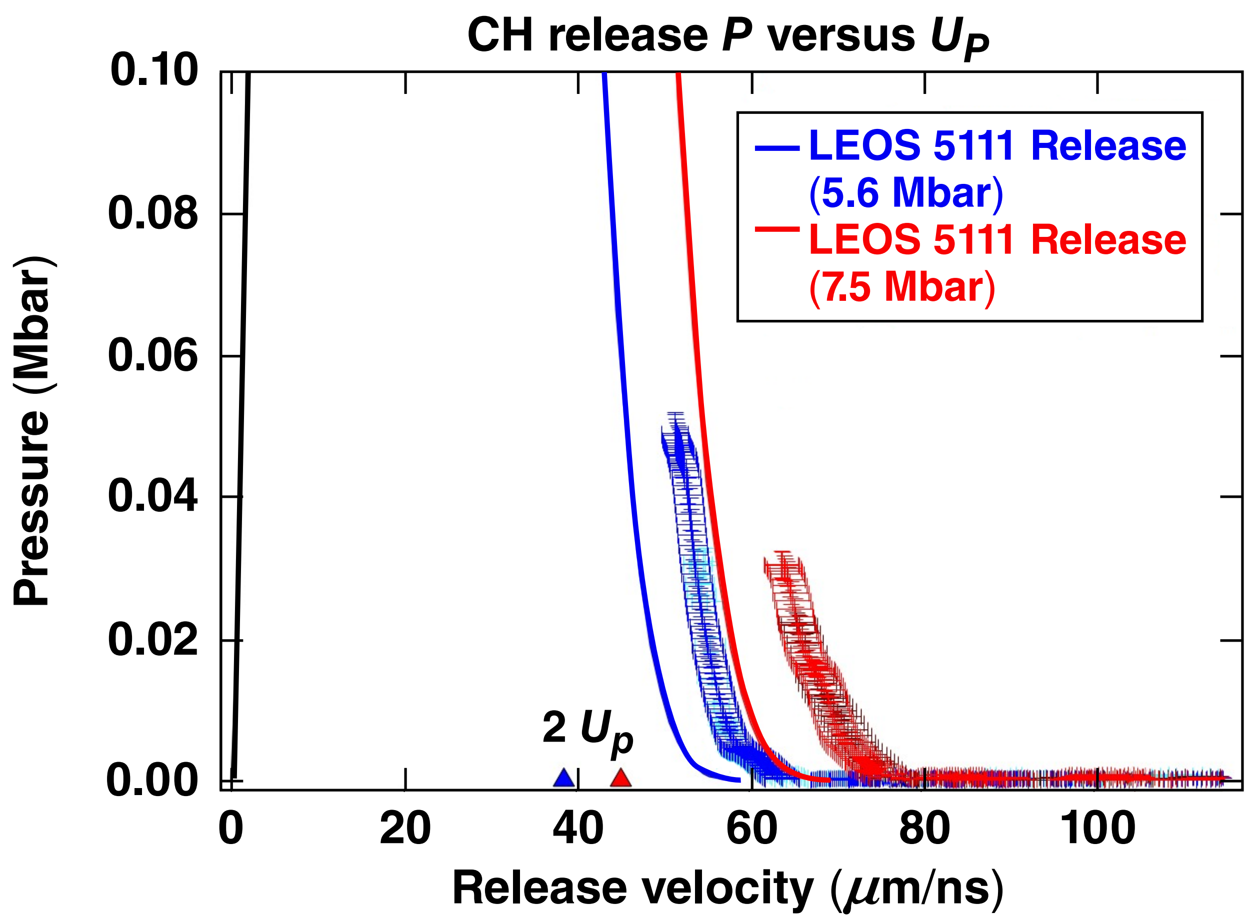
The Release of Shocked CH



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Summary

The release of a shocked material depends on the amount of entropy added by the shock wave

- Shocked material releases along a characteristic isentrope, determined by the shock pressure and the equation of state (EOS)
  - weak shocks: $U_{release} \approx 2\ U_p$
  - strong shocks: ($\geq$ 0.4 Mbar): $2\ U_p < U_{release} < 4\ U_p$
- Shock release is studied using momentum-transfer analysis
- Initial results indicate EOS models underestimate the entropy added by shock waves

Motivation

- Release physics is important for
  - understanding early stages of an inertial confinement fusion (ICF) implosion
  - impedance-match measurements
  - shockless compression (ICE) experiments
- Characterizing the shock release may allow EOS measurements in regions with pressures much lower than shock measurements

Collaborators

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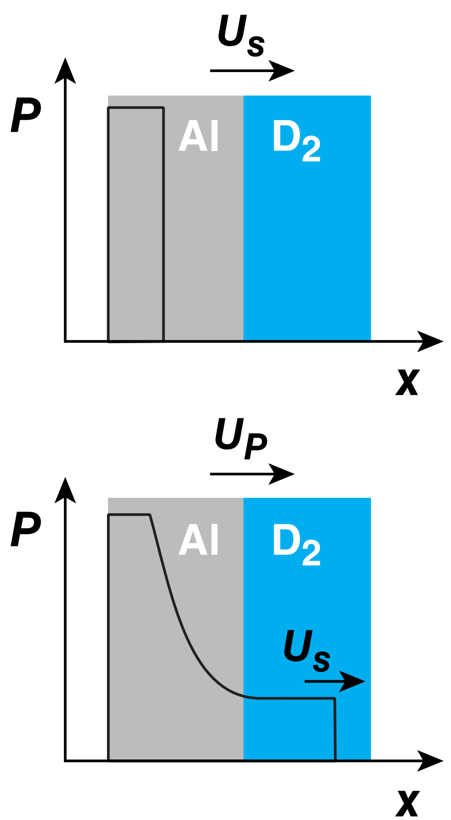
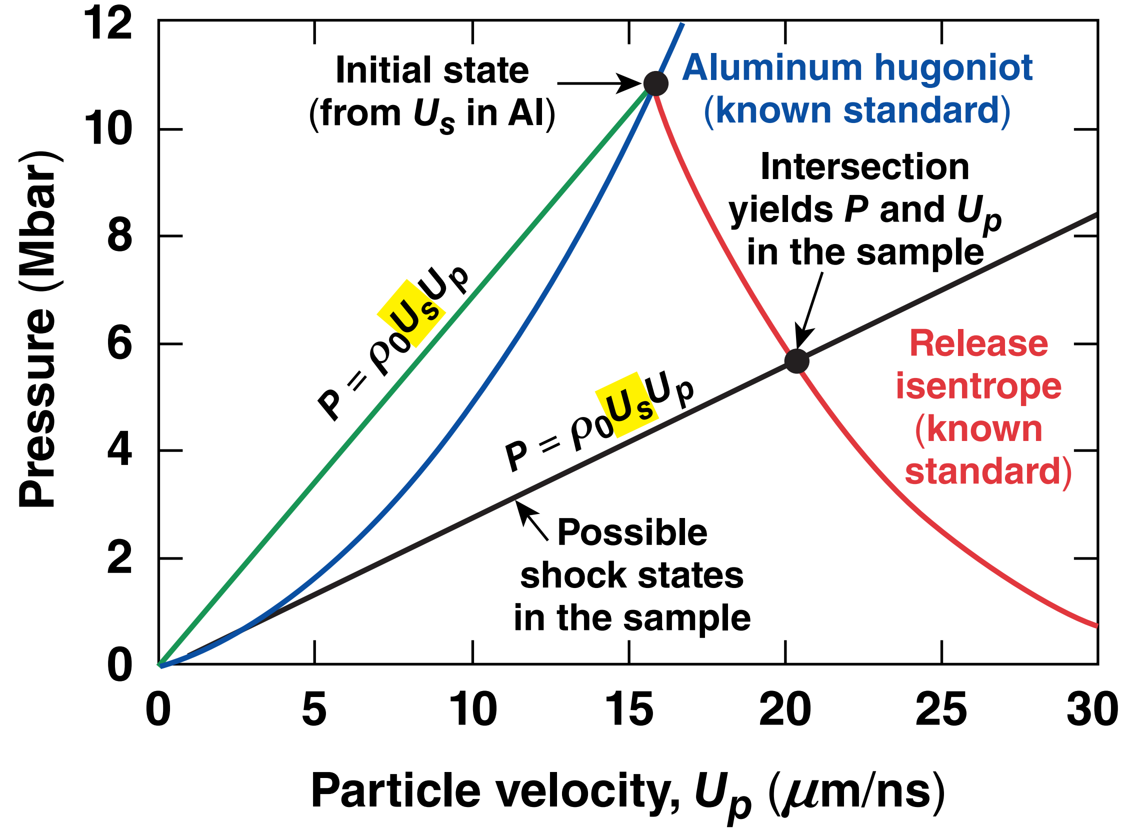
The impedance-match method relies on the shock and release behaviors of a known standard





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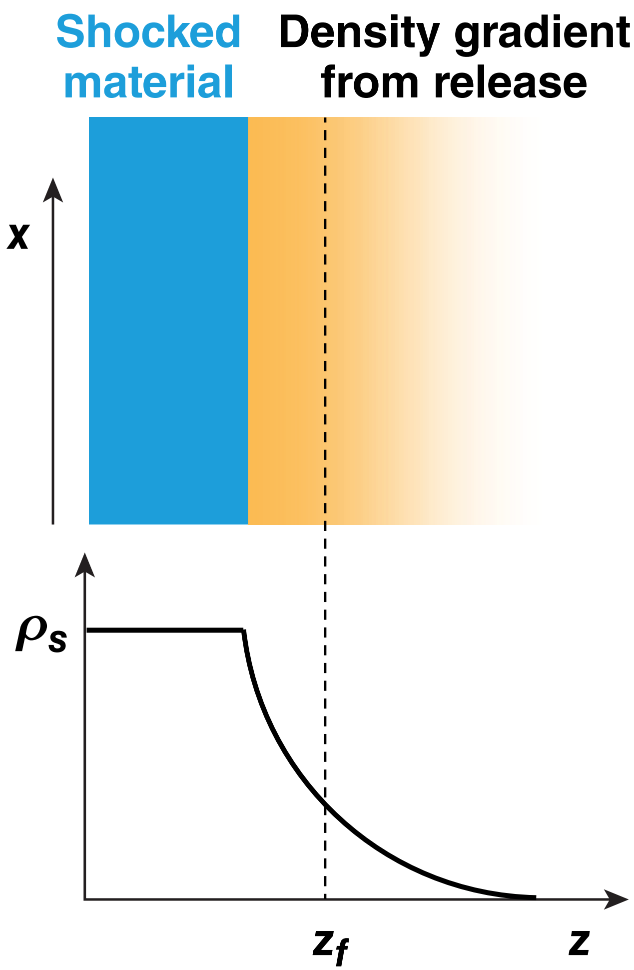
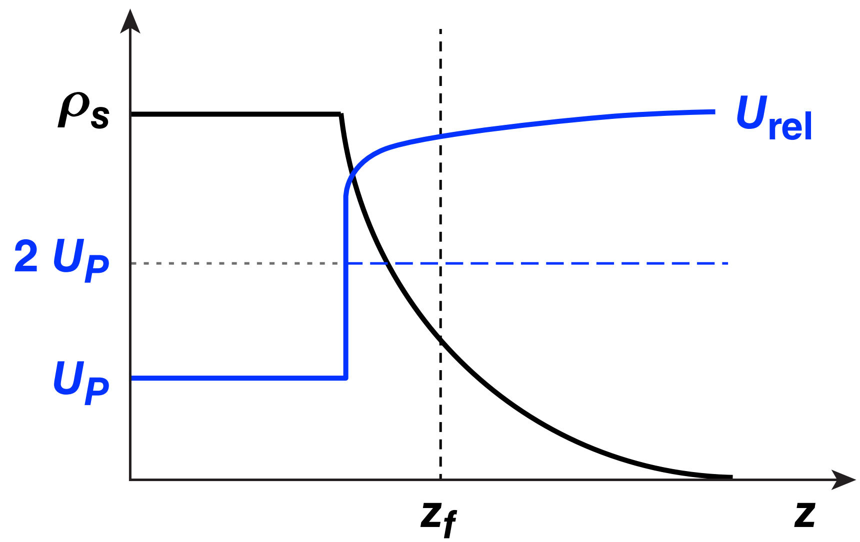
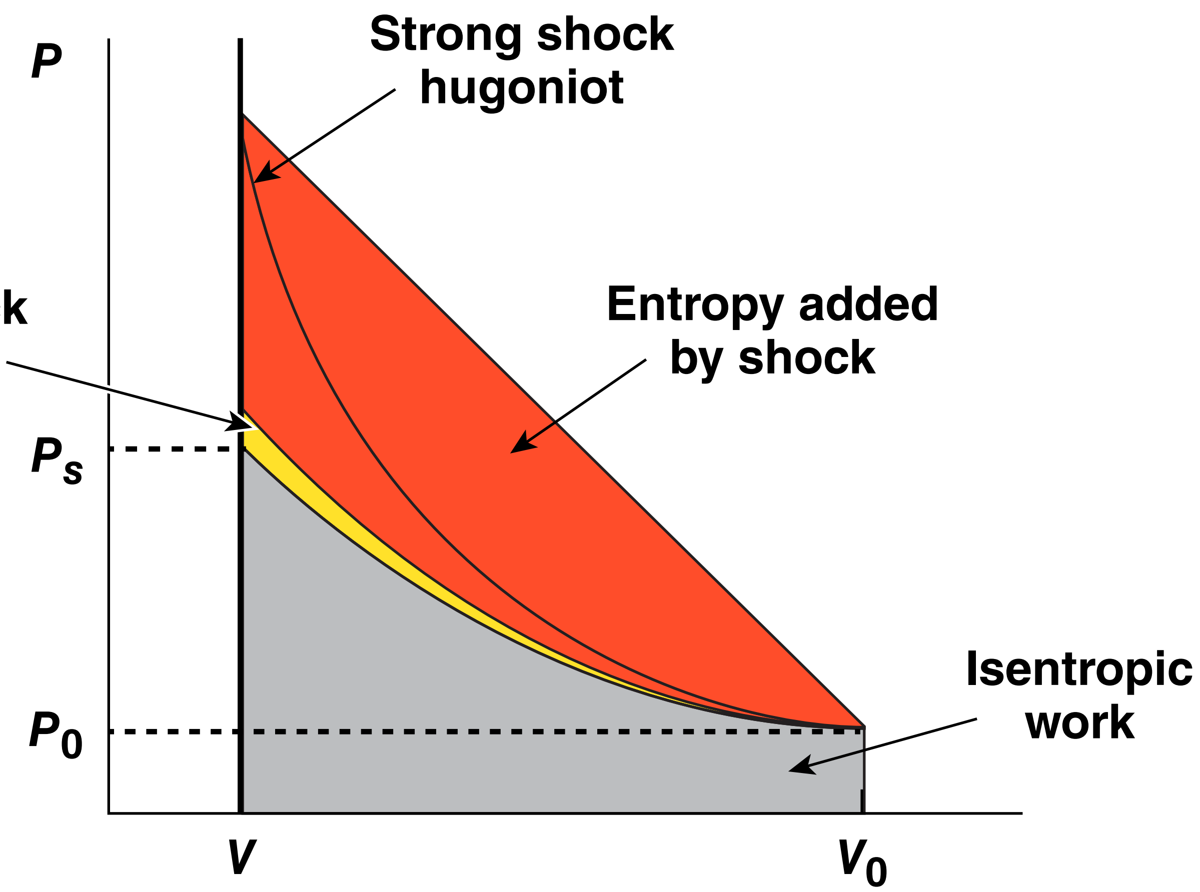
Courtesy P. Celliers (LLNL)

Upon release, shocked material accelerates as it rarifies into a vacuum





For strong shocks, the added entropy becomes large compared to the compressive work



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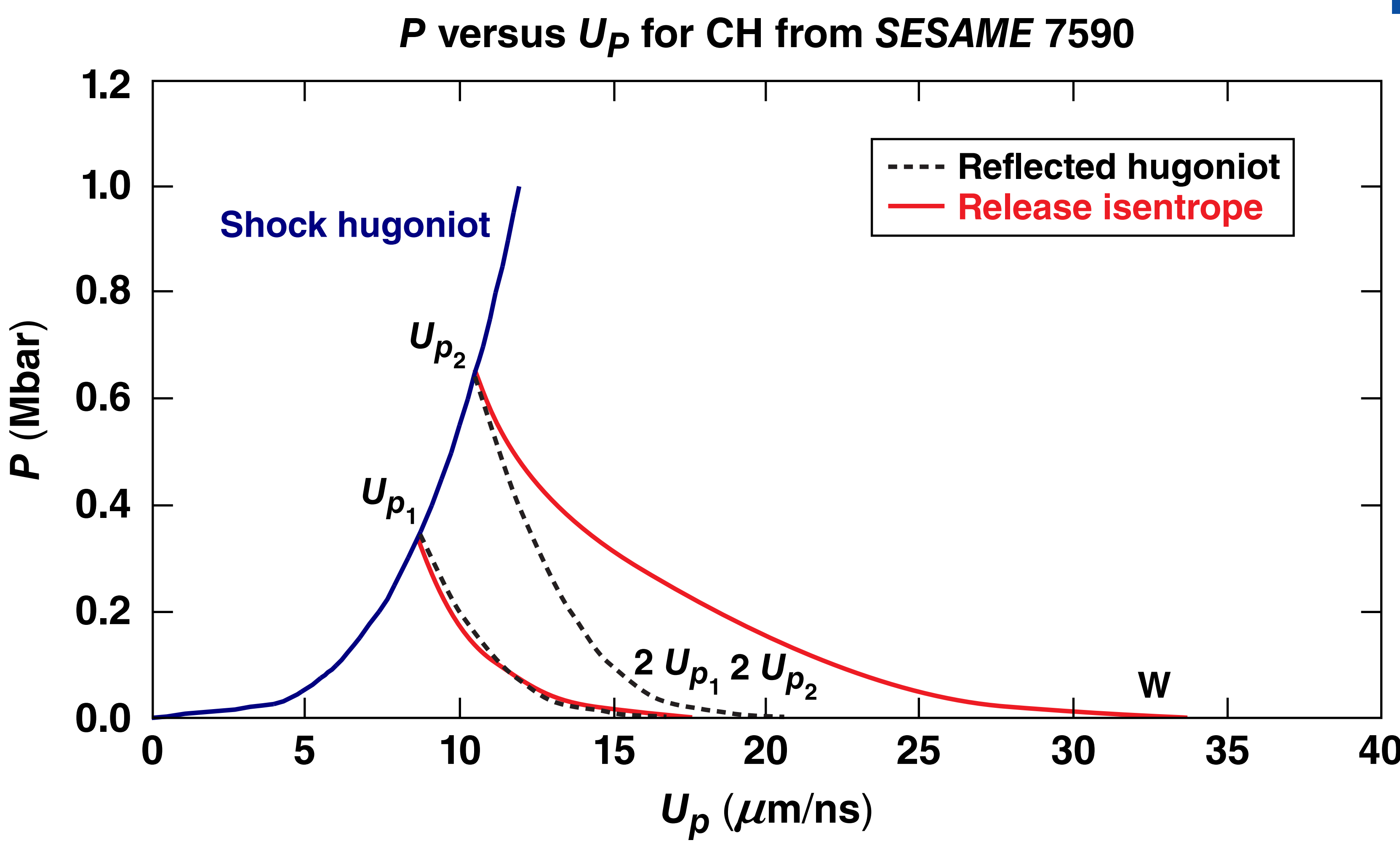
Release follows an isentrope determined by final shock pressure at breakout



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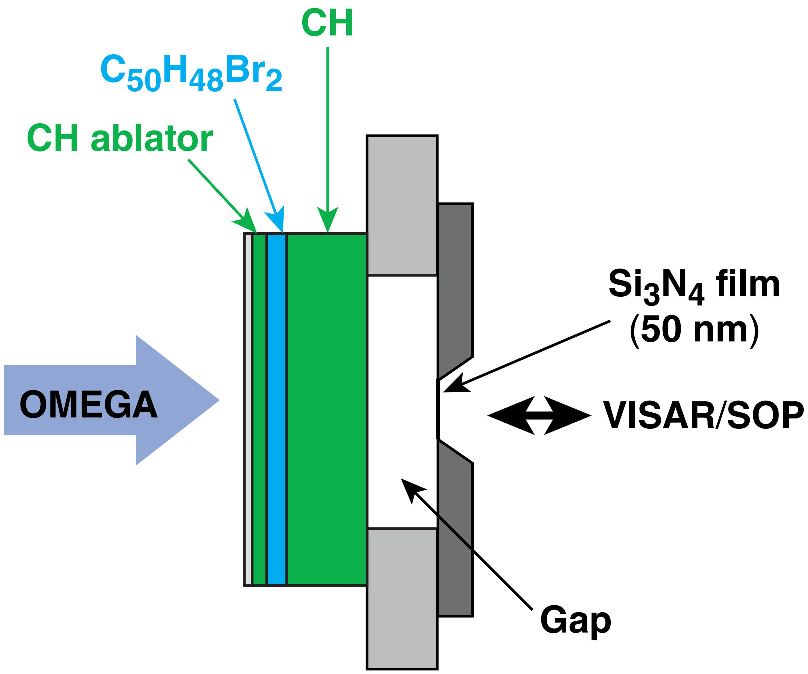
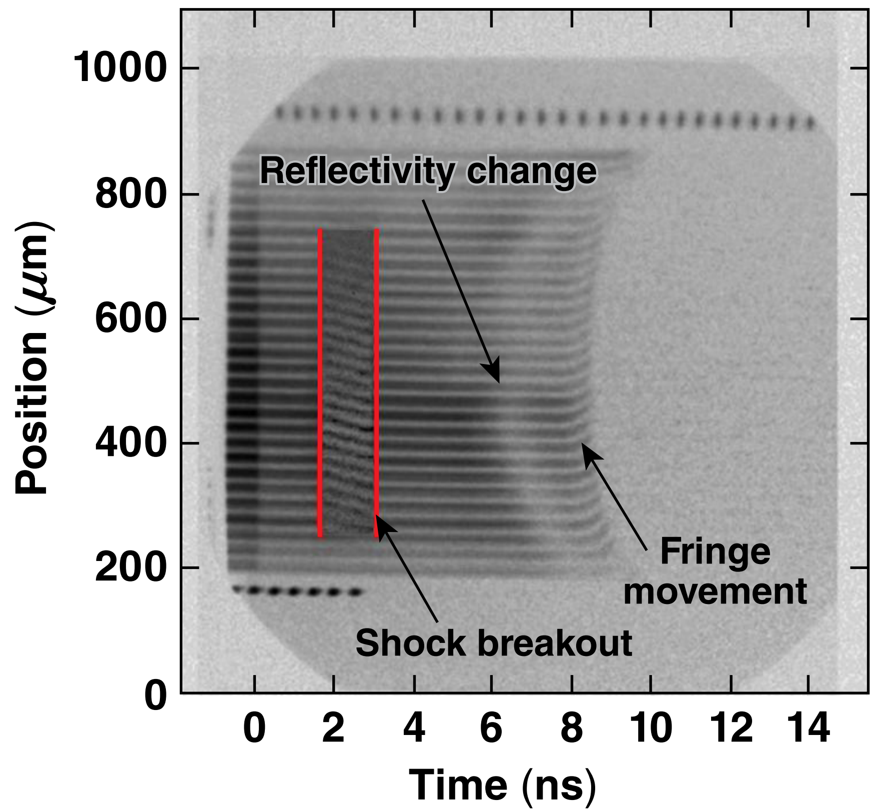
Target design enables low pressure regions of the CH release isentrope to be examined

Witness film: silicon nitride (50 nm)



Silicon nitride (50 nm) (s64755)
Laser energy = 846.7 J



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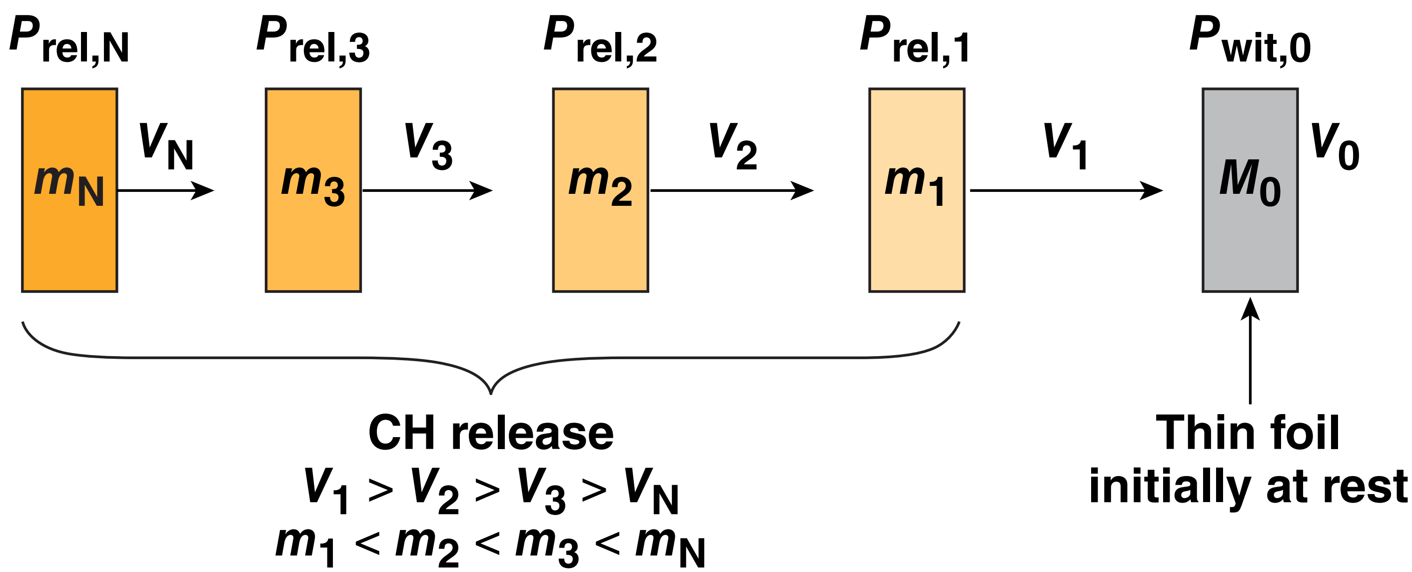
Courtesy D. Fratanduono (LLNL)

Conservation of momentum is used to determine the release into vacuum

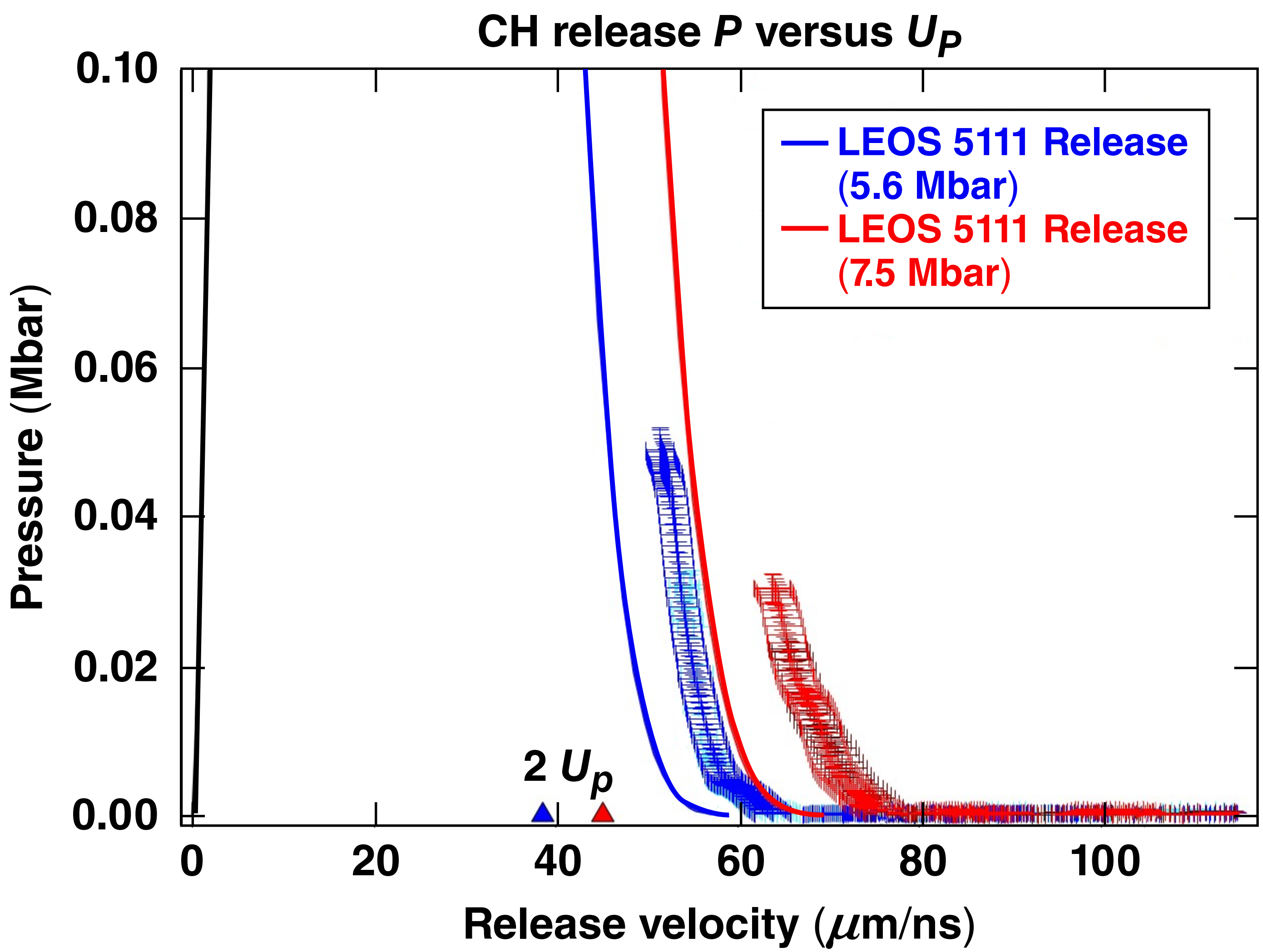


$$P_{wit,N} = \sum_{n=0}^{N} P_{rel,N} + P_{wit,0}$$

Measure $V_{witness}$ using VISAR and get $V_{release}$ from transit time. Iterate momentum over time accounting for mass increase and displacement of witness.

Courtesy D. Fratanduono (LLNL)

Release measurements indicate that LEOS 5111 is underestimating the release velocity



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