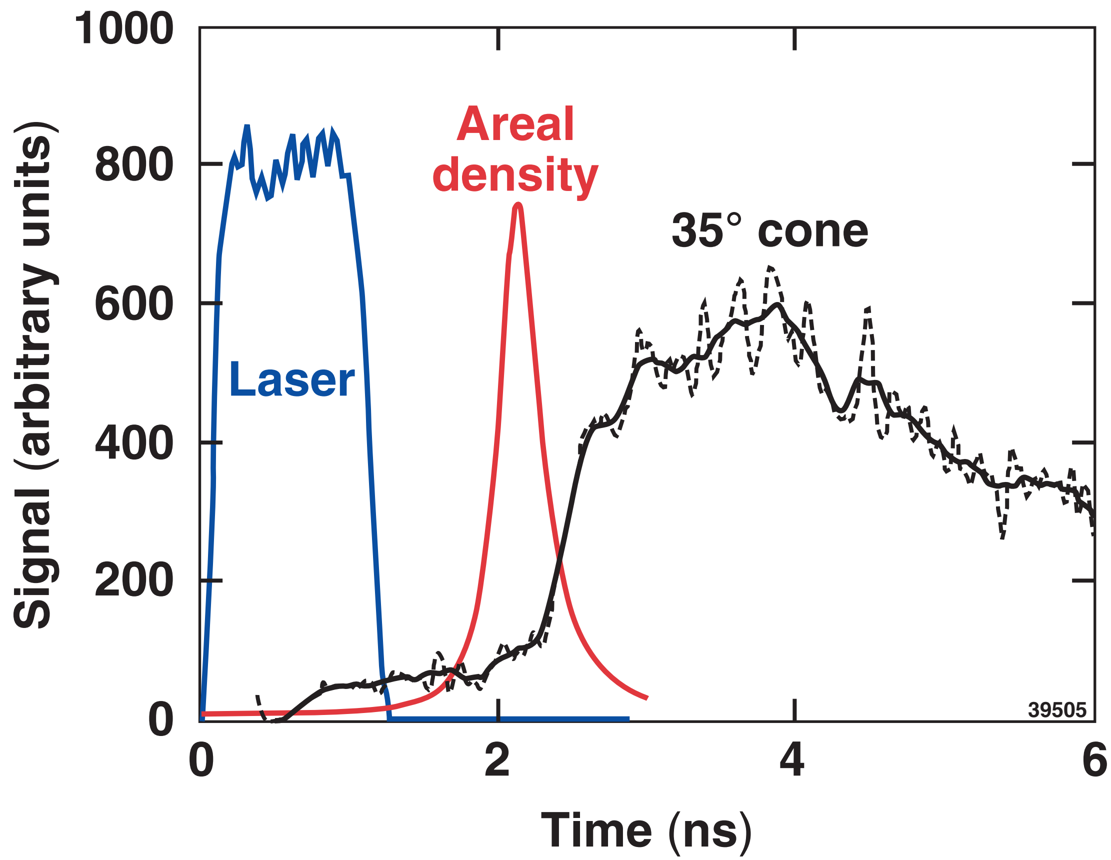




- Shot 39505, 1 ns pulse, 21 kJ, 54 beams, 24 μm CH shell

E13824a

The emission inside the 35° cone starts after the time of peak compression (~2.1 ns)



- Lineouts through the tip of the cone in the center of the SOP streak
- Areal density from 1-D hydrocode simulations
- Shock temperature ~10 eV

E13804

Summary/Conclusions

With the current target design plasma filling of the interior of the cone starts after peak compression

UR LLE

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