Lawrence Livermore National Laboratory

Multiplexing PDV (MPDV-X8)

PDV Workshop
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Diagnostic Development of a Multiplexed PDV System

- Combine multiple PDV signals to one detector
  - Each scope channel has 50us record length
    - Agilent 10GHz / 40GS/s
  - Add a 4usec delay between each signal
  - Four or Eight signals on each scope channel
    - Four scope channels = 16 or 32 channel system

- Independent Single Reference
  - Allows the reference to be set depending on the return signal
  - A tunable reference would allow for optical heterodyning, which would increase the temporal resolution of our short pulse signals

MPDVx8 – Multiplex Time Delay PDV

MPDV-X8 (Time Domain Multiplexed PDV 8 probes)

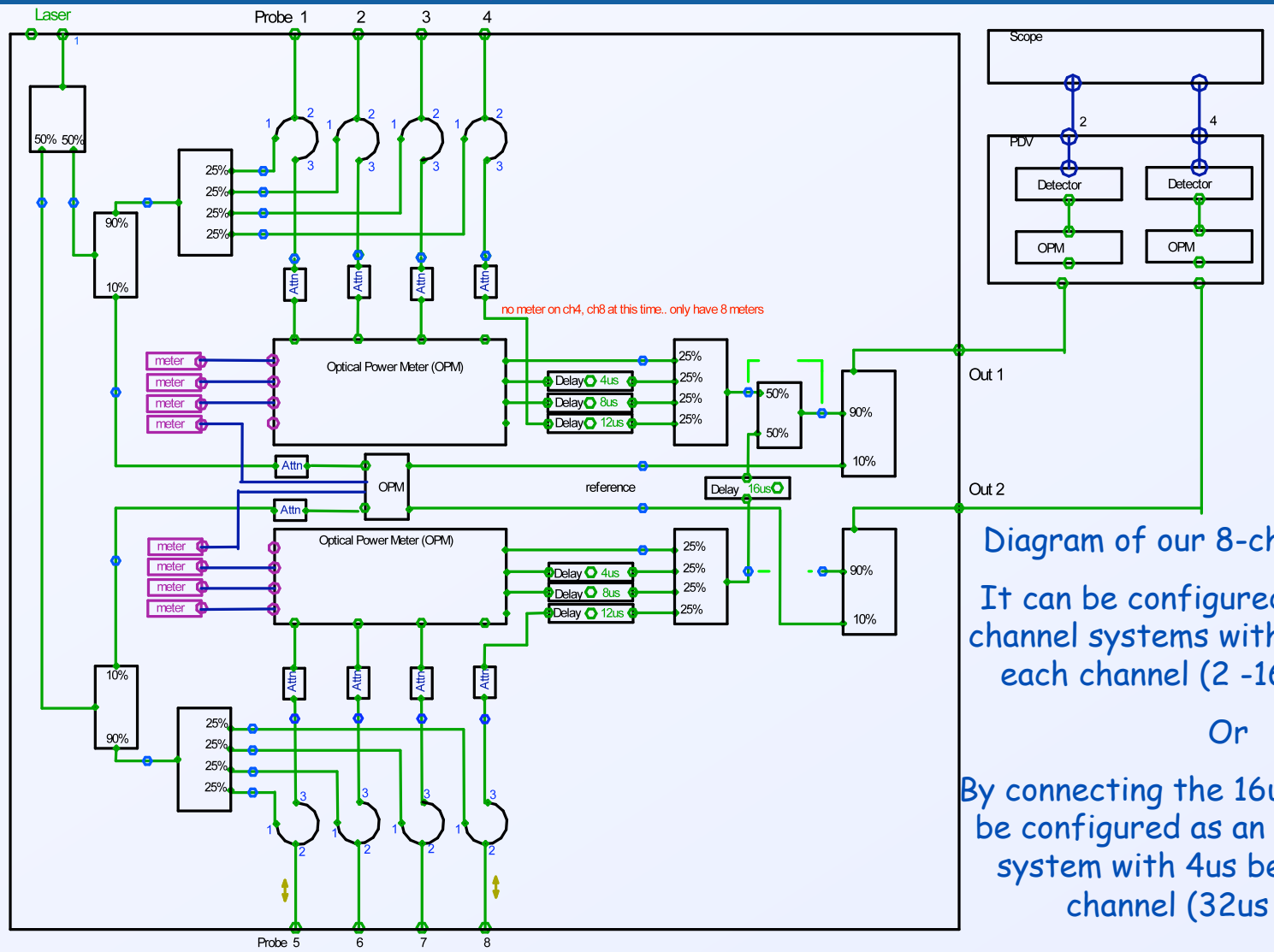


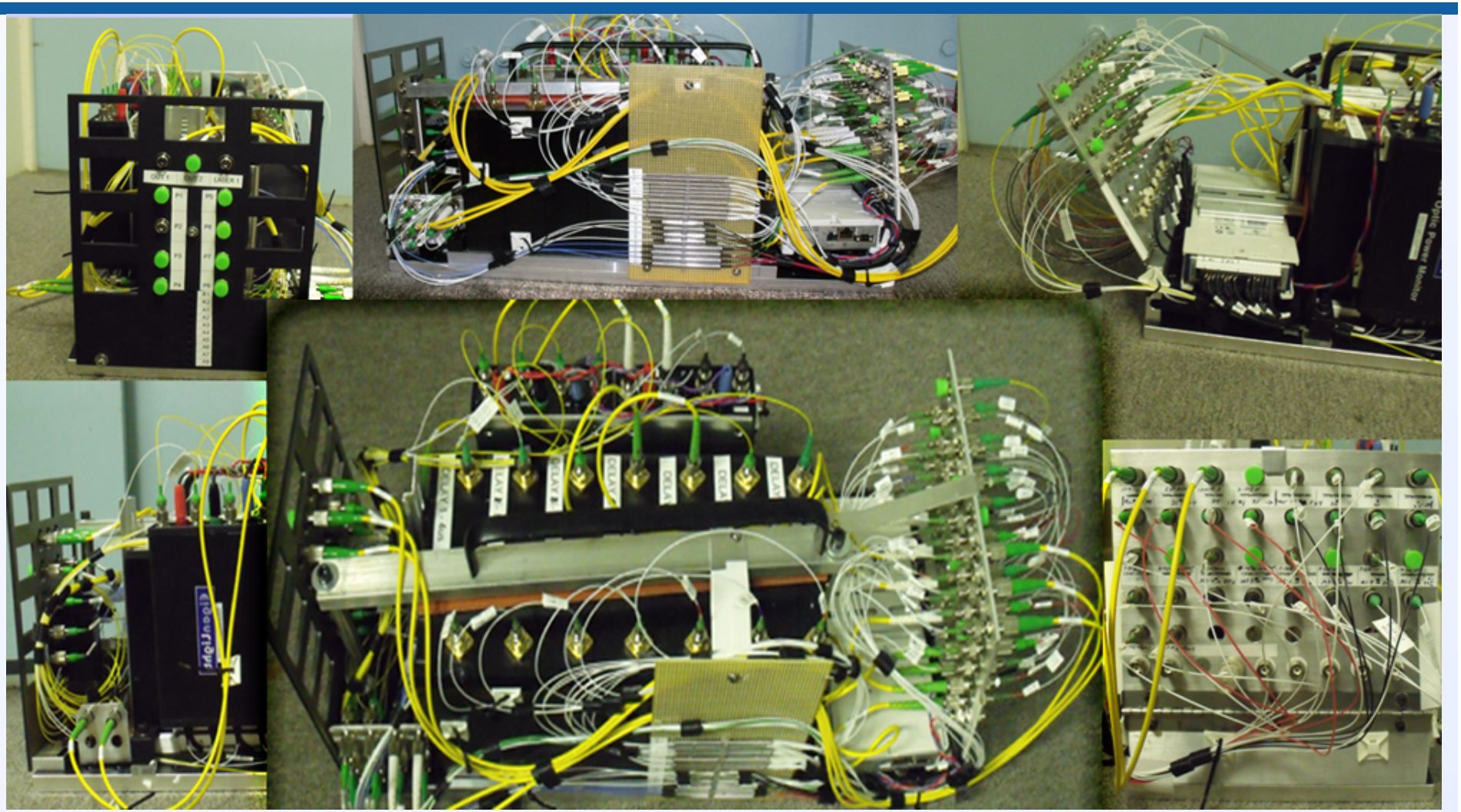
Diagram of our 8-channel system

It can be configured as two four channel systems with 4us between each channel (2 -16us records)

Or

By connecting the 16us delay, it can be configured as an eight channel system with 4us between each channel (32us record)

MPDV-x8 – Time Delay Multiplex PDV Chassis

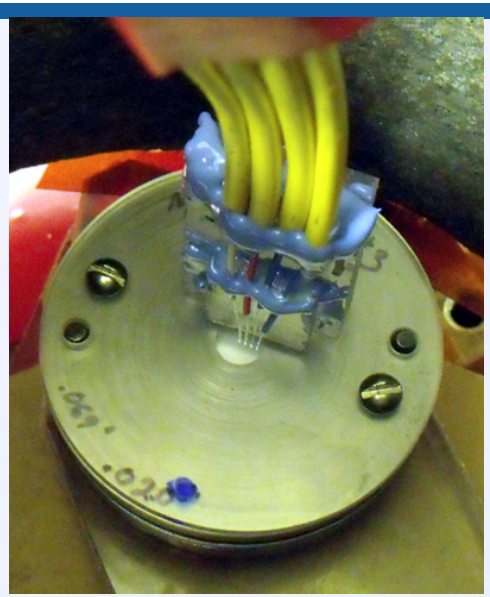


Measure the Velocity and the Impact Pressure of a Projectile Simultaneously at Multiple Locations

- Problems
  - Deformation of the projectile can produce a 'curved' surface, which lowers the Return Signal from a Specular Surface
  - PMMA Window
    - Impact into a window to determine the Pressure
    - PMMA can be damaged by the PDV Laser
  - 10dB signal loss through 4 channel multiplexer
    - Could use a optical switch to replace the combiner
      - Increase output by 6dB on a 4 channel multiplex system
      - Reliability for a single shot event?

Electro-optic Crystal –
no moving parts 300ns switching time

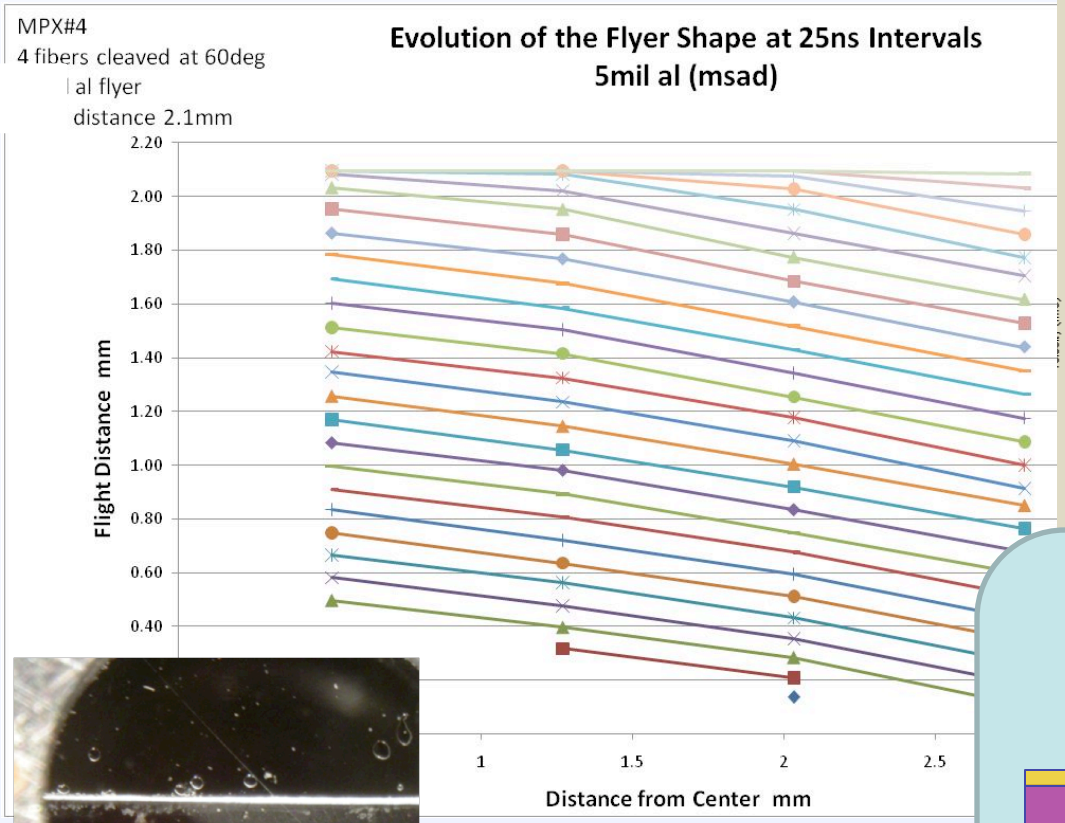
Current Issues:

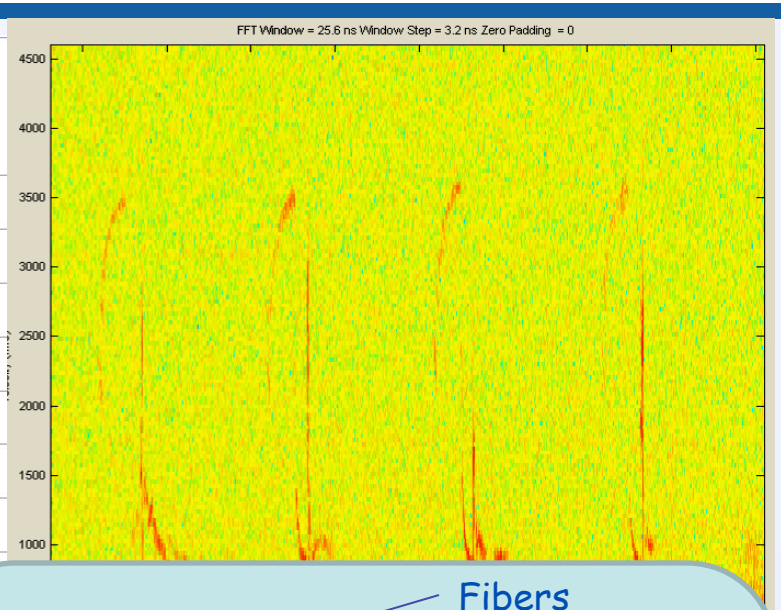


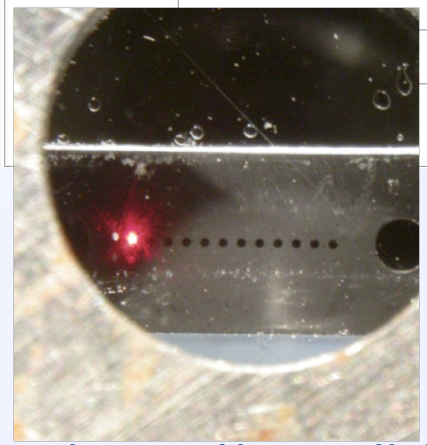
- Probes
  - Spacing is limited by diameter of probe
- Bare fibers have been used (Good start)
  - Short focal distance
    - Lower signal return
    - Can be placed very close together
    - Poor pointing accuracy
      - 8 Deg wedge
  - Solution - commercial linear array with a lenslet array

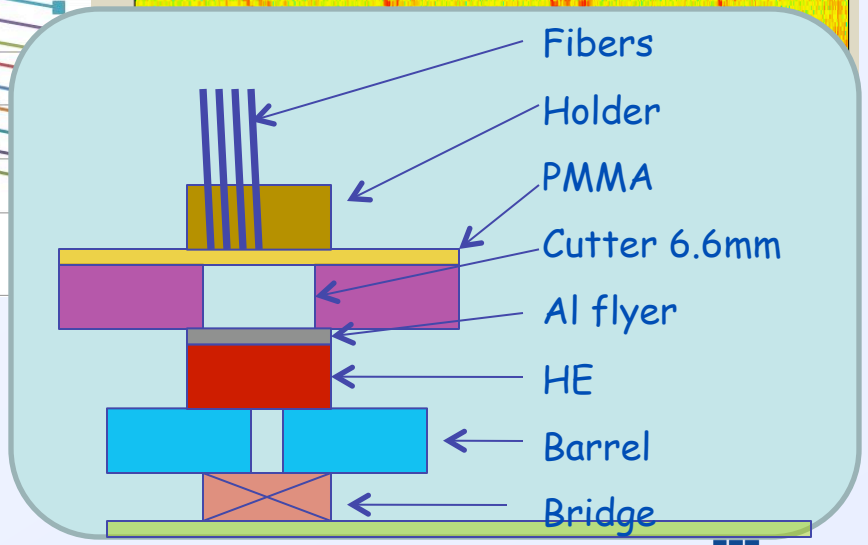
- Short Pulse / Fast Rise Time Measurement
  - Limited by the sample rate of the scope
  - Heterodyning the PDV signal with an external reference will help this problem

Explosively Driven Aluminum Flyer

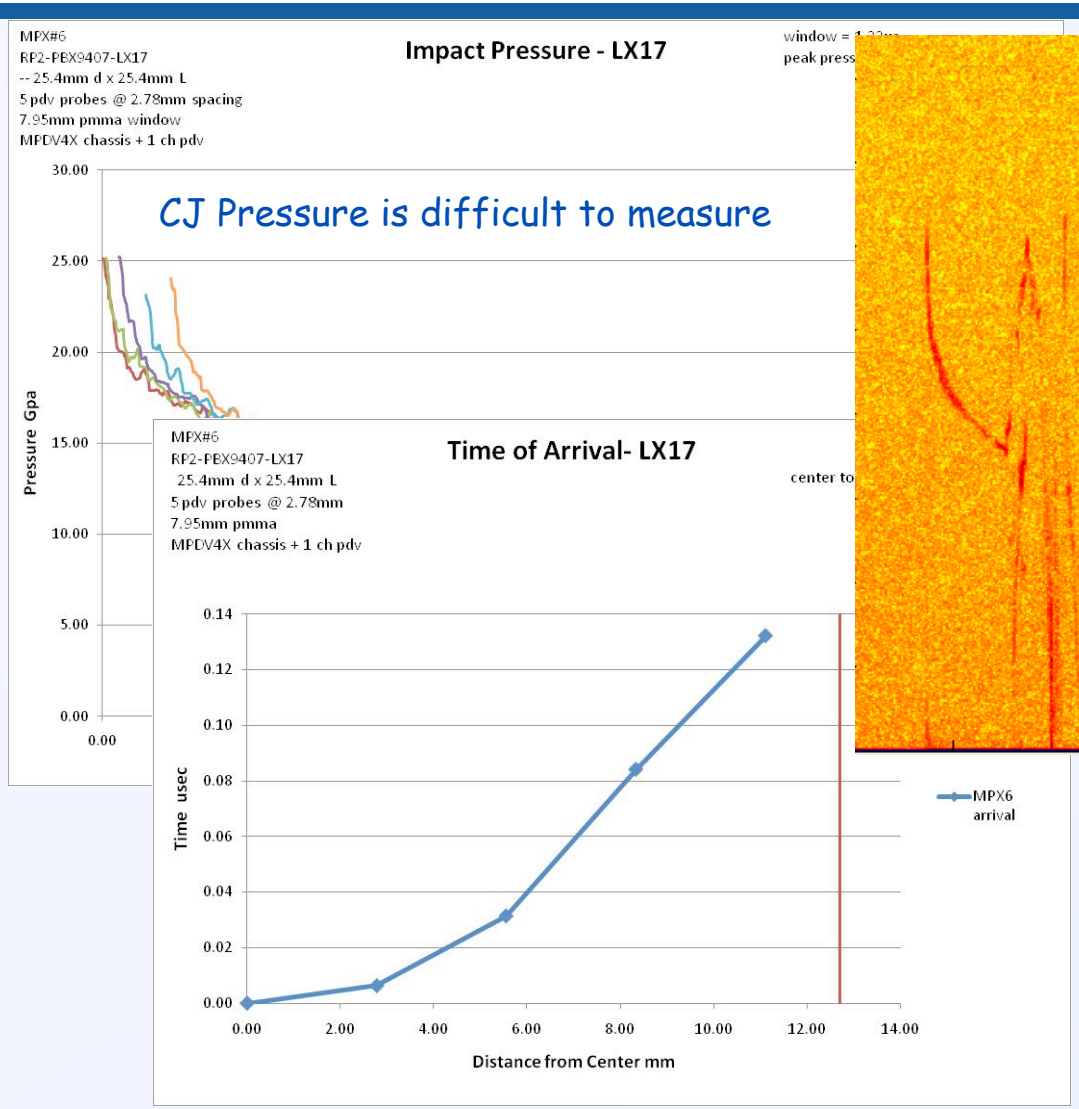


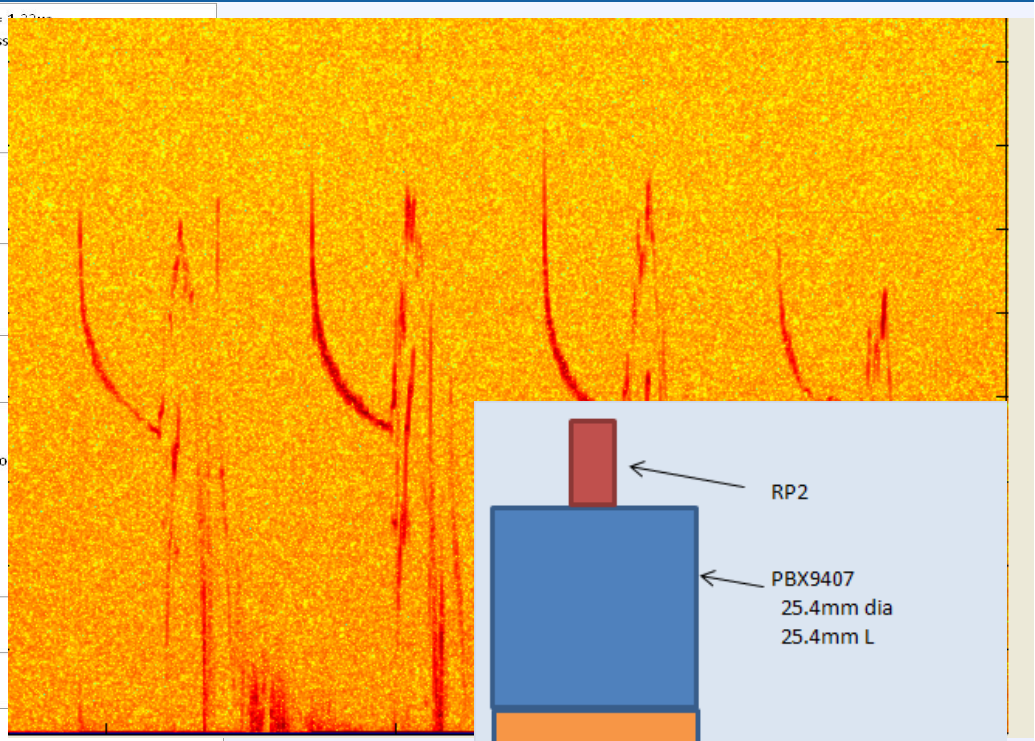


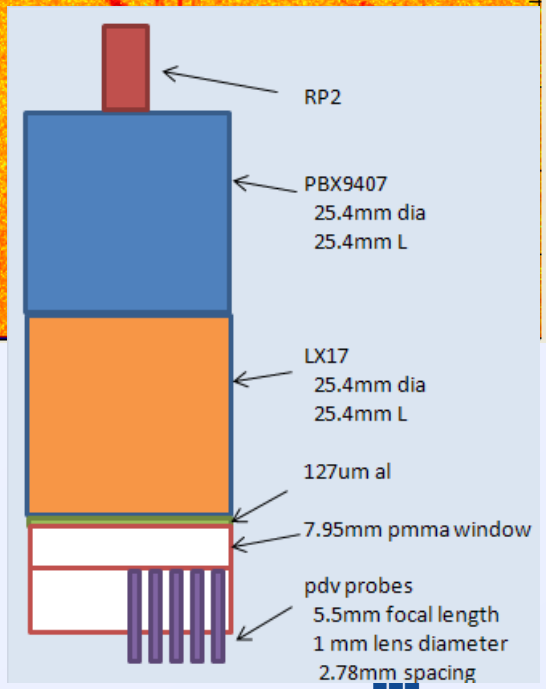




High Explosive Shock Arrival

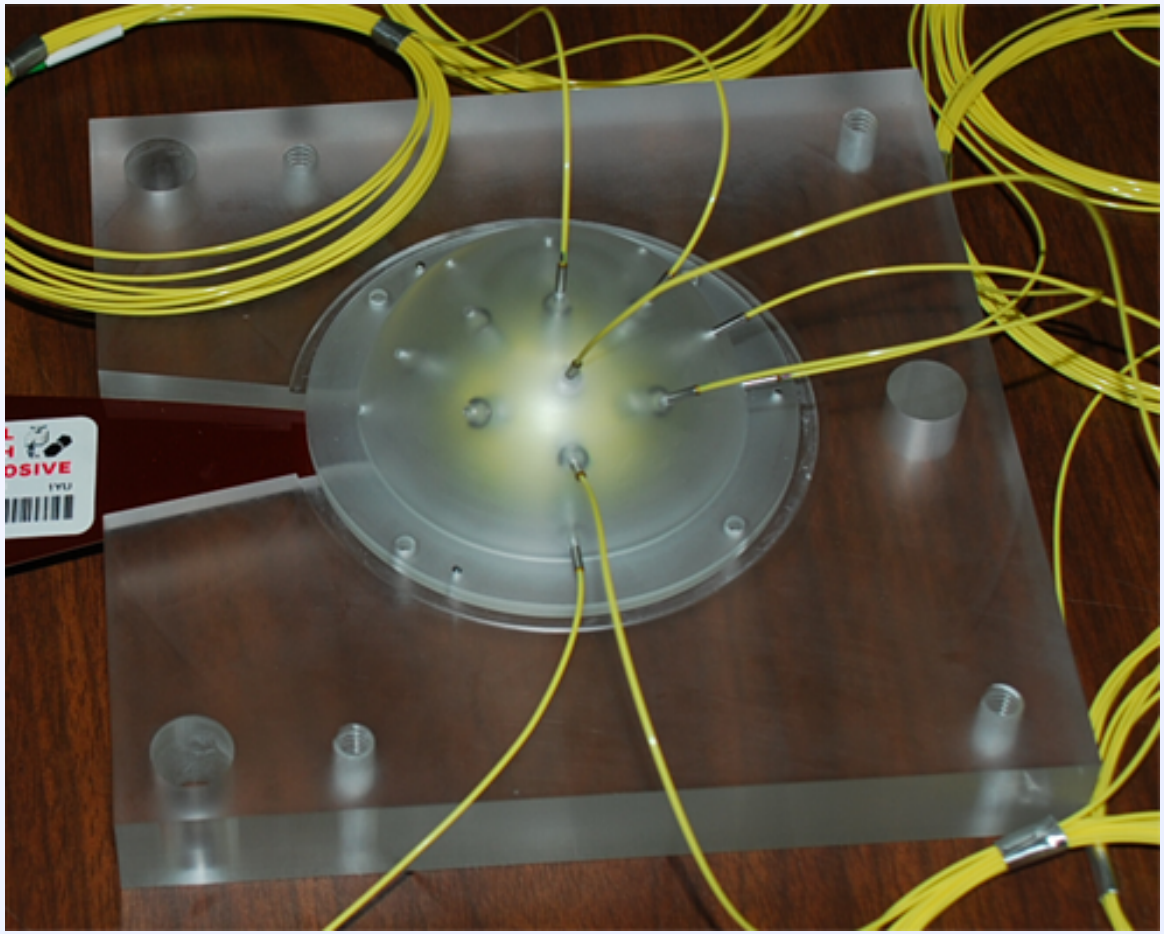






16 PDV Probe – H.E. Pressure & Shock Arrival

- 16 probes
- Spherical

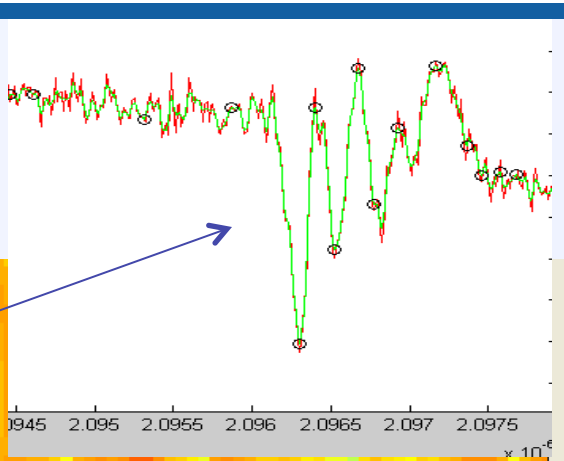


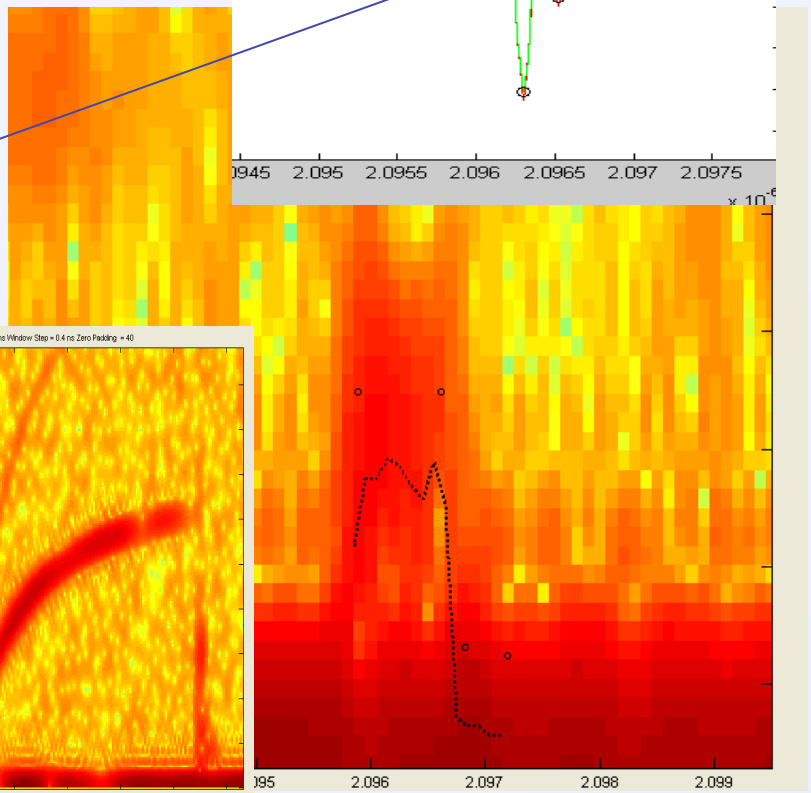
Conclusions / Future

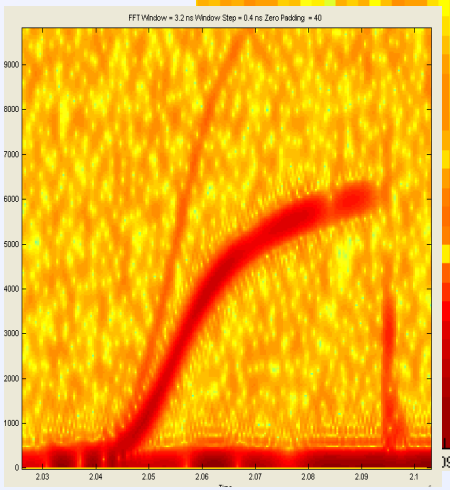
- Preliminary work shows that MPDV instrument allows for experiments that were previously unattainable
- Multiple channels (>32 channels) are necessary for the future
- Heterodyning – a tunable laser is on order
  - Increase the number of data points on the PDV signal
- A tunable laser for the reference allows for a way to test the system prior to use.

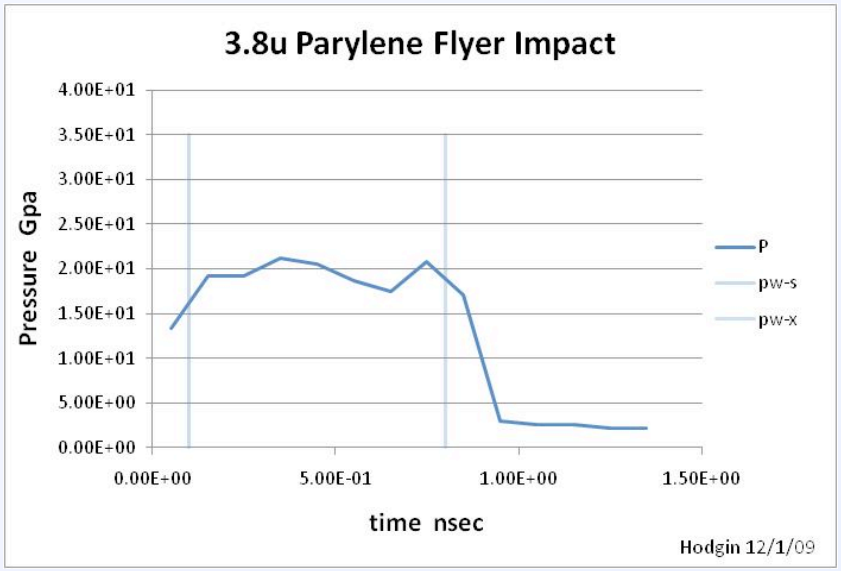
Thin Flyer LiF Impact using Lecroy 30GHz 80GS/s Scope

- 3.8um Parylene Flyer
- Impact Velocity = 6km/sec
- Impact Pulse Width = .7ns
- Pressure = 20GPa
- Only 3 cycles of PDV data!









Al Flyer into LiF, Fiber Ferrule 250um Spacing