Beam pointing control activities

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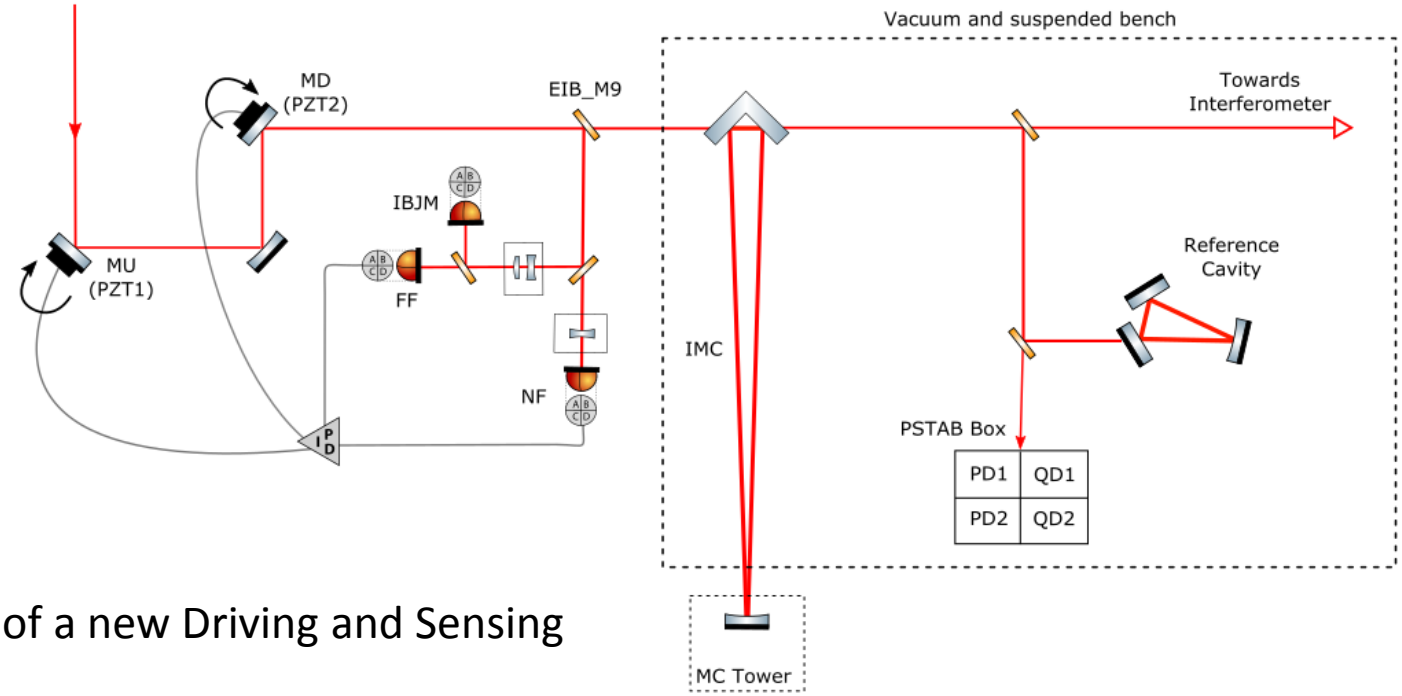
ISYS commissioning meeting

Resume of the activities

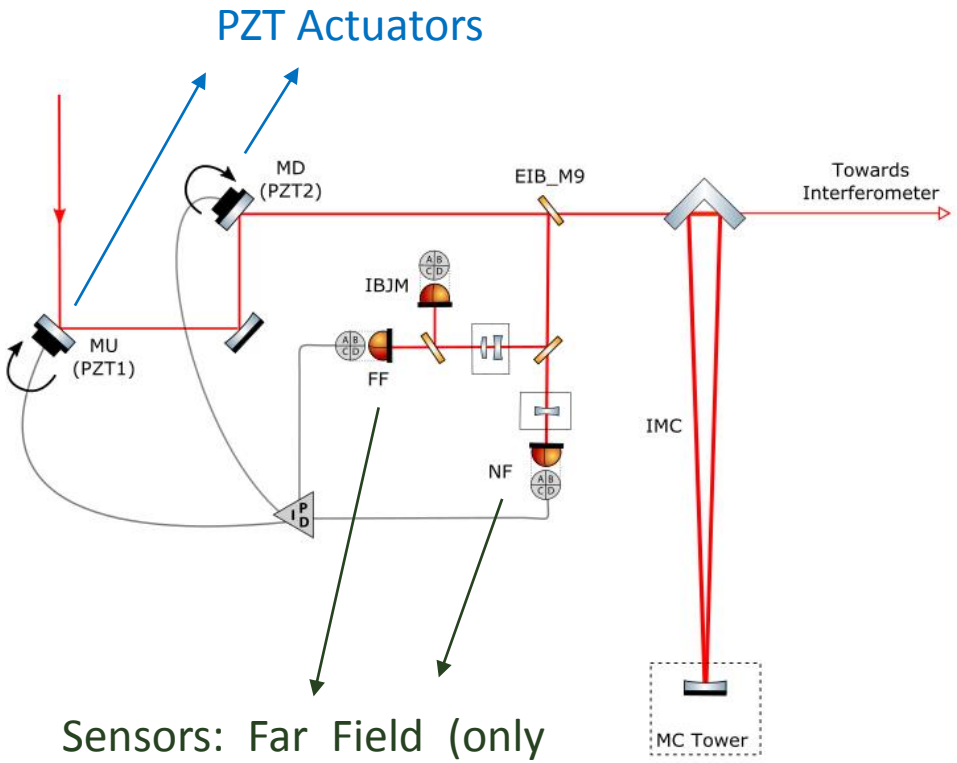


1- Implementation of a new Driving and Sensing matrix for the BPC

2- Analyses of the beam jitter after the IMC

3- Coupling factor of the beam jitter into RIN at the PSTAB photodiodes

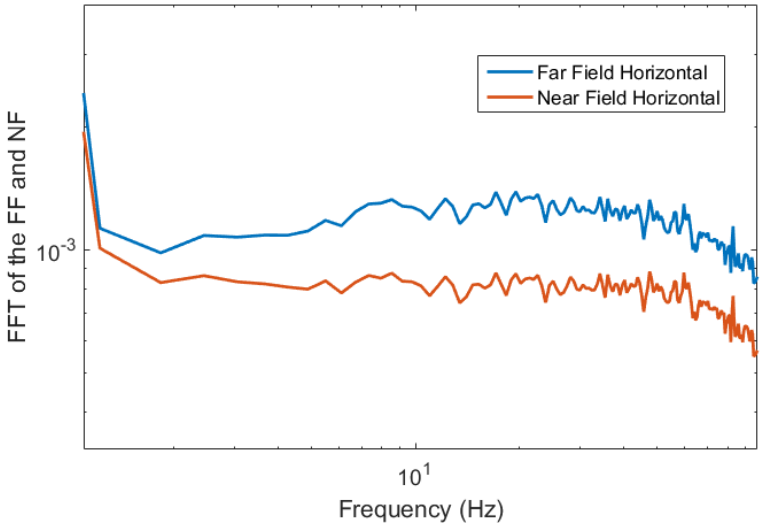
New Driving and Sensing matrices for the BPC



Sensors: Far Field (only tilt) and Near Field quadrants

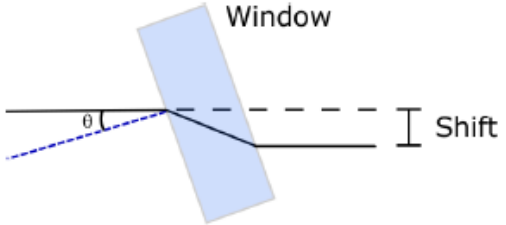
Motivation

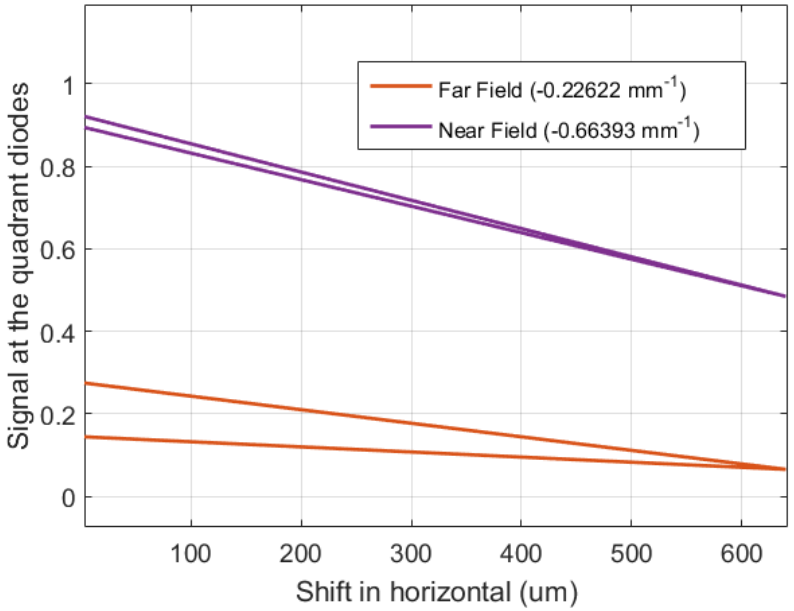
Shift on the BPC was producing a larger value on the FF than on the NF



New Driving and Sensing matrices for the BPC

Experimental check if the quadrants are well placed:





Signal on the FF is 3.5 smaller than the NF!

Conclusion: Driving of the BPC is not good.

New Driving matrix for the BPC

New Driving was obtained from the TF between the PZT mirrors and the FF and NF:

$$\begin{pmatrix} \mathrm{Fh} \\ \mathrm{Nh} \\ \mathrm{Fv} \\ \mathrm{Nv} \end{pmatrix} = \begin{pmatrix} 3.05 & -7.34 & -0.36 & 0.6 \\ -0.22 & 0.8 & 0.05 & -0.09 \\ -0.04 & -0.06 & -4.03 & 7.45 \\ -0.01 & 0.01 & -0.13 & 0.4 \end{pmatrix} \begin{pmatrix} \mathrm{MUh} \\ \mathrm{MDh} \\ \mathrm{MUv} \\ \mathrm{MDv} \end{pmatrix}$$

Noise injections at the PZT actuators

Pure shift at the IMC dihedron:

$$\mathrm{Fh} = 0 \rightarrow \mathrm{MUh} = 2.4066\ \mathrm{MDh}$$
$$\mathrm{Fv} = 0 \rightarrow \mathrm{MUv} = 1.8486\ \mathrm{MDv}$$

Pure tilt at the IMC dihedron:

obtained from the theoretical ABCD matrices and a correction given by a calibration factor

New Driving matrix at the BPC

New Driving:

$$\begin{pmatrix} \mathrm{MUh} \\ \mathrm{MUv} \\ \mathrm{MDh} \\ \mathrm{MDv} \end{pmatrix} = \begin{pmatrix} 0 & -1.7529 & 2.4066 & 0 \\ -1.3466 & 0 & 0 & 1.8486 \\ 0 & -1 & 1 & 0 \\ -1 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \mathrm{txC} \\ \mathrm{tyC} \\ \mathrm{xC} \\ \mathrm{yC} \end{pmatrix}$$

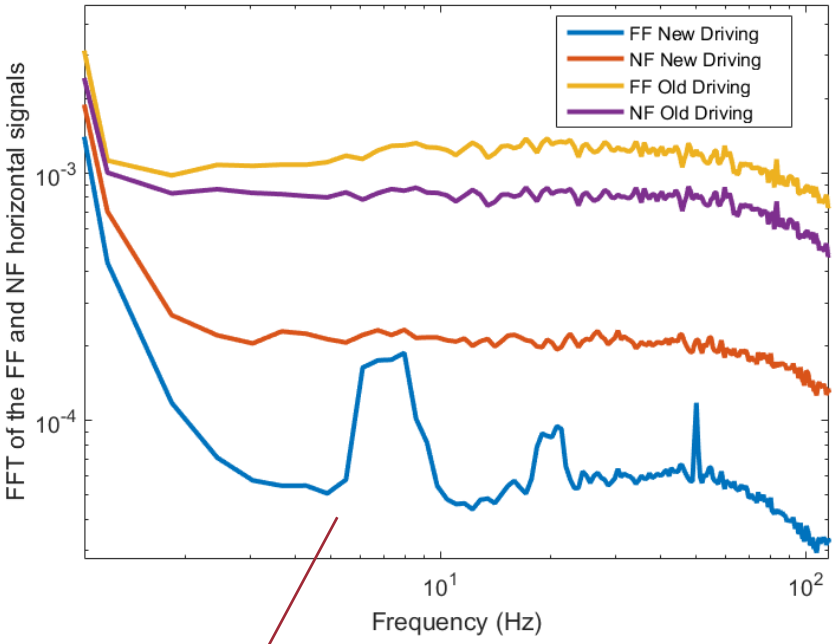
Temporary calibration factors:

$$\mathrm{CxC} = 0.0021$$
$$\mathrm{CyC} = 0.0035$$
$$\mathrm{CtxC} = 0.0175$$
$$\mathrm{CtyC} = 0.0141$$

The final calibration factors will be obtained from the tz and ty of the suspended bench.

- Injection in txCorr : Bs_txCorr / IB_tz = -1.433
- Injection in tyCorr : Bs_tyCorr / IB_ty = -2.07

Results of the New Driving matrix for the BPC



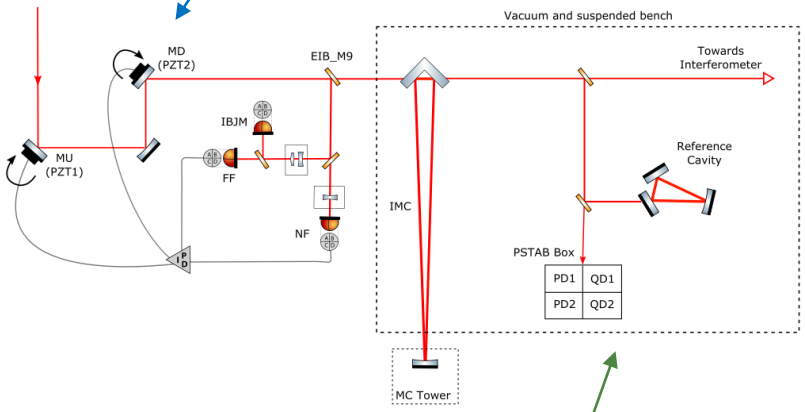
Far Field sees less shift now!

New Driving better agreement with the experimental window measurement

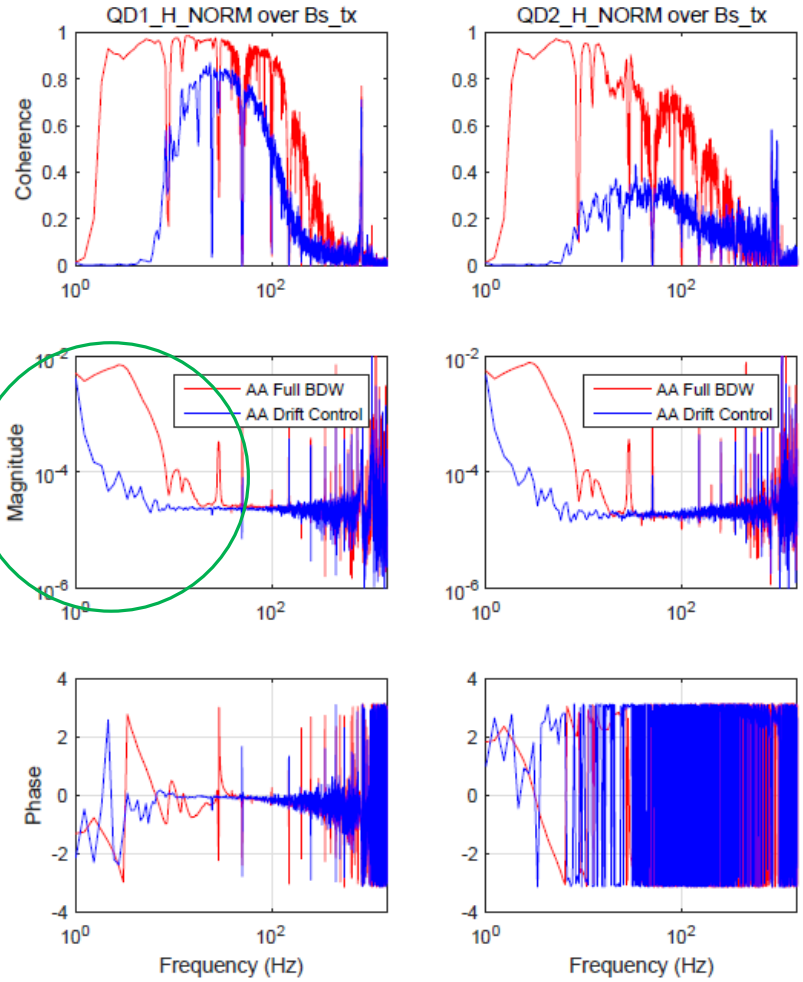
		New Driving	Window	Old Driving	Theoretical
Vertical shift	Fv/y	-0.2	-0.12205	2.2	0.02
	Fh/y	-0.25	-0.05684	-0.4	0
	Nv/y	0.5	0.36616	0.6	0.55
	Nh/y	Not flat!	0.013854	0.1	0
Horiz. shift	Fv/x	-0.4	-0.054286	-0.1	0
	Fh/x	0.2	-0.22622	-1.3	0.02
	Nv/x	0.0426	0.074685	0.1	0
	Nh/x	0.71	0.66393	0.8	0.55

Beam jitter at the PSTAB quadrants

Injected beam jitter!



Sensed beam jitter!

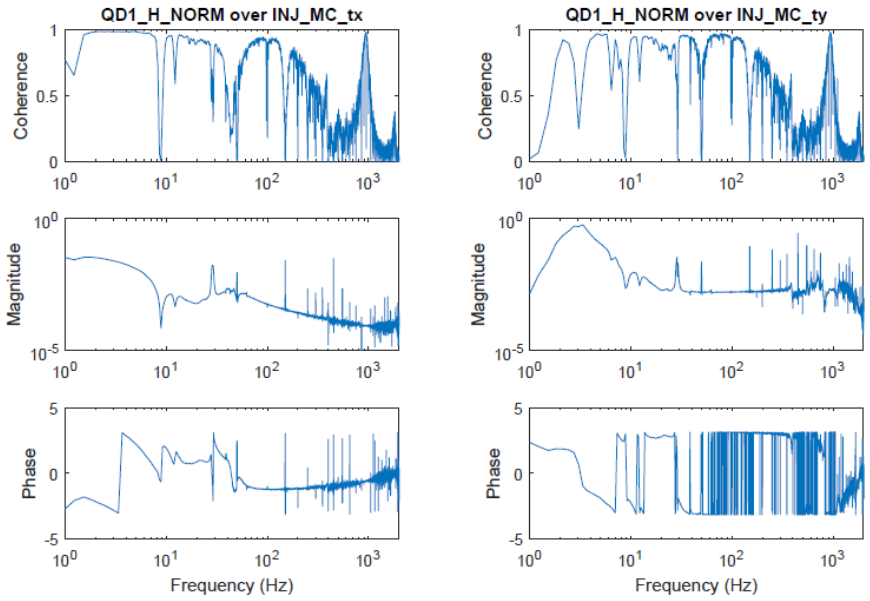


Not flat!

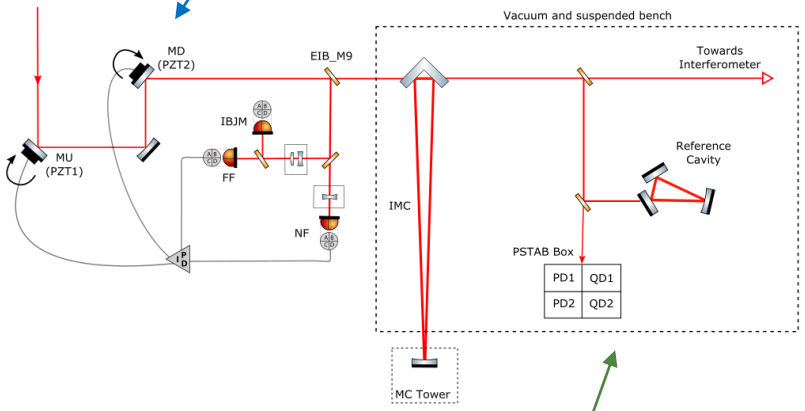
- ✓ TF of the quadrants is flat for all frequencies

Beam jitter at the PSTAB quadrants

Correlation between quadrants signals and parameters of the suspended bench



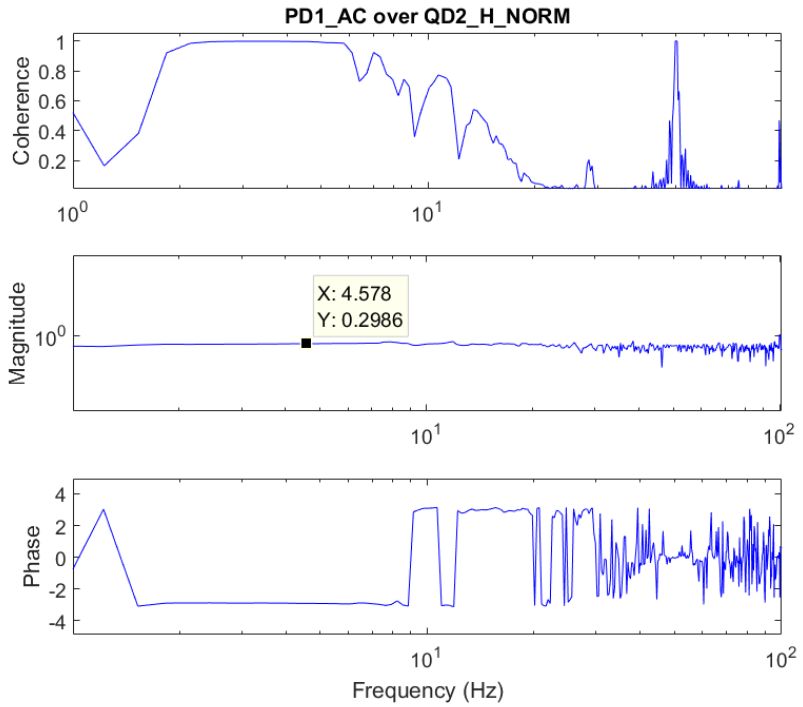
Injected beam jitter!



Sensed beam jitter!

Beam jitter into RIN coupling factor at the PSTAB photodiodes

$$\kappa = \frac{\mathrm{RIN\_ind}}{\Delta} \quad \left[\frac{1}{\mathrm{m}}\right]$$



For the PD1 photodiode (out-of-loop sensor):

$$\text{Horizontal Coupling (ty injection): } \mathrm{K_h} = 0.7571 \times 15 = 11.3\ \mathrm{m^{-1}}$$ (K_h = 2.2 m^{-1})

$$\text{Vertical Coupling (y injection): } \mathrm{K_v} = 0.2936 \times 15 = 4.4\ \mathrm{m^{-1}}$$ (K_v = 1.3 m^{-1})

Residual beam jitter at the input of the IMC

Tilt ←

Shift ←

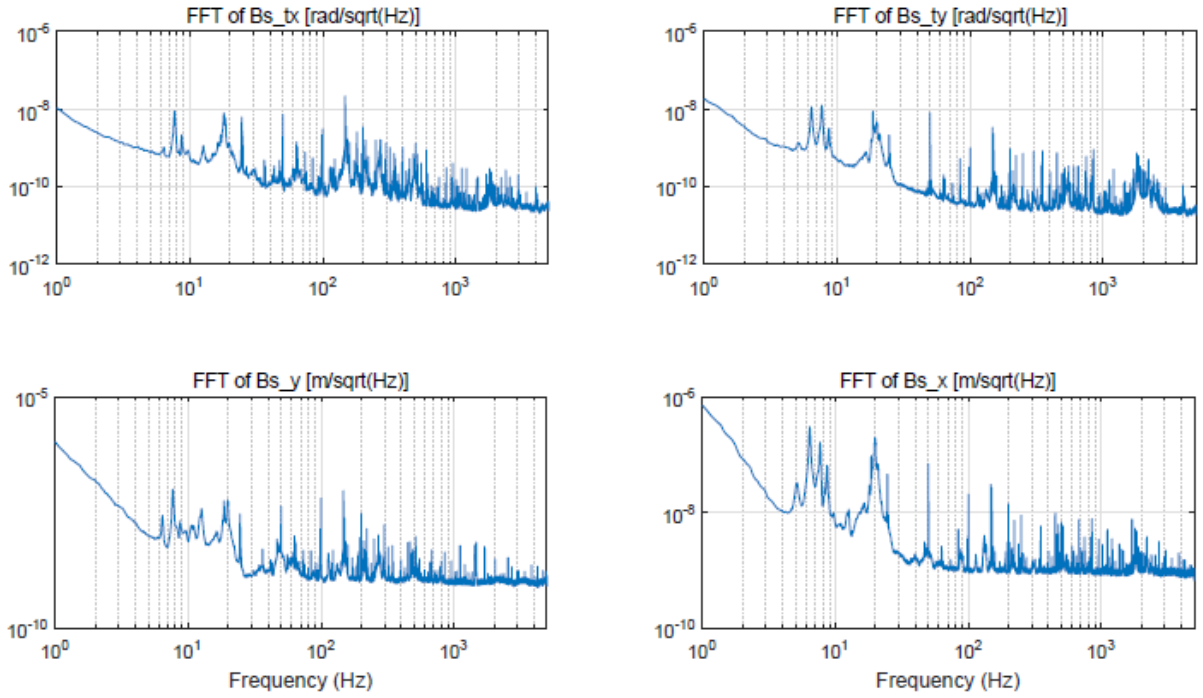
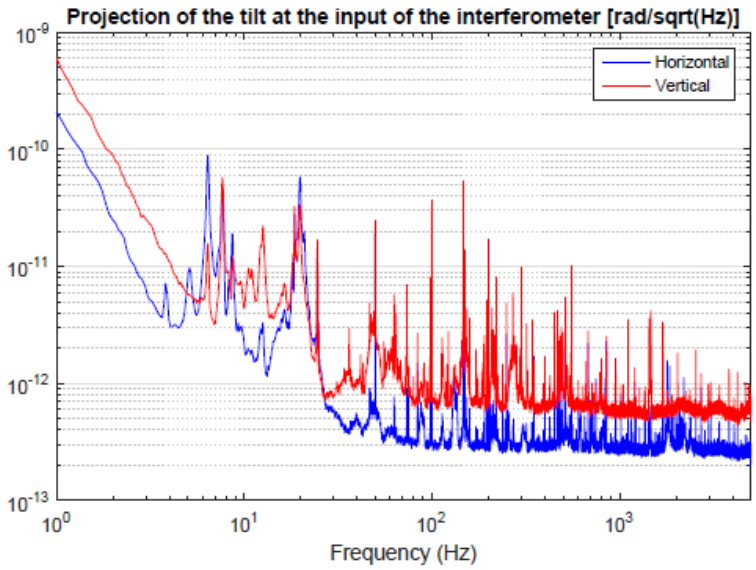
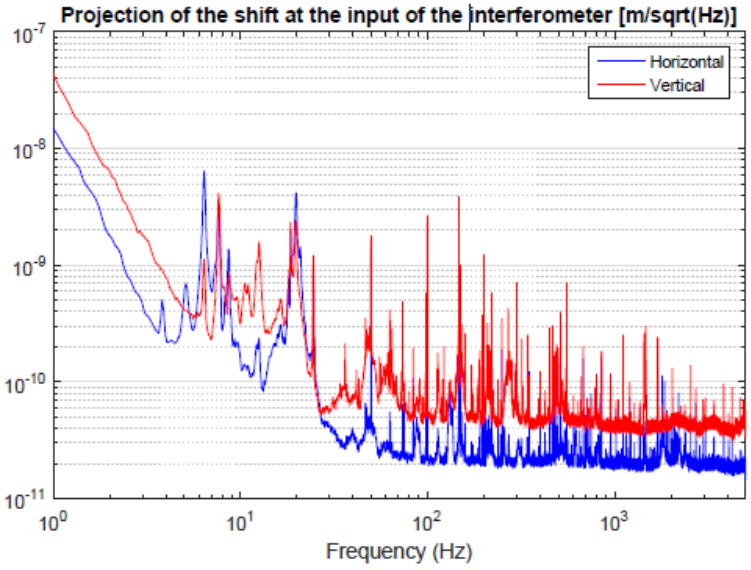


Figure 4.1: FFT of the residual beam jitter at the input of the IMC. The GPS used is 1155610817 (3 am on 19 of August), duration 800 sec.

Residual beam jitter at the input of the ITF



Tilt



Shift