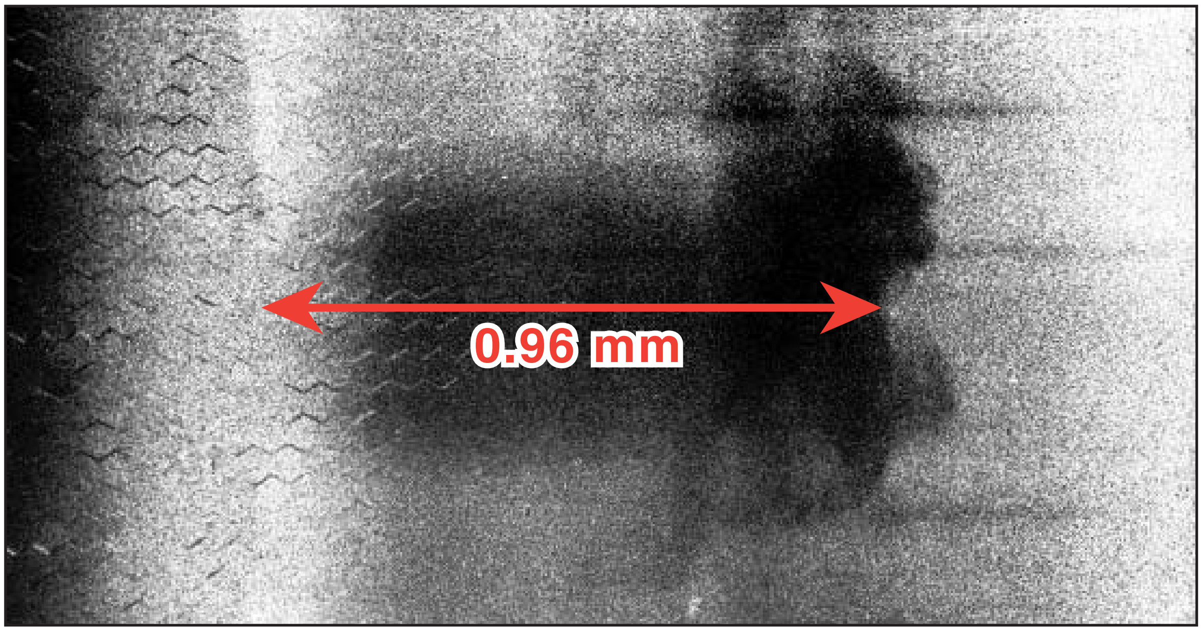
Hydrodynamic Jet Experiments on OMEGA



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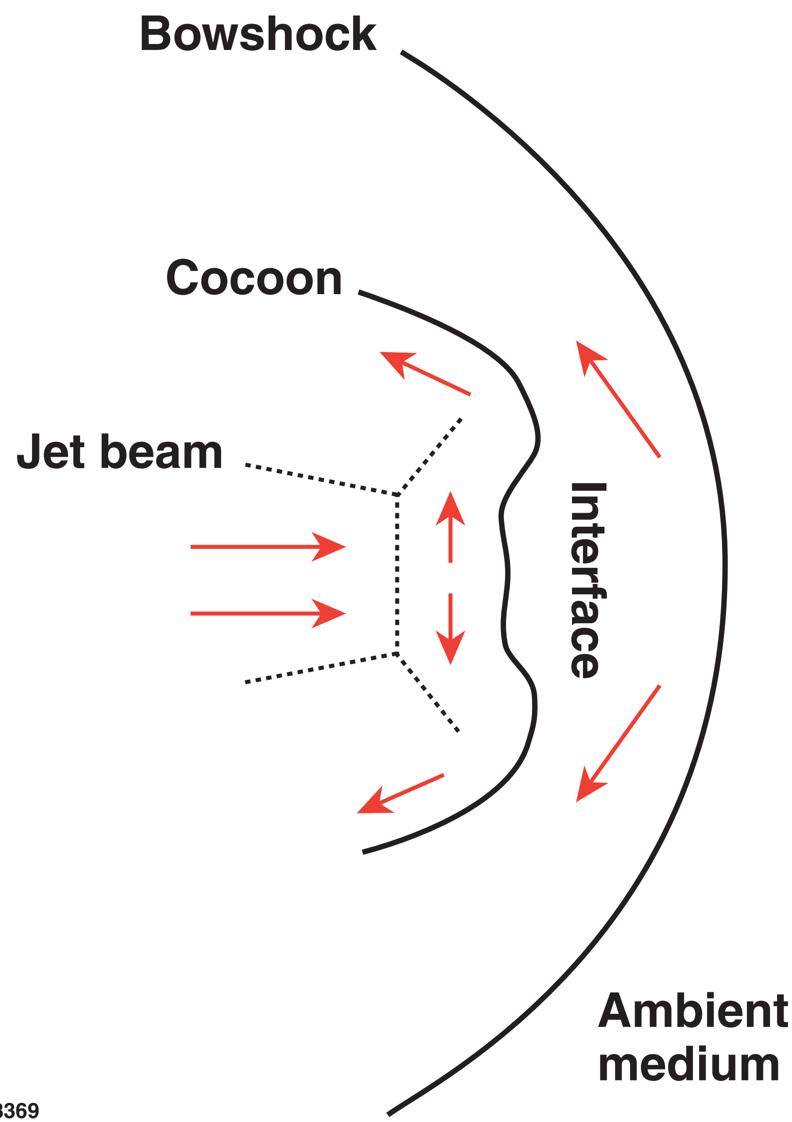
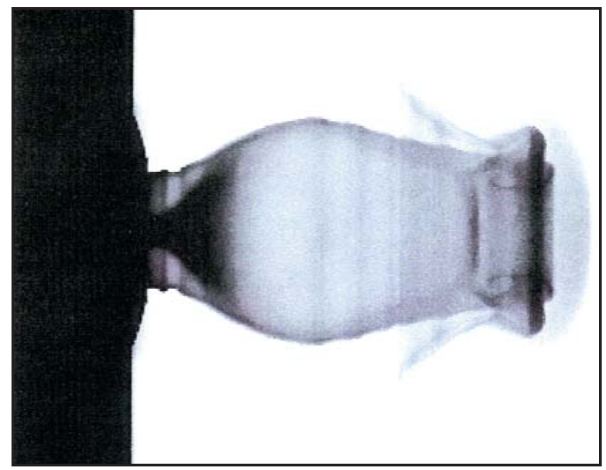
Summary

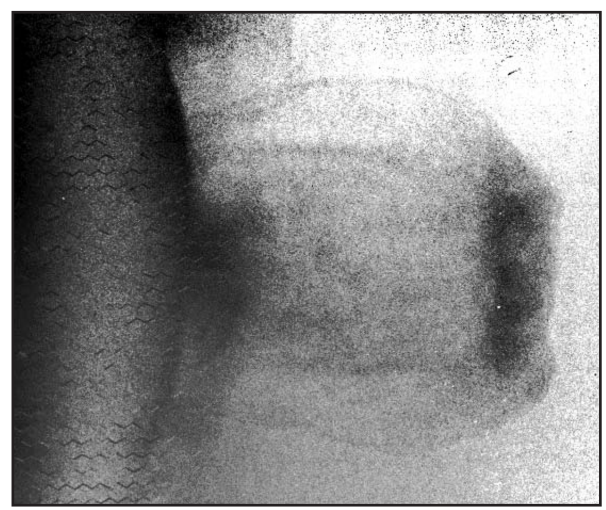
Evolution of either the ambient response to a jet or the jet material itself can be studied by judicious selection of backlighter and target materials

- A set of experiments has been designed and conducted to observe jet features using the OMEGA Laser.
- Jet features predicted by analytic theory and hydrodynamic simulations are observed in the experimental data.
- Measured axial jet velocities are consistent with output from 2-D hydrodynamic simulations.

The observation of key jet features in laboratory experiments can be used to constrain models







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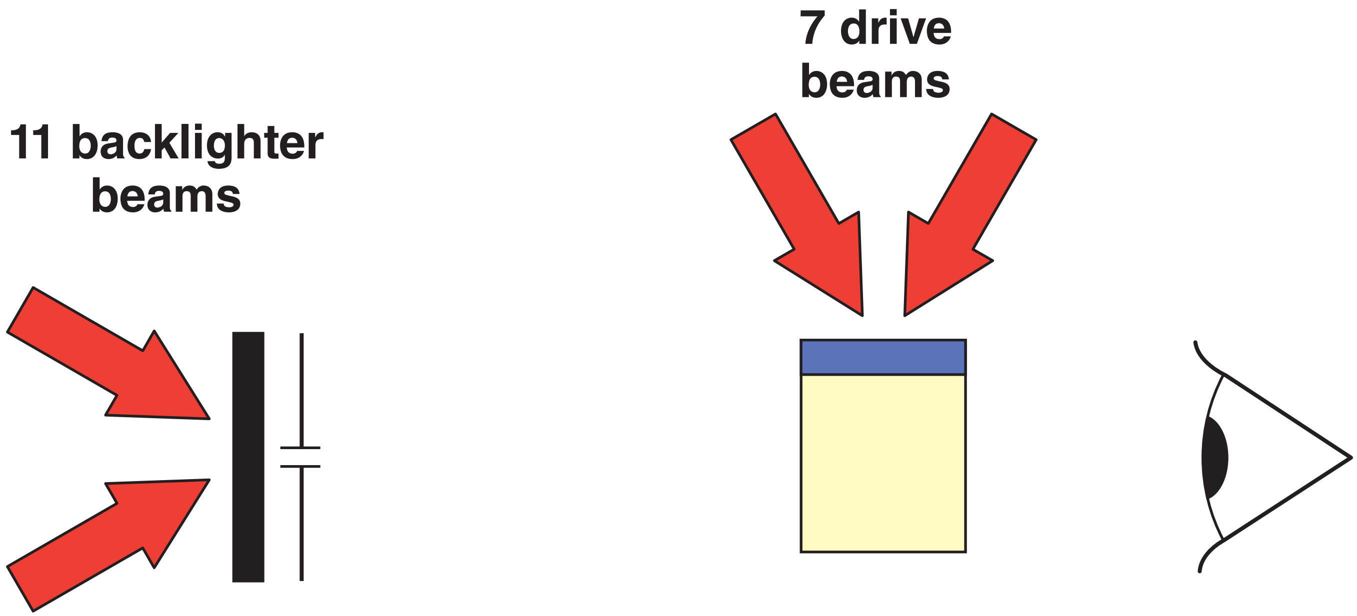
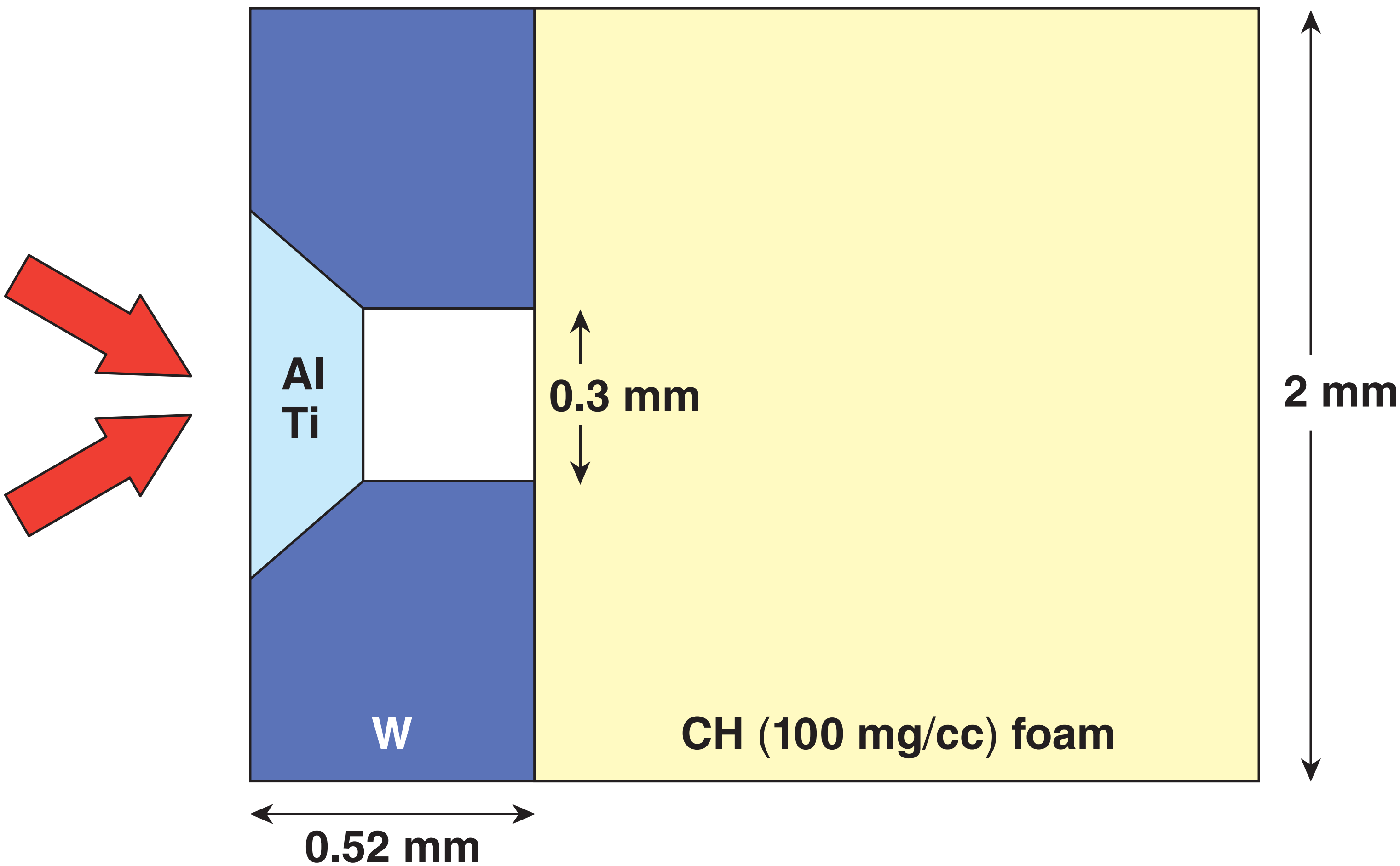
Backlighter targets are used to produce side-on point-projection radiographs[1] of hydrodynamic jet targets



Drive beams are fired 100 or 150 ns before the backlighter beams.

[1] D. K. Bradley *et al*., Opt. Lett. 27, 134 (2002).

Jets are formed by ablating material from metal plugs through a washer into a foam



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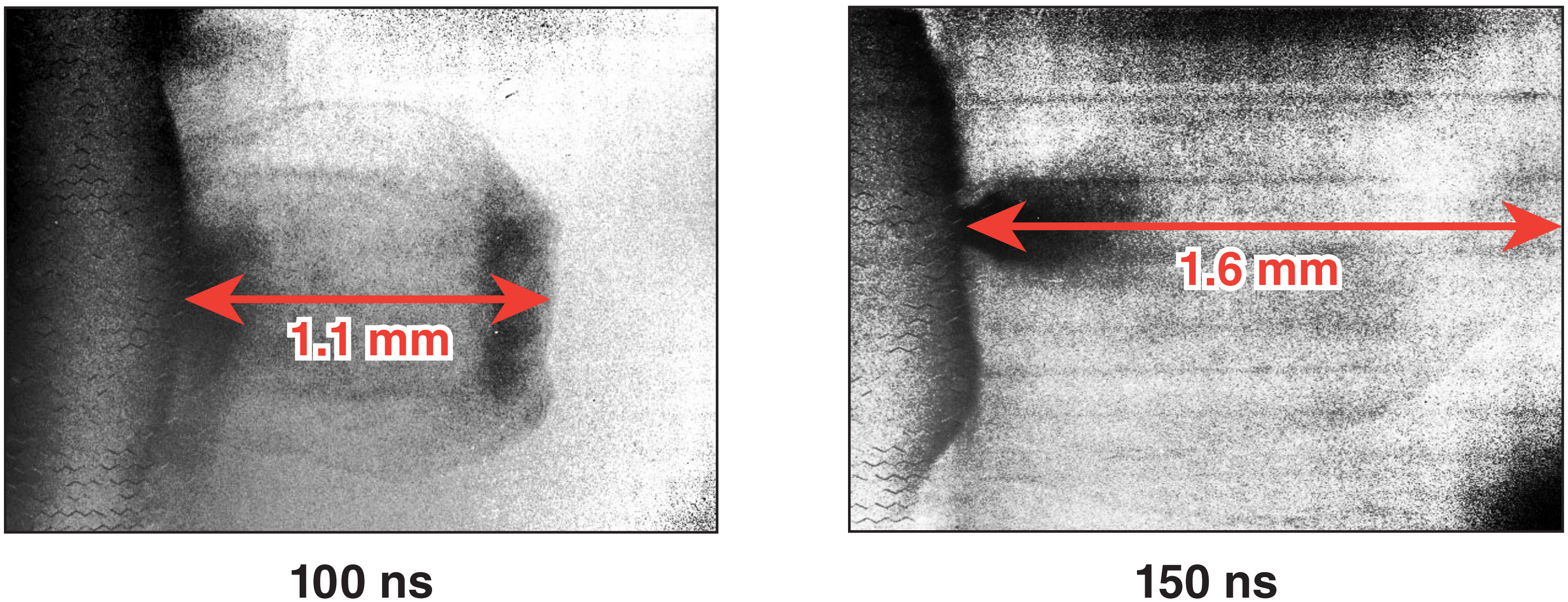
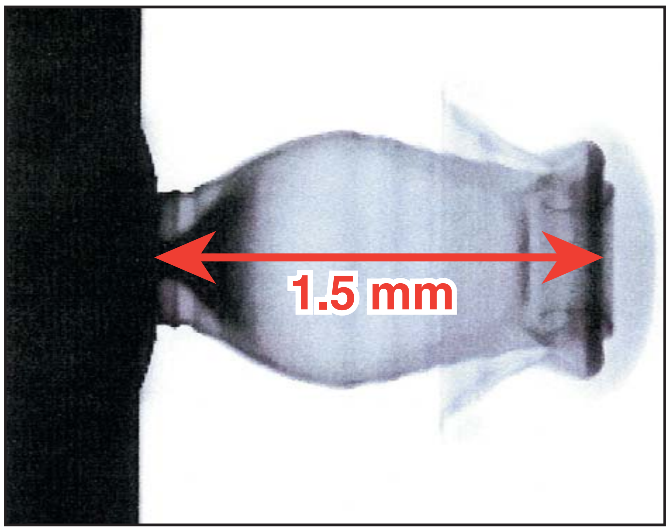
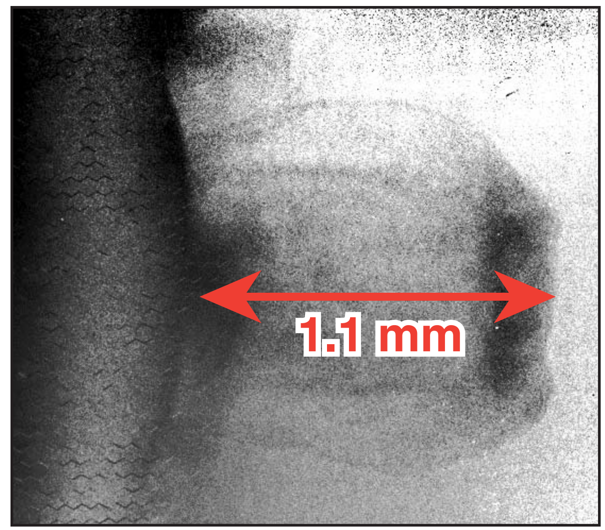
V was used to backlight Al jets at 100 and 150 ns to enhance structure in the ambient medium



This backlighter was optimized for sensitivity to the CH foam, so the evolution of several shock surfaces can be observed.

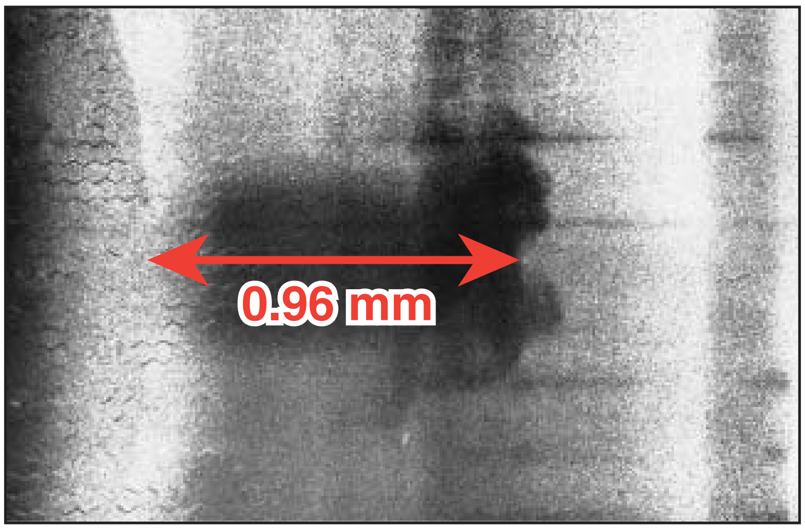
A simulation of the 100-ns data overestimates the jet expansion



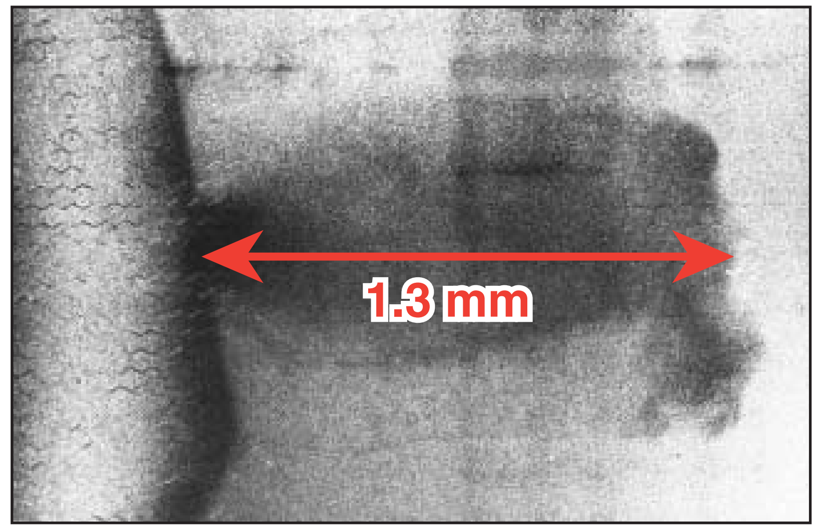


- The beam opening angle and axial velocity are too large.
- The front of the cocoon and interface region are similar.
- The jet beam is not visible in the experiment.

Fe was used to backlight Ti jets at 100 and 150 ns to show structure in the jet core



100 ns



150 ns

This backlighter is sensitive to the jet core, formed from the Ti-plug material, which remains collimated as it propagates.

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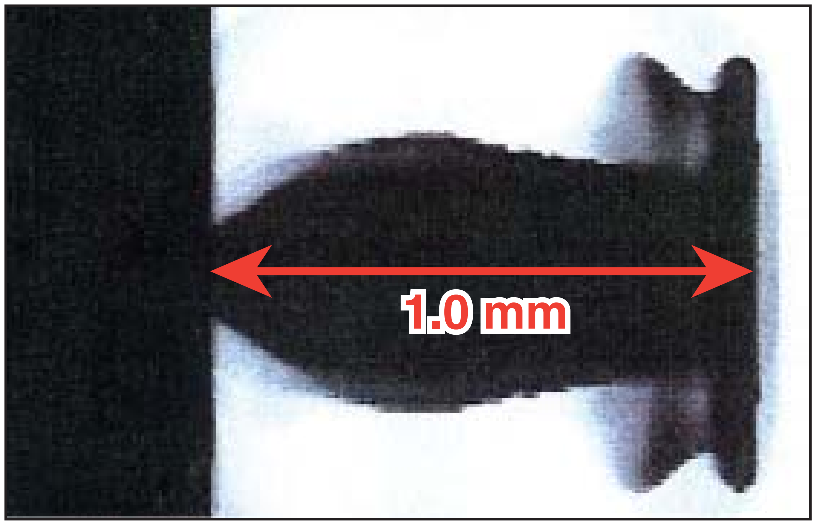
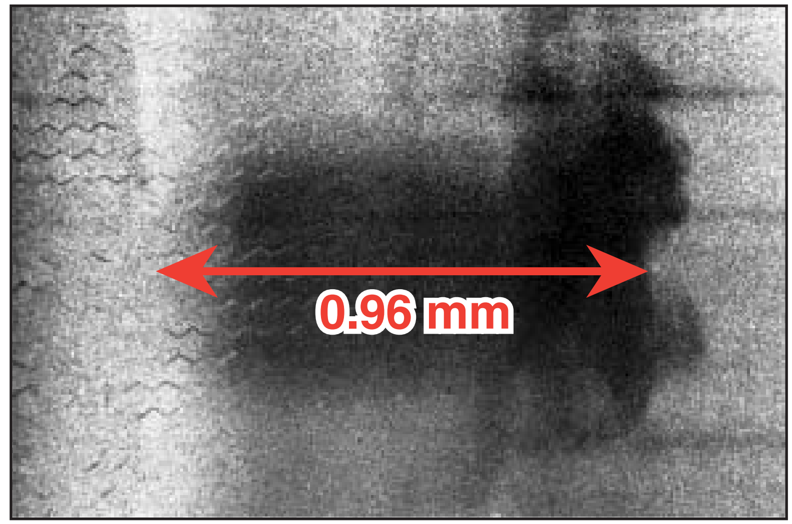
Instabilities can be tracked in the Ti jet data



Simulation



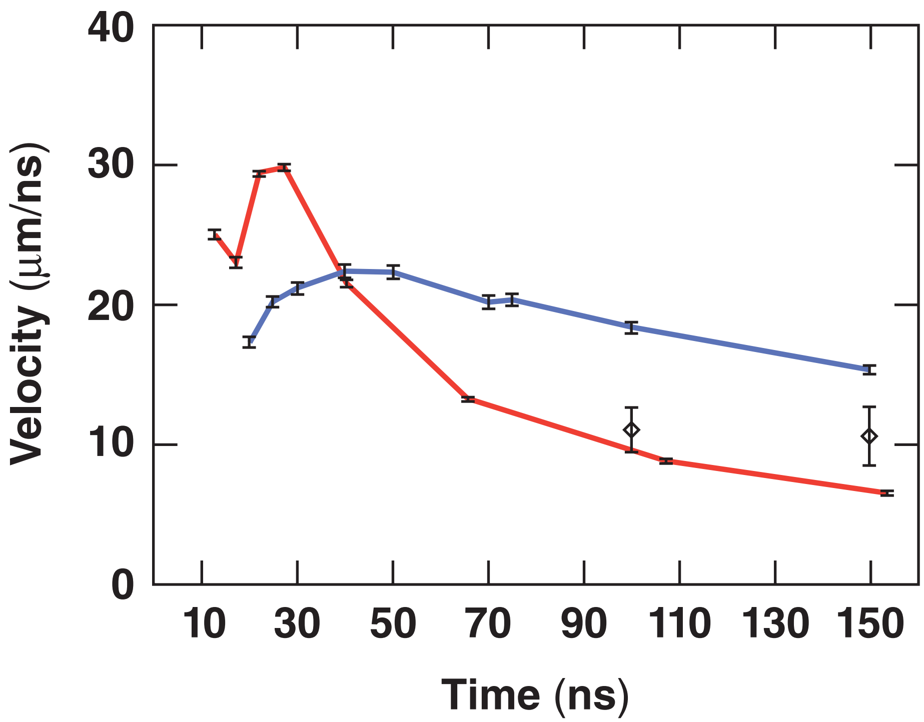
Experiment

- Axisymmetric simulations predict a flat working surface, while experiments exhibit 3-D instabilities.
- 3-D simulations will be needed for a quantitative comparison.
- Predicted Ti jet velocities match experimental values.

E13375

B. H. Wilde, p. 11, 11/2/04, LA-UR-04-6671

Simulations predict the axial velocity of the Al jet



Upper simulation:

ALE code
2.5-μm resolution
temperature drive

Lower simulation:

Eulerian PPM code
10-μm resolution
laser energy drive

- Shockwave breakout from the washer occurs at 70 to 75 ns for upper simulation, past 100 ns in lower simulation, and before 100 ns in experiments.
- The experimental data points at 100 and 150 ns, shown with diamonds, are consistent with the simulation predictions.

E13828

Summary/Conclusions

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