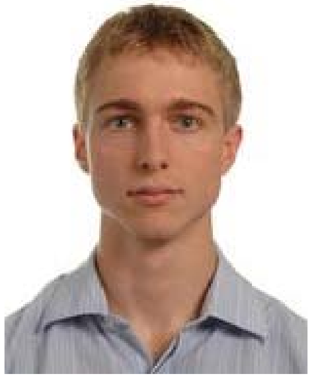
MONALISA

Monitoring Alignment & Stabilisation with high Accuracy



MPhys

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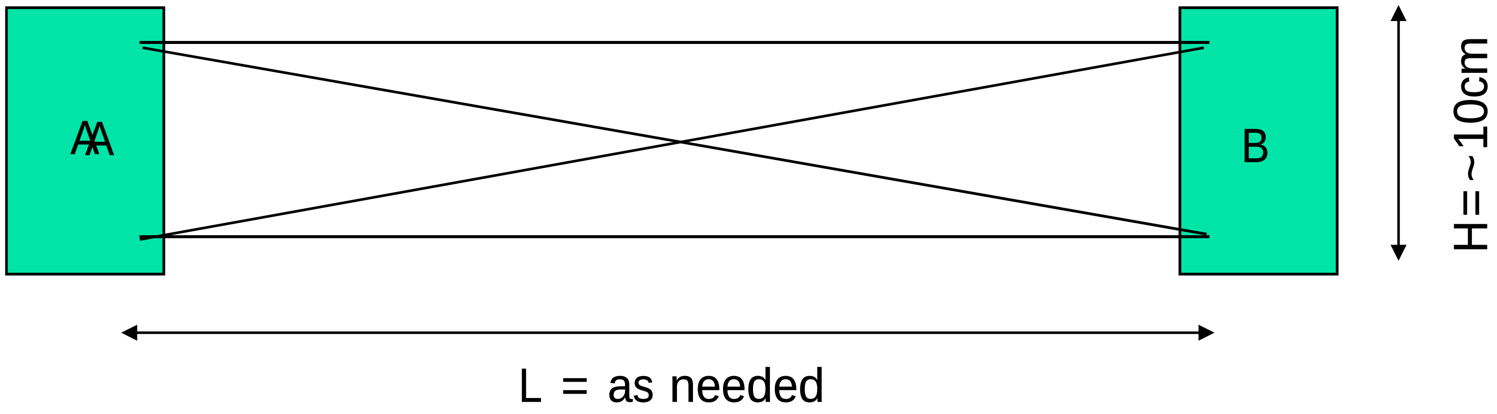
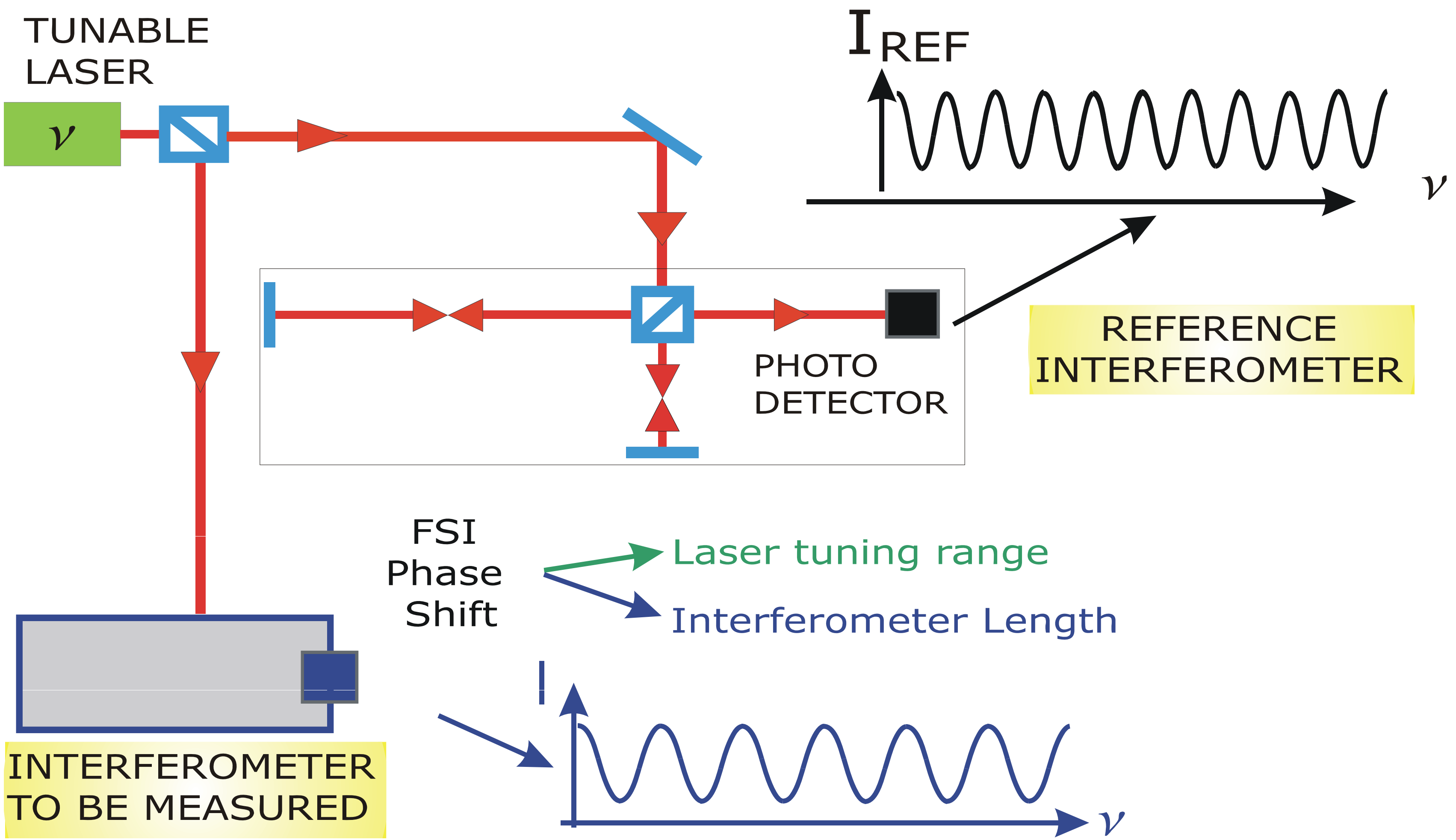


- 2-dim sketch (3d requires second lateral measurement)
  - Use mechanical stability of small platforms A&B.
  - Use multiple lines to cancel systematic effects
  - Resolution scales aproximately with H/L

FSI: Frequency Scanning Interferometry

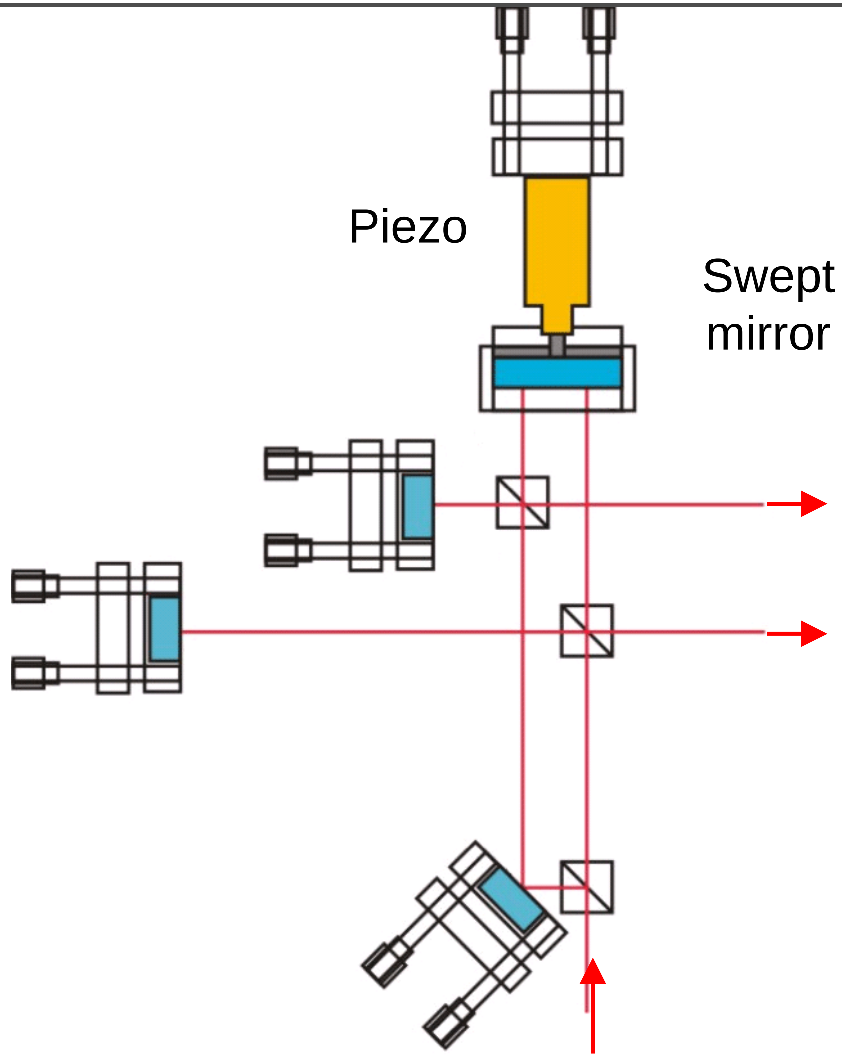


Progress in 06 / 07

- Hardware
  - Built novel Interferometer designs
  - Pioneered new phase measurement techniques
  - Still making vacuum vessel to demonstrate nm precision
  - Tested compact launch optics
- Software
  - Developed novel phase analysis technique
  - Collaborated with LiCAS on OO analysis package
  - Developed binary file format for data handling
    - users MonAliSA, LiCAS and ATLAS (FSI)…
    - Available in Java, C and LabVIEW

Parallel Reference Interferometer

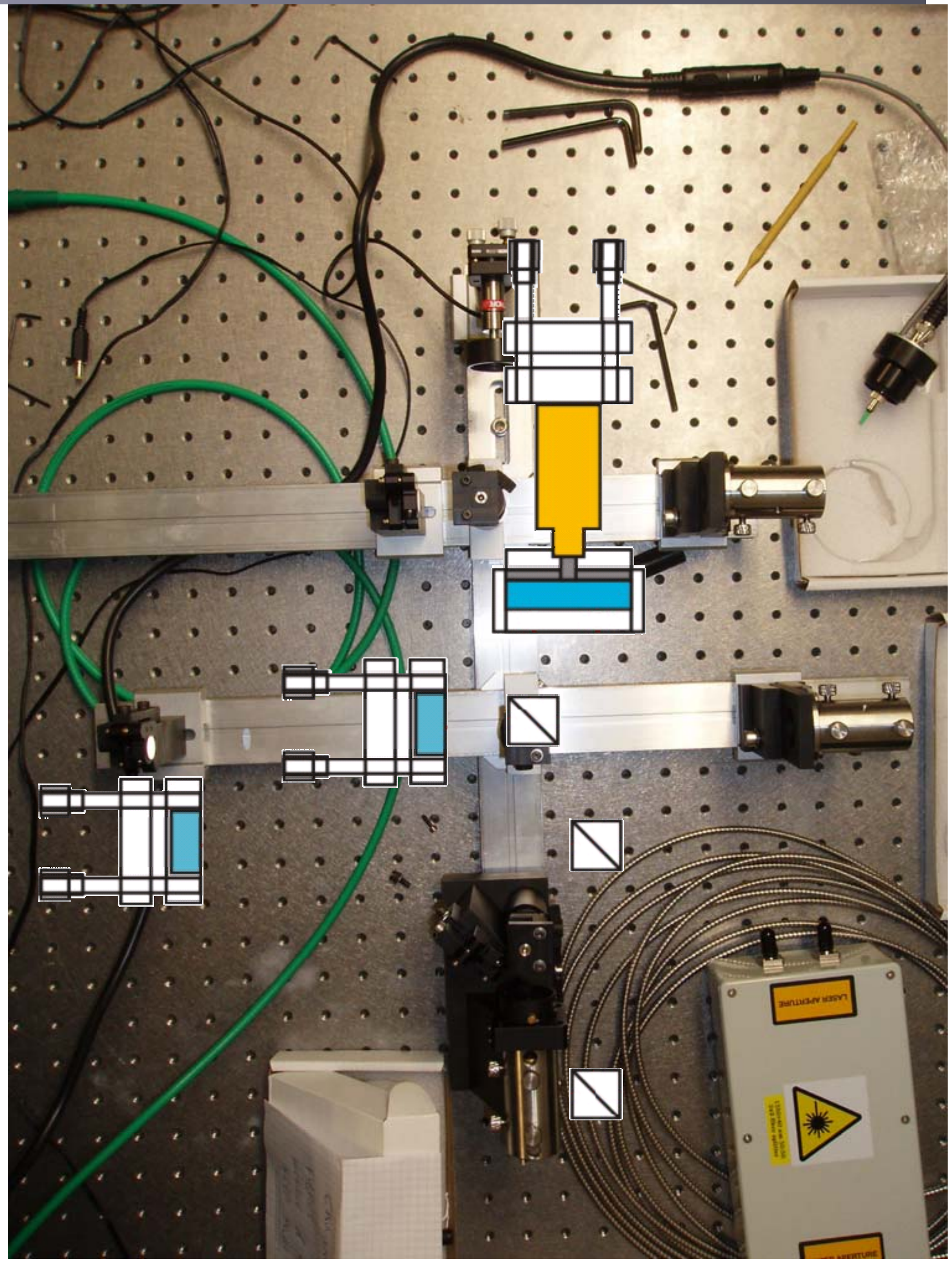
- Both interferometers have same mirror sweep
- Interferometers cross check step size and other systematics
- If one is very short and one quite long, uneven laser tuning can be more easily followed



- Parallel Michelson interferometers built and tested

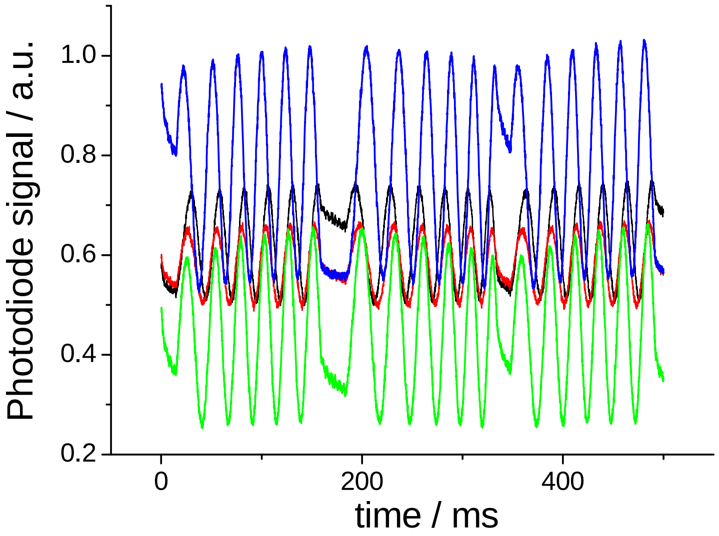
- Installed continuous thermometer readout system

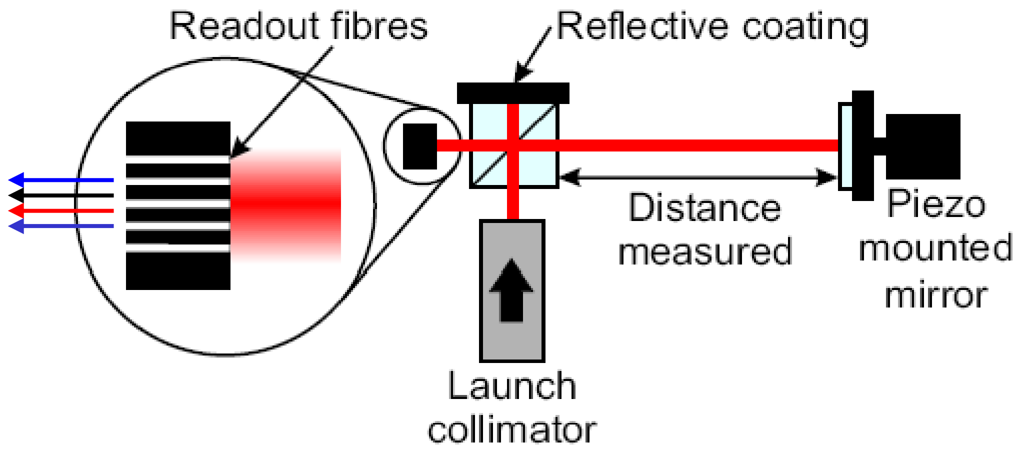
- Calibration studies this autumn

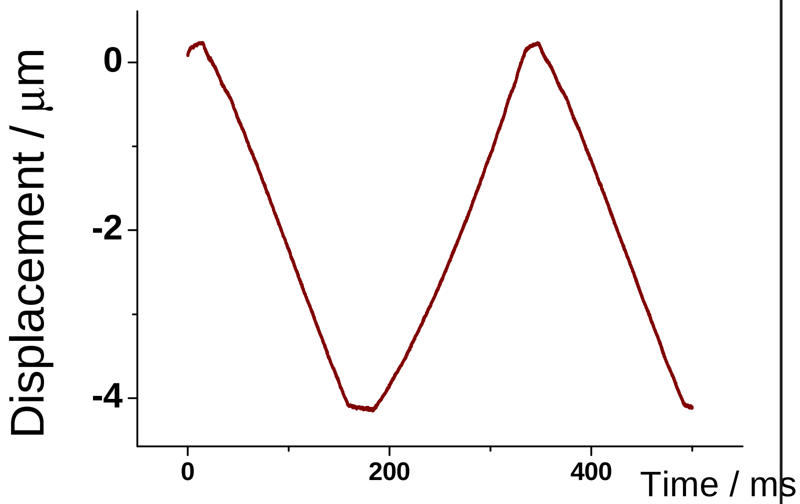


Multi-fibre read out (compact launch)

FFI: Fixed Frequency Interferometry (OPD 400mm)







- Fixed frequency laser (FFI)
- Same interferometer can be used for FSI
- Test *shown here* with moving mirror
- First stationary mirror test :
  - resolution 5 nm demonstrated
  - to be improved with vaccuum
  - and laser frequency stabilisation
  - temperature and pressure dependence look reasonable

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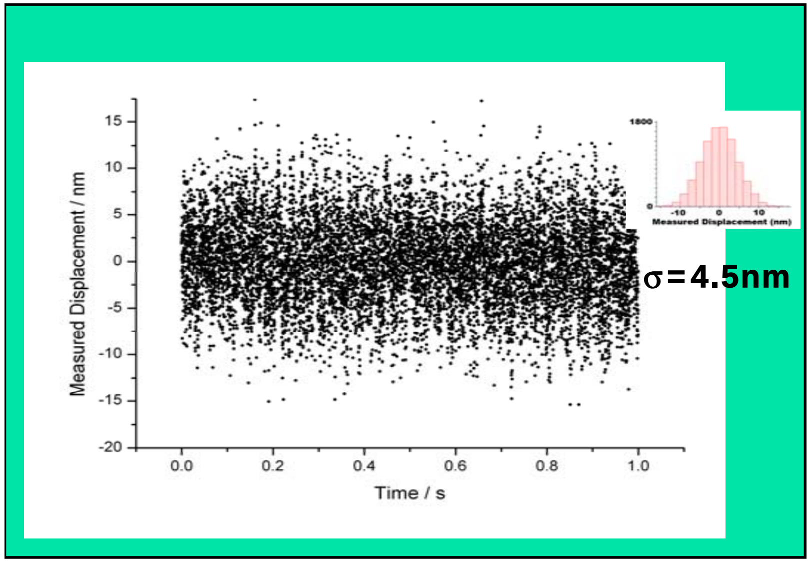

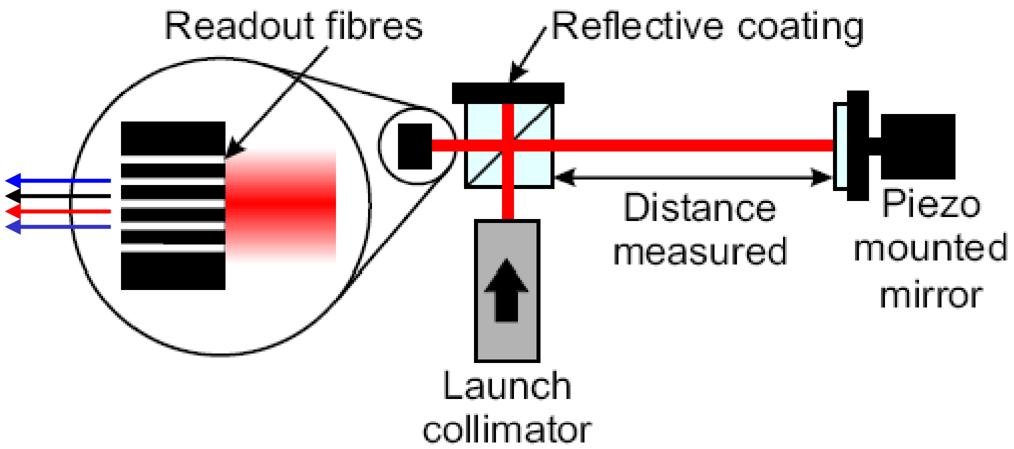

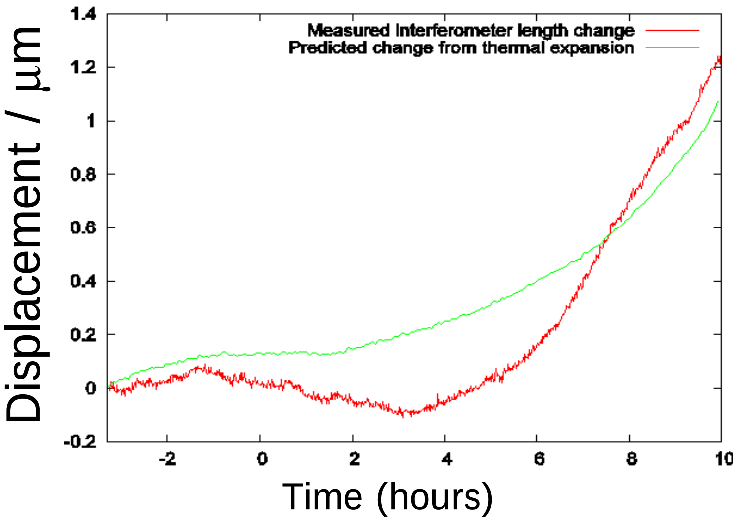

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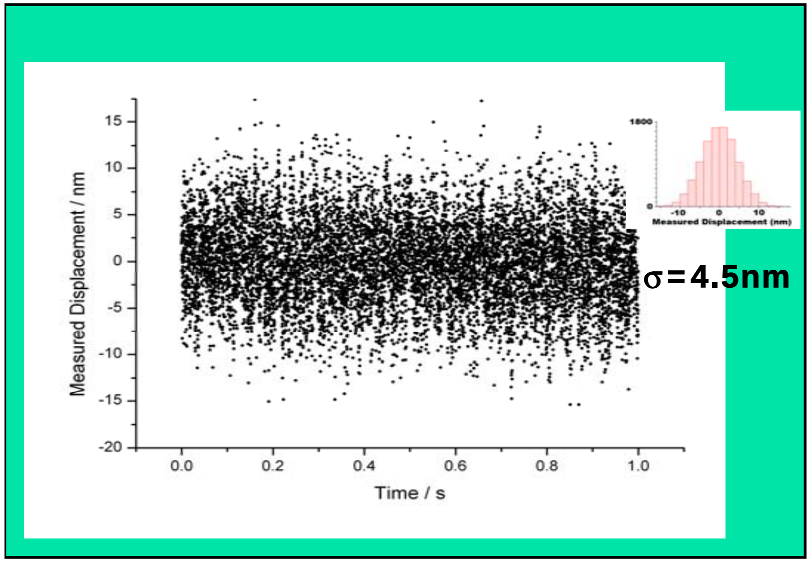

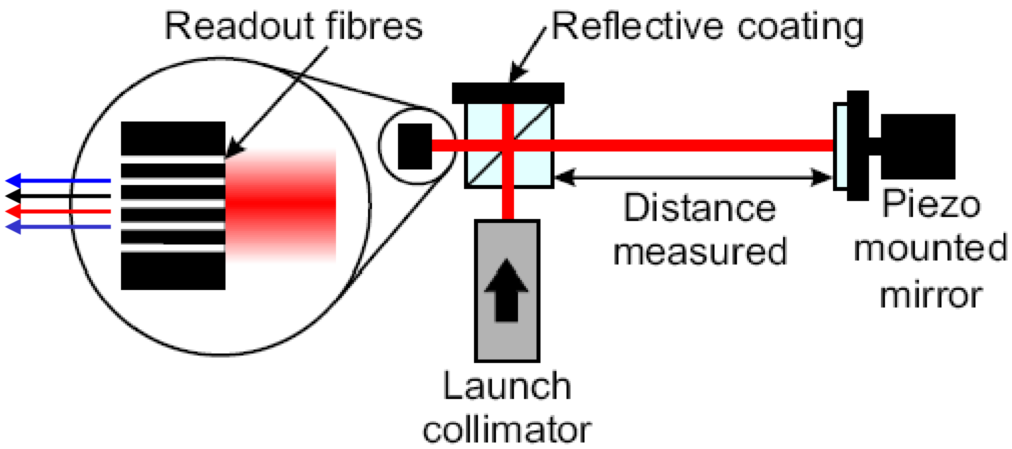

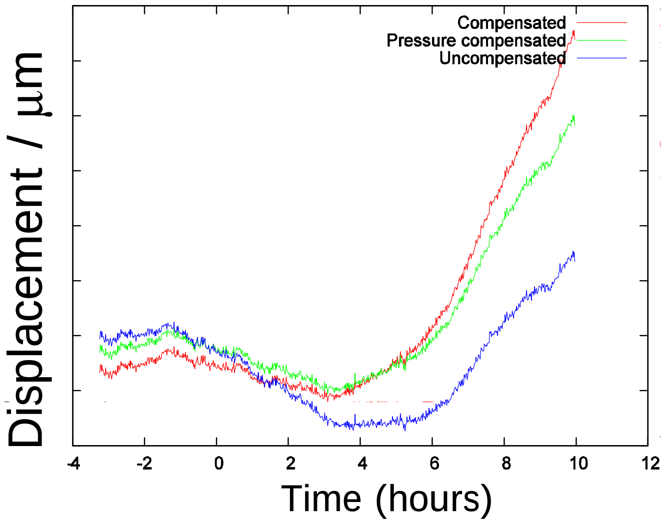

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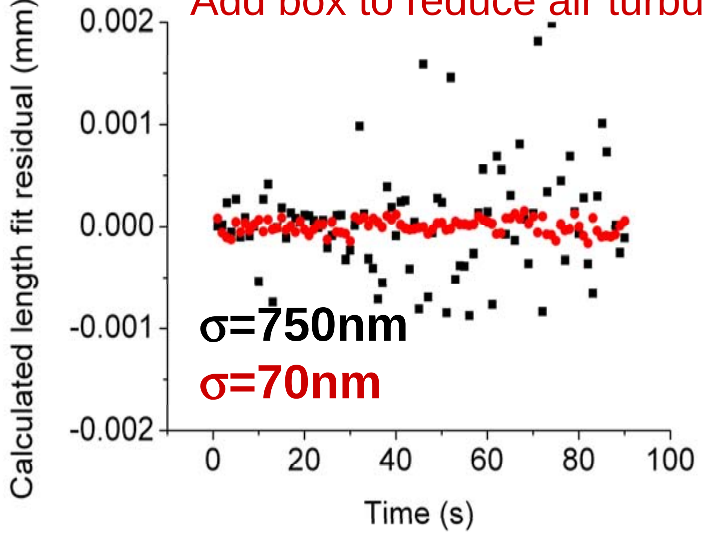
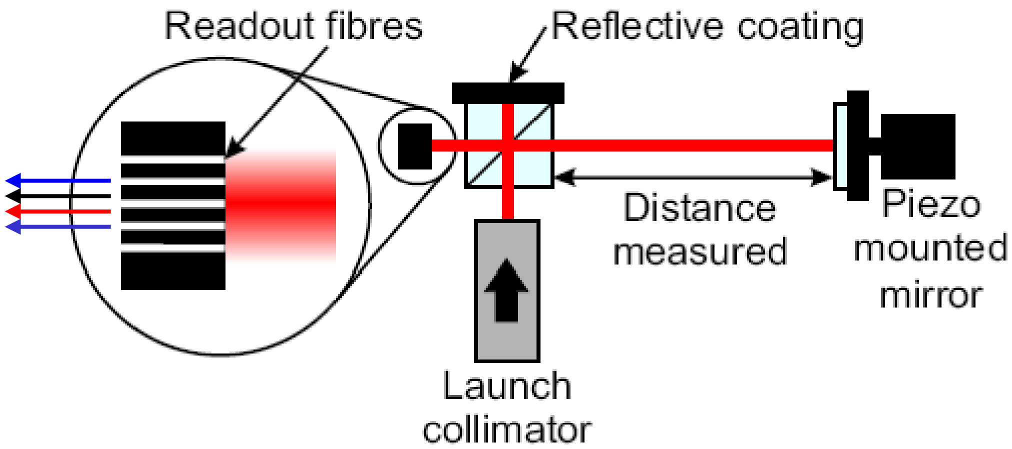
FSI:Frequency Scanning Interferometry (OPD 400mm)

Add box to reduce air turbulence





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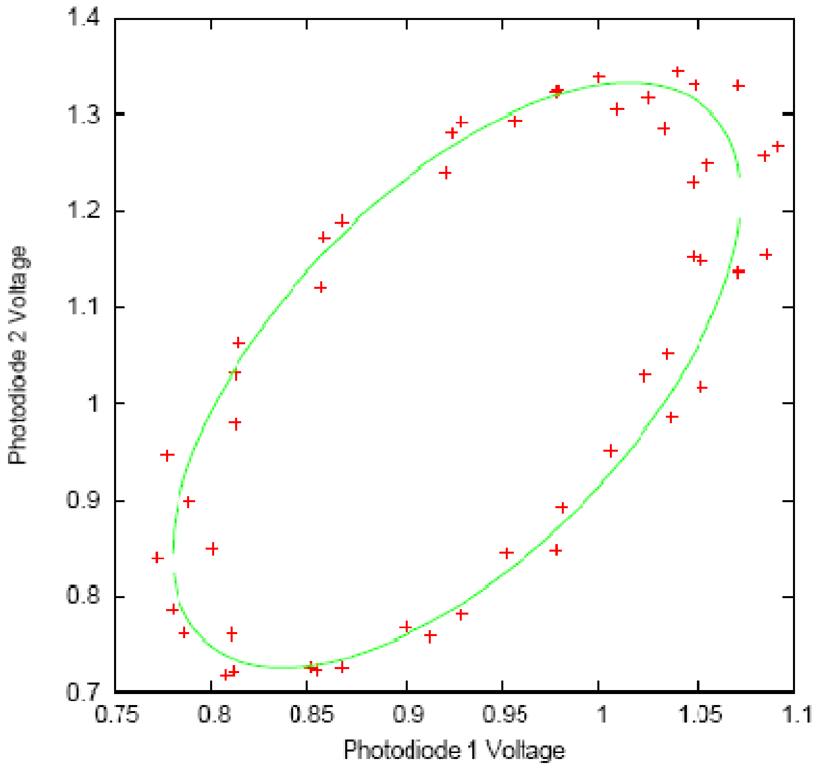
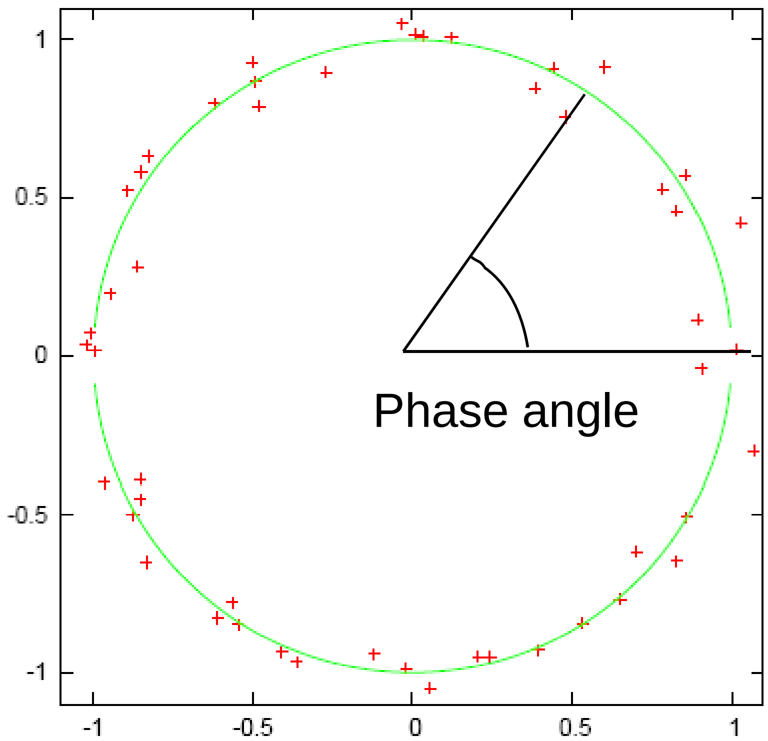
- Novel technique for multi-fibre phase



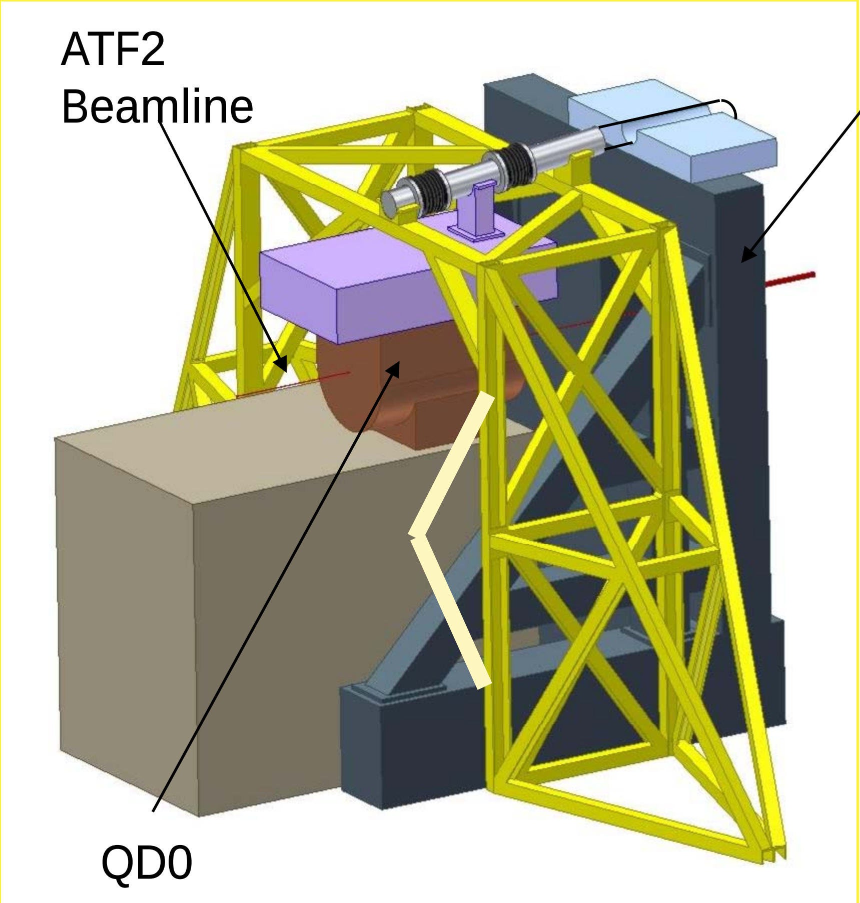
Signals from 2 fibres



Normalise onto unit circle

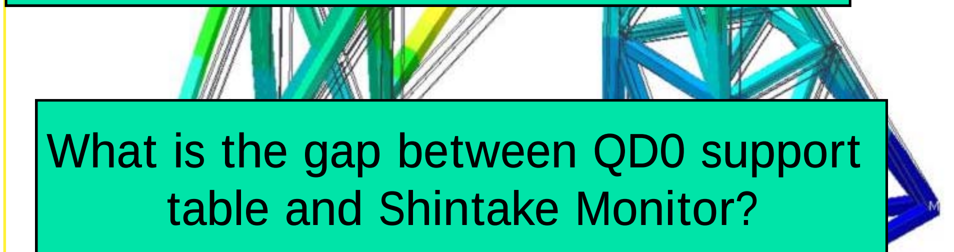
Setup at ATF2

Goal: Prove we don't induce vibrations onto Shintake monitor

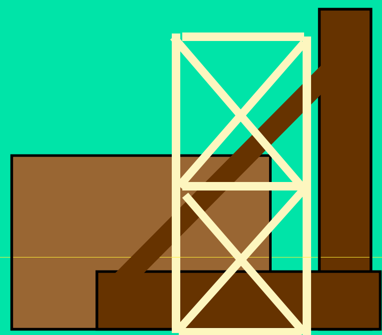


Problem:
No room for wings that are required to get necessary stiffness

Possible solutions:
- -Attach to QD0 support table
- -Cross brace between Shintake table and QD0 support table

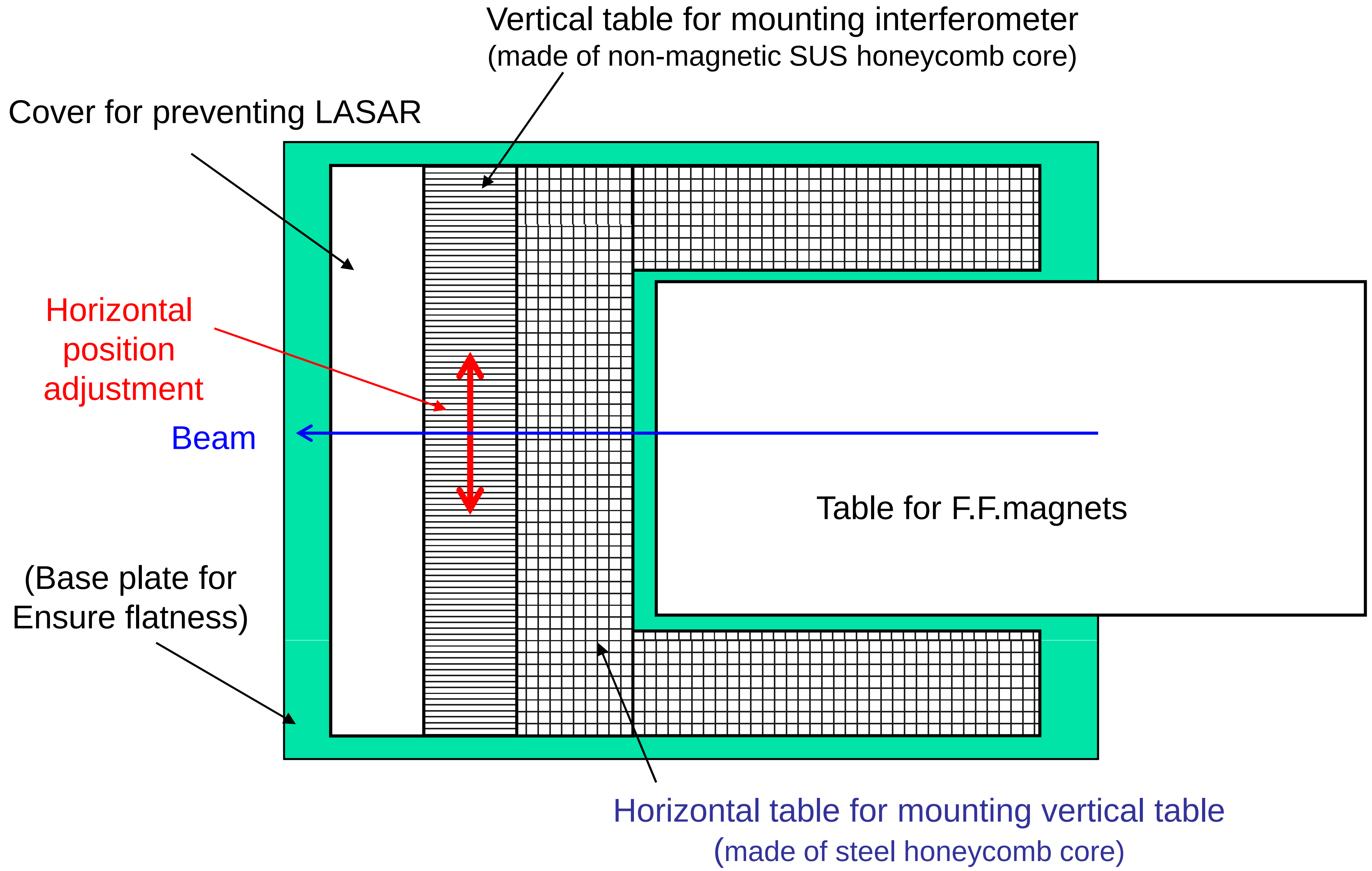


What is the gap between QD0 support table and Shintake Monitor?

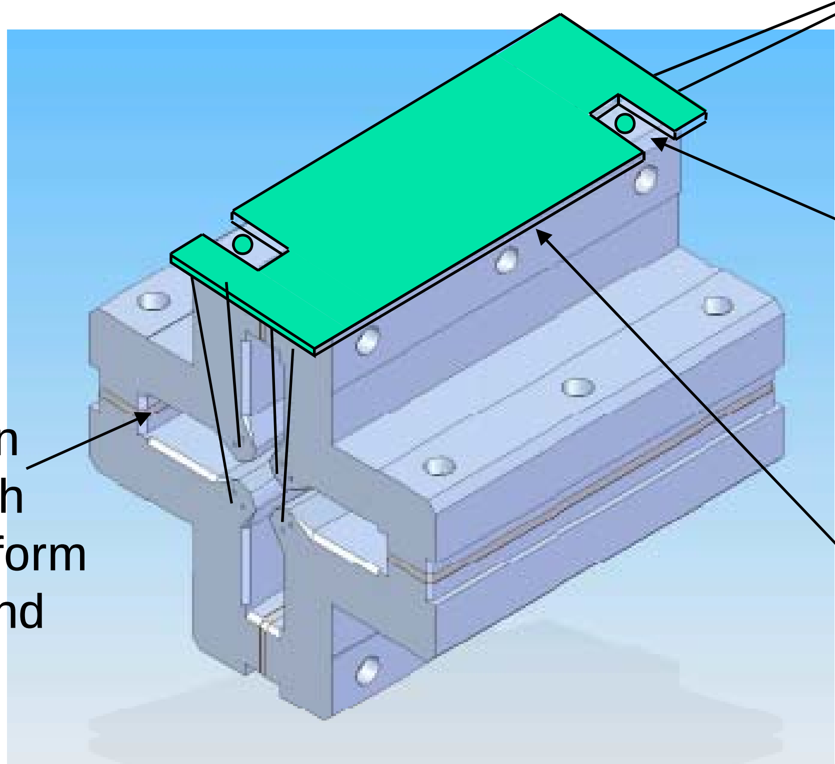


Rigid mount for optical table

-top view outline



CSM mount at magnet end



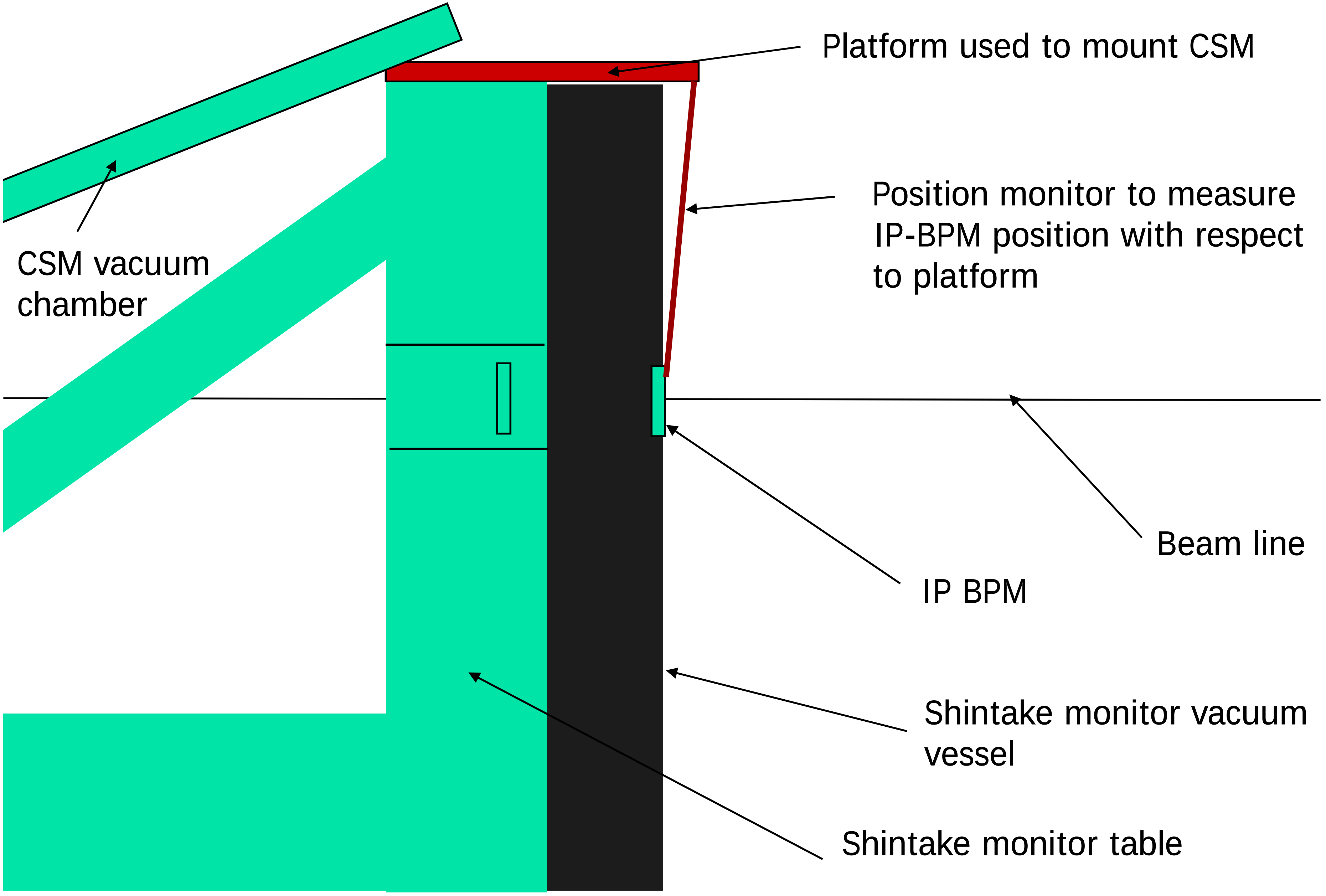
Survey holes

What is size of cutouts required to mount survey nests

Observe motion of pole tips with respect to platform on upstream end of magnet

CSM mounted on this platform

CSM mount at Shintake monitor end



Next steps

- Develop mounting structure compatible with ATF2 layout
  - Is there space for a cross brace between Shintake monitor and magnet table
  - Can we attach our system to magnet table
- Develop real designs for platforms on magnet and Shintake monitor side.
- Make conceptual design for CSM vacuum vessel.

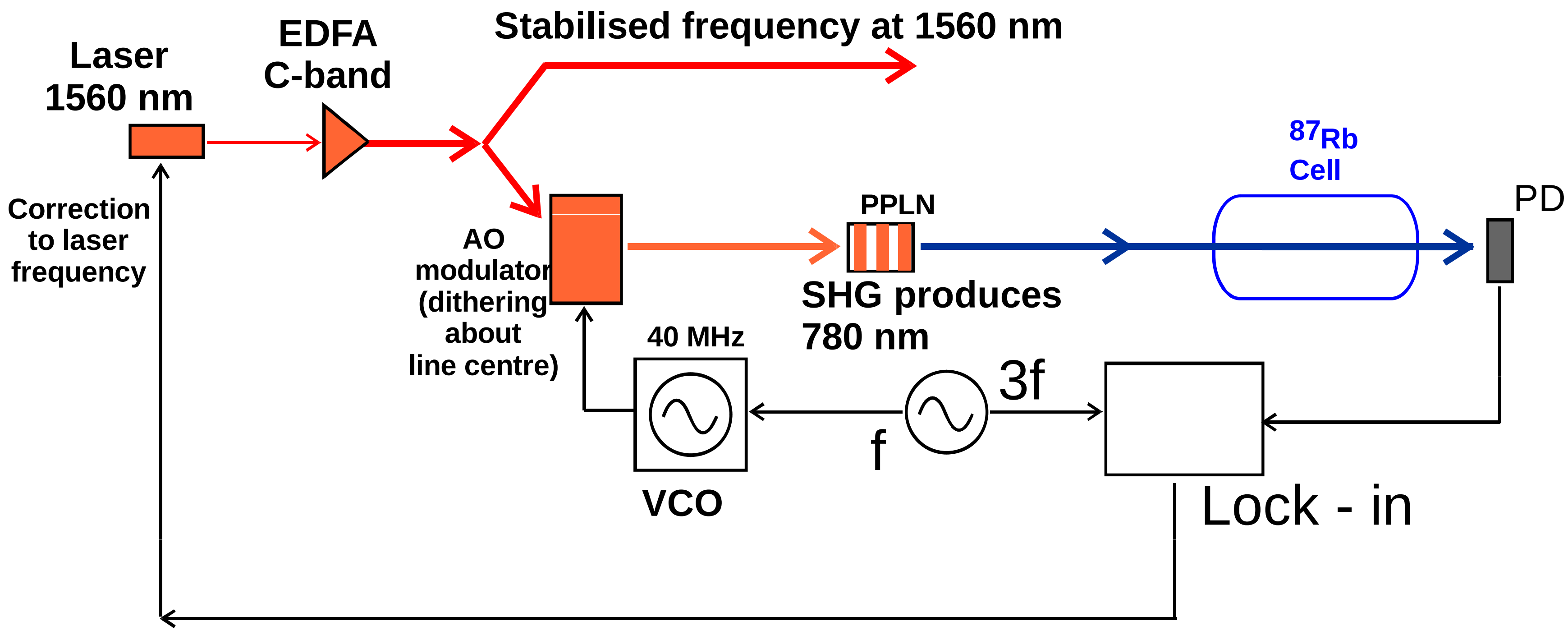
Plans

- Develop CSM
- Monitor ATF2 IP
- Laser frequency stabilisation with ^{87}Rb standard
  - Required for stable FFI
- Demonstrate nm resolution in vacuo
  - Install interferometers into vacuum drum
- Continue analysis software collaboration with LiCAS
  - Analysis framework
  - Adapt LiCAS readout hardware / software

Frequency stabilisation

Frequency standard: ^{87}Rb D_2 line at 780 nm

Simplified Schematic:



Frequency standard : $^{87}Rb\ D_2$ line at 780 nm

- Take ultra – narrow line-width laser at 1560 nm
- Amplify with EDFA (erbium doped fibre)
- Frequency double in PPLN to produce 780 nm
- Use saturated absorption spectroscopy ^{87}Rb to pick out hyperfine structure
- Lock source laser to peak providing stability of a few kHz (compared to 1 MHz without Rb)
- At 10 m range, 1 MHz limits resolution to 5 nm
  - locked laser (theoretically 20 pm)
  - other errors will take over