First glance at the response of a CNGS target rod to the beam

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- Setup
- Performance
  - Temperature
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Aim of the test

- To strike the target with the proton beam
- Measure
  - mechanical vibrations
  - damping constants
- input to/compare with simulations

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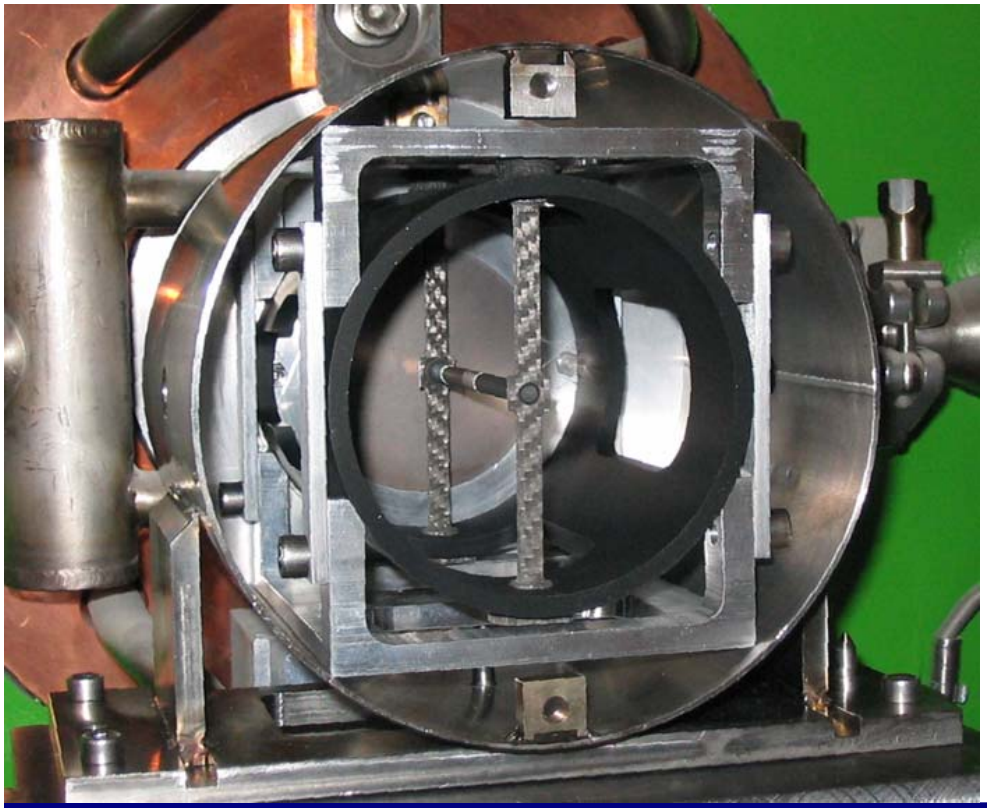
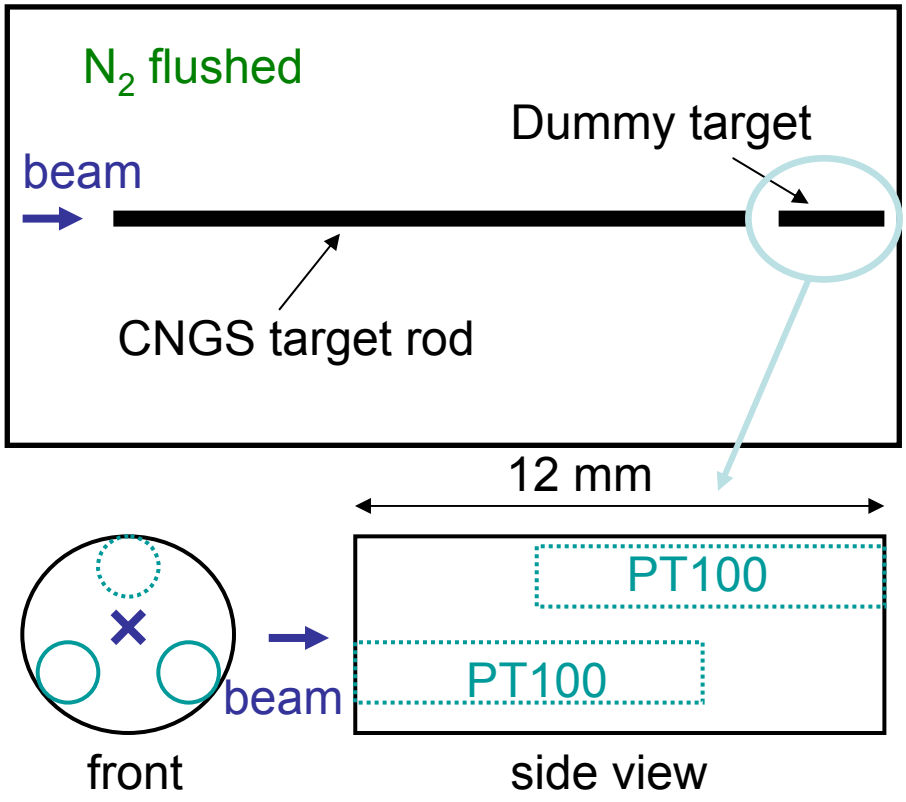
Setup

- Nominal target rod: graphite, d = 0.5 cm, l = 10cm
- N2 atmosphere, 2l/min flow
- Dummy target downstream with PT100





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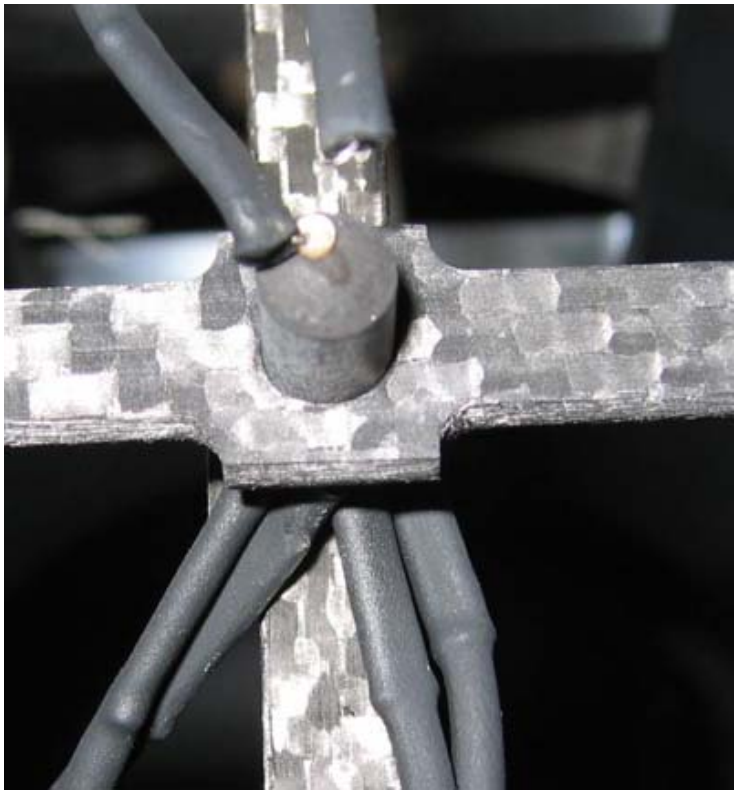
Diagnostics

- Laser Doppler-Vibrometer
  - Mechanical deformation of rod

- Pt100 Sensors
  - Temperature, beam position



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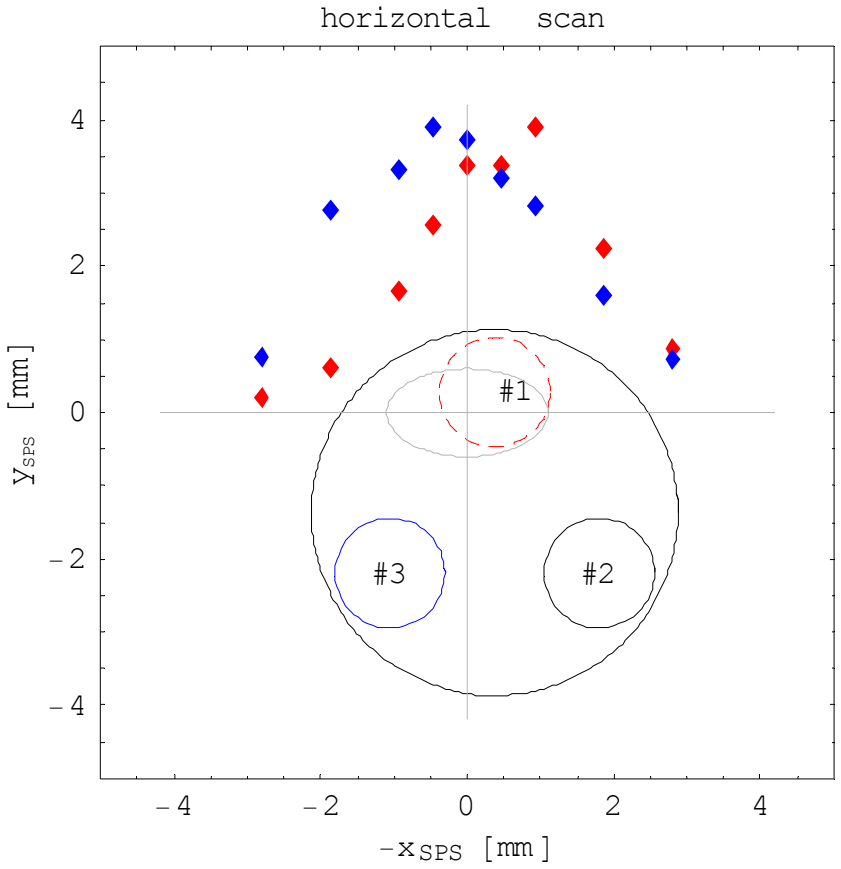
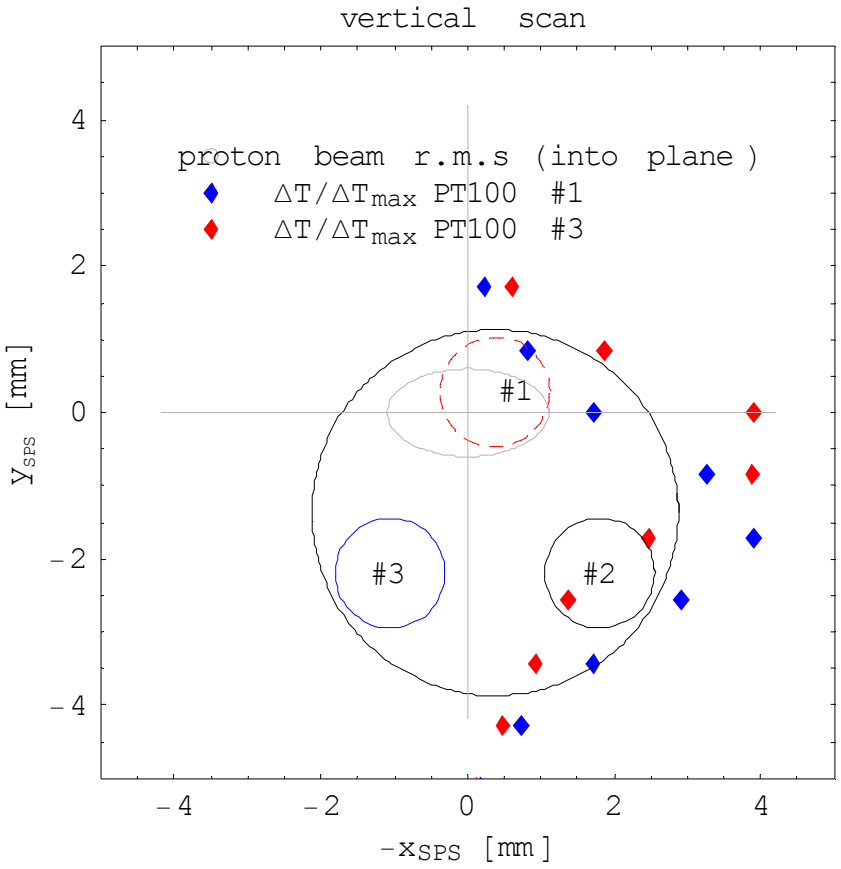
temperature vs. position scan





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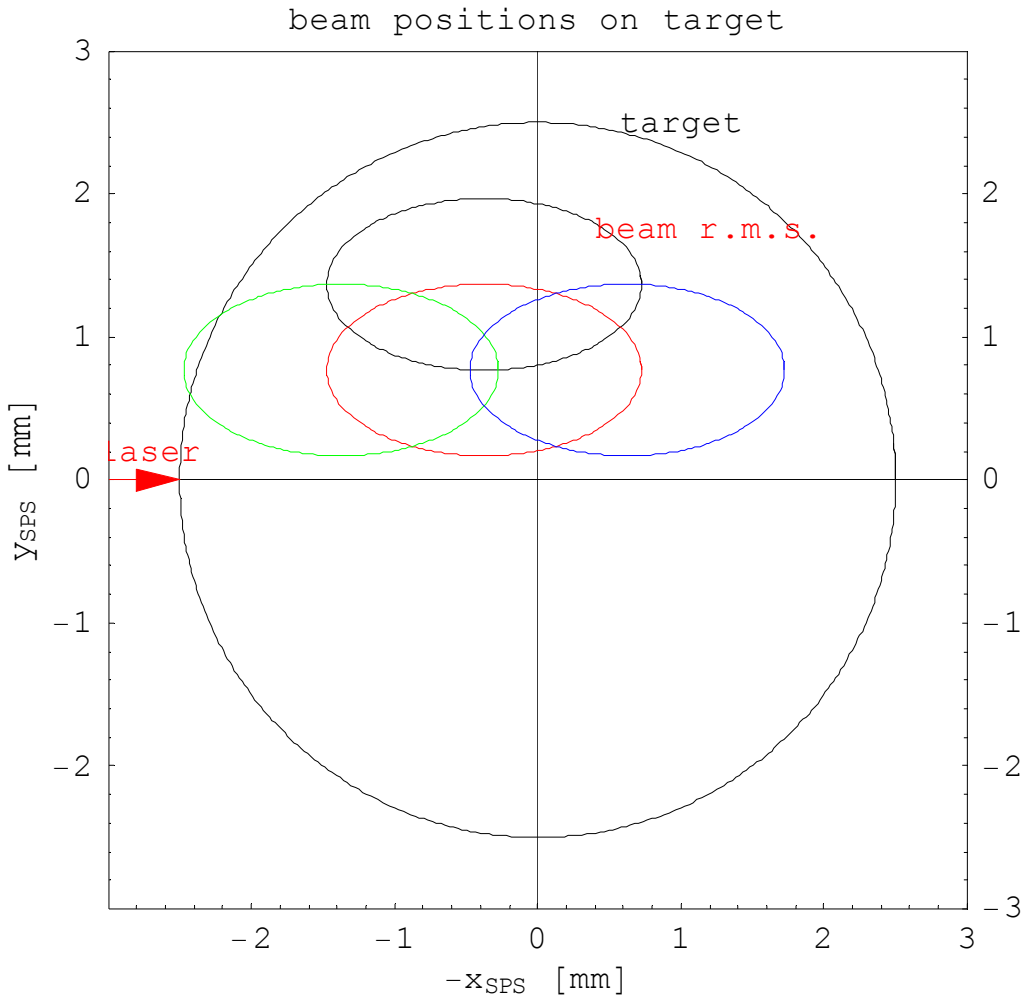
Beam position



- Various positions
- Overall to high
  - by 0.8mm
- Radial displacement
  - r > 0.9 mm
  - r < 1.6 mm

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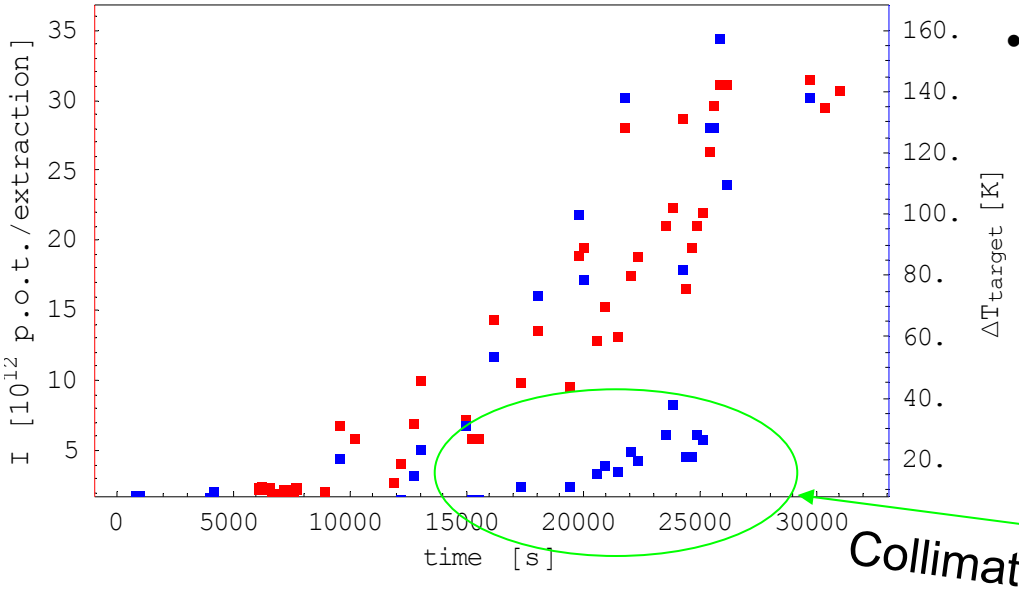
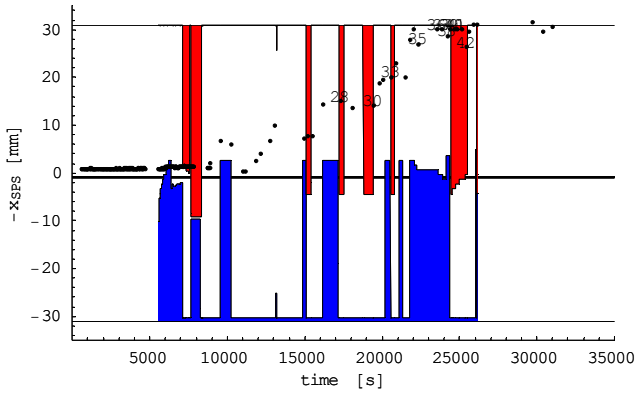
temperature reading

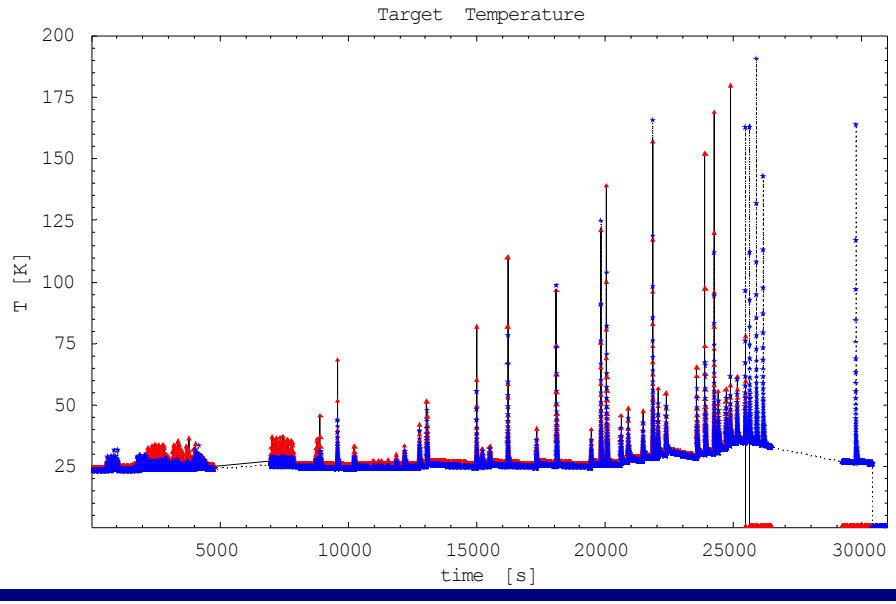


- Linear relation
  temperature ↔ intensity

not corrected for changes of beam position

Collimator(s)





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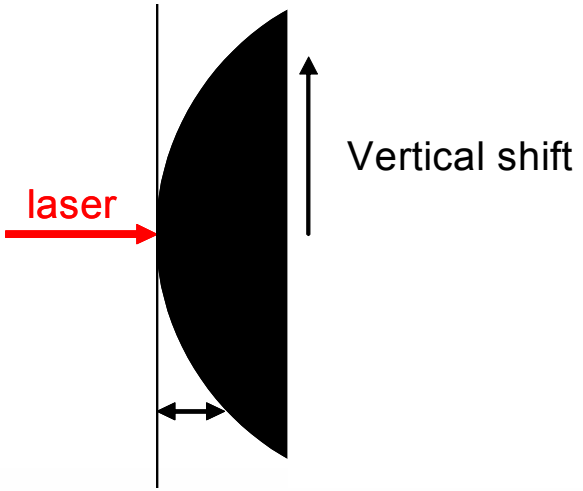
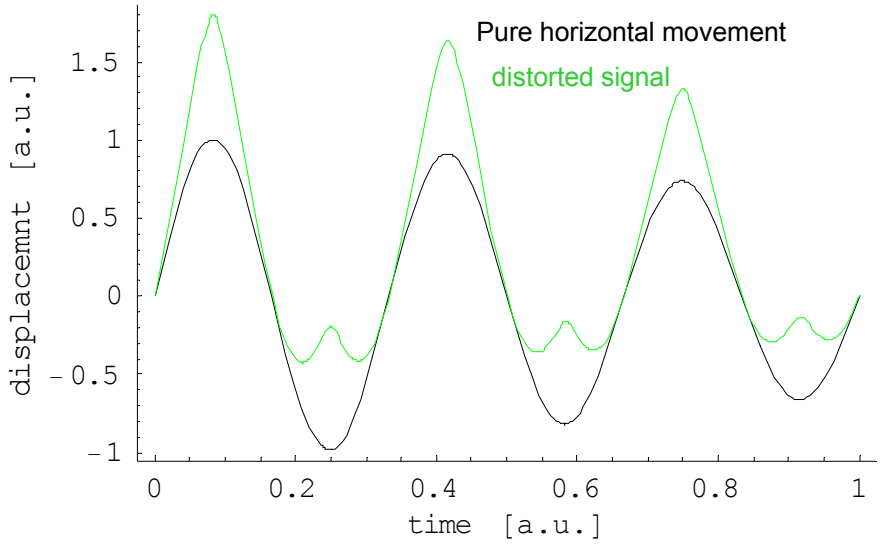
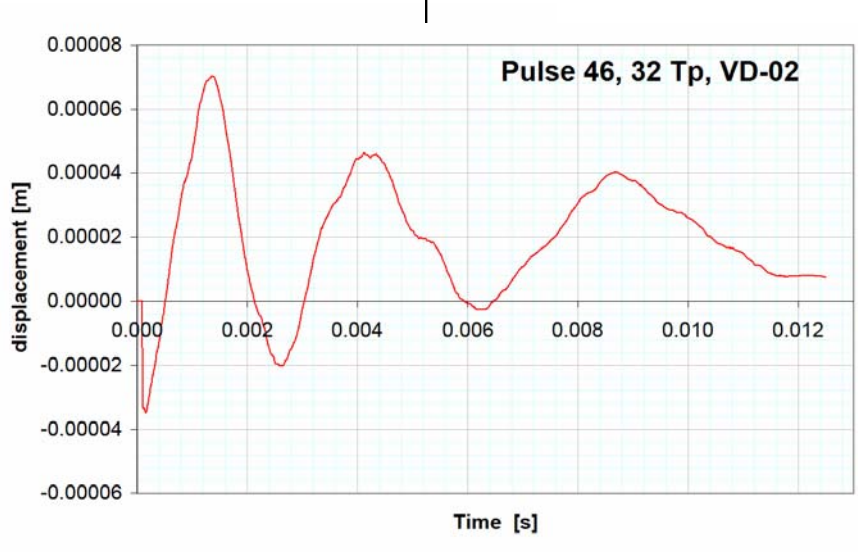
laser vibrometer response

LVM records velocity coaxial with laser beam

- intention to measure horizontal displacement
- vertical movement of target distorts signal







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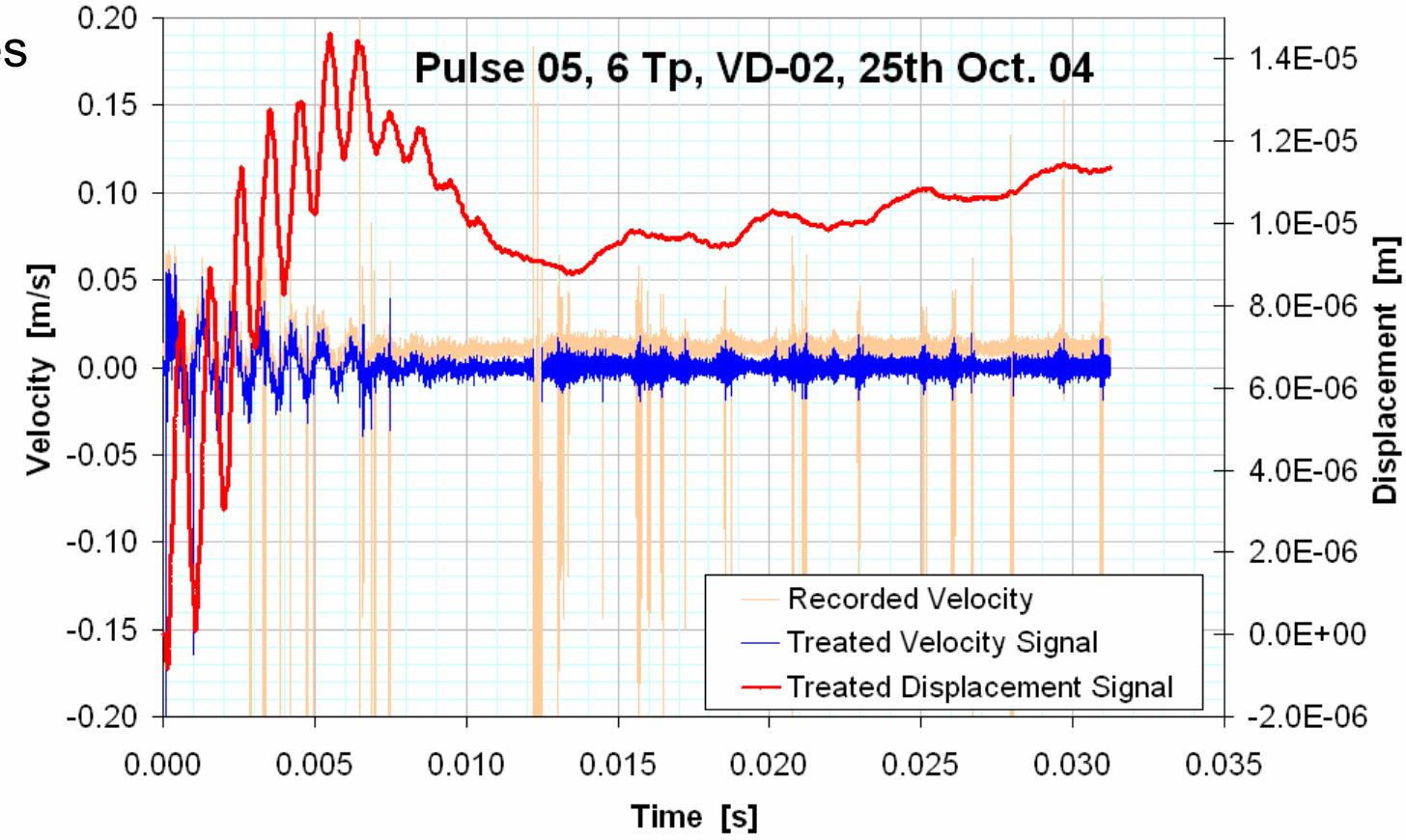
noise suppression

LVM records velocity co-axial with laser beam

- Random spikes
- Velocity offset



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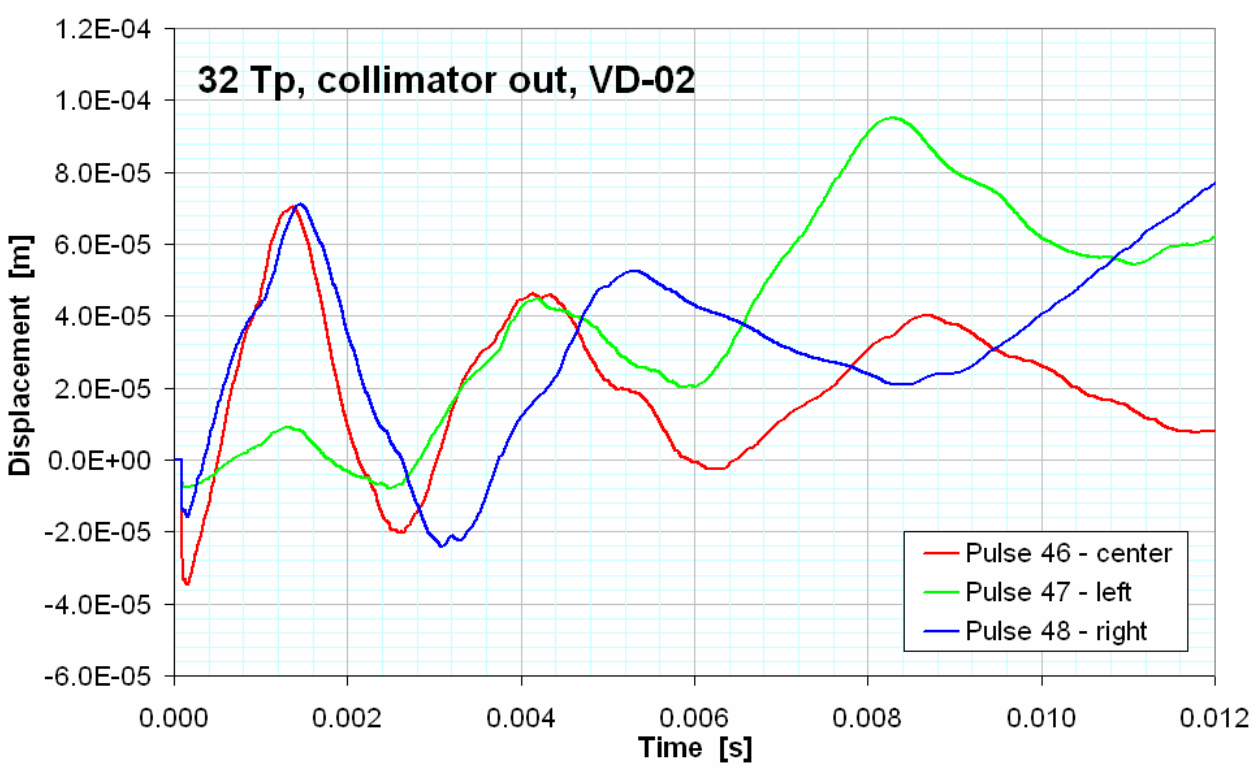
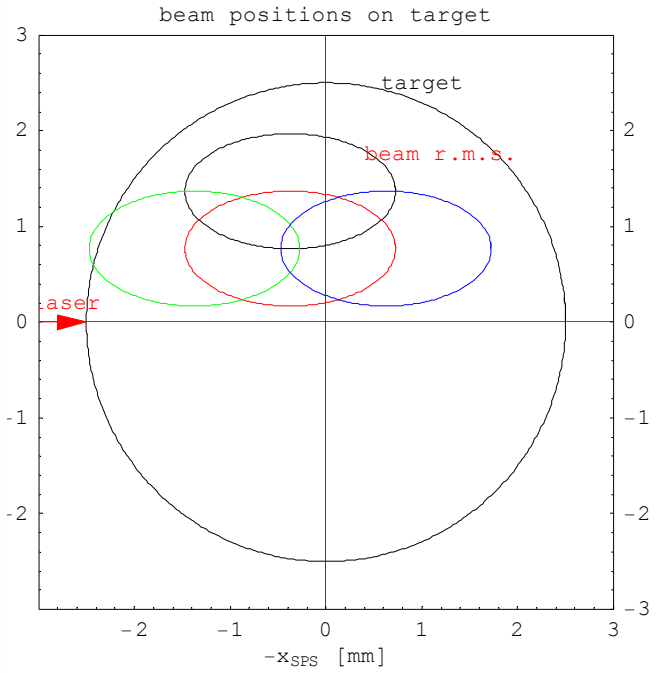
horizontal beam scan





Displaced beam results in bending

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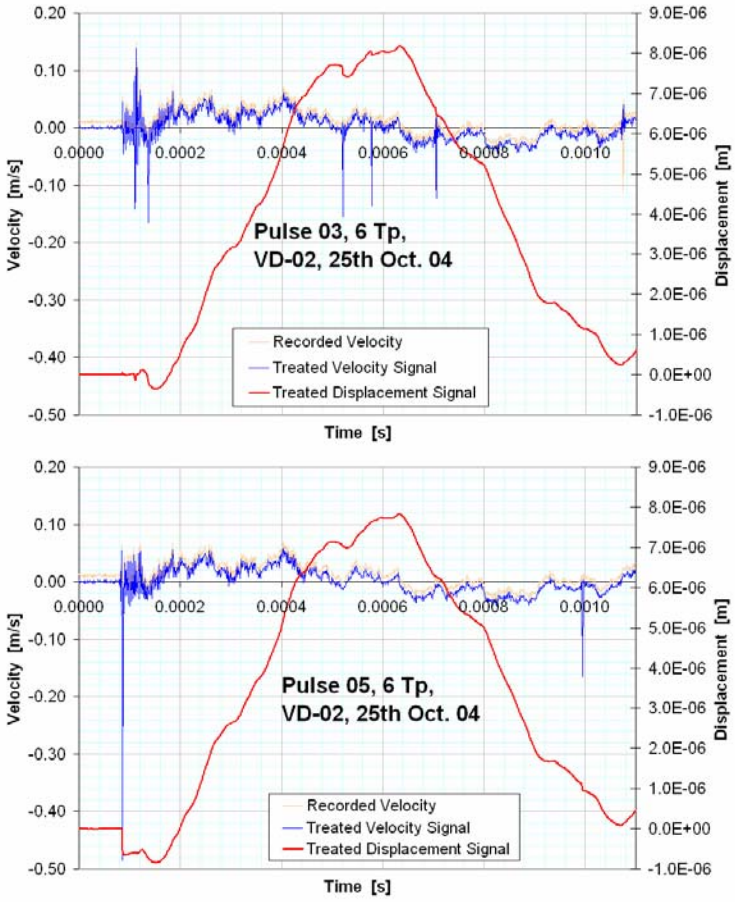
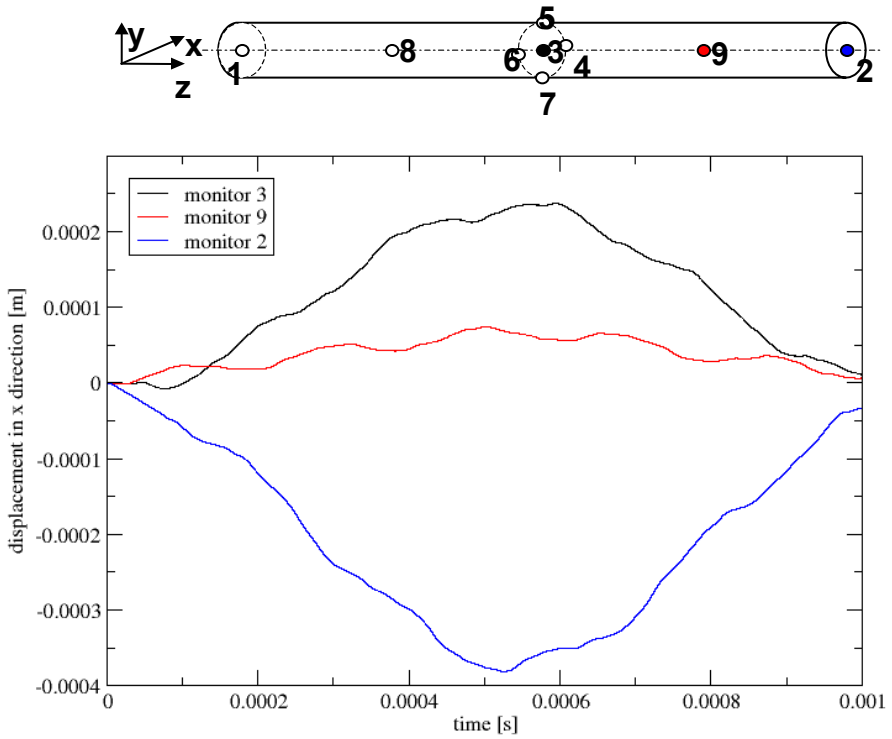
Qualitative Comparison

experiment ↔ simulation



0.6 10^{13} p.o.t., TT40, 25th Oct.



3.5 x 10^{13} p.o.t.
L. Massidda and F. Mura, CRS4

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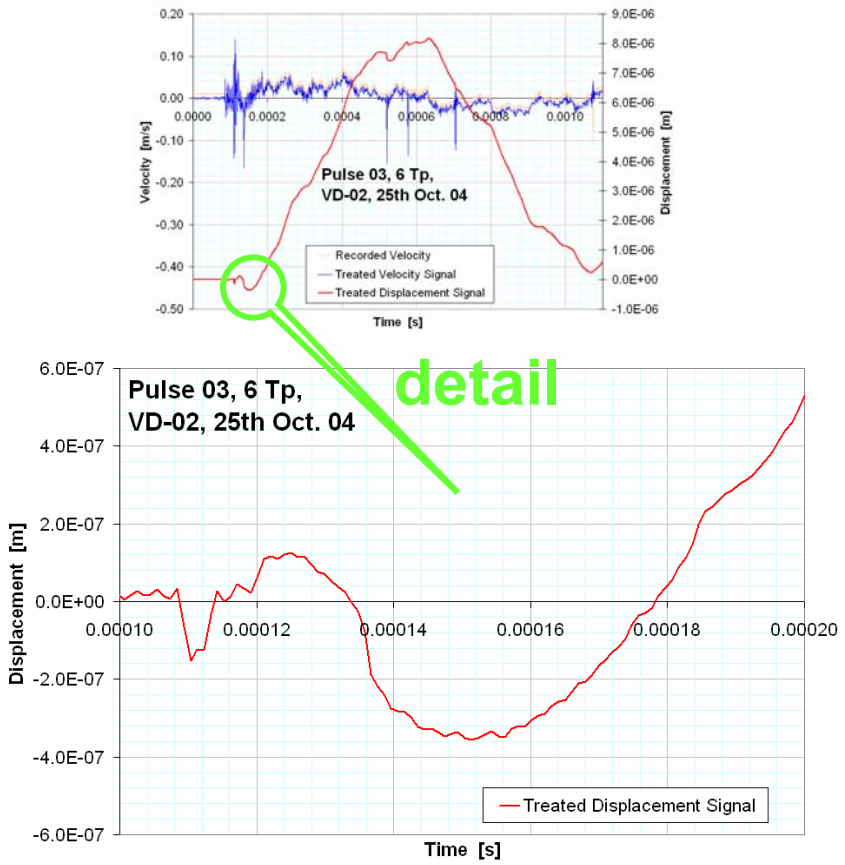
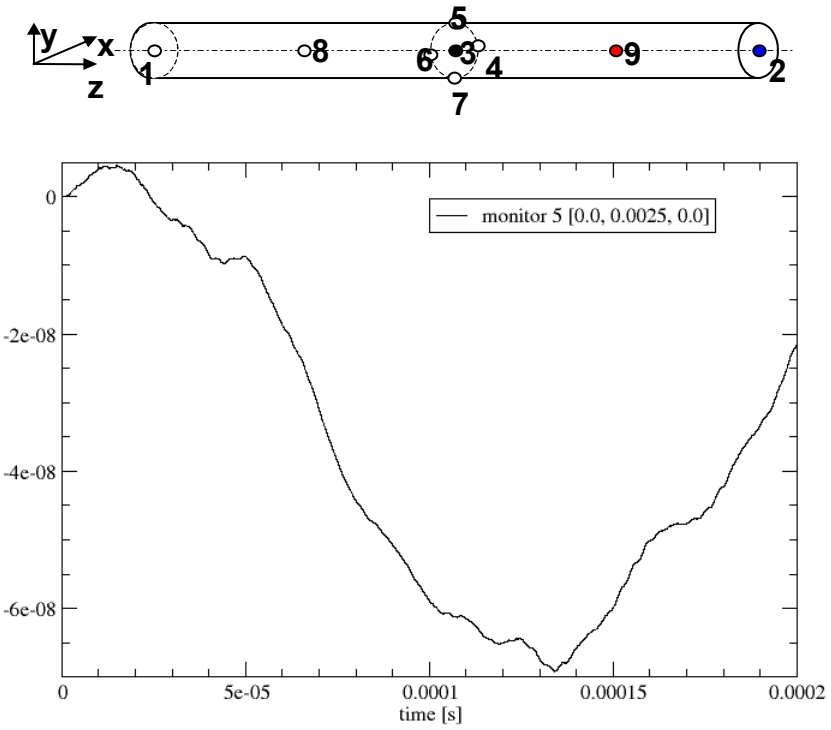
Qualitative Comparison

experiment ↔ simulation



0.6 10^{13} p.o.t., displaced, TT40, 25th Oct.



3.5 x 10^{13} p.o.t., centered, L. Massidda and F. Mura, CRS4

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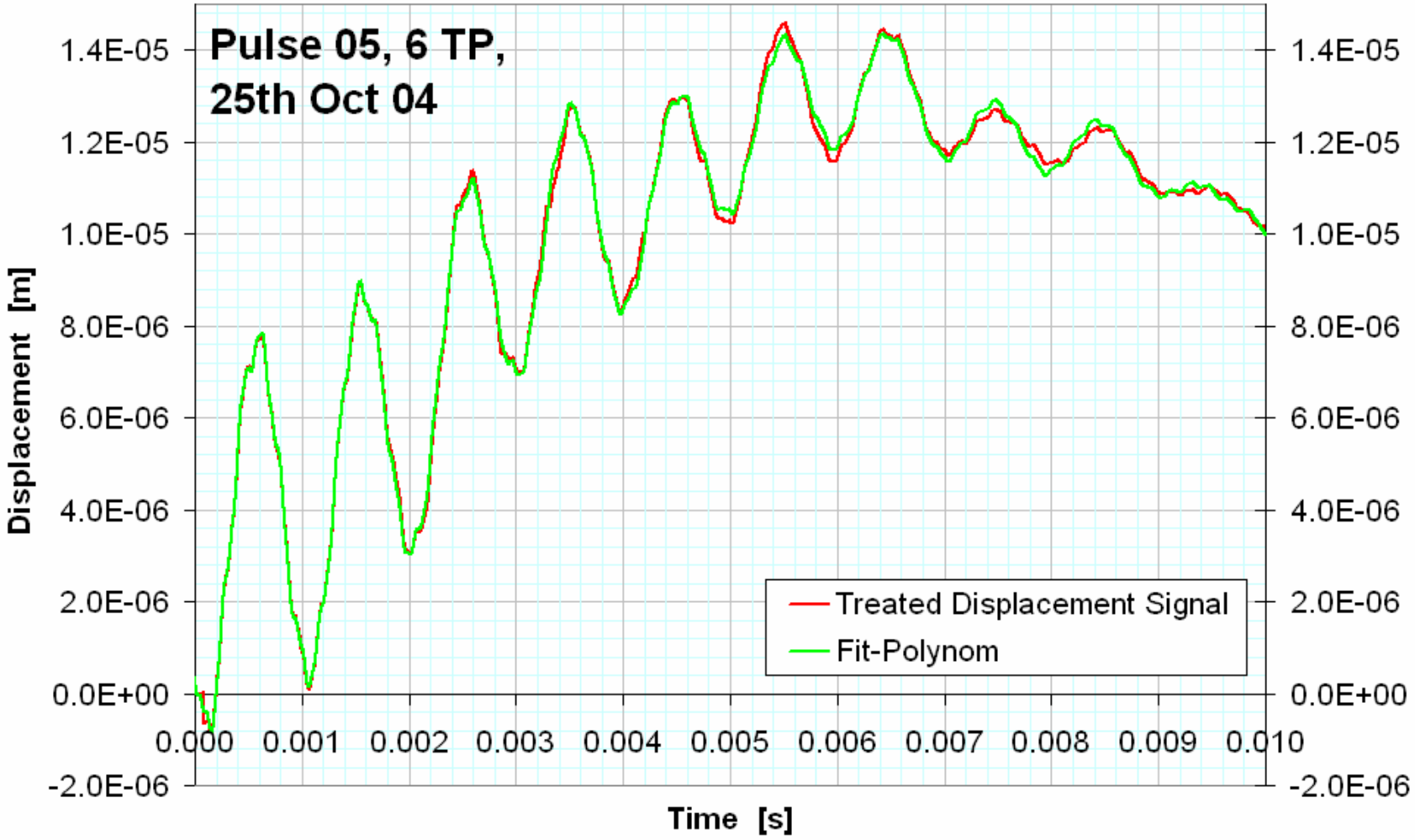
Damping



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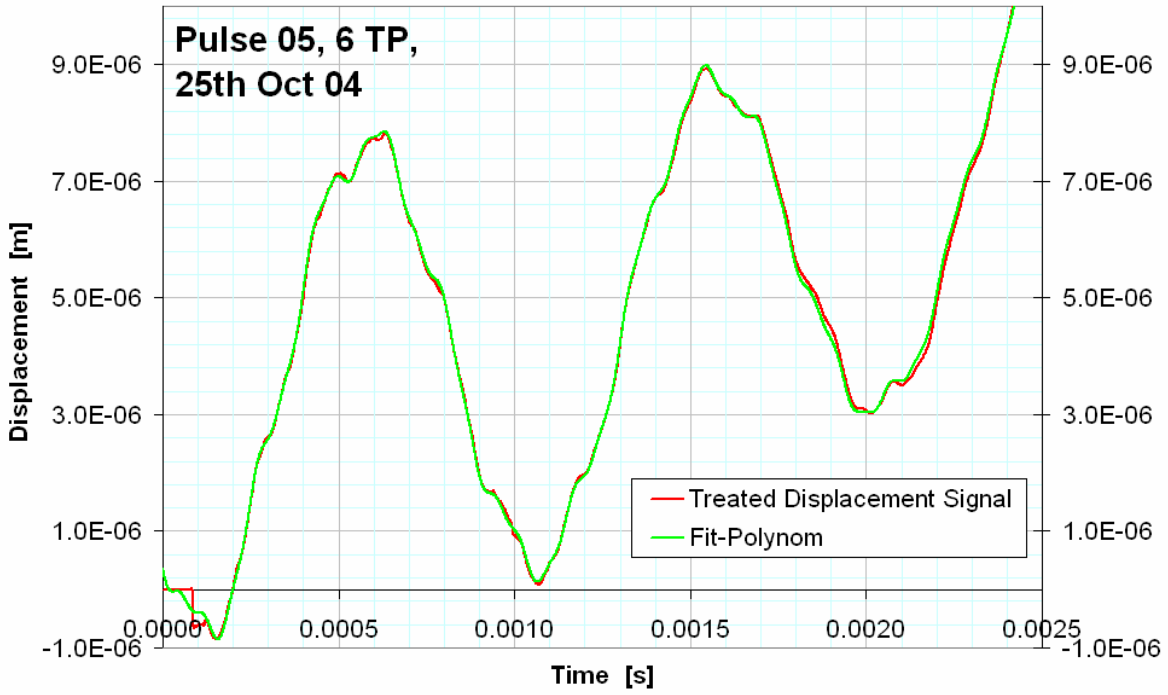
Non-Linear Fit of the Signal



$$3.43501\times10^{-6}\,e^{198.863\,t}\,(\cos[232.768\,t]+\sin[232.768\,t])+$$
$$1.72292\times10^{-6}\,e^{-465.917\,t}\,(\cos[1767.48\,t]-\sin[1767.48\,t])-2.73973\times10^{-12}\,e^{1636.4\,t}\,(\cos[1867.27\,t]+\sin[1867.27\,t])+$$
$$2.94561\times10^{-14}\,e^{2074.94\,t}\,(\cos[2548.18\,t]+\sin[2548.18\,t])-4.50195\times10^{-7}\,e^{-267.048\,t}\,(\cos[3110.5\,t]+\sin[3110.5\,t])+$$
$$6.67683\times10^{-10}\,e^{738.441\,t}\,(\cos[4094.13\,t]+\sin[4094.13\,t])+1.23202\times10^{-9}\,e^{-4334.65\,t}\,(\cos[5934.24\,t]+\sin[5934.24\,t])+$$
$$0.0000673651\,e^{-415.155\,t}\,(\cos[6297.72\,t]+\sin[6297.72\,t])-0.0000705036\,e^{-403.418\,t}\,(\cos[6313.31\,t]+\sin[6313.31\,t])-$$
$$7.32912\times10^{-7}\,e^{-3291.7\,t}\,(\cos[9767.18\,t]+\sin[9767.18\,t])-1.67809\times10^{-7}\,e^{-120.098\,t}\,(\cos[34875.5\,t]+\sin[34875.5\,t])-$$
$$2.19902\times10^{-7}\,e^{-286.797\,t}\,(\cos[34978.7\,t]-\sin[34978.7\,t])-7.6409\times10^{-8}\,e^{-227.914\,t}\,(\cos[83905.6\,t]+\sin[83905.6\,t])$$

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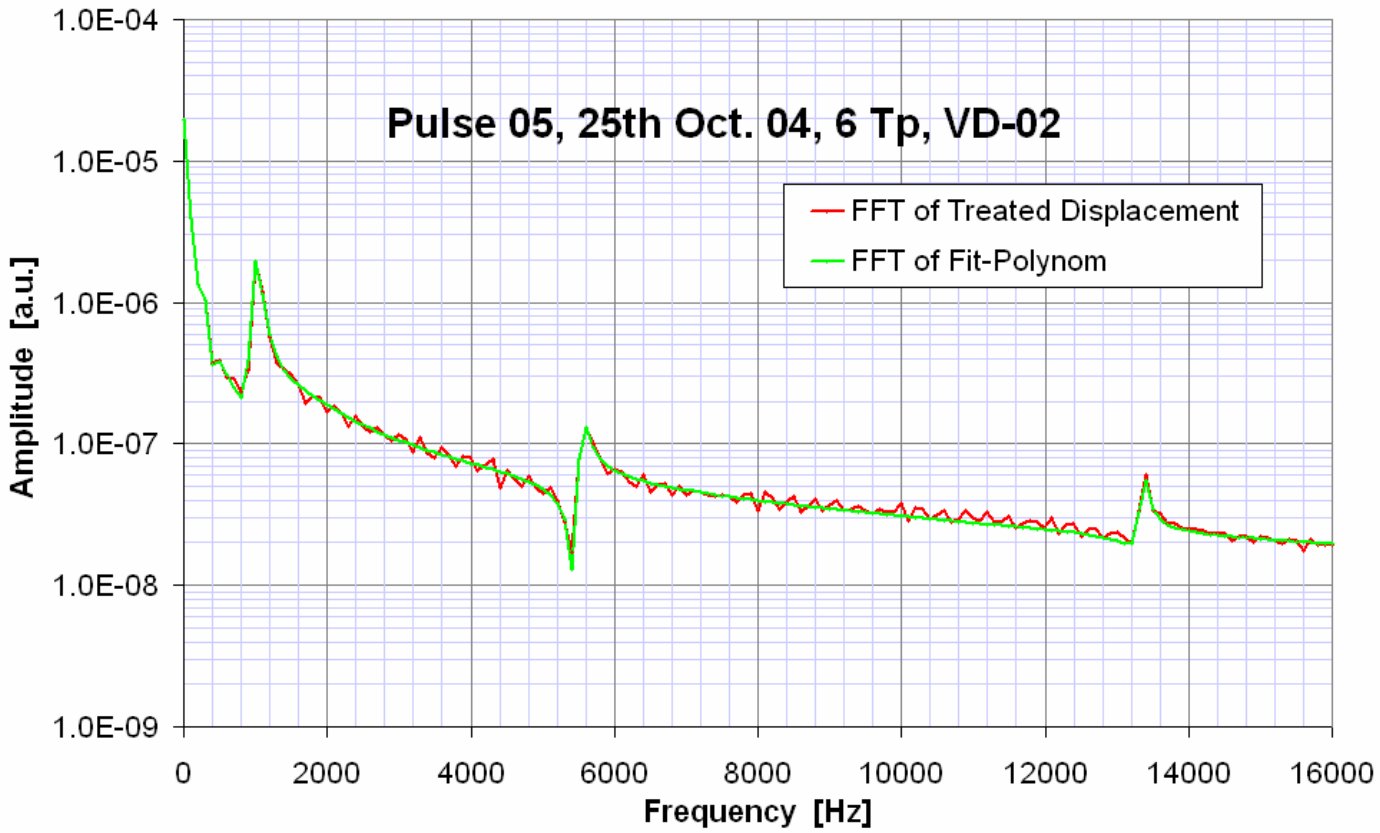
FFT analysis



frequency [Hz]	damping time [ms]
37	5.03
281	2.15
297	0.61
406	0.48
495	3.74
652	1.35
944	0.23
1002	2.41
1005	2.48
1554	0.30
5551	8.33
5567	3.49
13354	4.39

Damping time → 1/e

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Conclusion

- experimental method using LVM proven
- Successful usage of PT100 in-beam
  - 2 out of three are mechanical broken at lead
  - third needs further investigation

1. Simulations qualitatively confirmed
2. Frequencies / Damping constants known

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Thanks

Thanks

for your

support!

Building 867-R-P73

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