NEVADA NATIONAL NNSS SECURITY SITE

SDRD SITE-DIRECTED RESEARCH & DEVELOPMENT

Observing the shock to detonation transition in nitromethane with PDV

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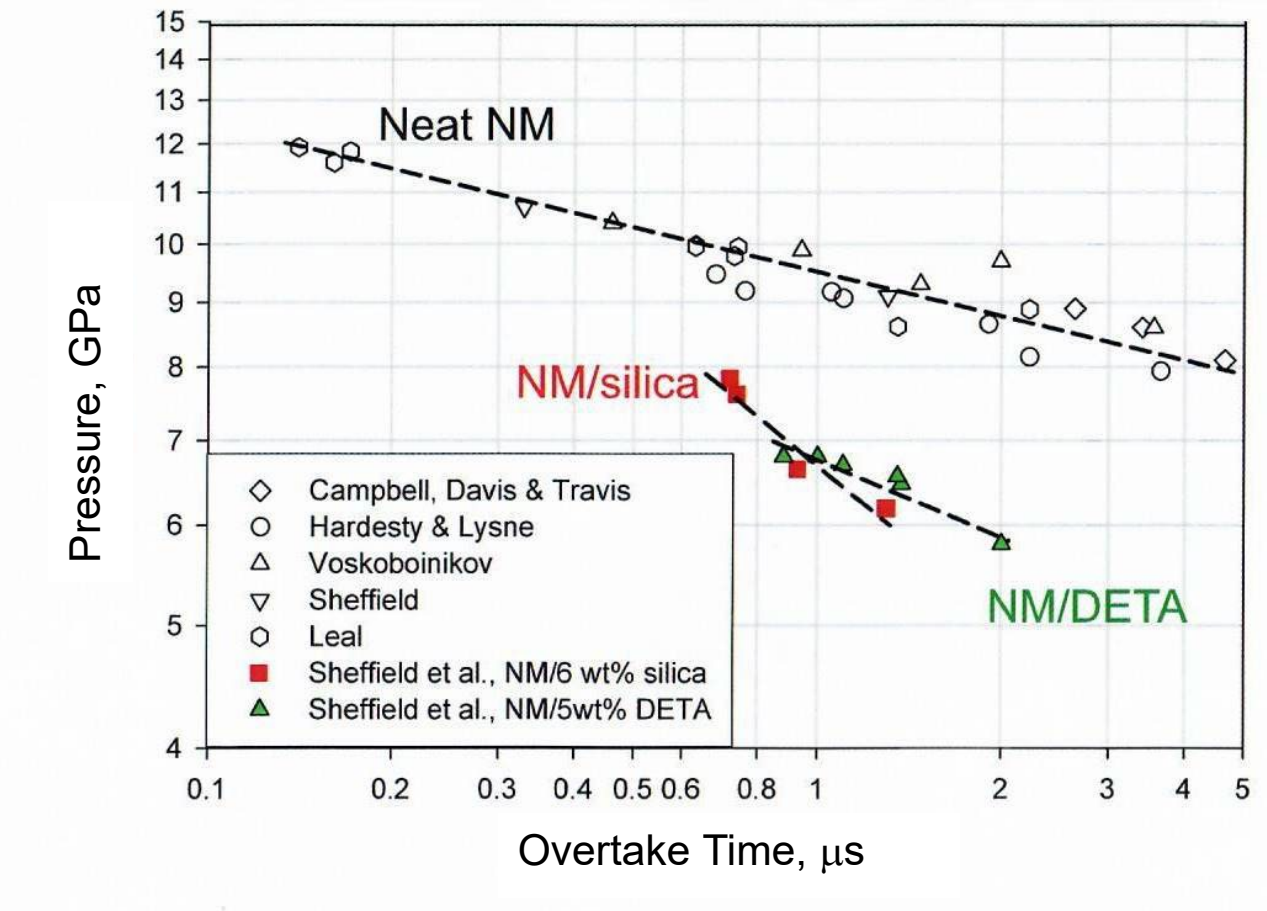
Background on shock to detonation

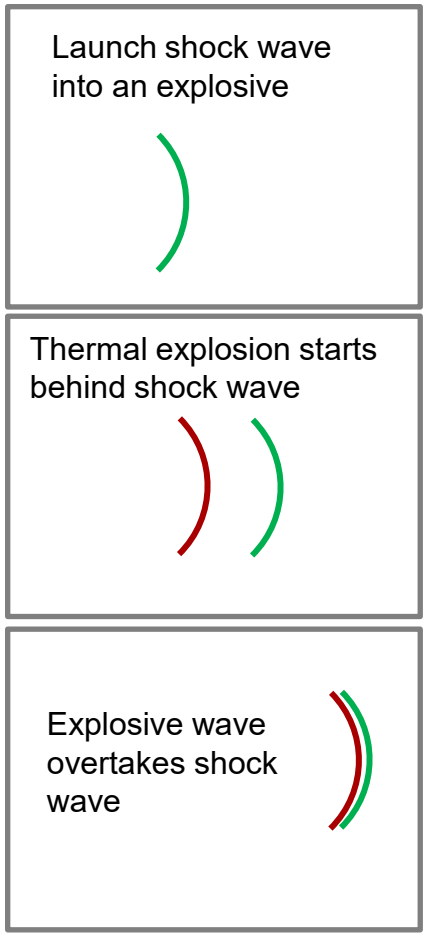
Measure the time it takes for explosive wave to “overtake” shock wave

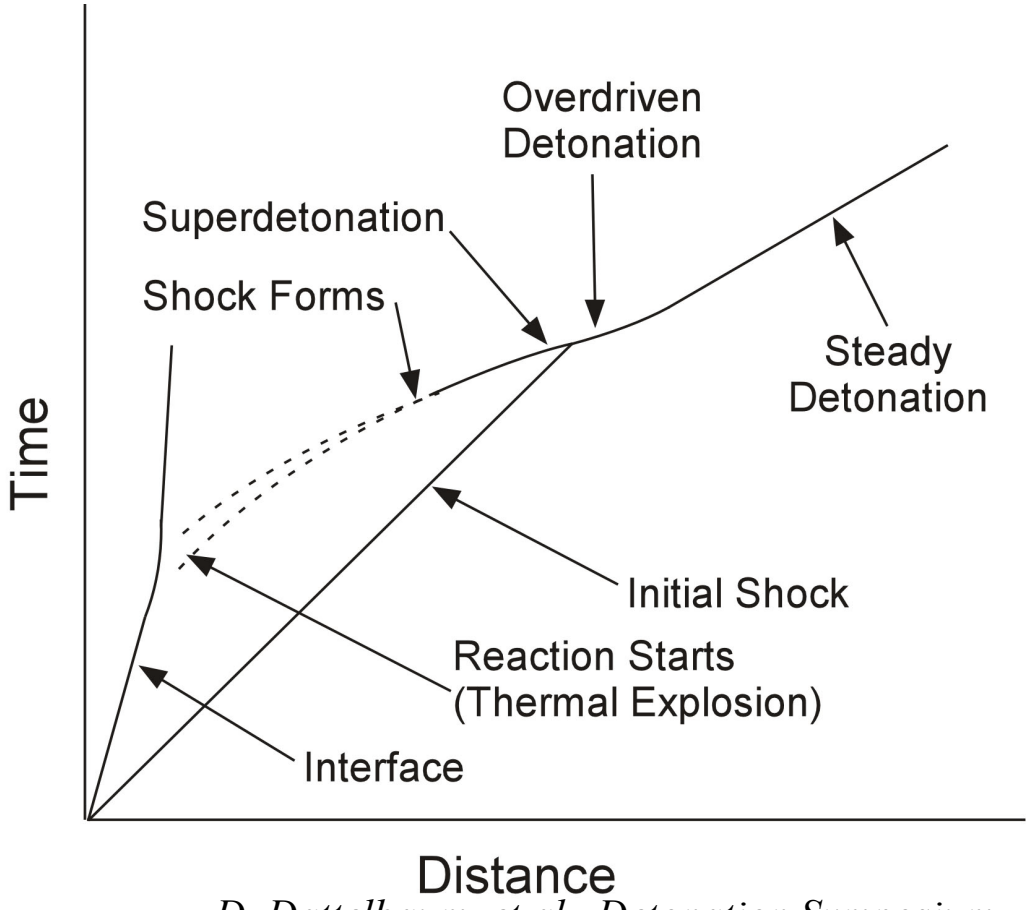
Pop plot



(Dattelbaum et al. 2010)

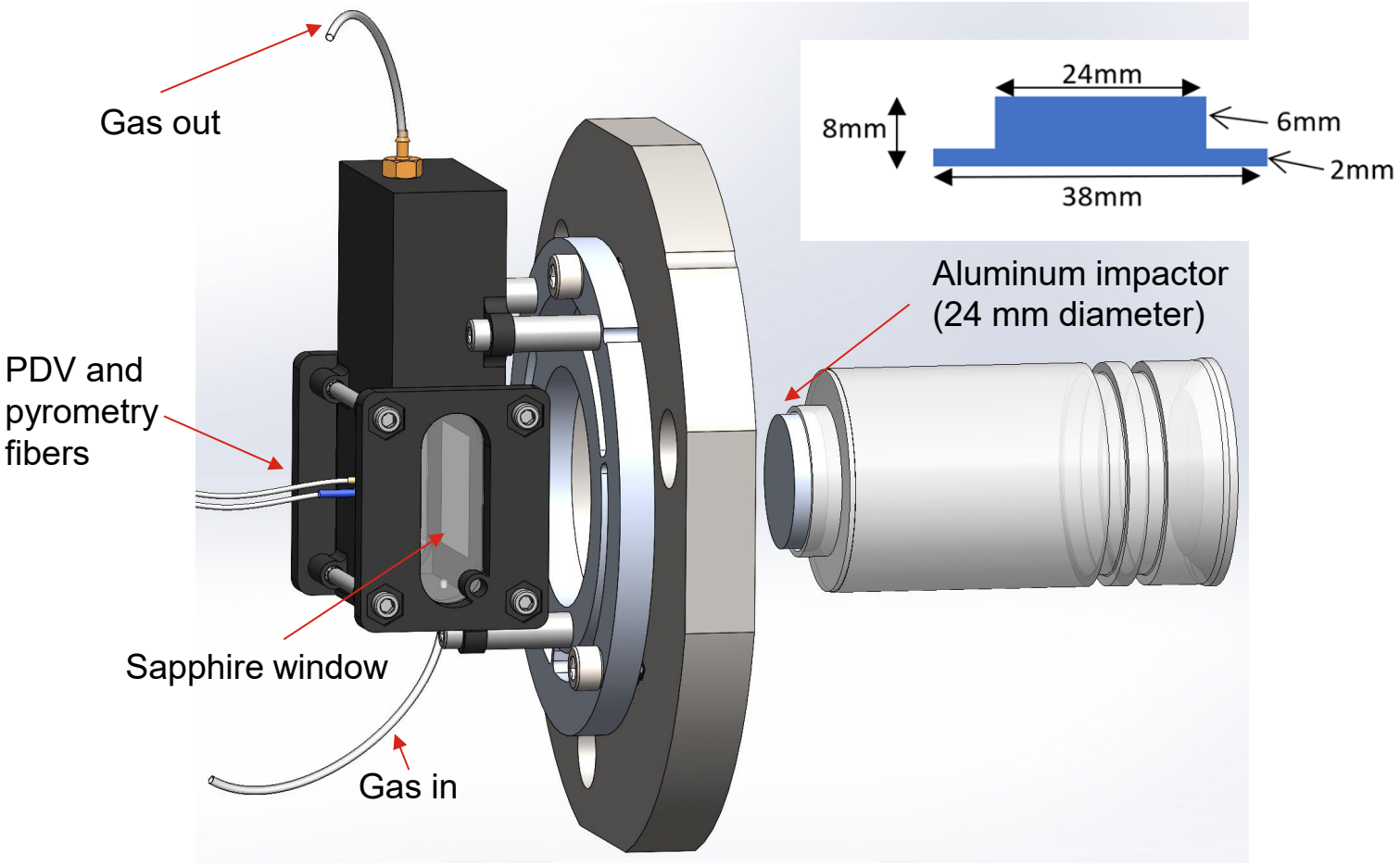
Background on shock to detonation





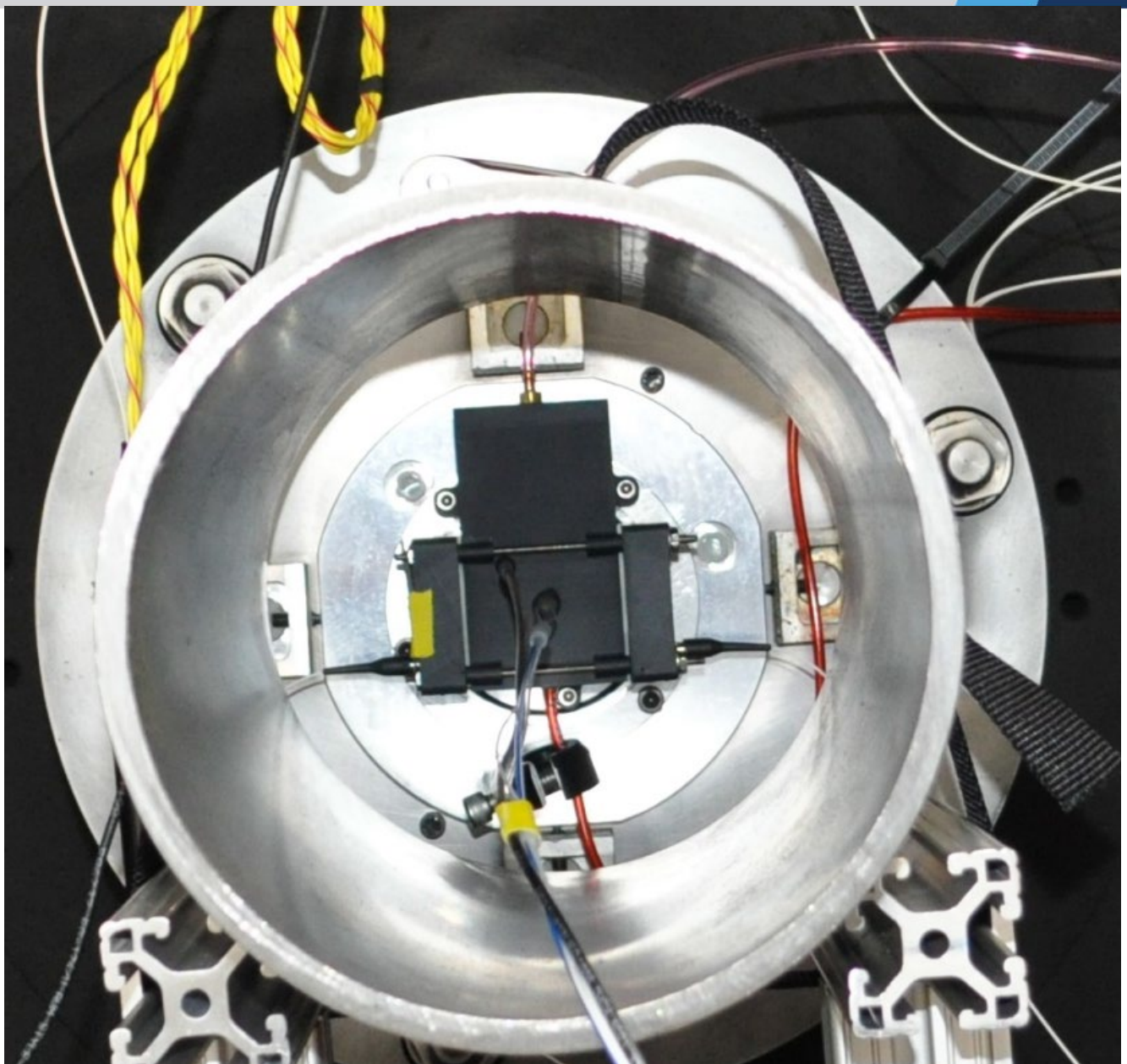
D. Dattelbaum, et al., Detonation Symposium, April 2010

Experimental design

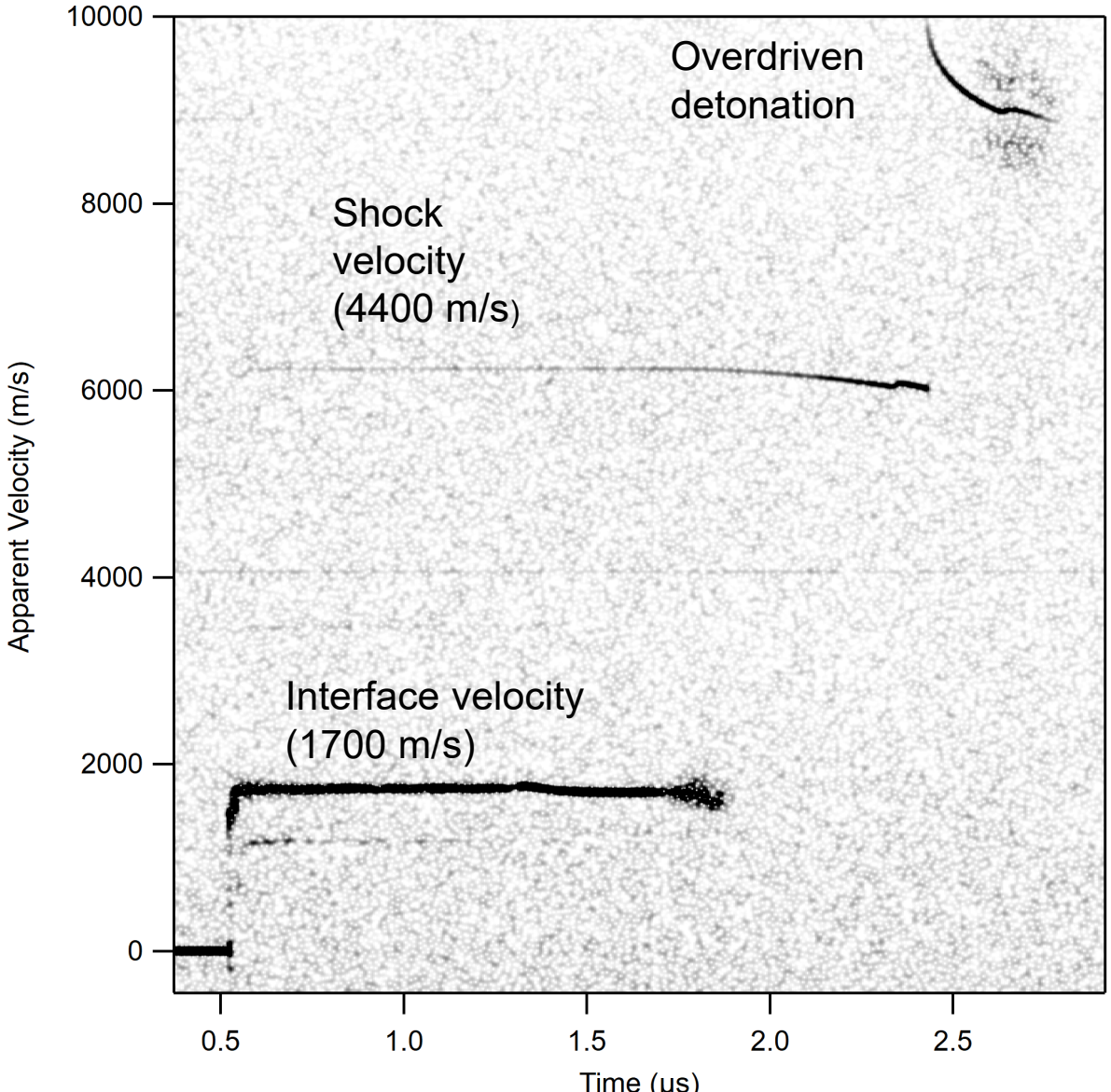


Package for powder gun experiments

Experiment setup

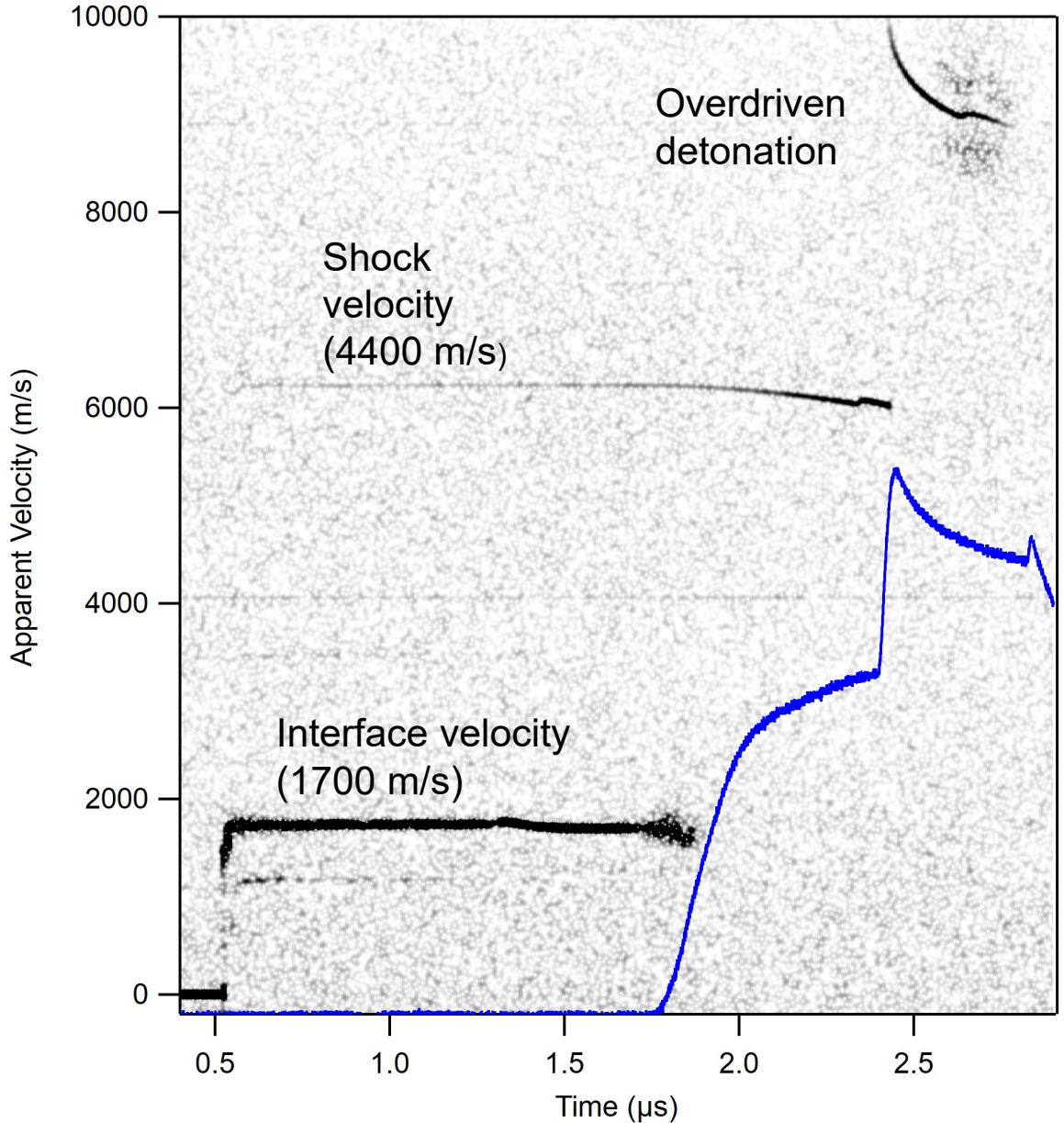


8.6 GPa shock to detonation in PDV data



Steady
detonation
(~6.3 km/s)

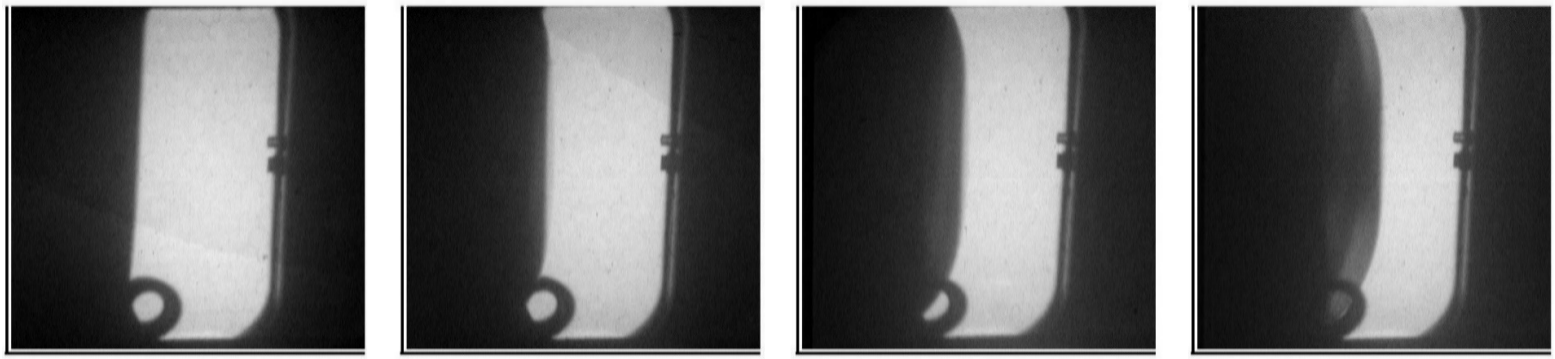
8.6 GPa shock to detonation in PDV data

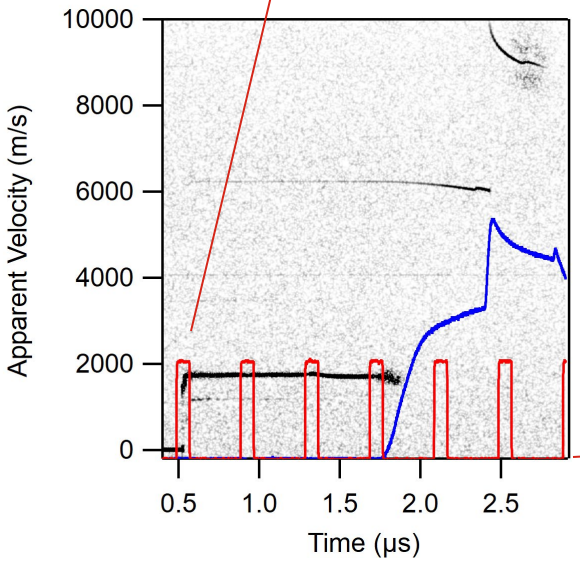


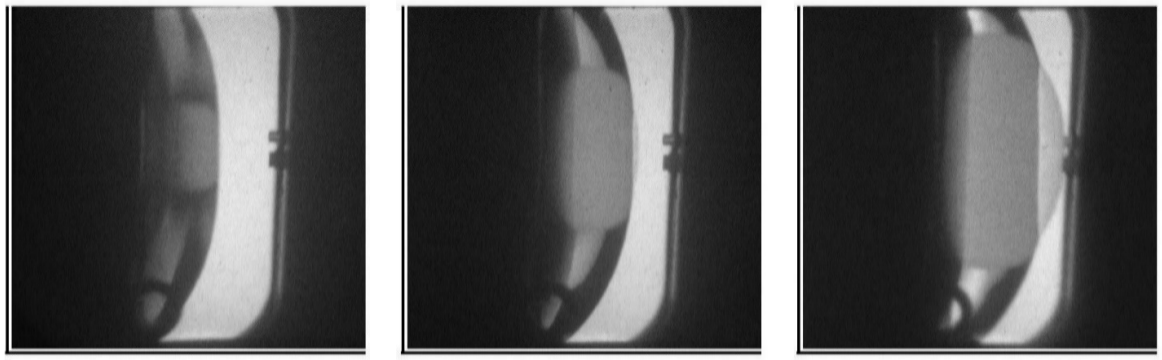
Steady detonation (~6300 m/s)

Radiance (arb. units)

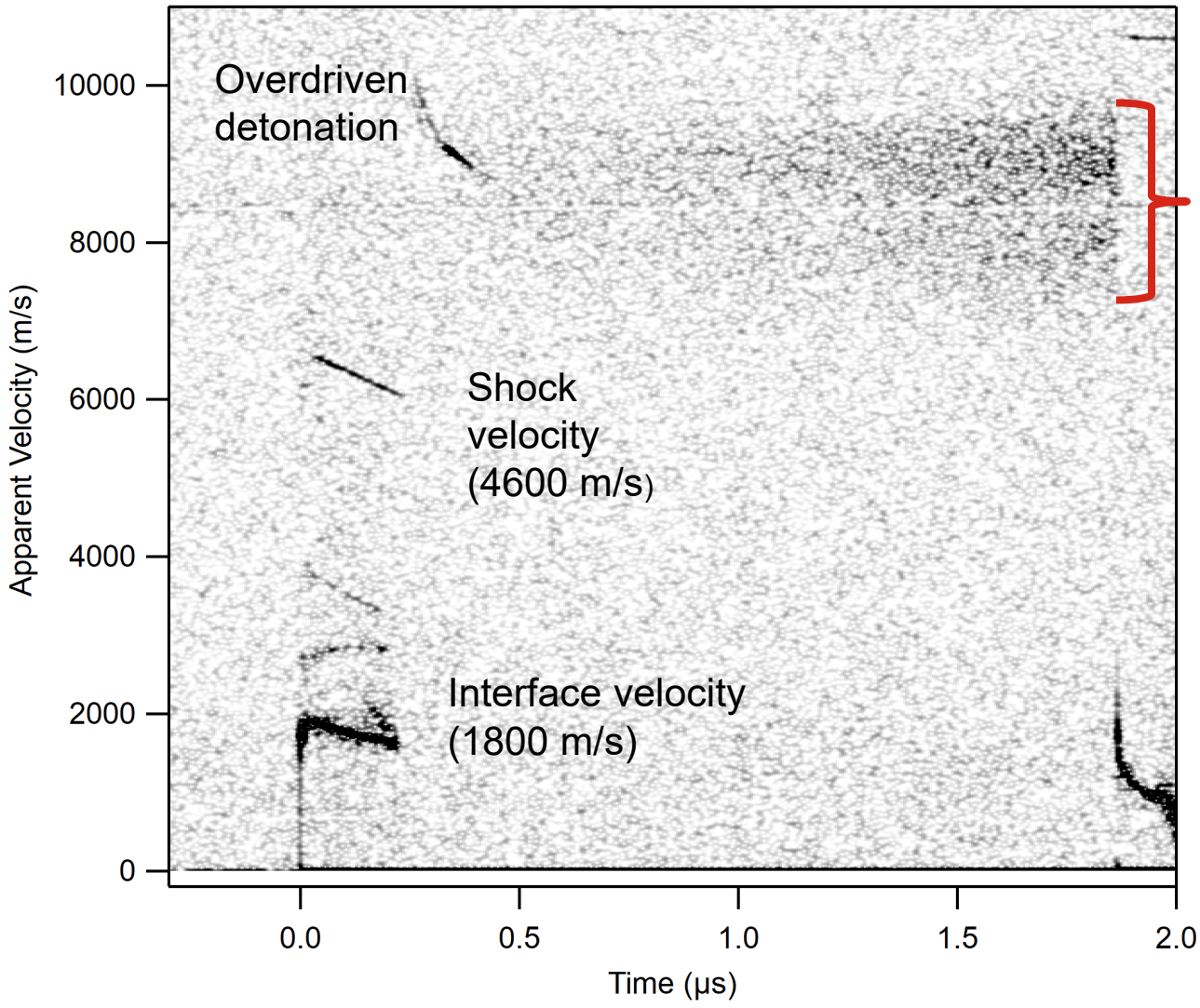
8.6 GPa shock to detonation visible image







HE driven shock to detonation



Steady detonation
(~6300 m/s
spread of 1700 m/s
or spread of 3 GHz)

Why does a steady detonation appear as a spread in velocities (frequencies)?

Maybe something to do with cellular detonation

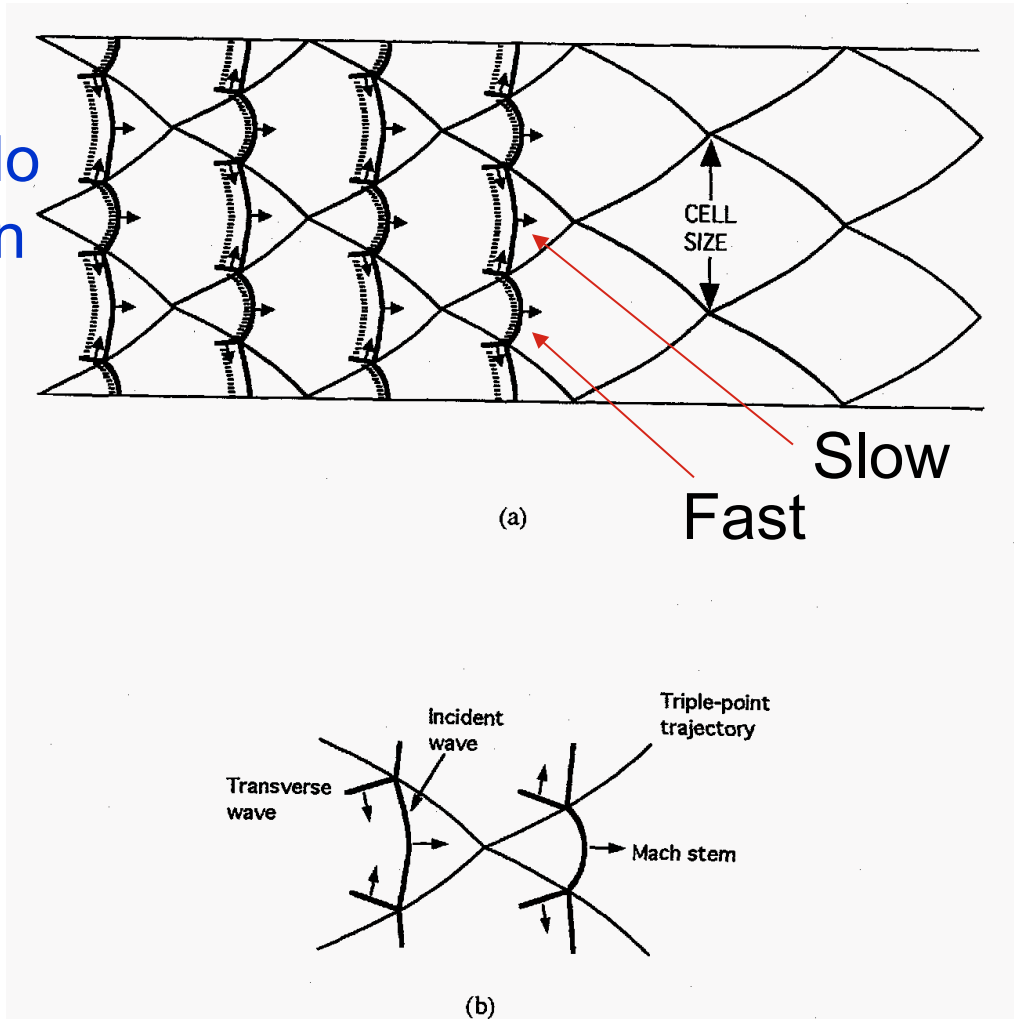
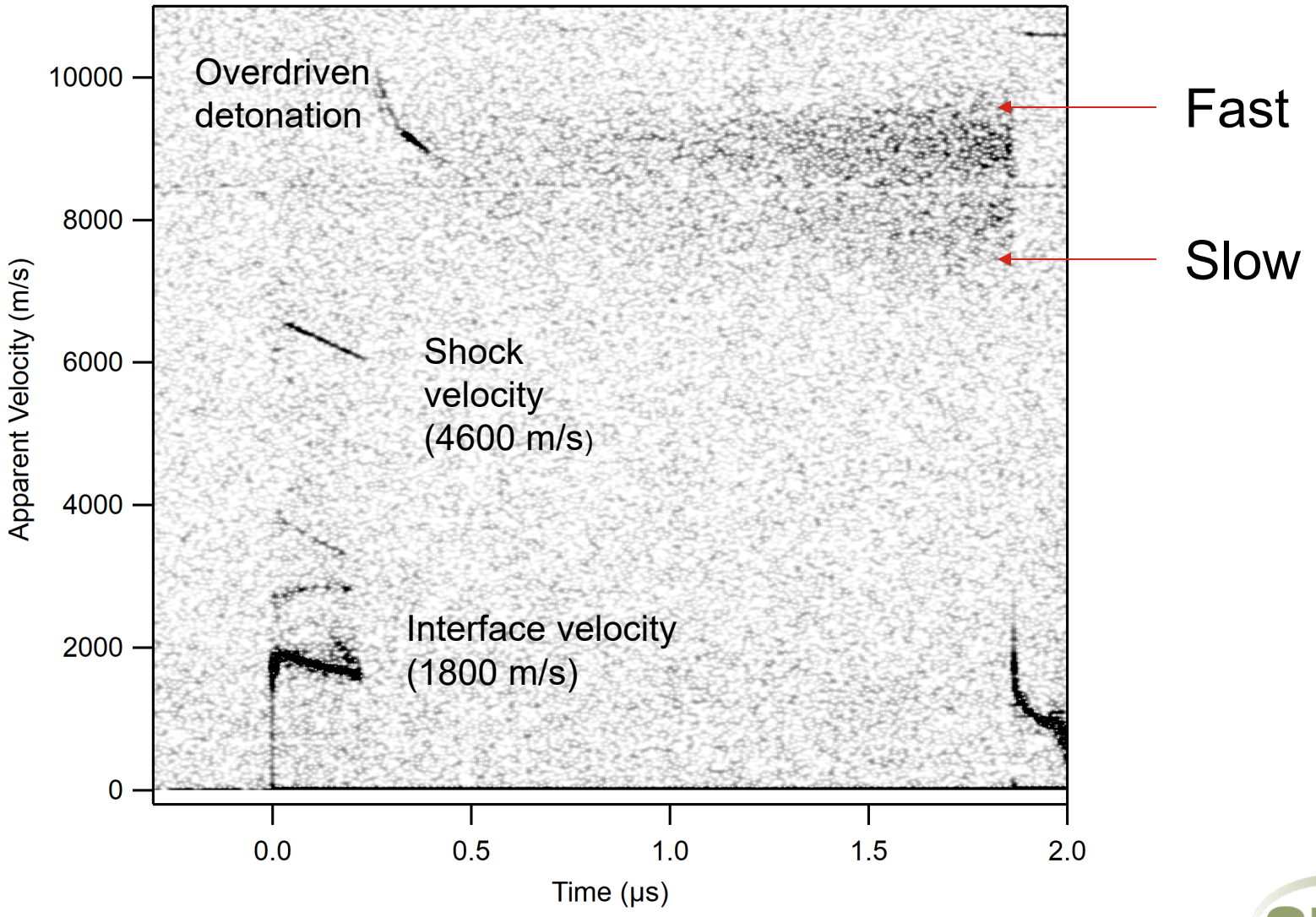


Figure from G. Ciccarelli, T Ginsberg, J. L. Boccio, OSTI reports 563843 (1997), doi 10.2172/563843

Max and min speed of cellular detonation?



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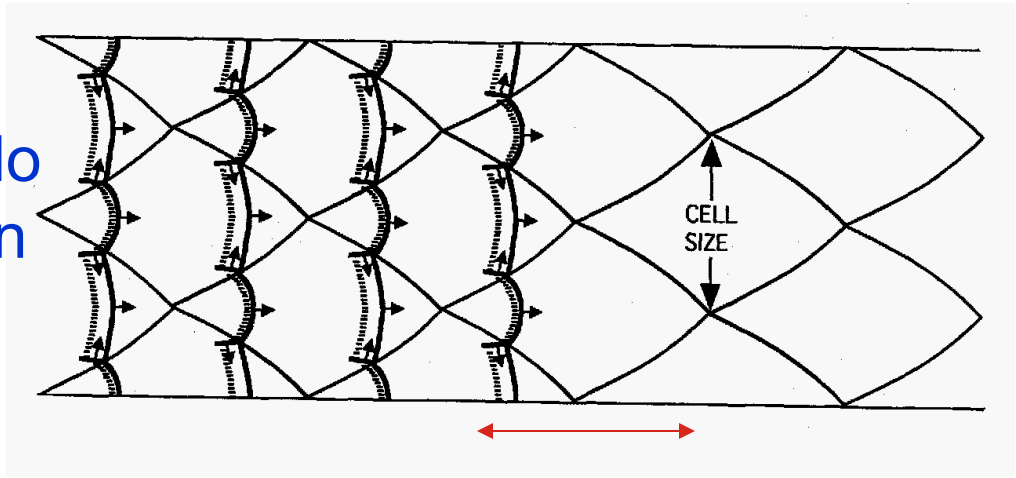


$$\lambda = D^{*}\Delta t$$

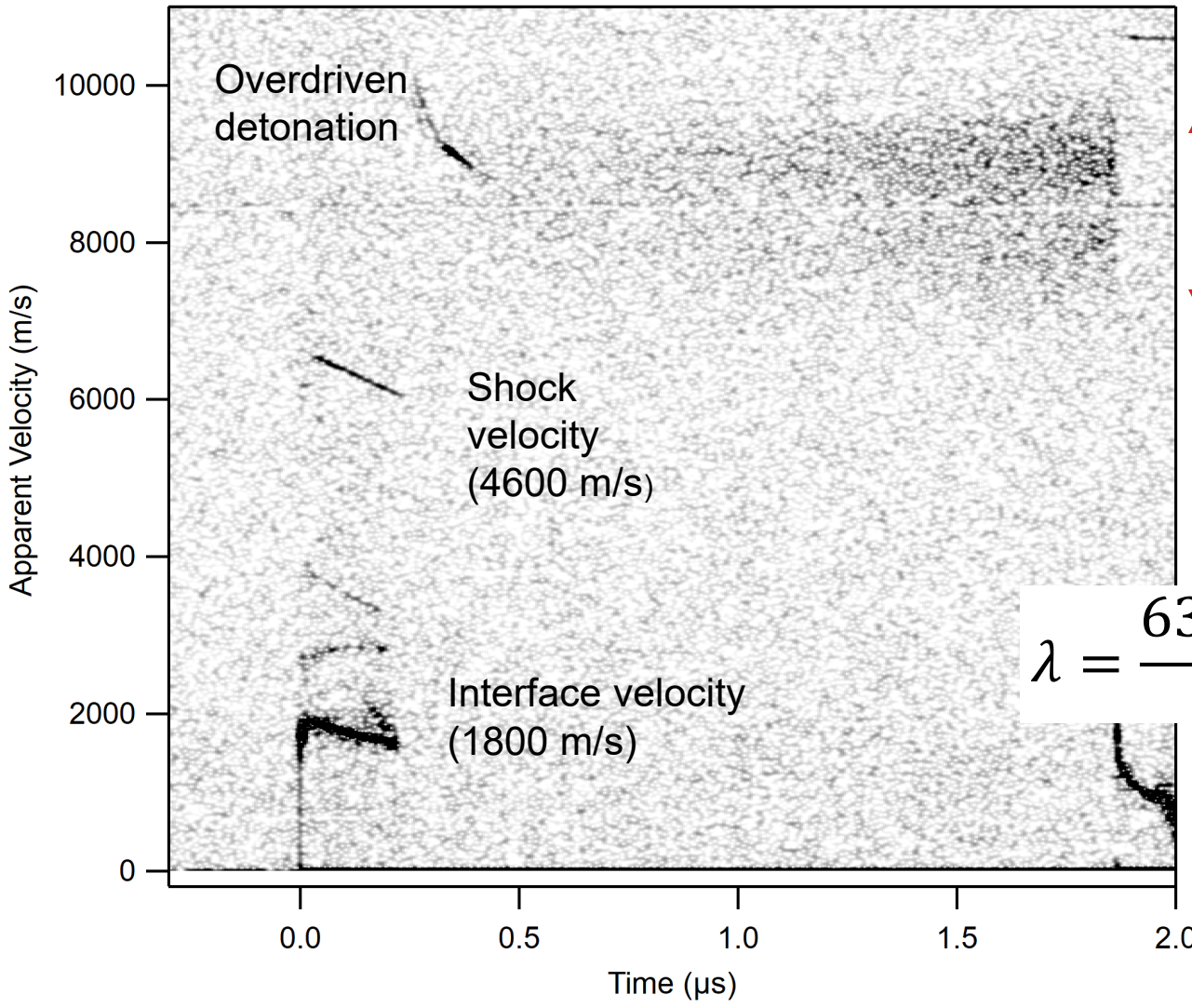
cell size

detonation speed

cell lifetime

Figure from G. Ciccarelli, T Ginsberg, J. L. Boccio, OSTI reports 563843 (1997), doi 10.2172/563843

Cell lifetime?



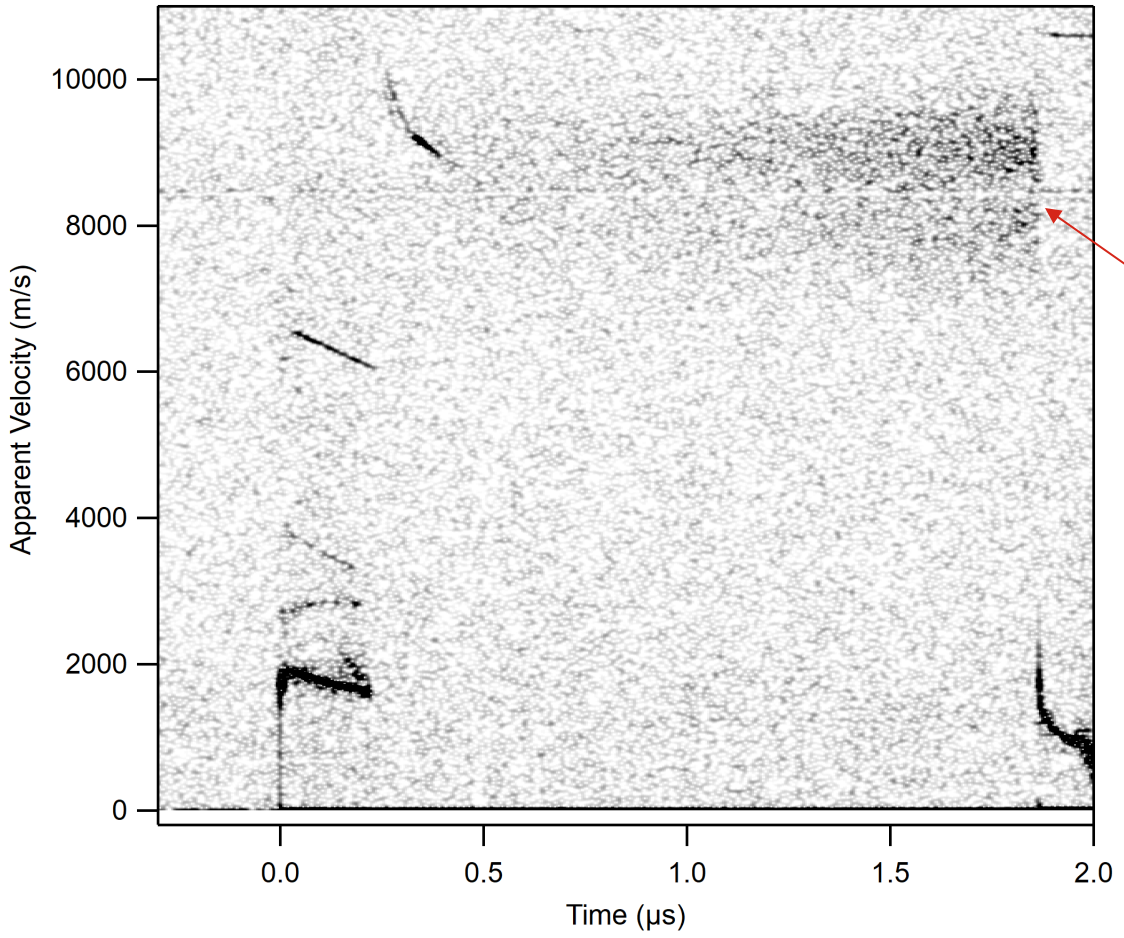
$\Delta f = 1/\Delta t$

spread in frequency

cell lifetime

$$\lambda = \frac{6300\ m/s}{3\ GHz} = 2\ \mu m$$

Maybe nothing to do with cellular detonation? Suggestions?



steady detonation