Processing Oscillatory Data with the PDV (U)

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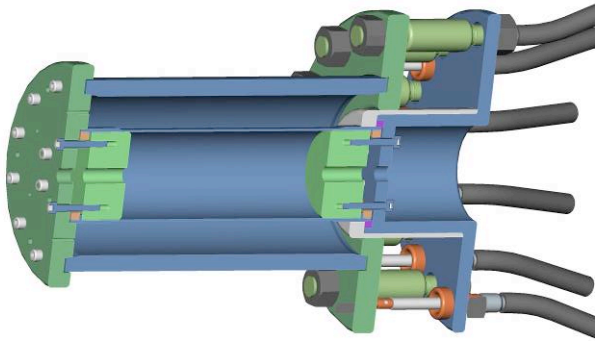
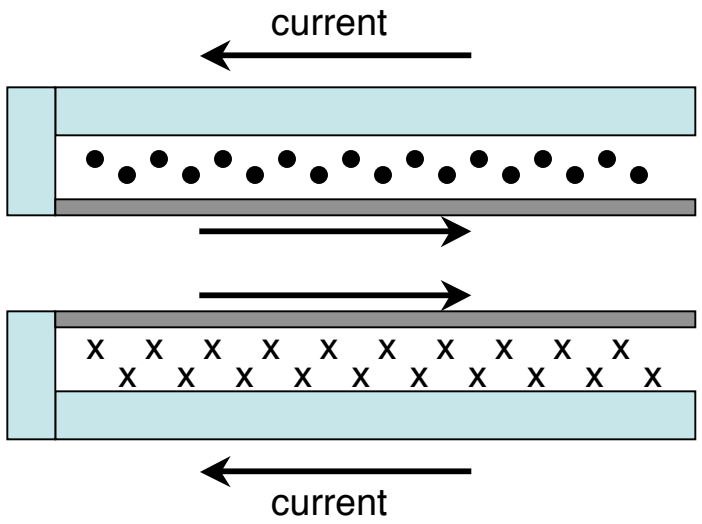
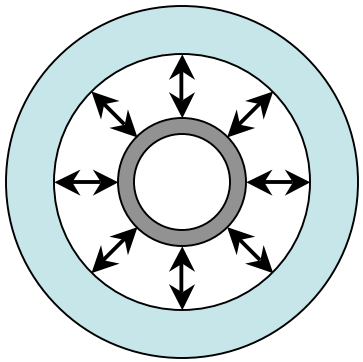
We recently fielded the PDV on a series of pulsed power tests



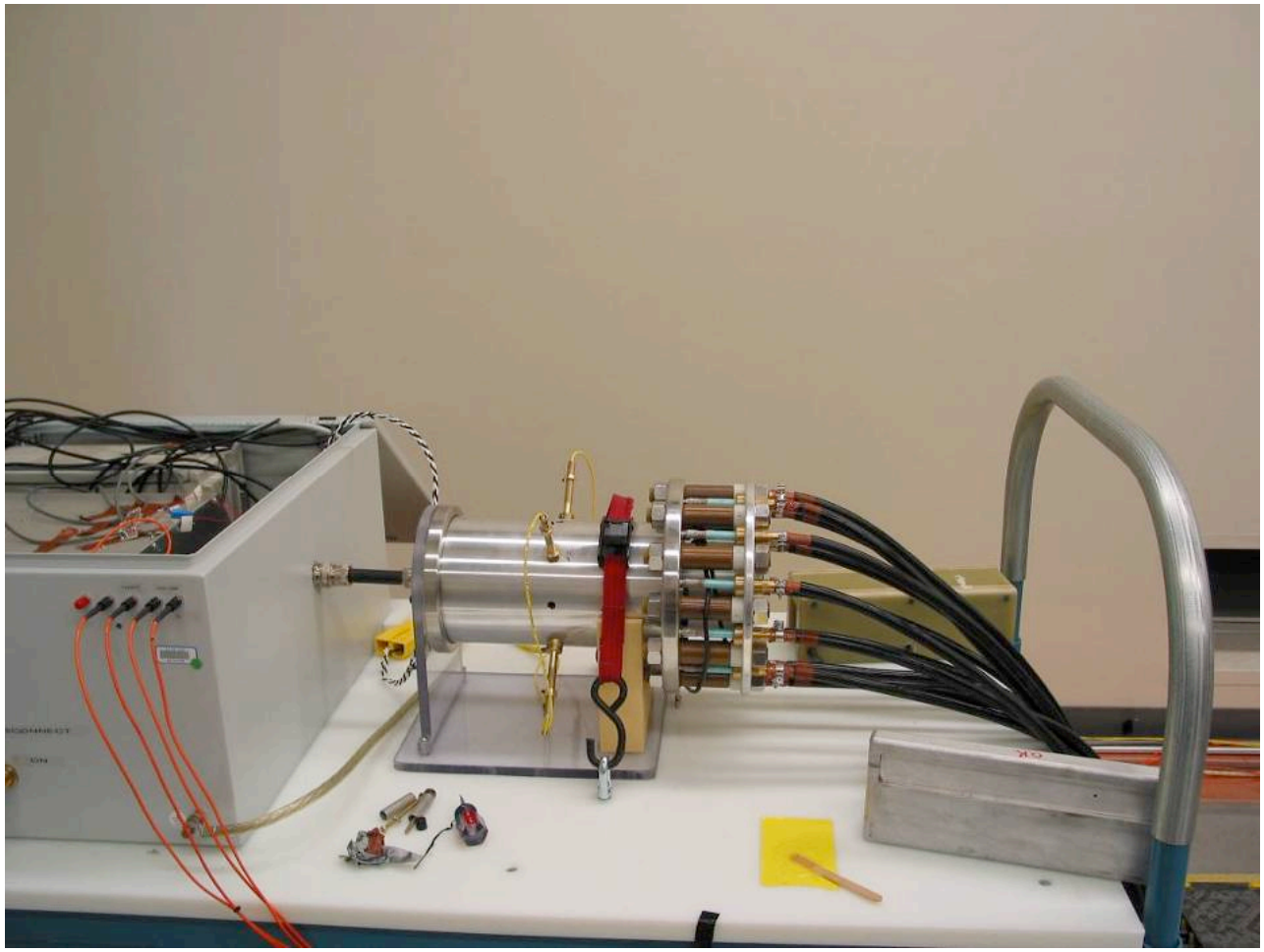
The test fixture provides validation data for new ALE3D codes



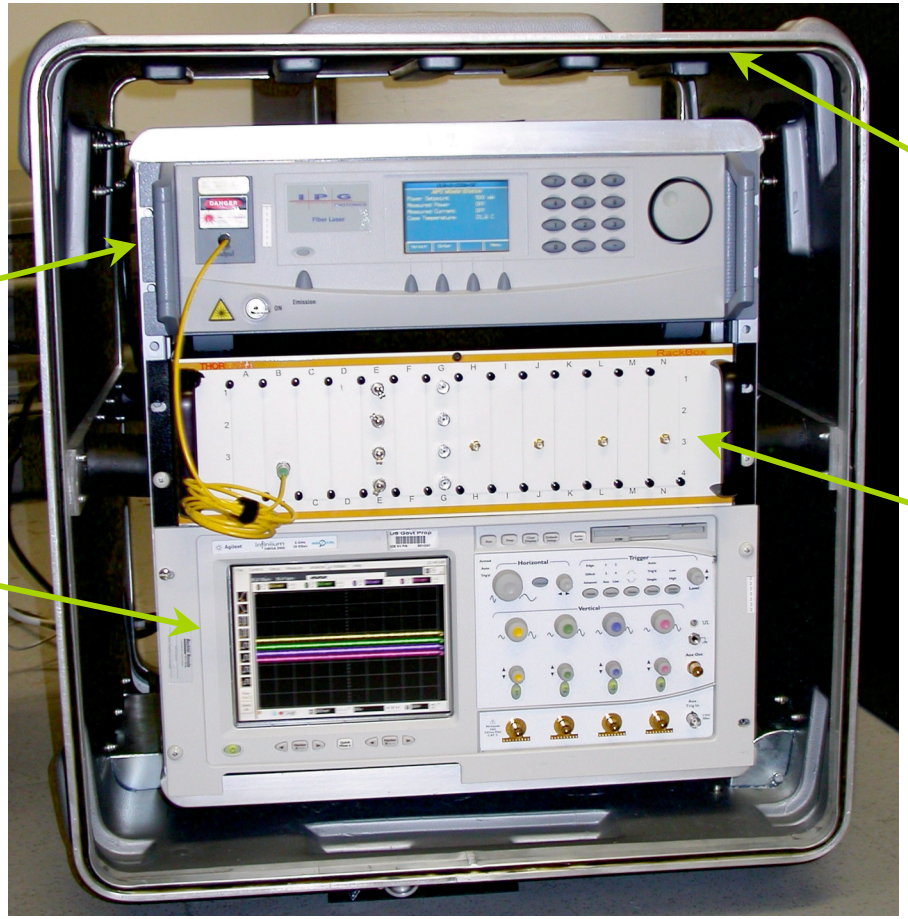
Large magnetic pressure tends to collapse inner tube



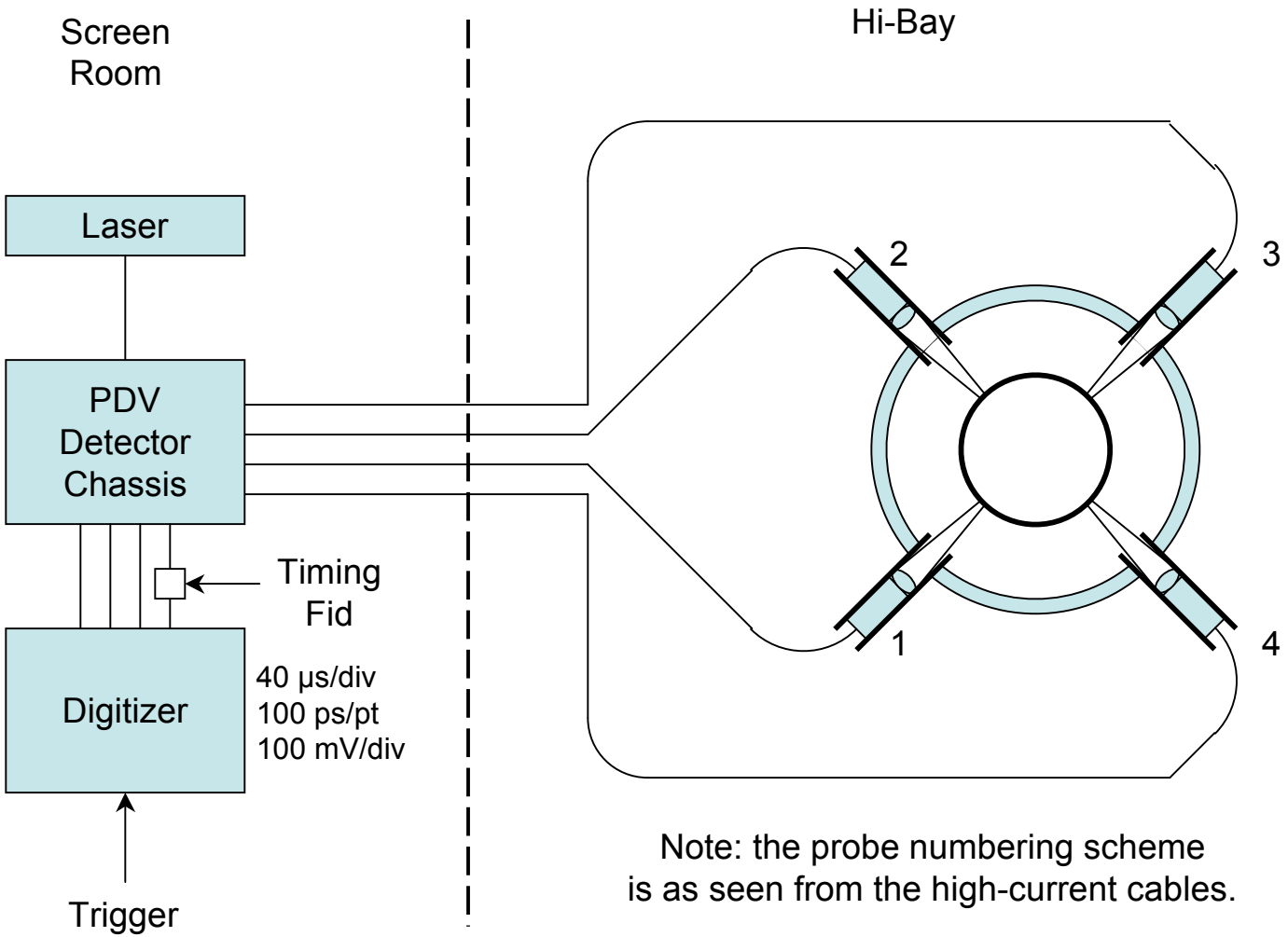
We had 4 probes mounted at the mid-plane at 90 degree angles



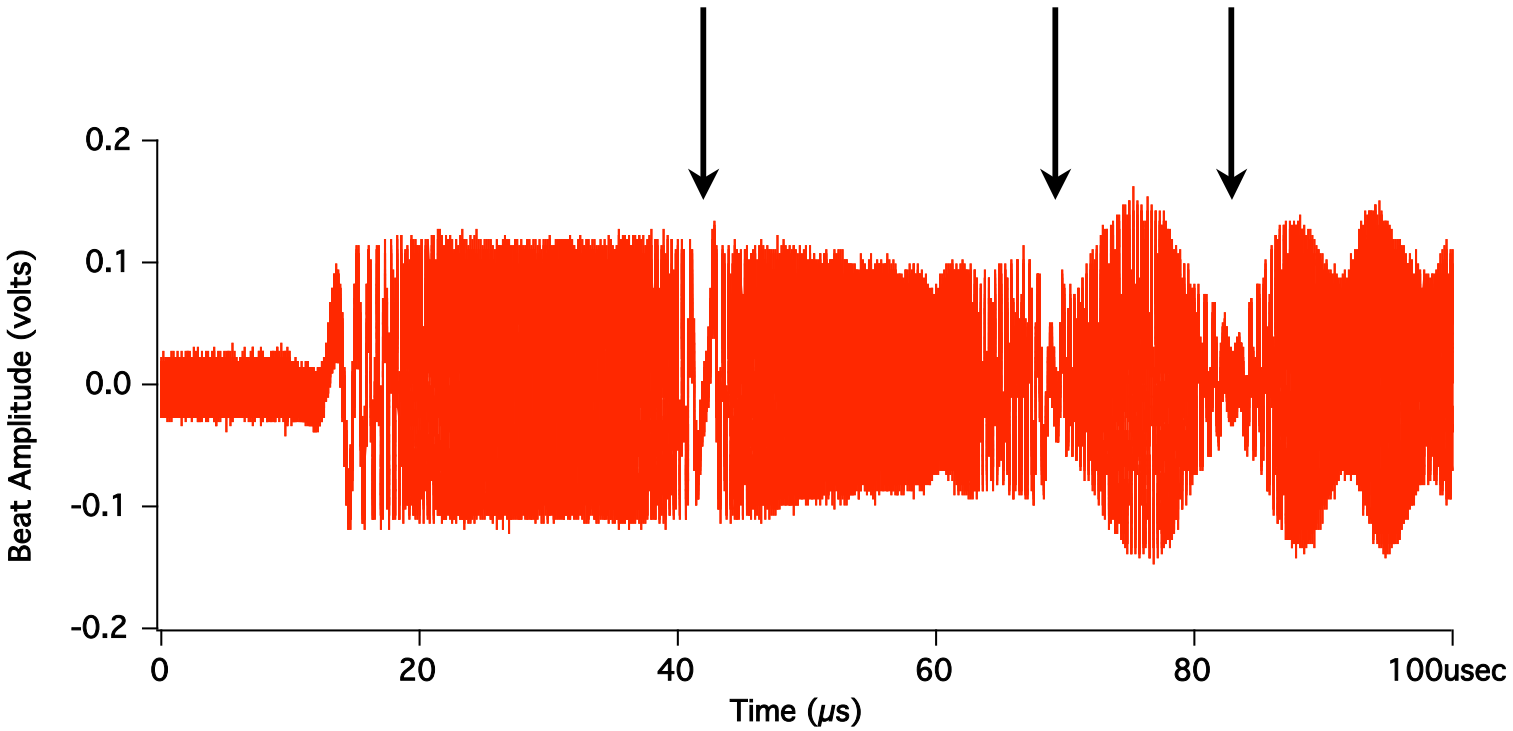
This portable rack holds a 4-channel Photonic Doppler Velocimeter System



We were told to expect low velocities (less than 100 m/s)

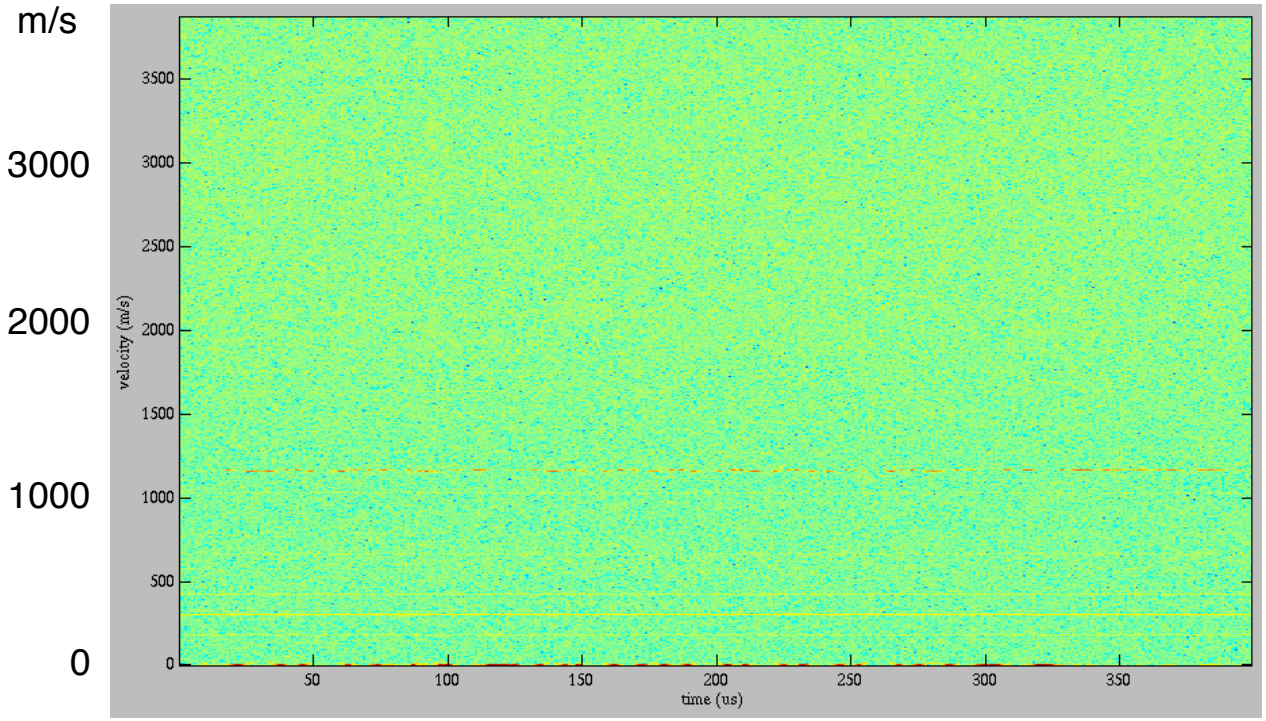


The beat amplitude goes to zero at zero velocity when the moving surface changes direction



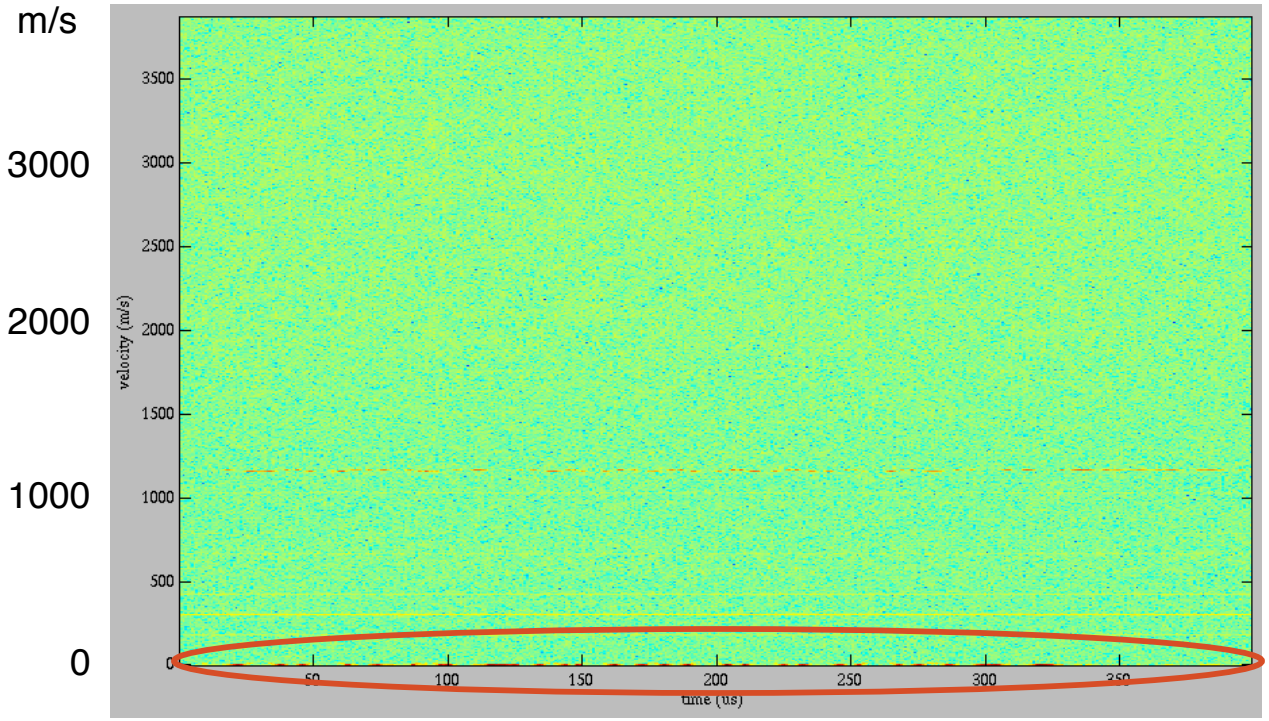
The spectrogram looks empty because the velocities are so low

Processed with 1.64 μs FT windows



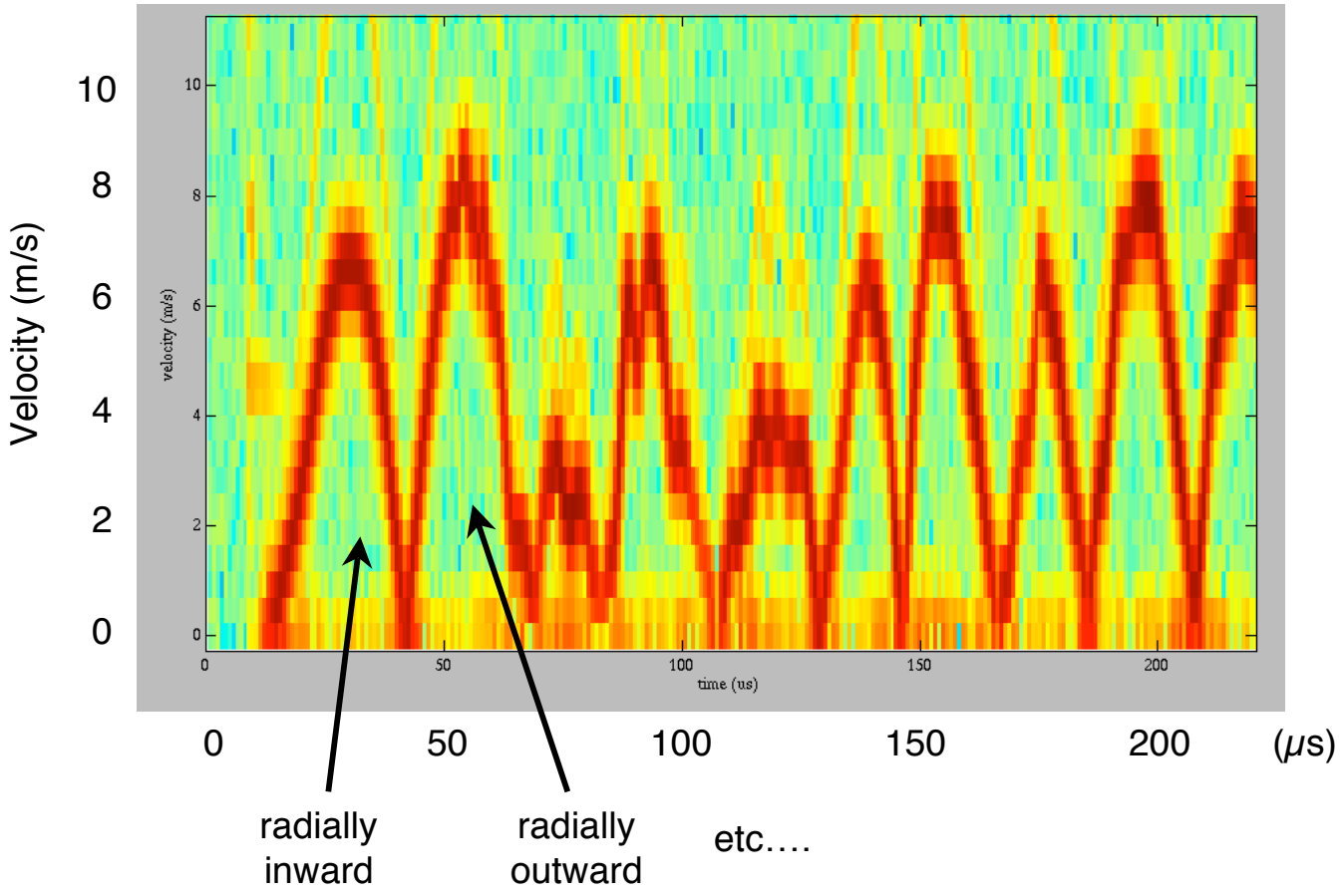
Expand the image near f = 0

Processed with 1.64 μs FT windows



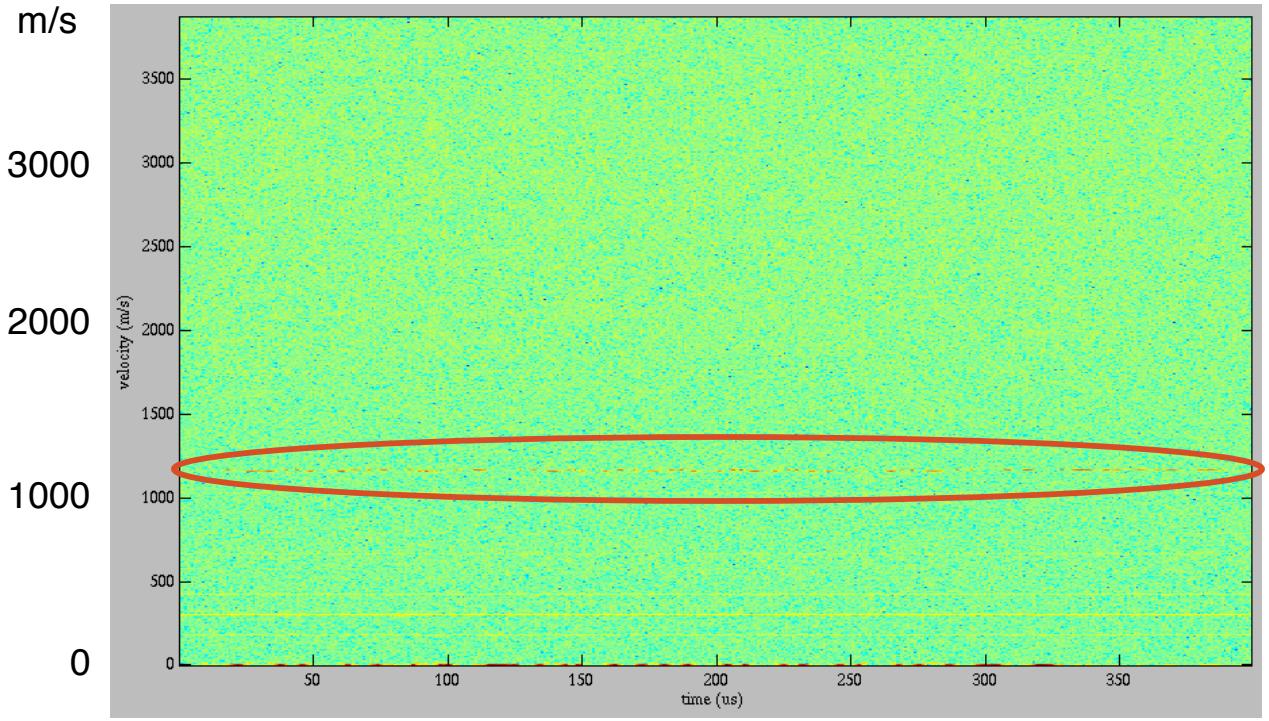
The spectrogram shows the oscillatory behavior

Analyzing this is very cumbersome

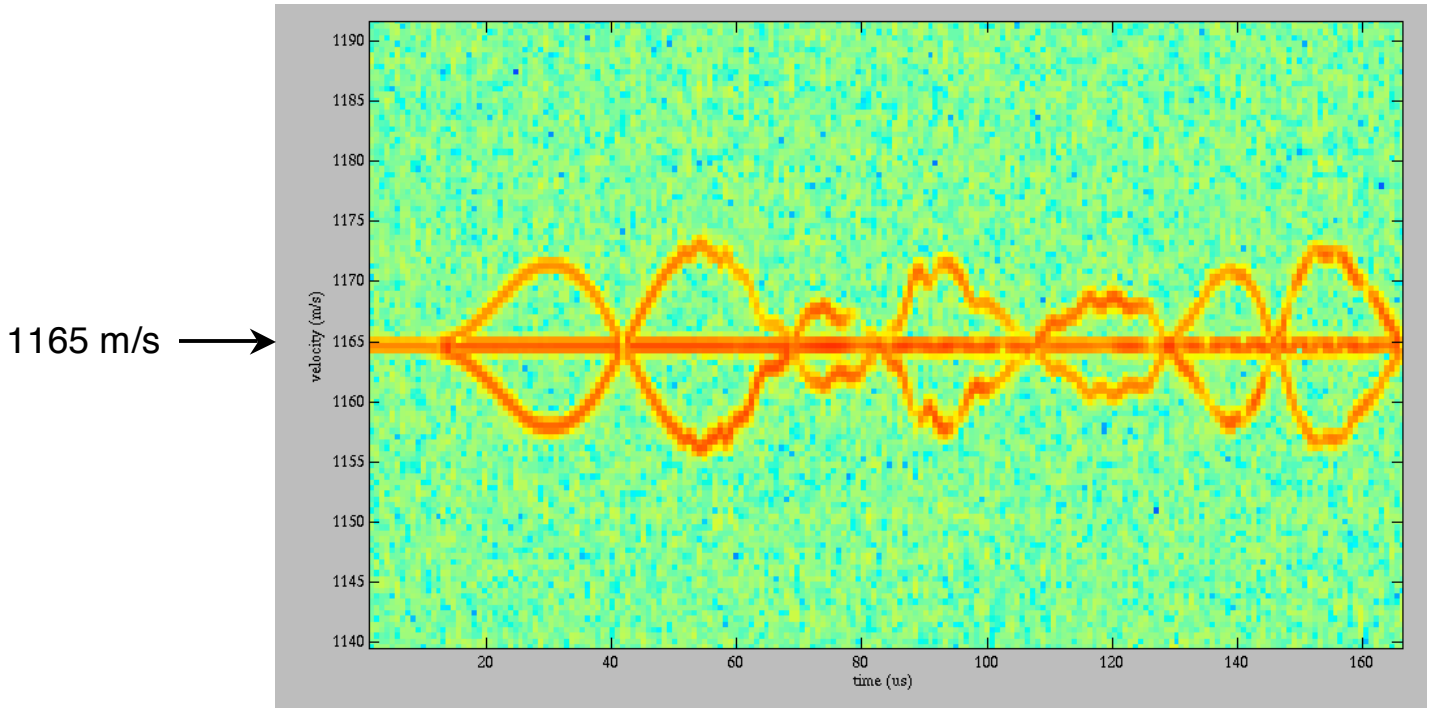


This laser has a sideband at 1.5 GHz
Expand the image around the sideband

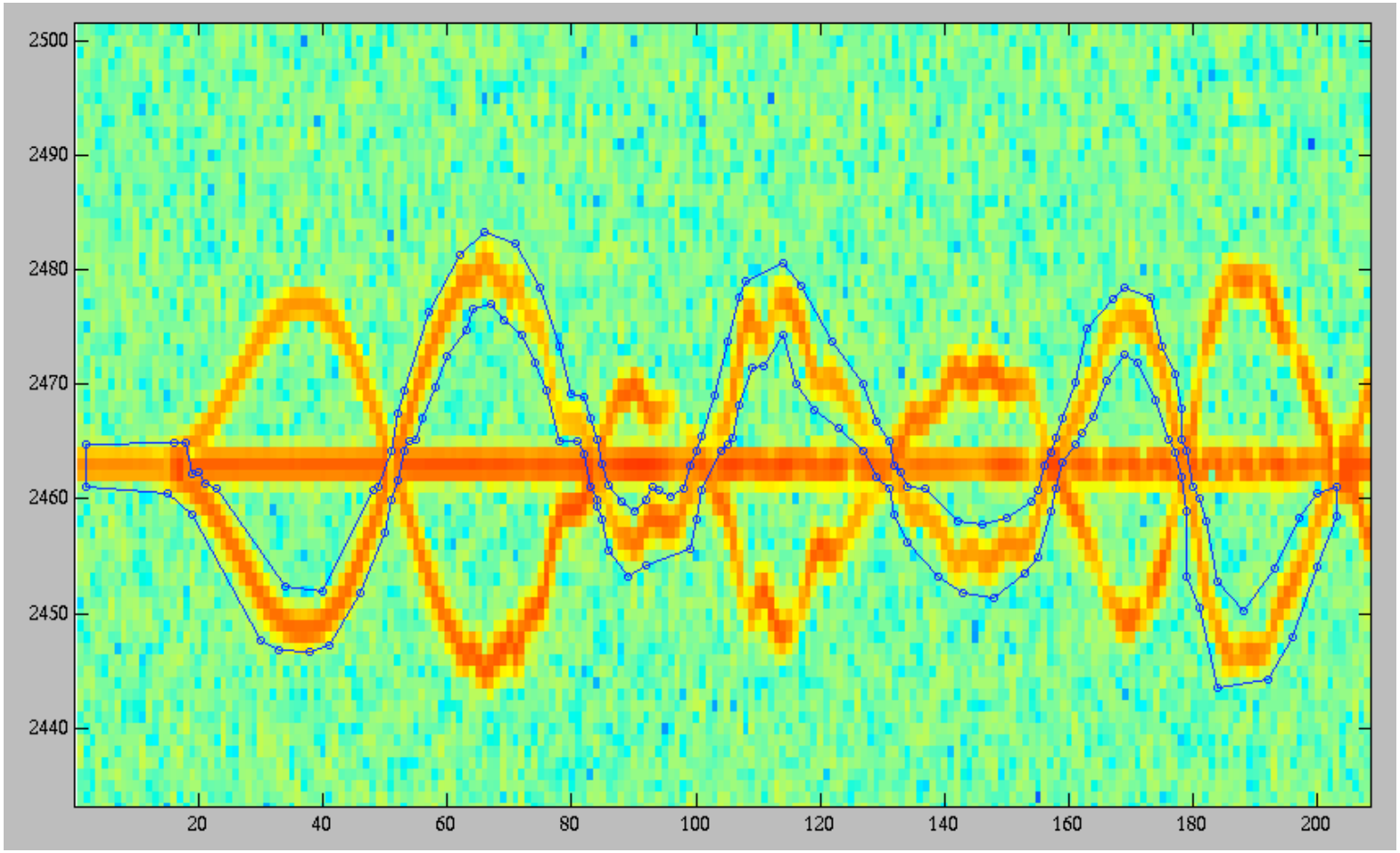
Processed with 1.64 μs FT windows



We see the sum and difference velocities on either side of the 1.5 GHz sideband



Use the analysis code to extract the desired velocities



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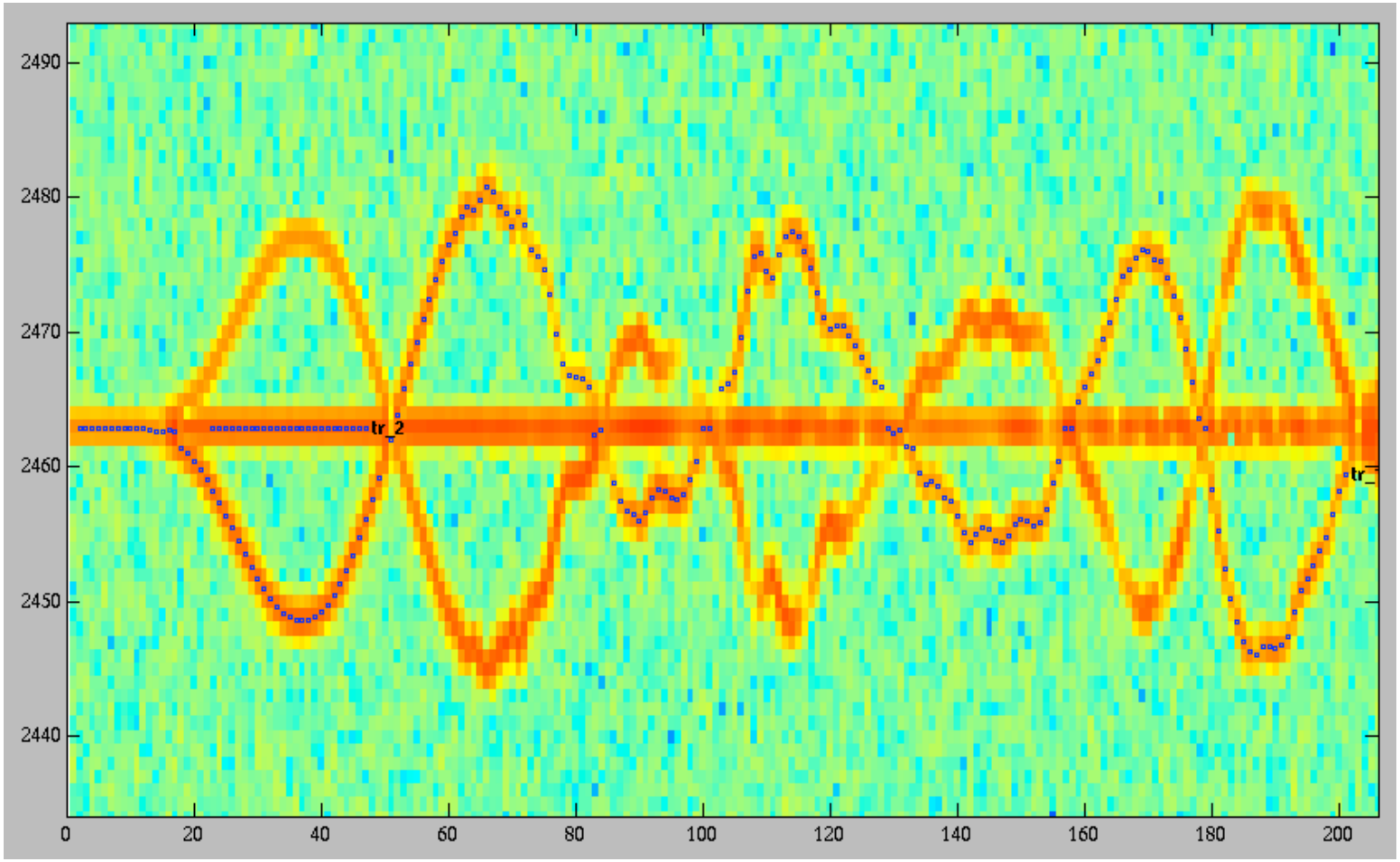
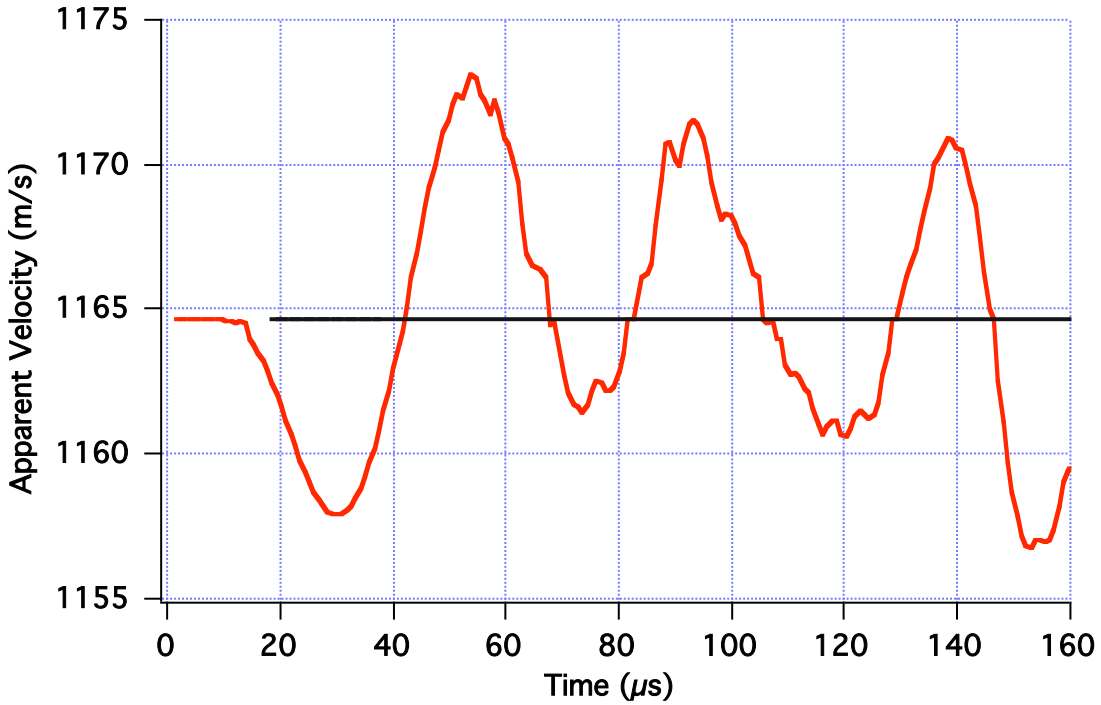
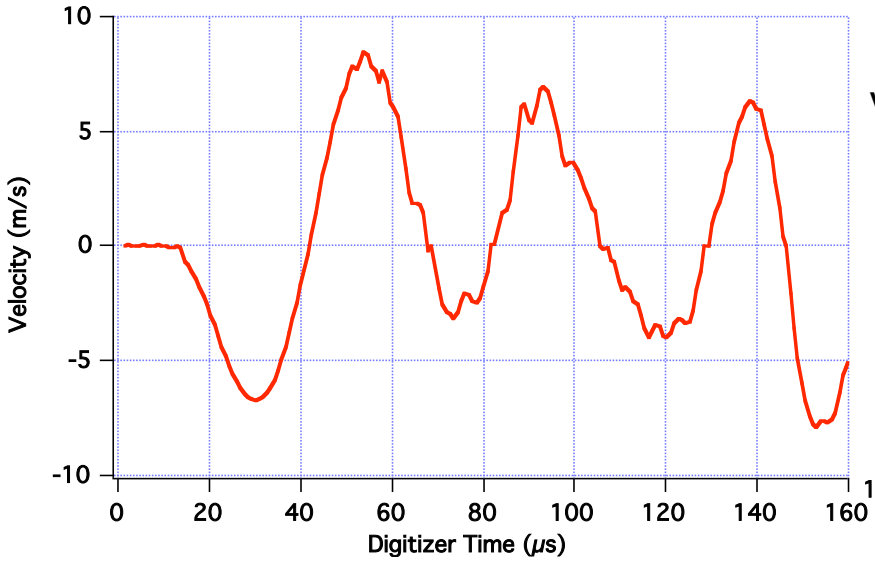


Extract the velocity time history from the spectrogram



Sideband velocity
= 1164.62 m/s

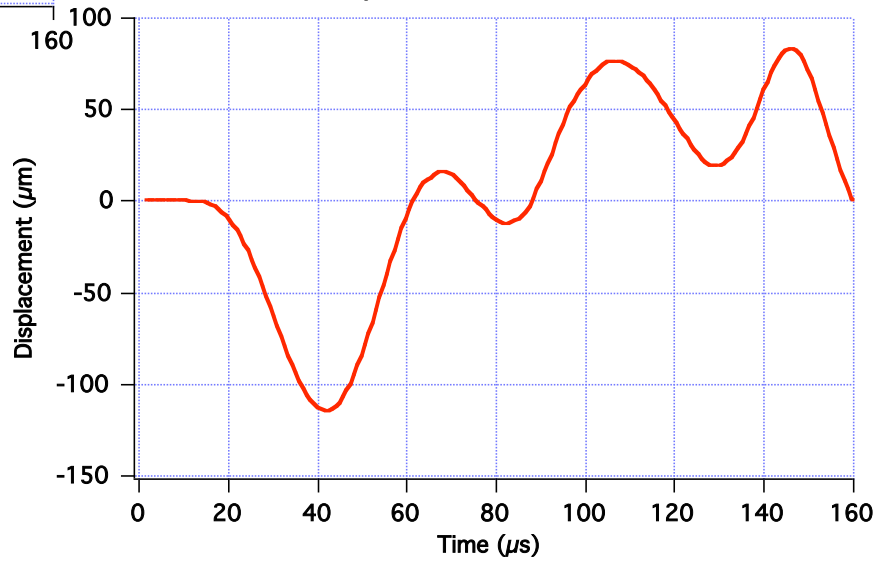
Subtract the sideband velocity and integrate to obtain displacement vs time



Velocity vs Time

integrate

Displacement vs Time



This analysis is much easier than working with the baseband solution

Conclusions

We used the PDV to obtain data from oscillatory motions

Analyzing the baseband velocity is cumbersome

Fortunately, our laser has a 1.5 GHz sideband

Analyzing the data around the sideband is much easier

Moral: a sideband in your laser is not always bad, but we will send the laser to the shop after this series of experiments is over