PDV modifications

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National Nuclear Security Administration

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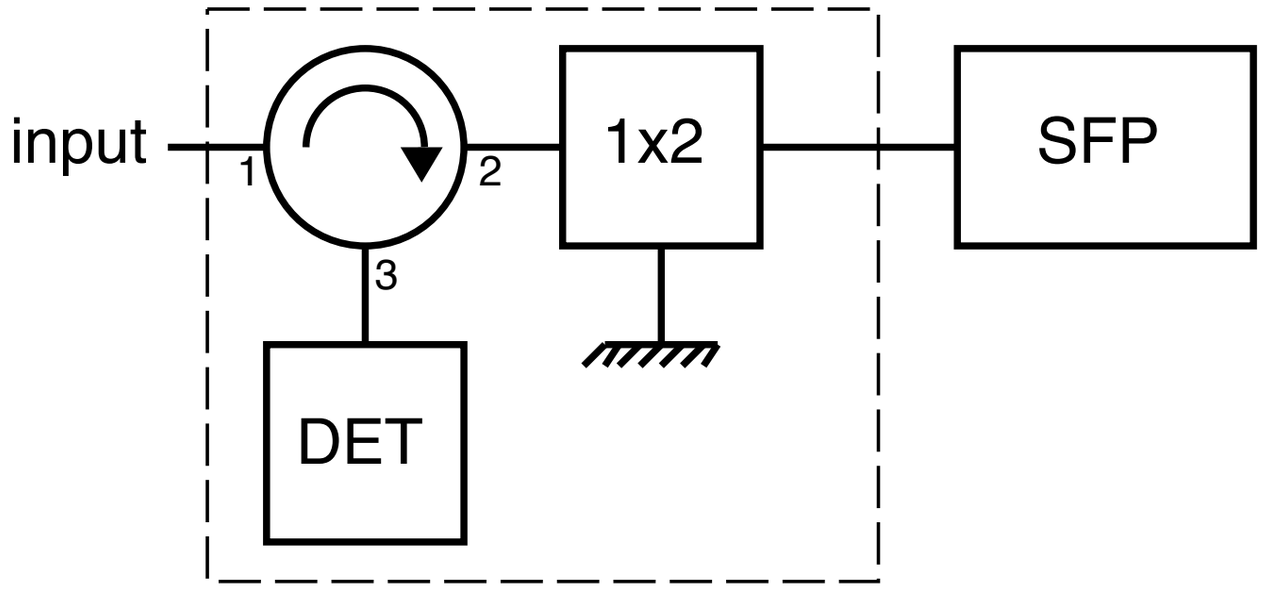
Conventional PDV

- Generation 1 system
  - Reference light separate from the probe
  - Reference path may occur before or after circulator

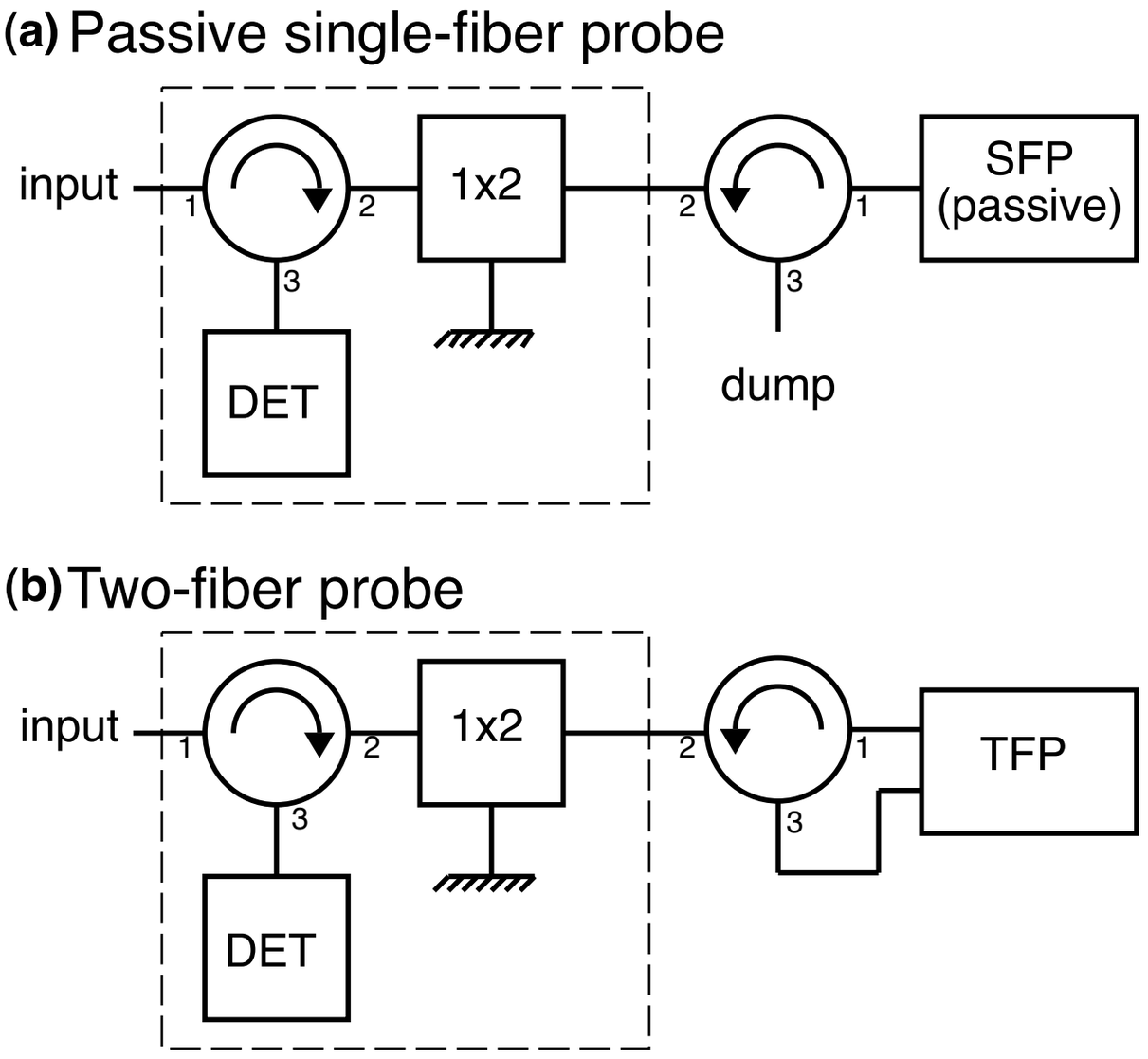


- Common example is the NSTec modular PDV
  - SFP: single-fiber probe
    - Send and receives light
  - Not shown:
    - Attenuators
    - Power meters
    - Connectors
    - A lot engineering...

- How do we modify these systems with making internal changes?
  - Flexibility
  - Scalability

Inverted circulator

- External circulator removes light from single-fiber probe path
- Passive probes are handy for transverse velocity measurements
  - Normal probe active
  - Off-normal probes passive
- Rejected light can be passed to a two-fiber probe (TFP)
  - New probe design choices



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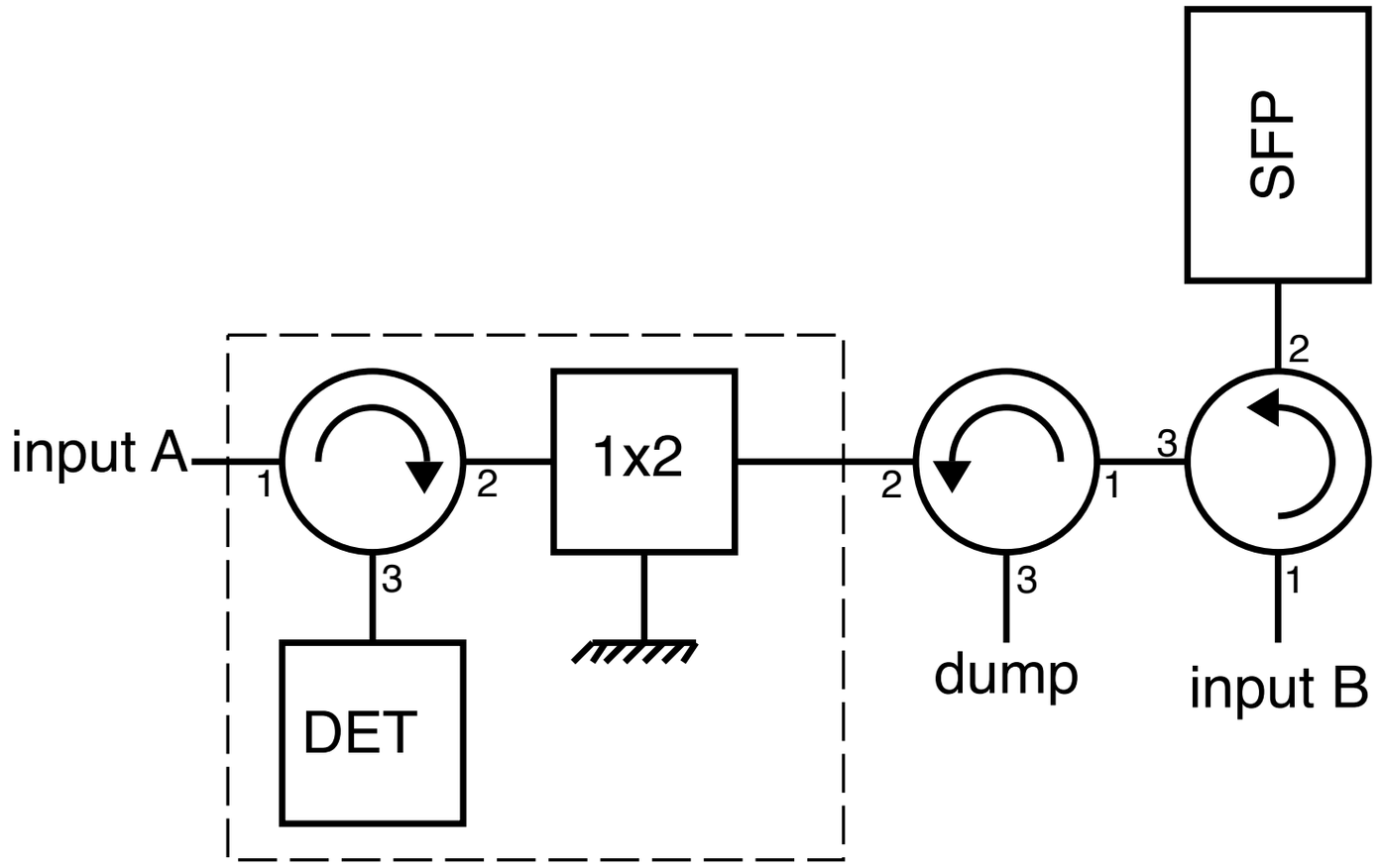
Frequency conversion mod.

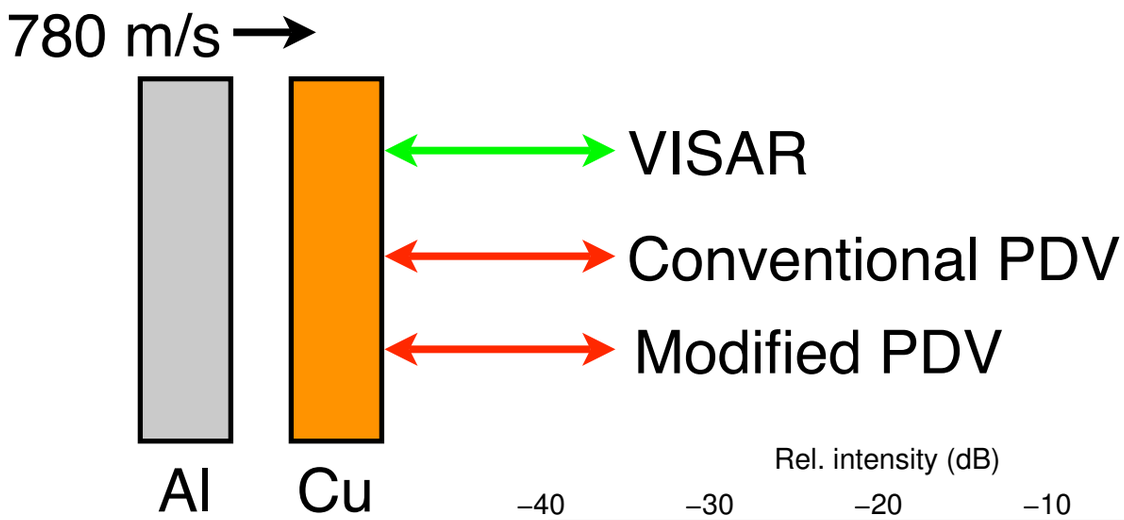
- Add a second laser for frequency conversion
  - Frequency stability is important
- PDV always beating
  - Digitizer setup is easy
  - Low velocities are NOT a problem

- Inverted circulator pair
  - Removes input A from probe path
  - Manages input B send/receive light
- 4-port circulator could probably be used

Frequency-conversion extensively tested on **dedicated** systems.

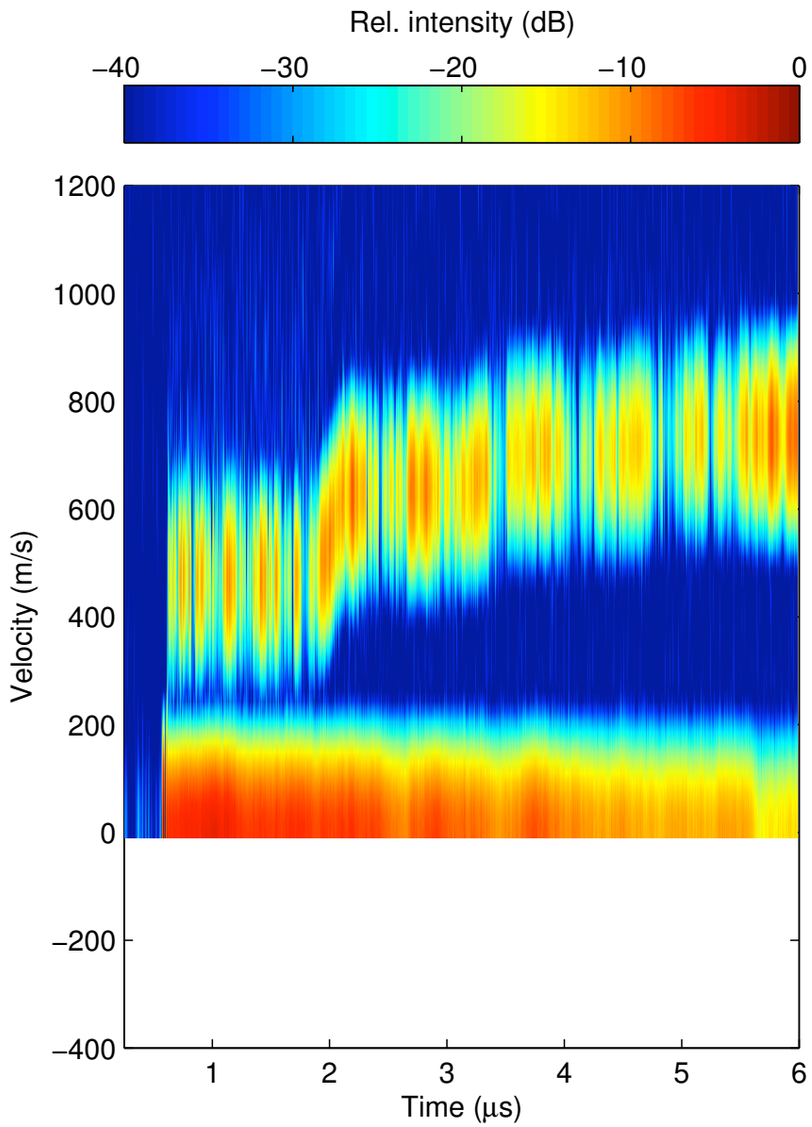


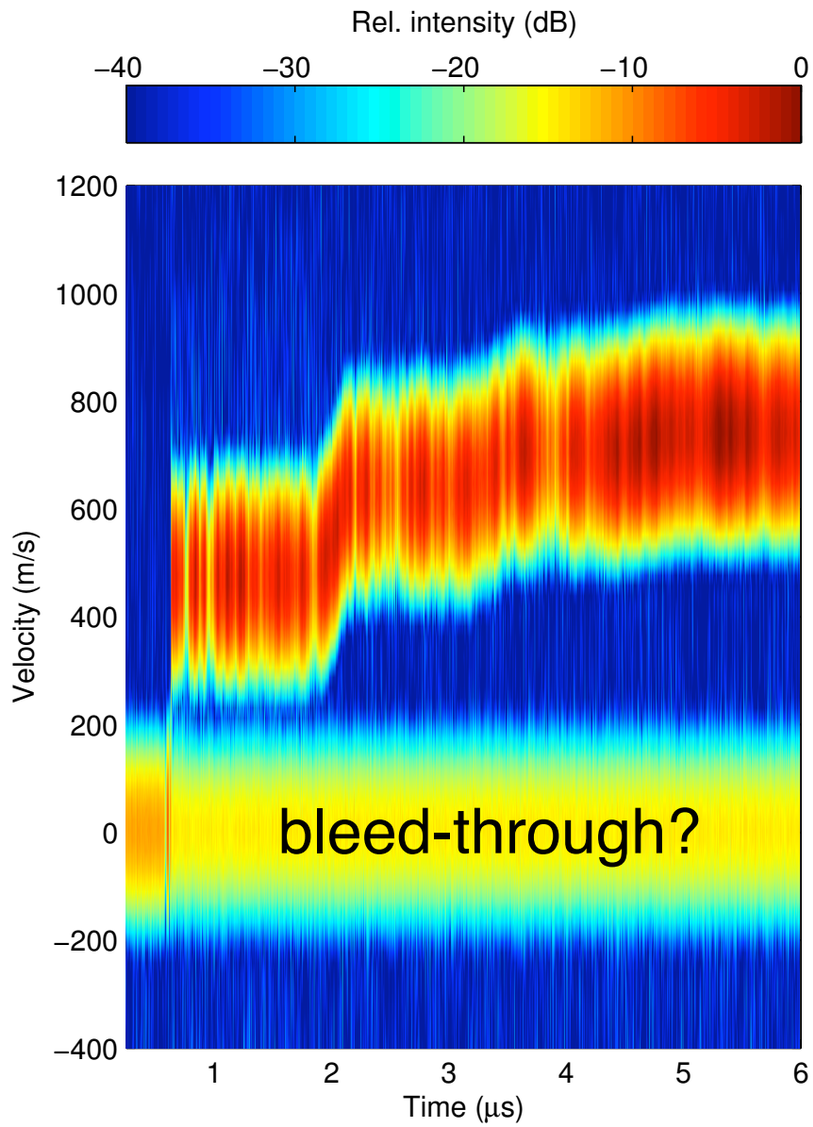
A quick experimental test



- Roughly 2 GHz frequency shift
- Collimated probes, diffuse target (~10 mm standoff)

Conventional spectrum





Modified spectrum

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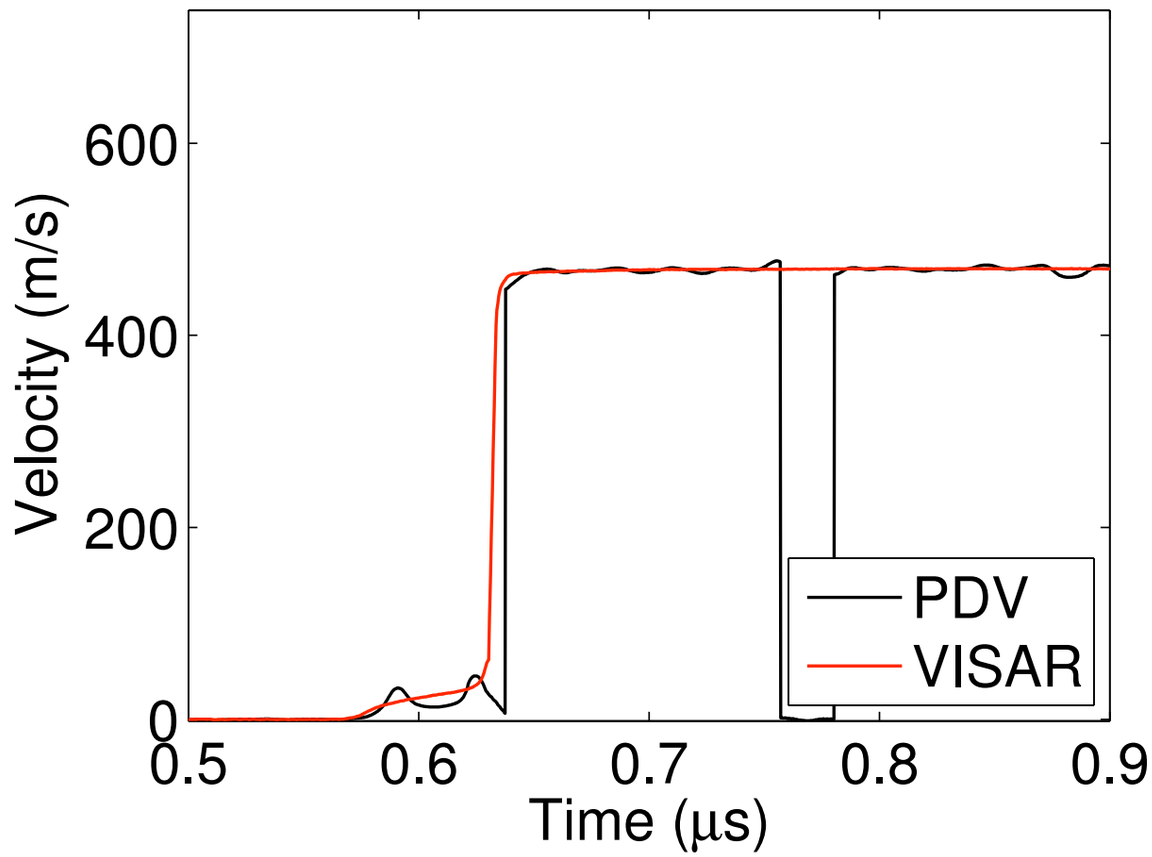
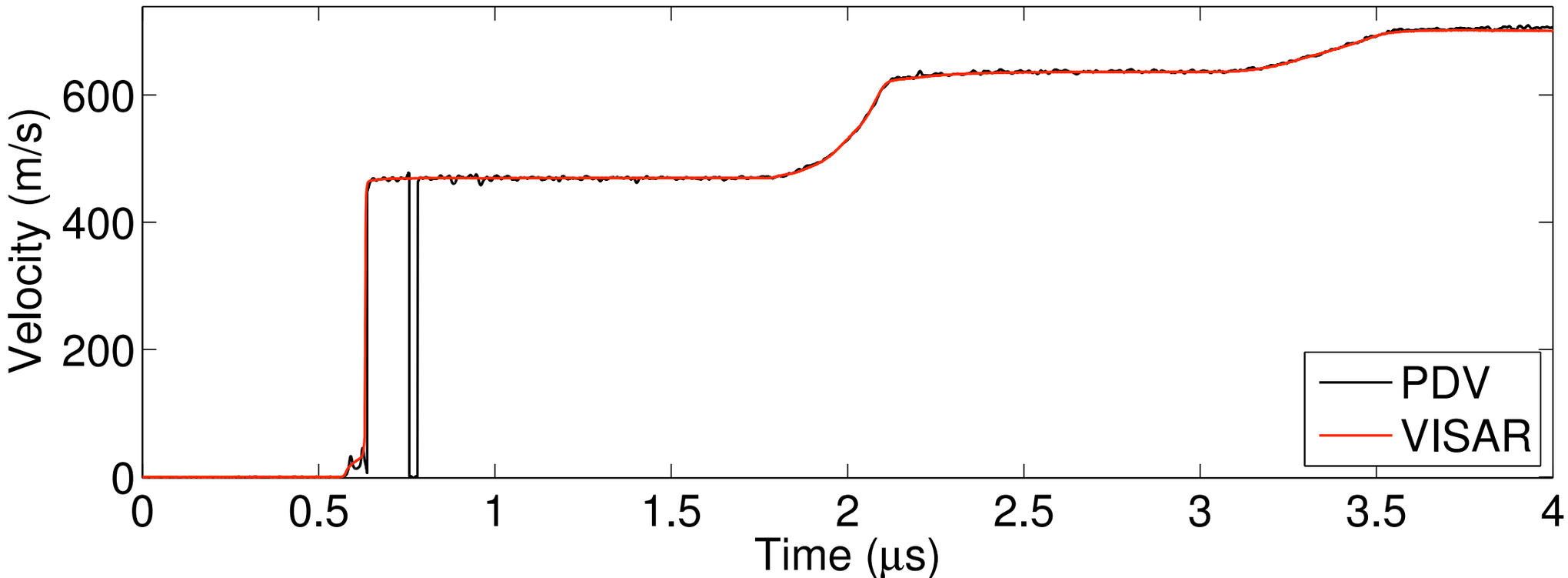
Results

- Basic concept is sound
  - Bleed-through is a problem
  - Looking at hardware and software solutions





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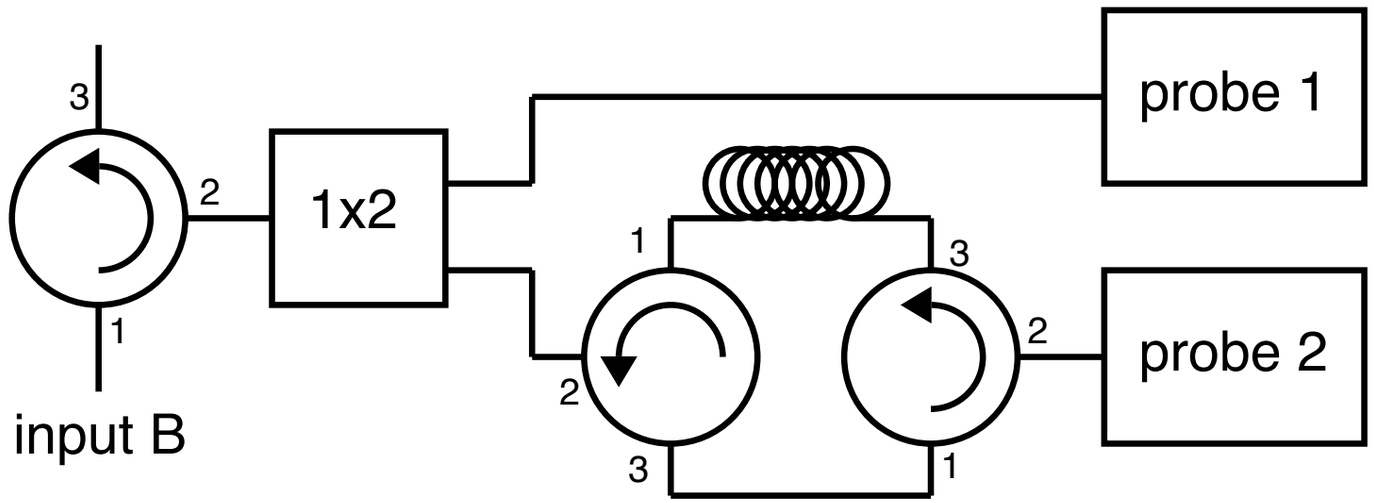
Multiplexing

- Time-domain multiplexing may benefit from short send, long receive configuration
  - Use a 10-20 us of target illumination to separate signals



- There are many other combinations and possibilities

Summary

- External modifications can transform a conventional PDV system to other useful configurations
  - Non-standard probes
  - Frequency-conversion measurements
- This approach is easier than supporting every conceivable measurement in the core PDV design
- Circulator specifications may be important
  - -30 dB isolation (common) probably not be enough
  - -50 dB isolation is available
  - Some bench testing may be needed

Acknowledgments

- Sheri Payne and Richard Hacking
  - Dedicated frequency-conversion PDVs

- Tom Ao
  - Coauthor of SIRHEN, which was written to analyze frequency-conversion PDV

- Mike Furnish and Scott Walker
  - Conventional PDV

- Tom Thornhill and Bill Reinhert
  - Impact experiment