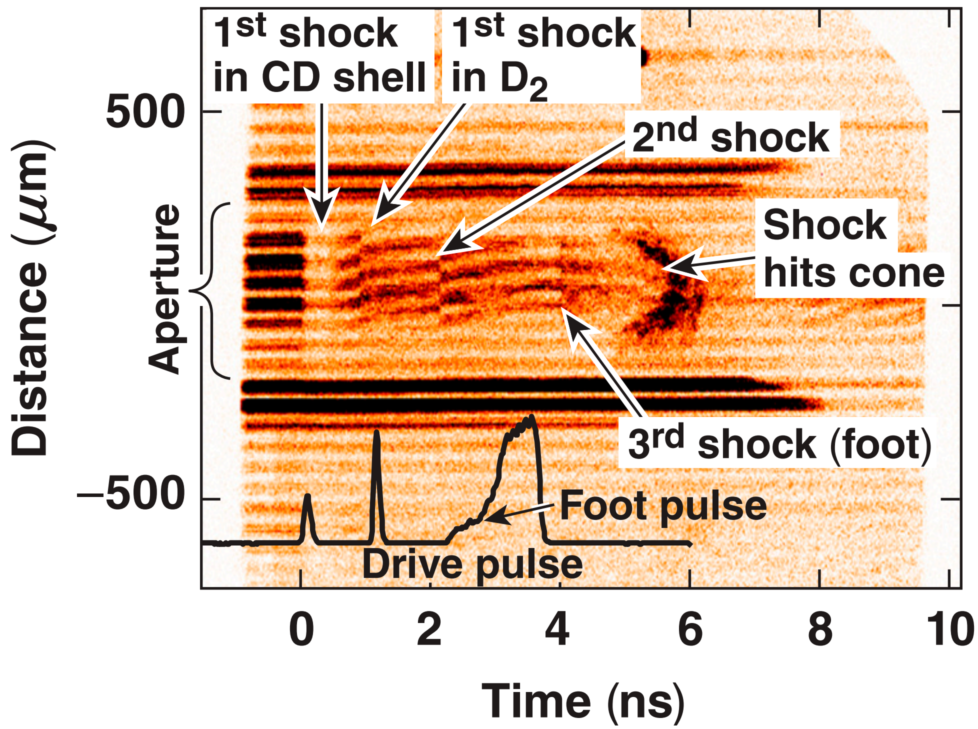
Shock-Timing Measurements in Directly Driven Spherical ICF Targets

VISAR Data



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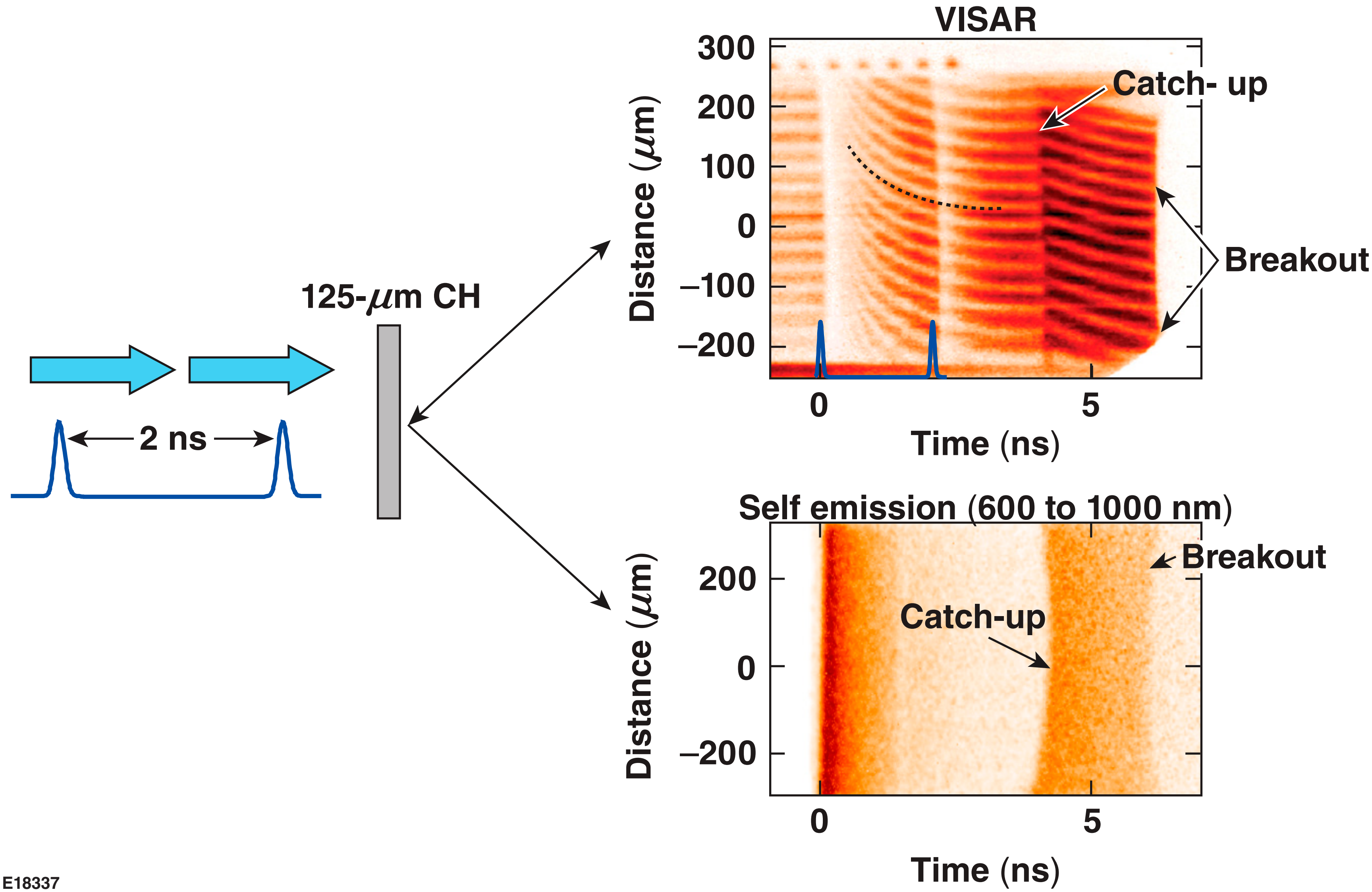
Summary

Shock velocity and timing measurements in spherical cryogenic-deuterium targets are used to optimize direct-drive implosions

- Timing of multiple shocks is critical to the performance of inertial confinement fusion targets
- Multiple spherical shocks are measured in cryogenic-deuterium targets
- Ramp compression of deuterium targets is difficult with continuous pulses; tuning discrete shock waves is easier
- Multiple-pulse experiments are correctly modeled
- Hydrodynamics of ablator–fuel interaction in cryogenic targets must be properly modeled

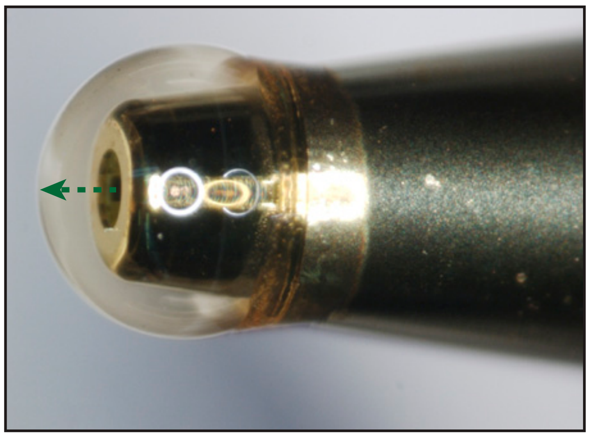
Shock velocity and timing are readily measured in transparent targets using optical diagnostics

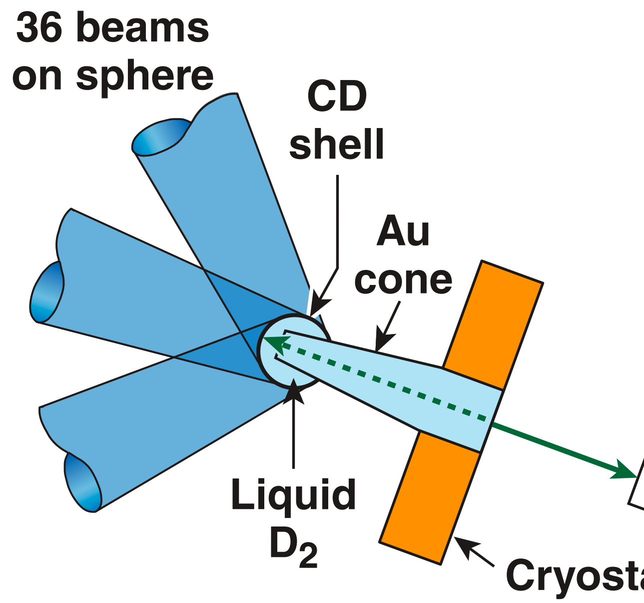


E18337

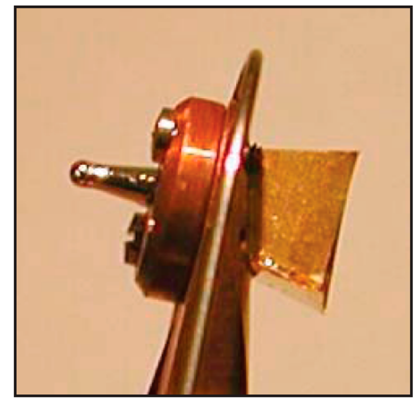
The timing of multiple convergent shocks is studied using cryogenic spheres with re-entrant cones

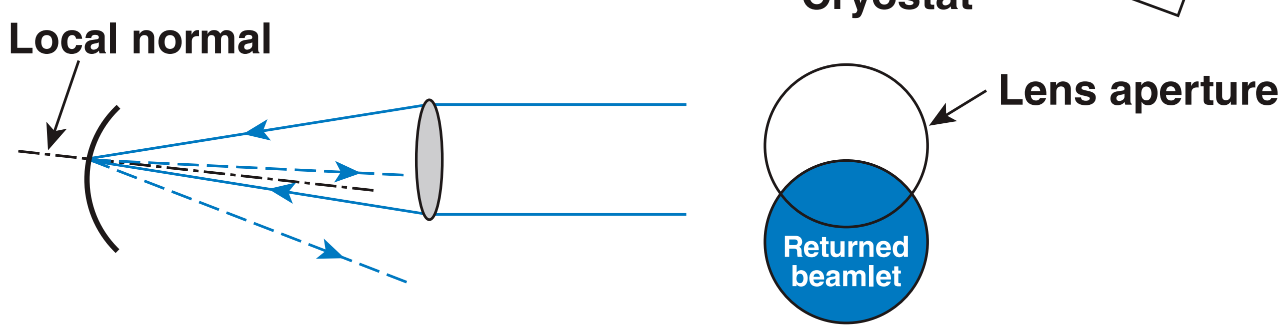
Capsule/cone detail



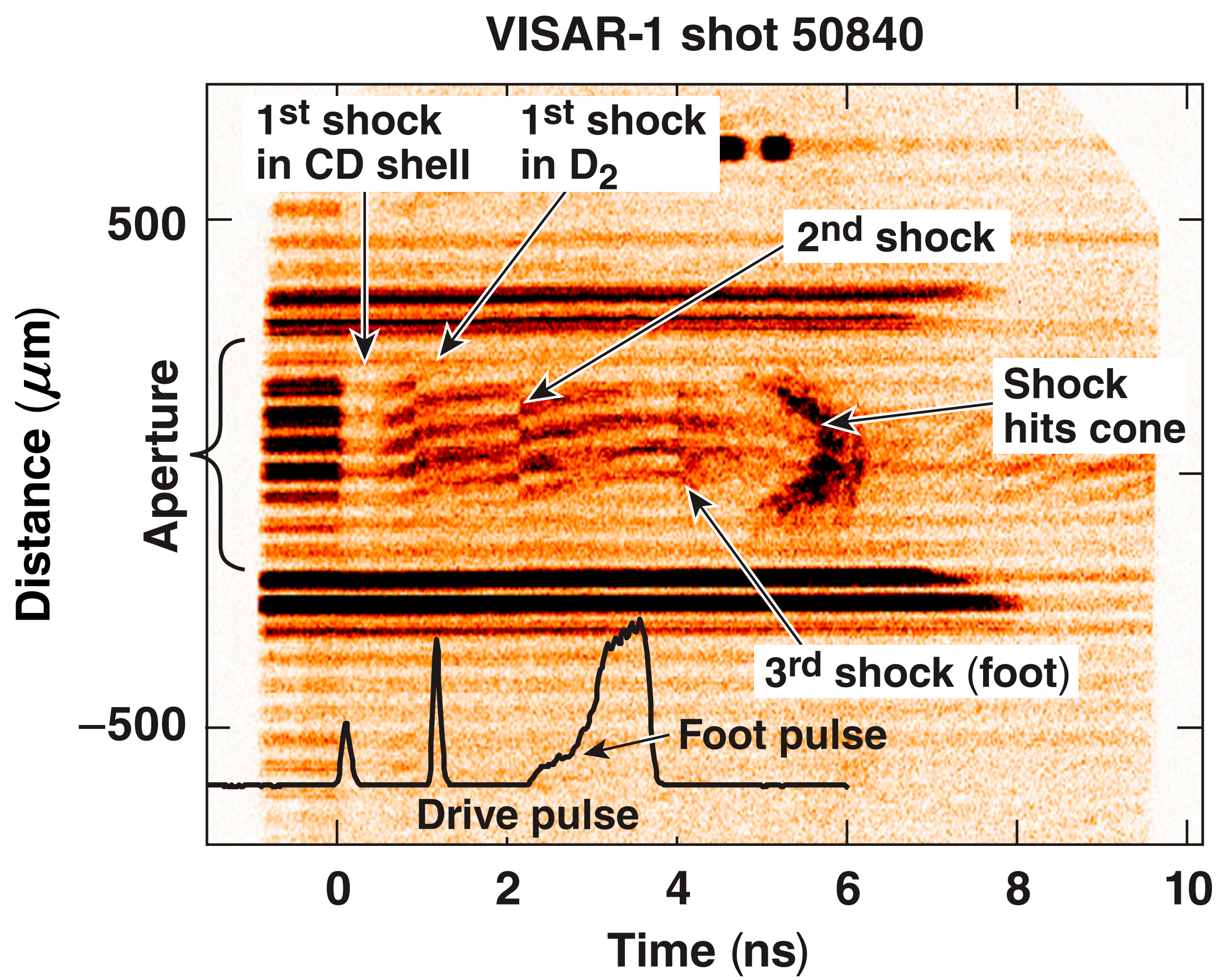


Full target



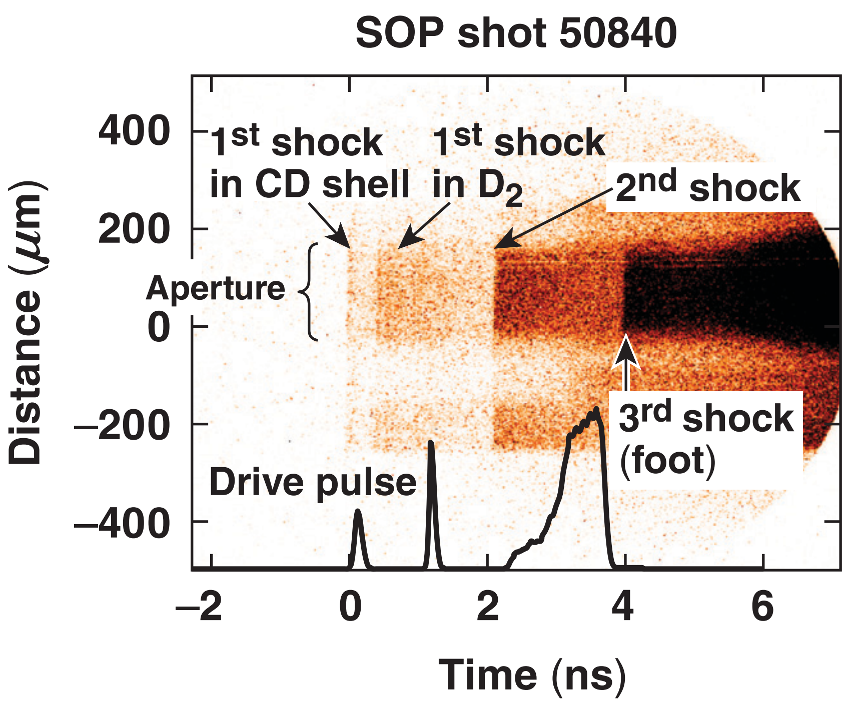


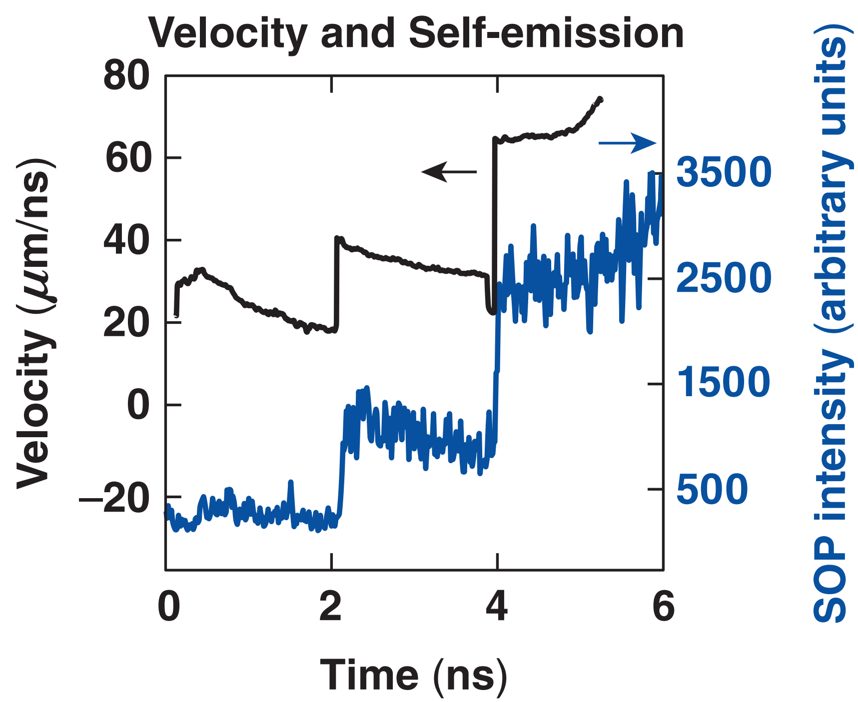
Three spherically convergent shocks were observed in directly-driven cryogenic spherical targets



U816d

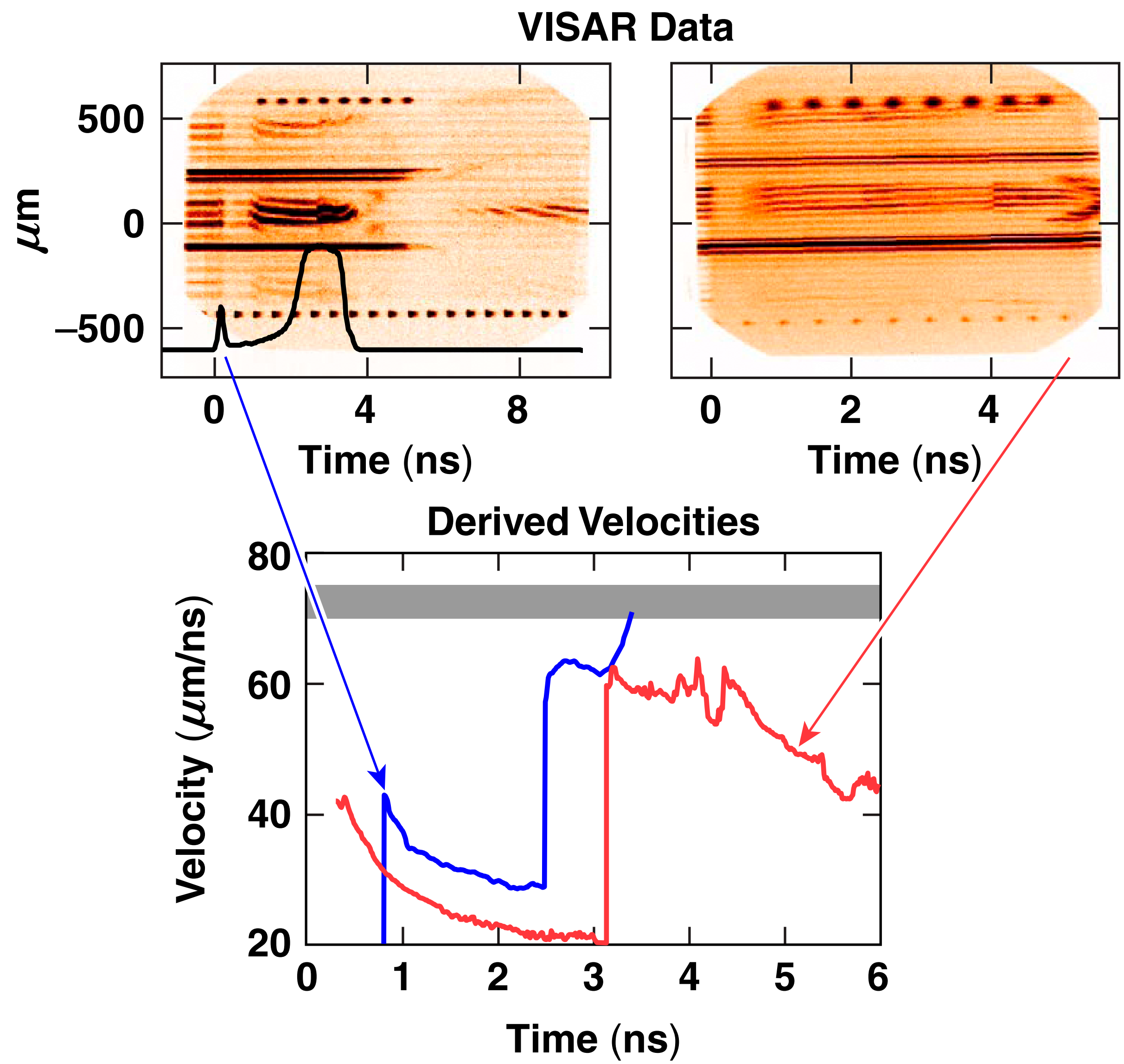
The temporal features in self-emission data confirm shock-timing observed in VISAR data





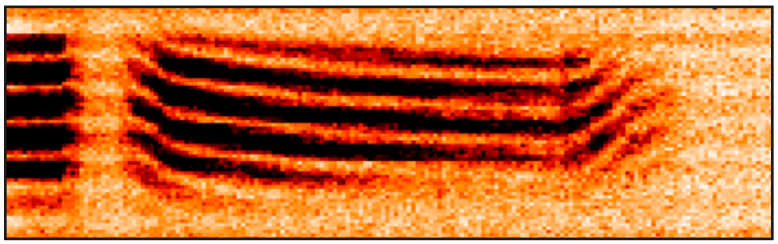
E17300b

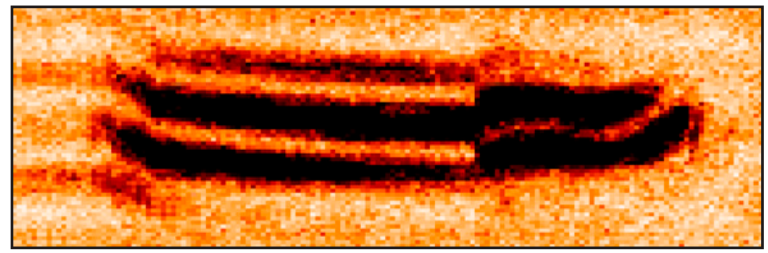
The VISAR signal abruptly ends at high deuterium shock velocities (~70 μm/ns); likely due to a radiative precursor

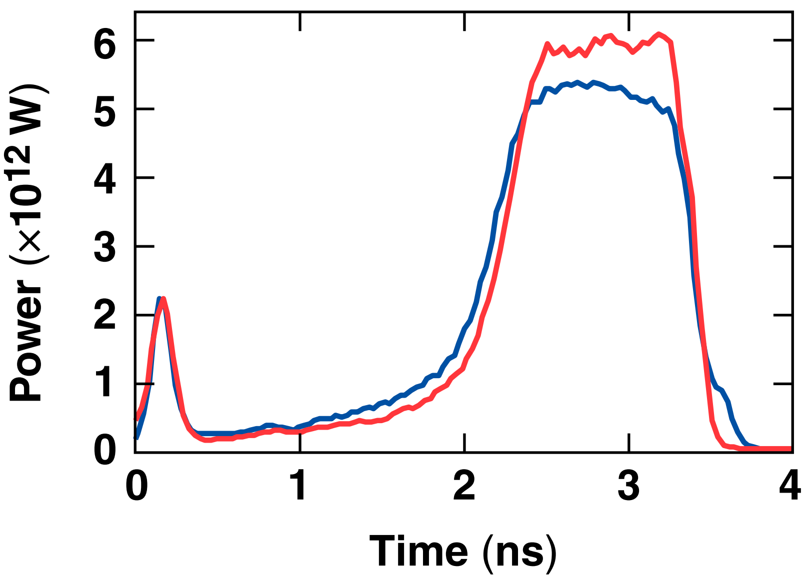


52627, 56553, 52471
E18422

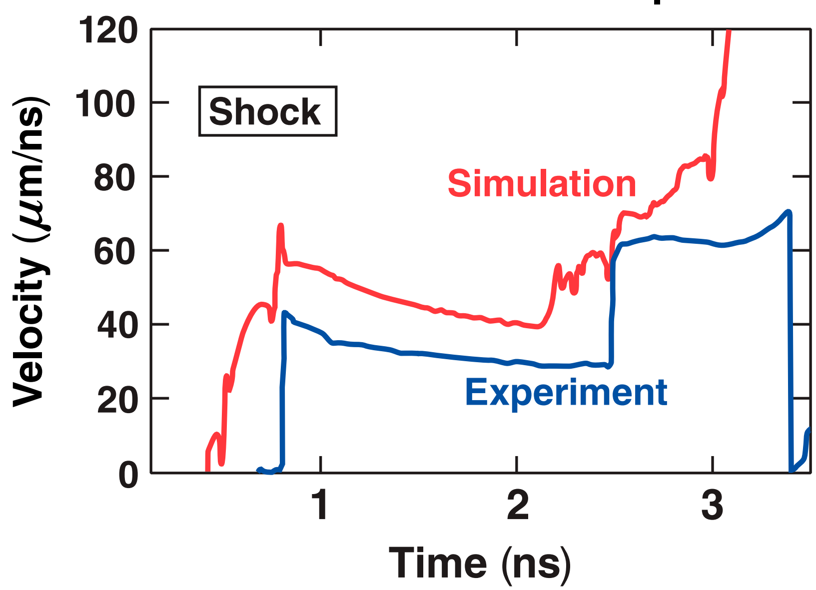
Similar ramped pulses can produce different "compression" waves; deuterium easily "shocks up"





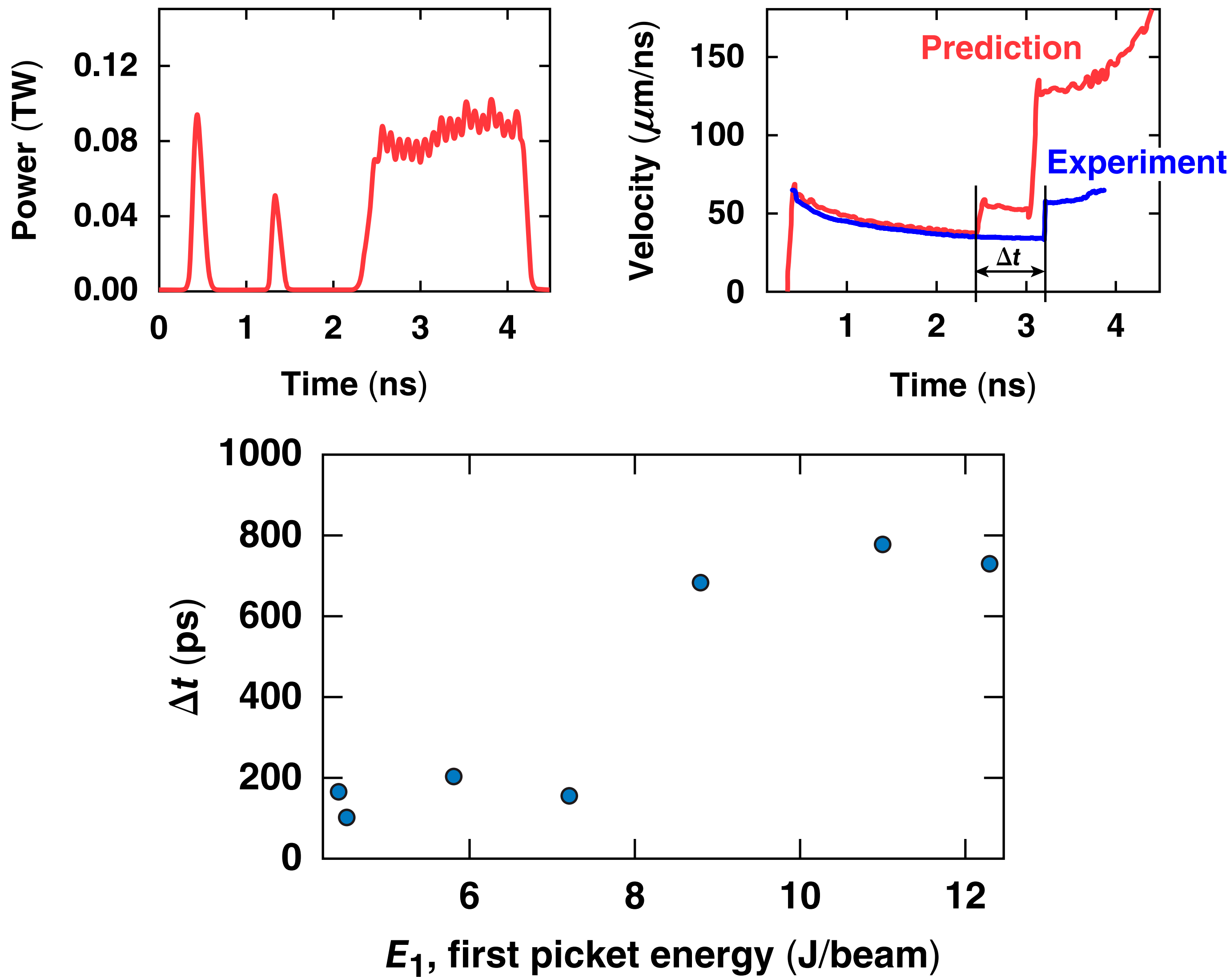


VISAR results for similar pulses

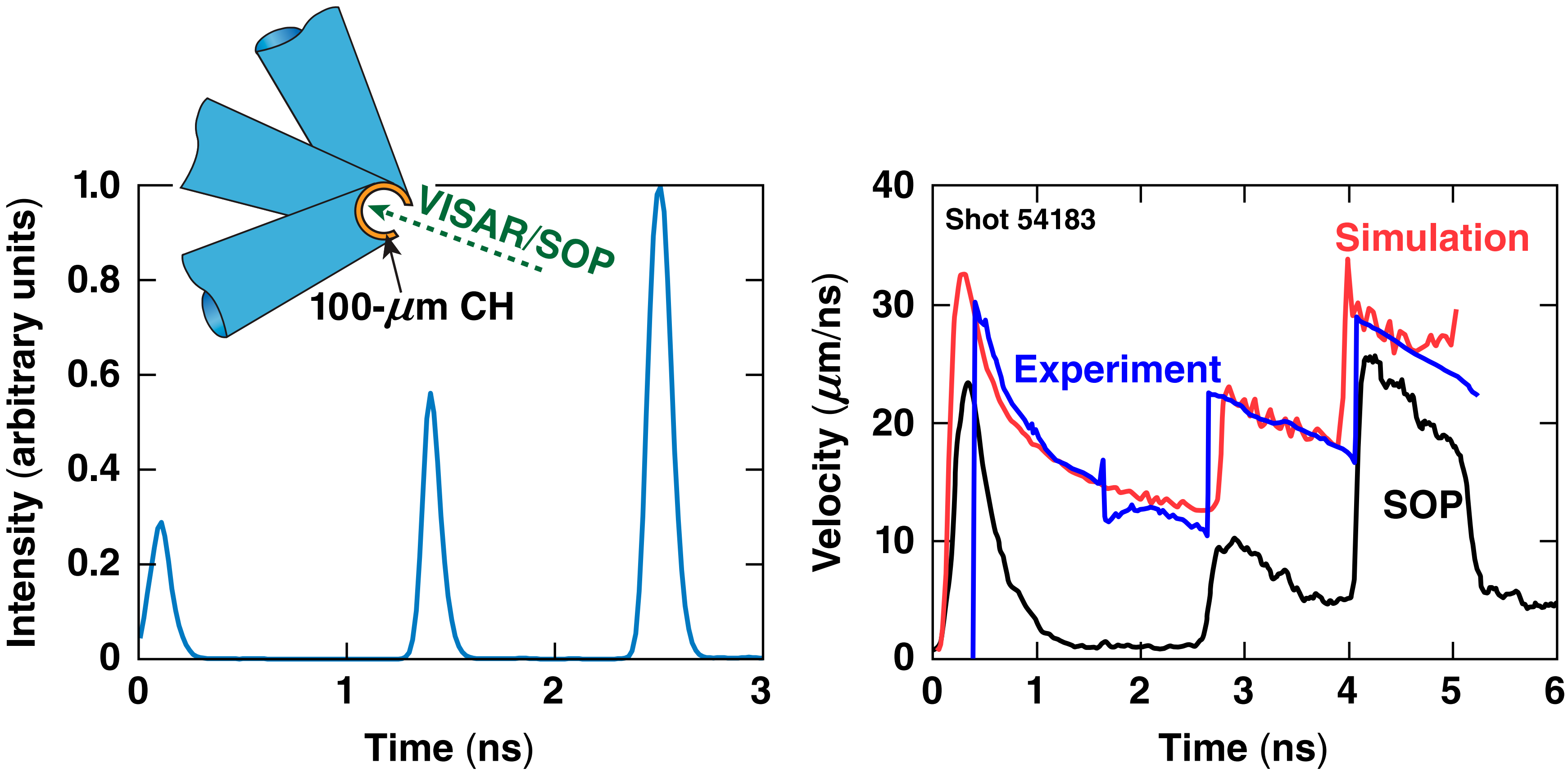


E18338

The time delay of shock coalescence has a threshold-like dependence on the first picket energy

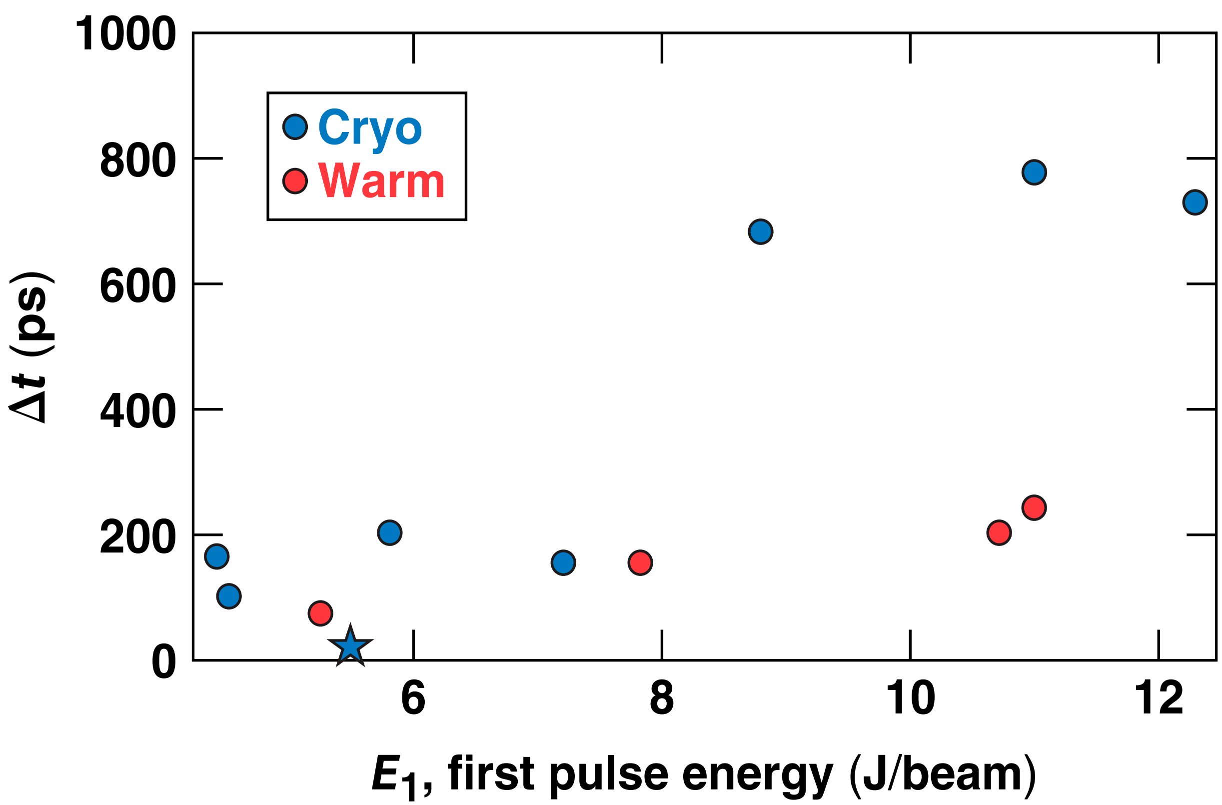


Shock-velocity comparison for warm CH spheres shows good agreement between simulations and experimental data



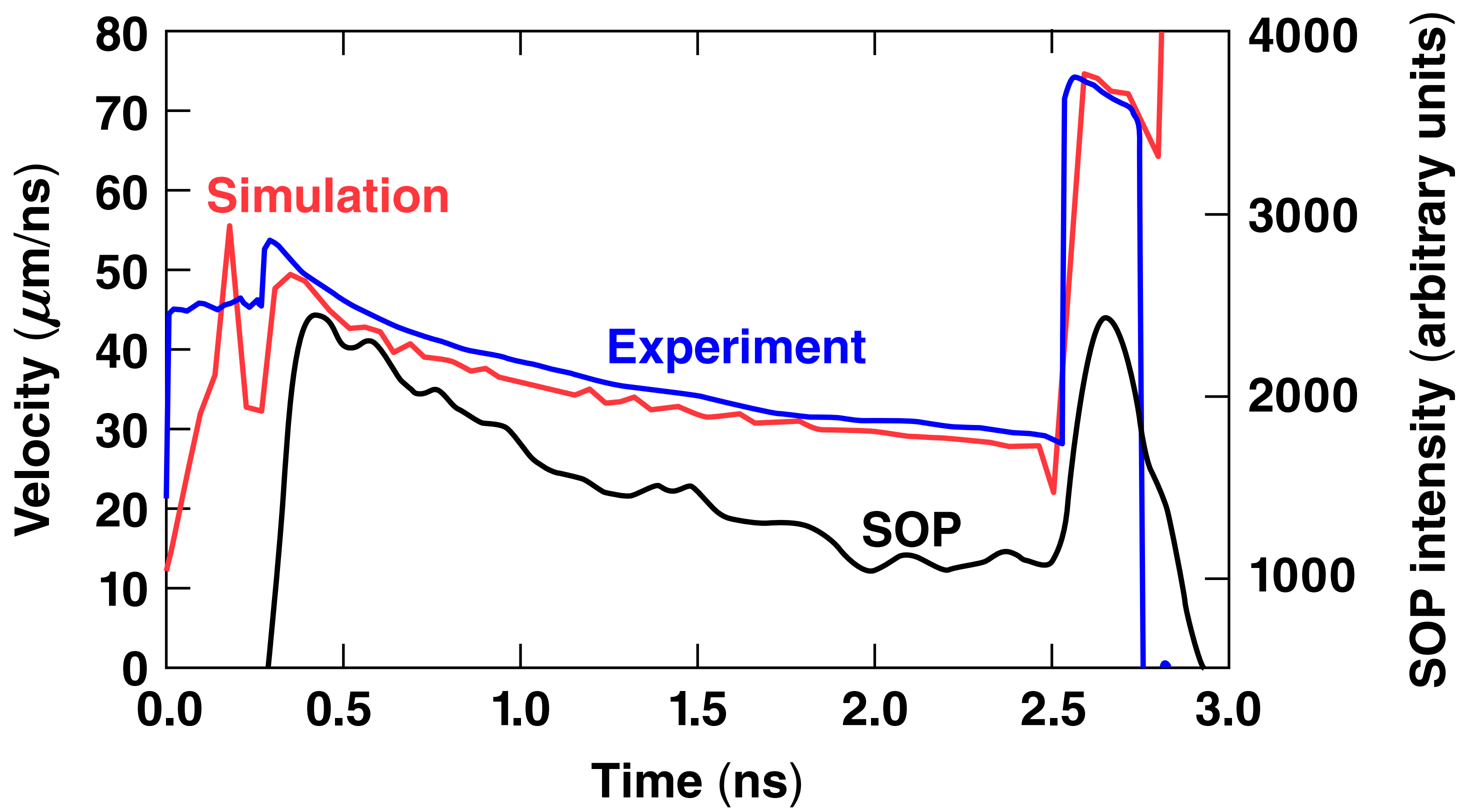
E18339

Shock-timing in warm CH targets does not exhibit dependence on pulse energy



Behavior in cryogenic targets may result from rarefactions created at ablator-fuel interface.

Simulations agree with measured shock velocity and timing for direct-drive cryogenic targets



E18444

Summary/Conclusions

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