Down Conversion Scheme for PDV (U)

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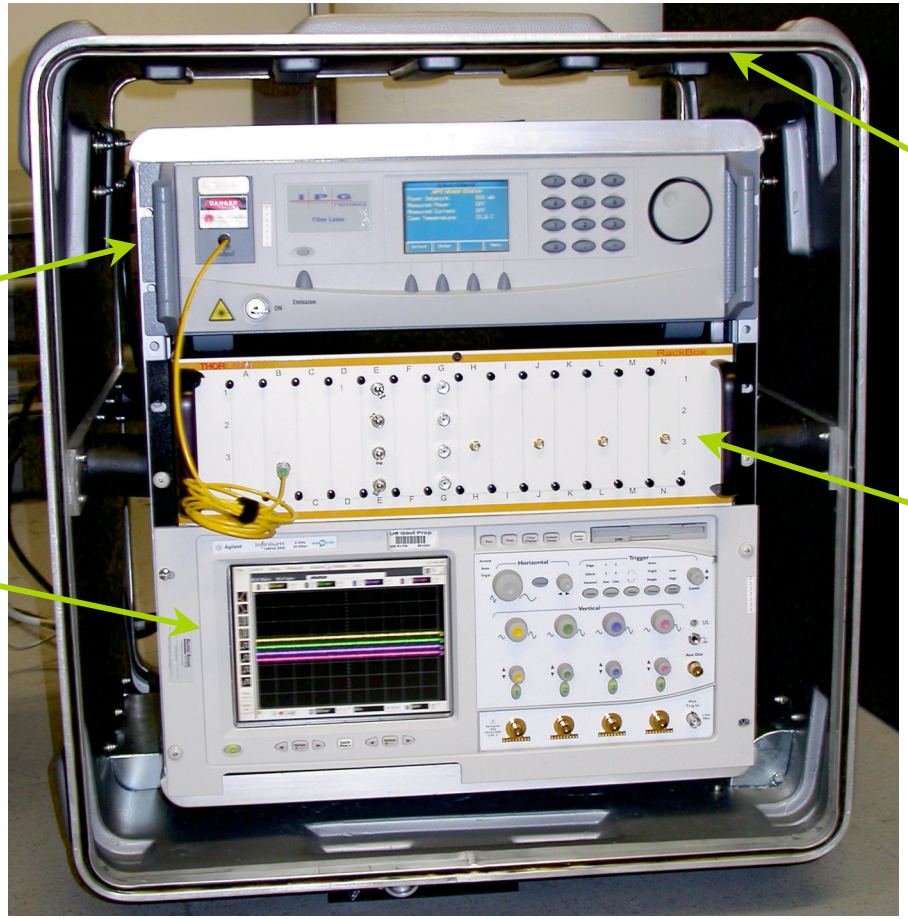
This portable rack holds a 4-channel Photonic Doppler Velocimeter System



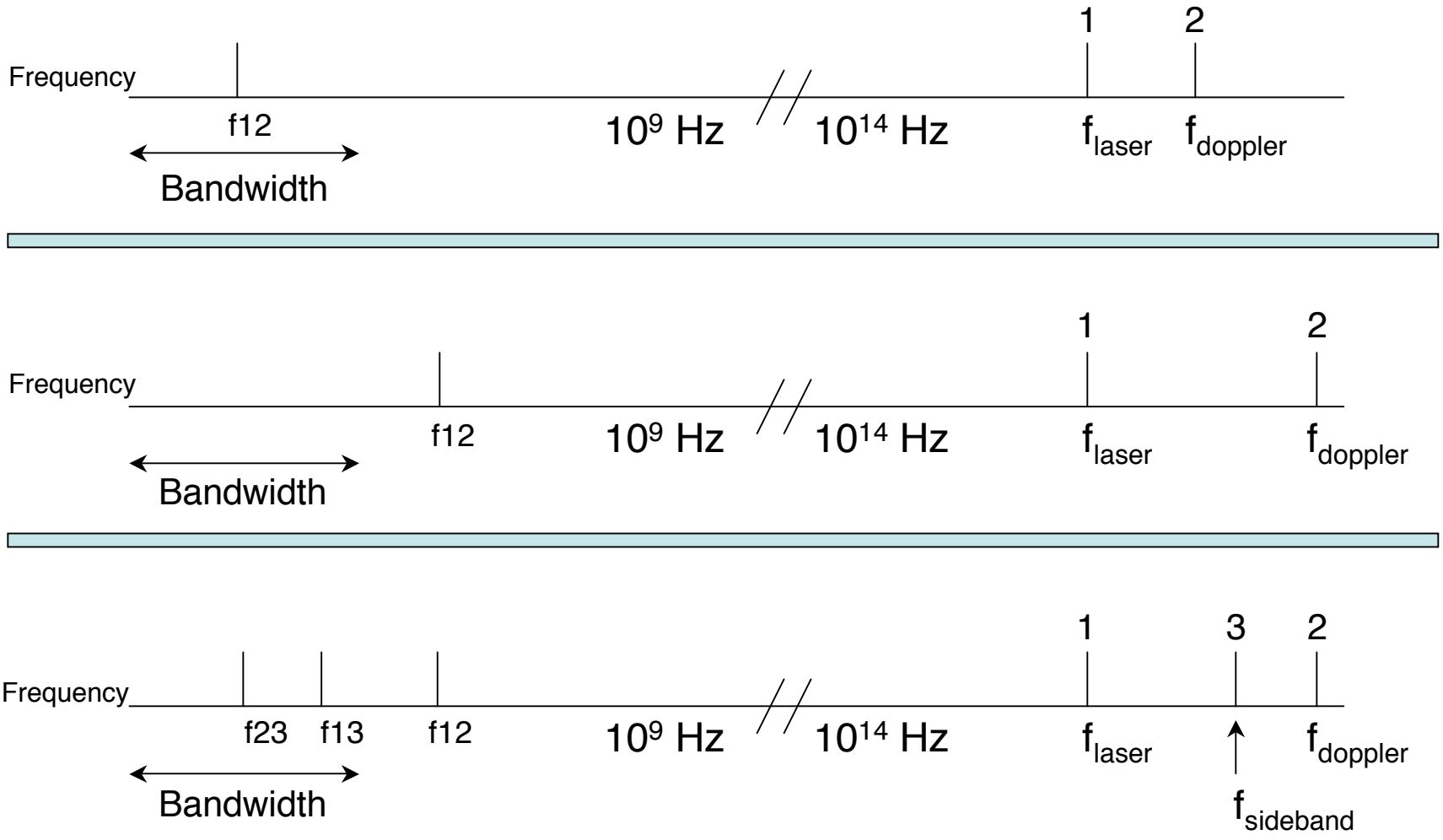
2 W CW laser

Fast Digitizing Scope

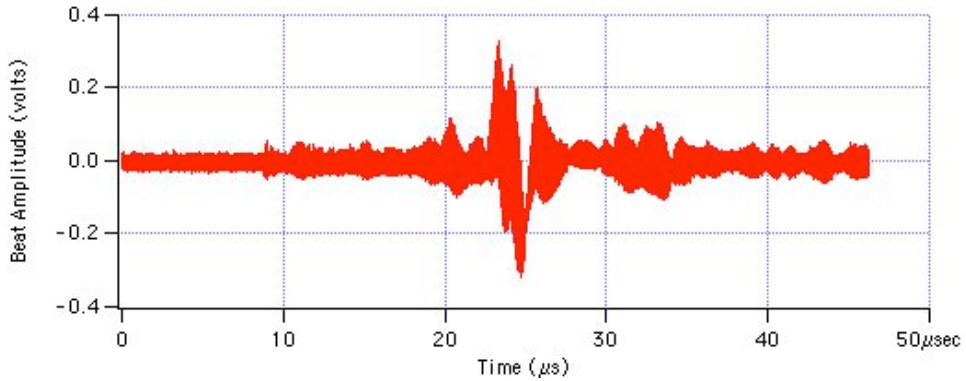
Shock-mounted carrying case with wheels

Custom fiber/detector chassis

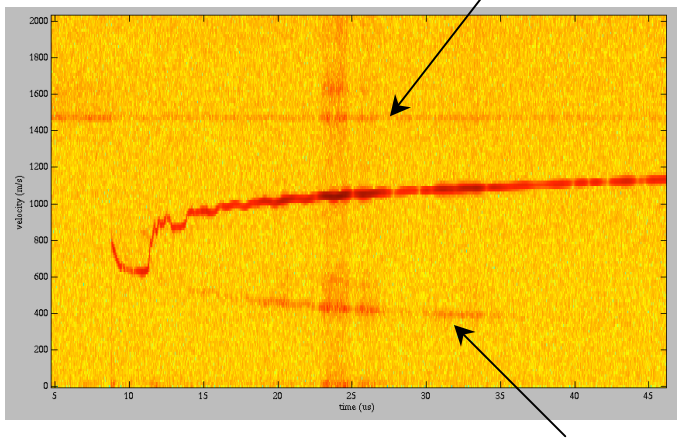
Introduce a higher frequency to beat against the too-high doppler-shifted frequency

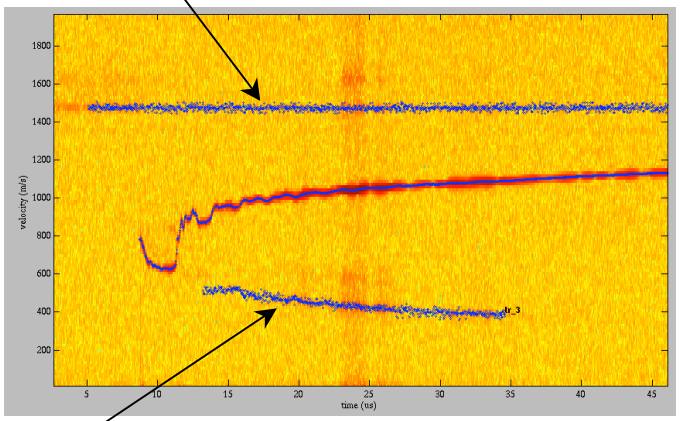


We have already seen evidence of the down-conversion process



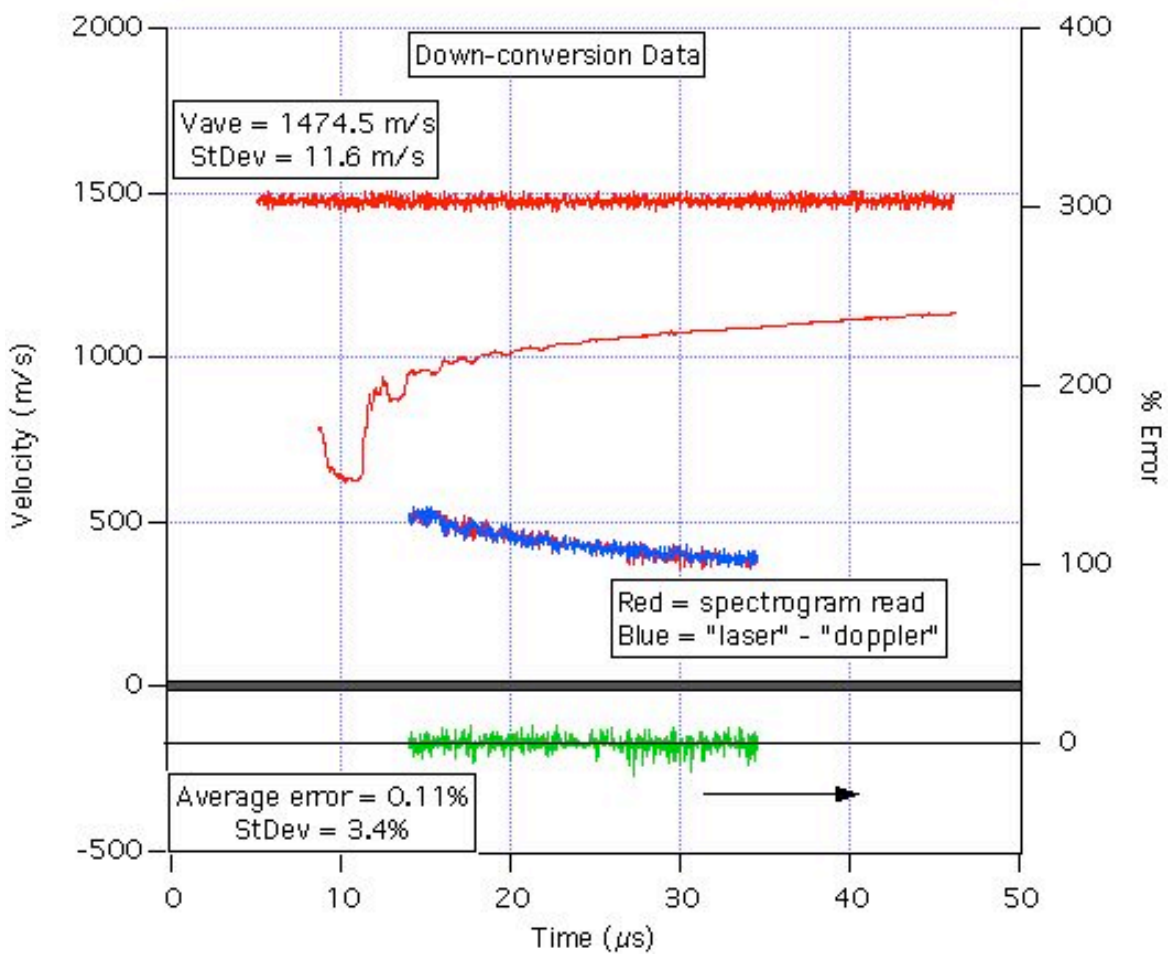
One of our lasers started emitting a sideband



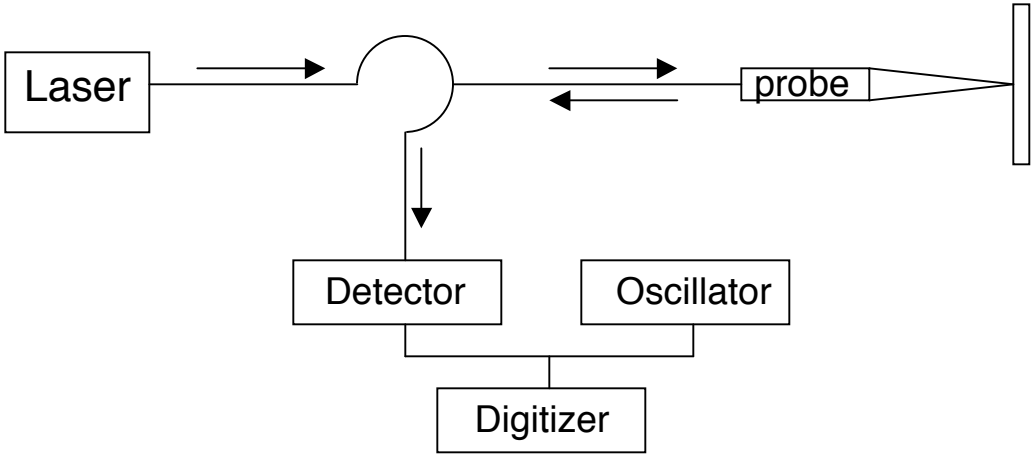


Down-shifted signal

This fortunate accident showed high accuracy although a little noisy



We thought about generating an electrical sideband

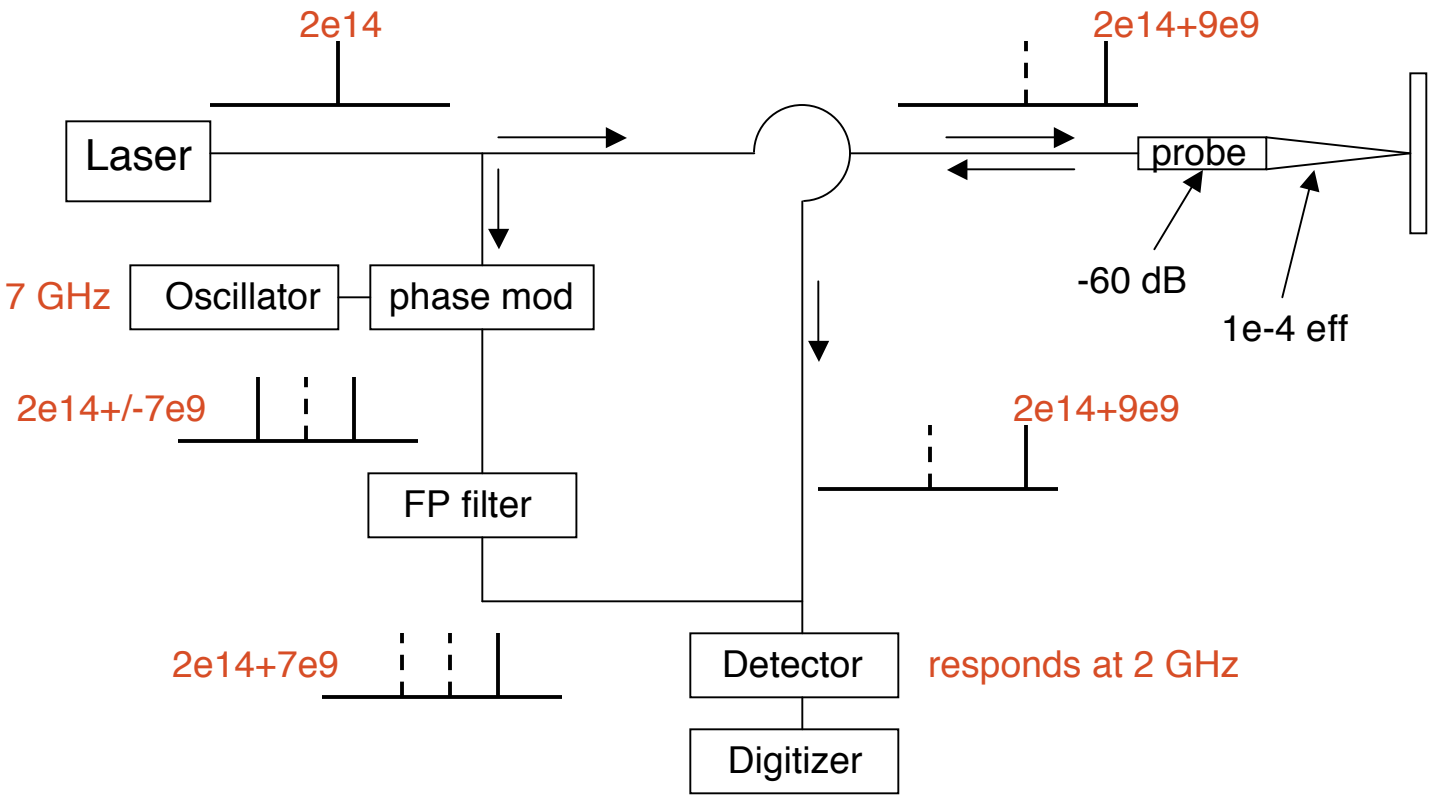


But, we would need higher bandwidth detectors…

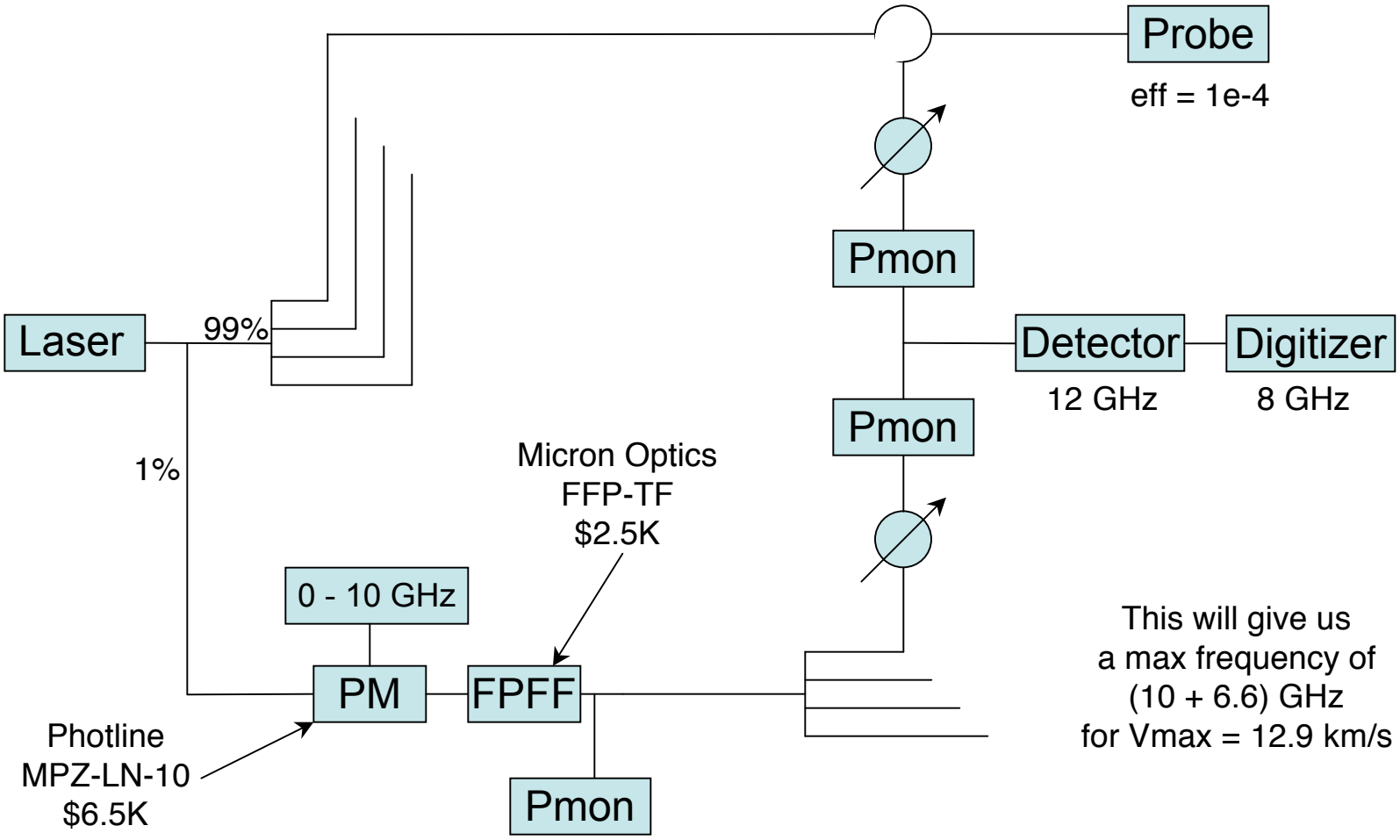
So, we decided to generate an optical sideband.

We use a phase modulator to generate the high-frequency sidebands

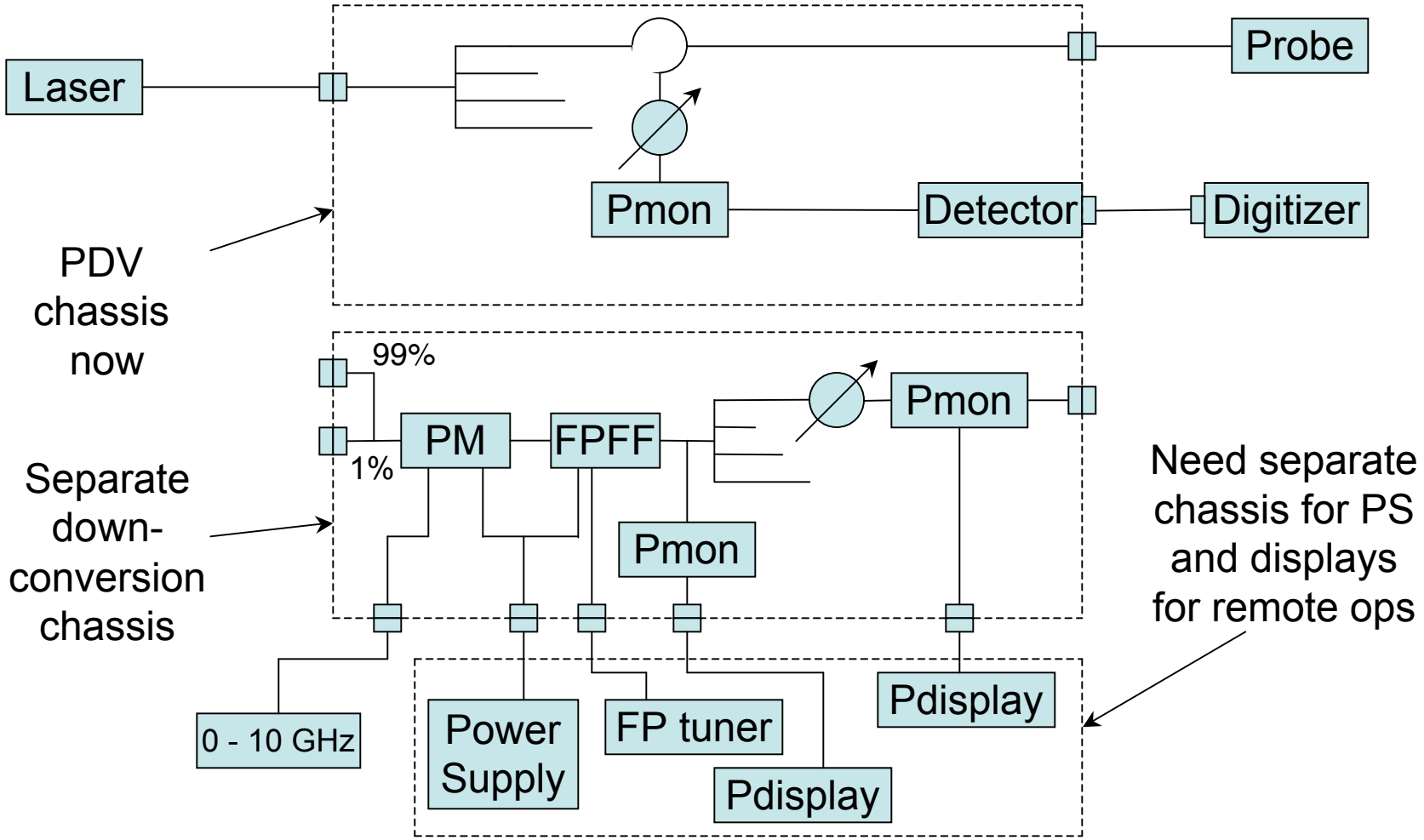
Example: doppler-shifted line 9 GHz above laser and oscillator at 7 GHz



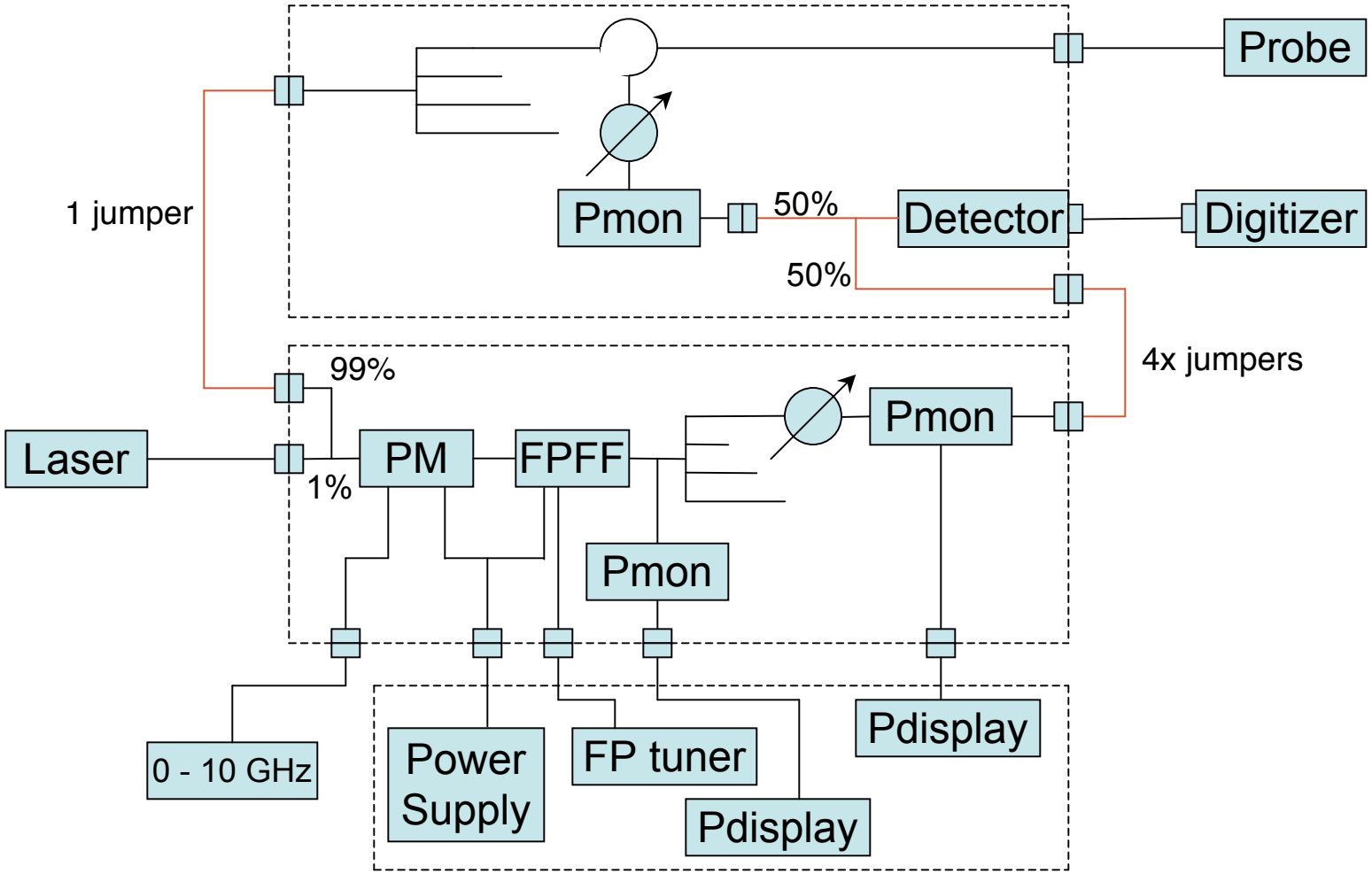
The components are commercially available and the power budget is easy



We built the down-conversion system into a separate chassis

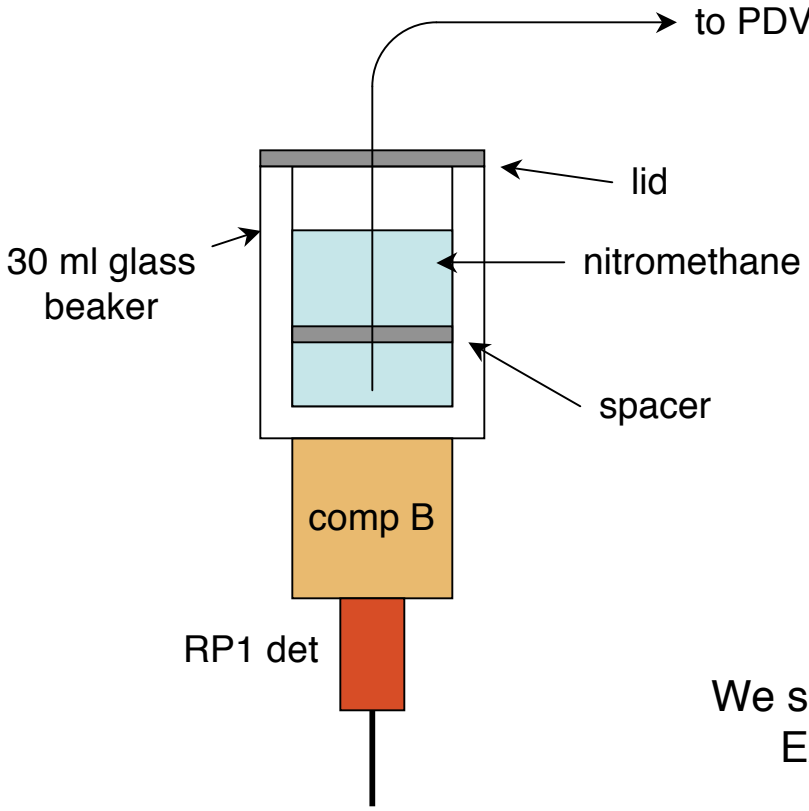


We need to connect the chassis with fiber jumpers



We tested the down-conversion scheme on a high-velocity shot

This is part of Dave Hare's embedded fiber program.



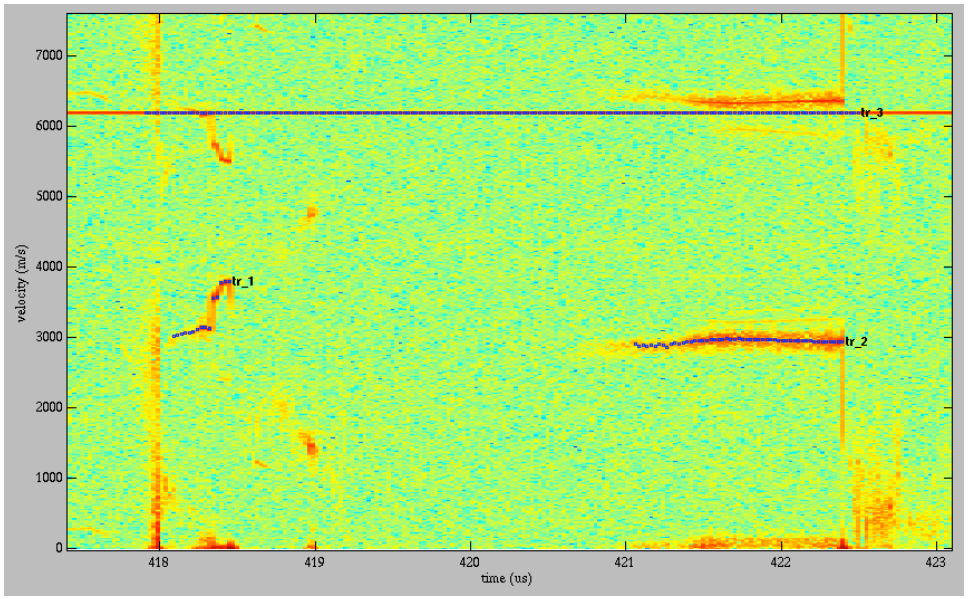
Nitromethane has a detonation speed of 6.28 km/s.

Looks like 9.22 km/s in the fiber.

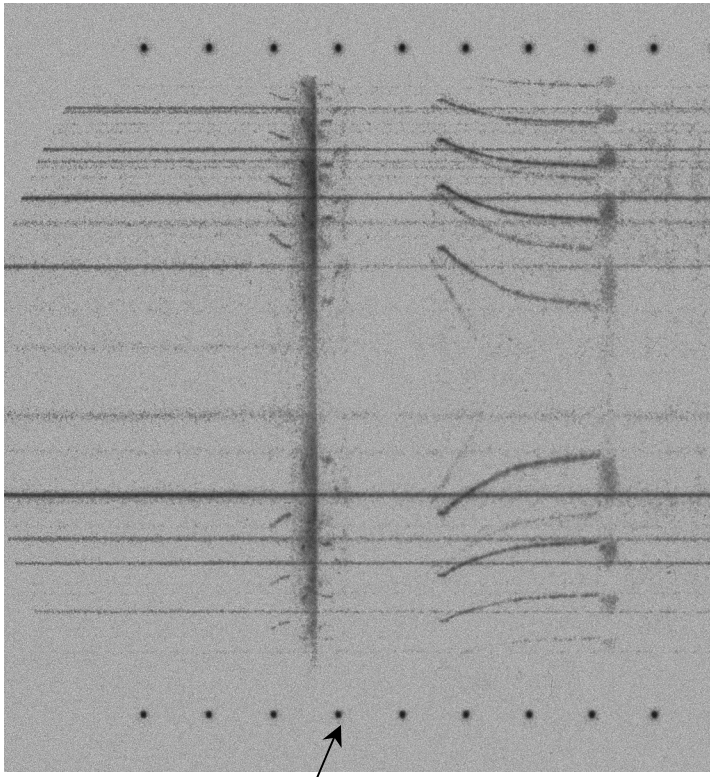
We set the PM oscillator at 8 GHz = 6.20 km/s.
Expect to see the signal around 3 km/s.

We finally obtained data on our 3rd try

PDV spectrogram

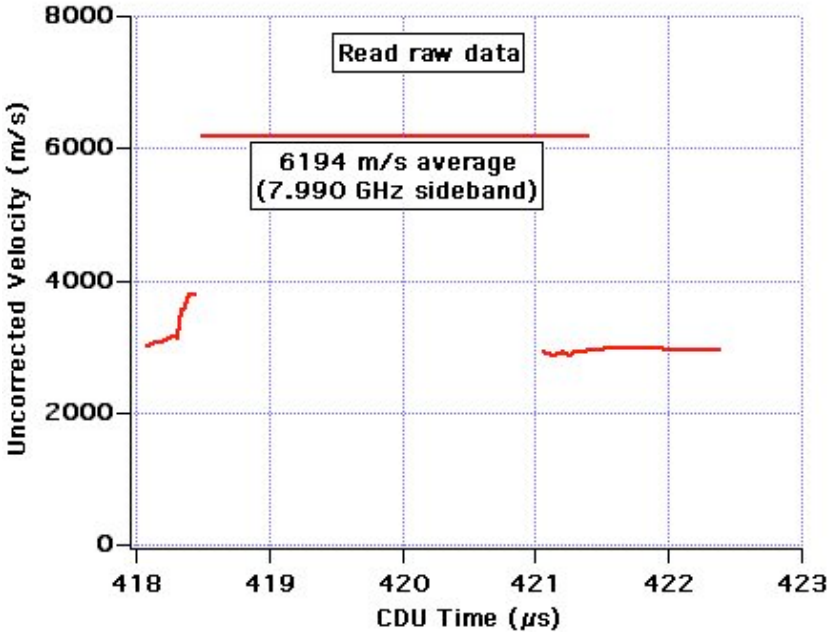


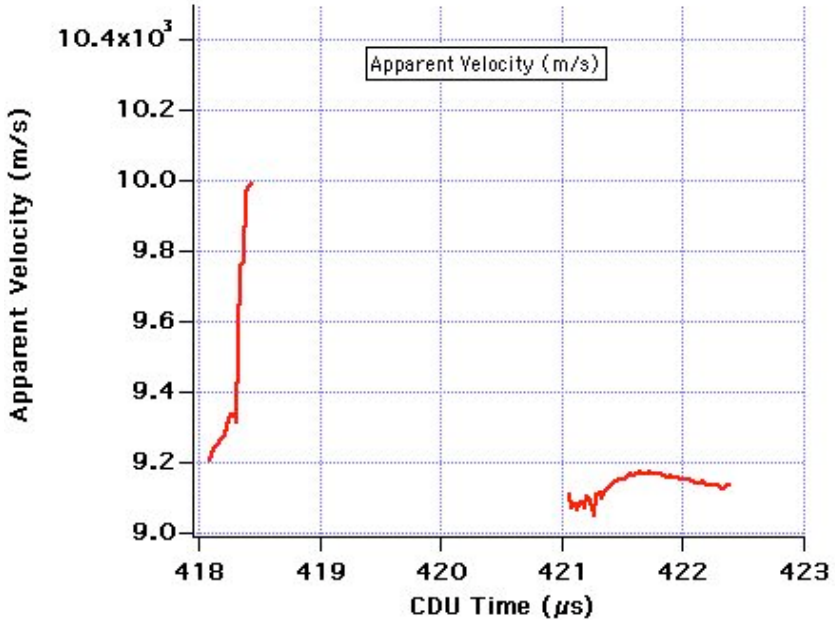
Fabry-Perot record (different shot)



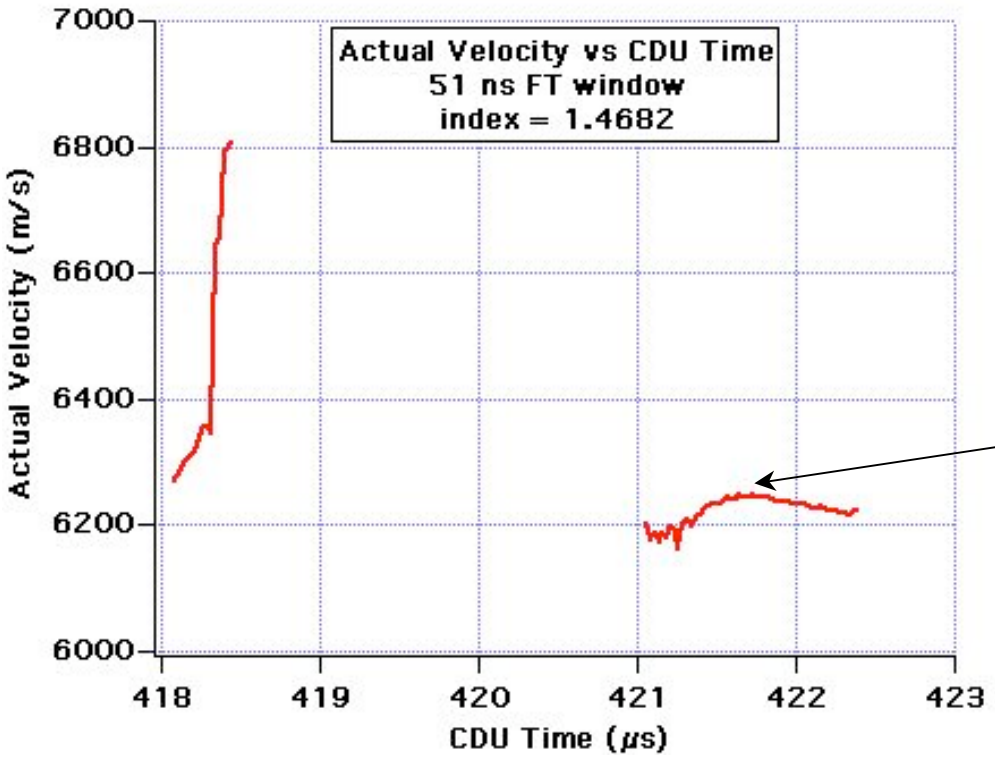
1 μs/dot

Read the spectrogram and convert to apparent velocity





Use the fiber index = 1.4682 to convert to actual velocity



Peak is approx 6.25 km/s

Conclusions

We finally obtained data at high velocities using the
down conversion technique--approx 9 km/s apparent.

Our system has Vmax = 13 km/s.

We still need to make the system more robust and easier to use
for field use.

This method also can be used to down shift few km/s velocities
into ranges accessible to standard, less expensive digitizers.