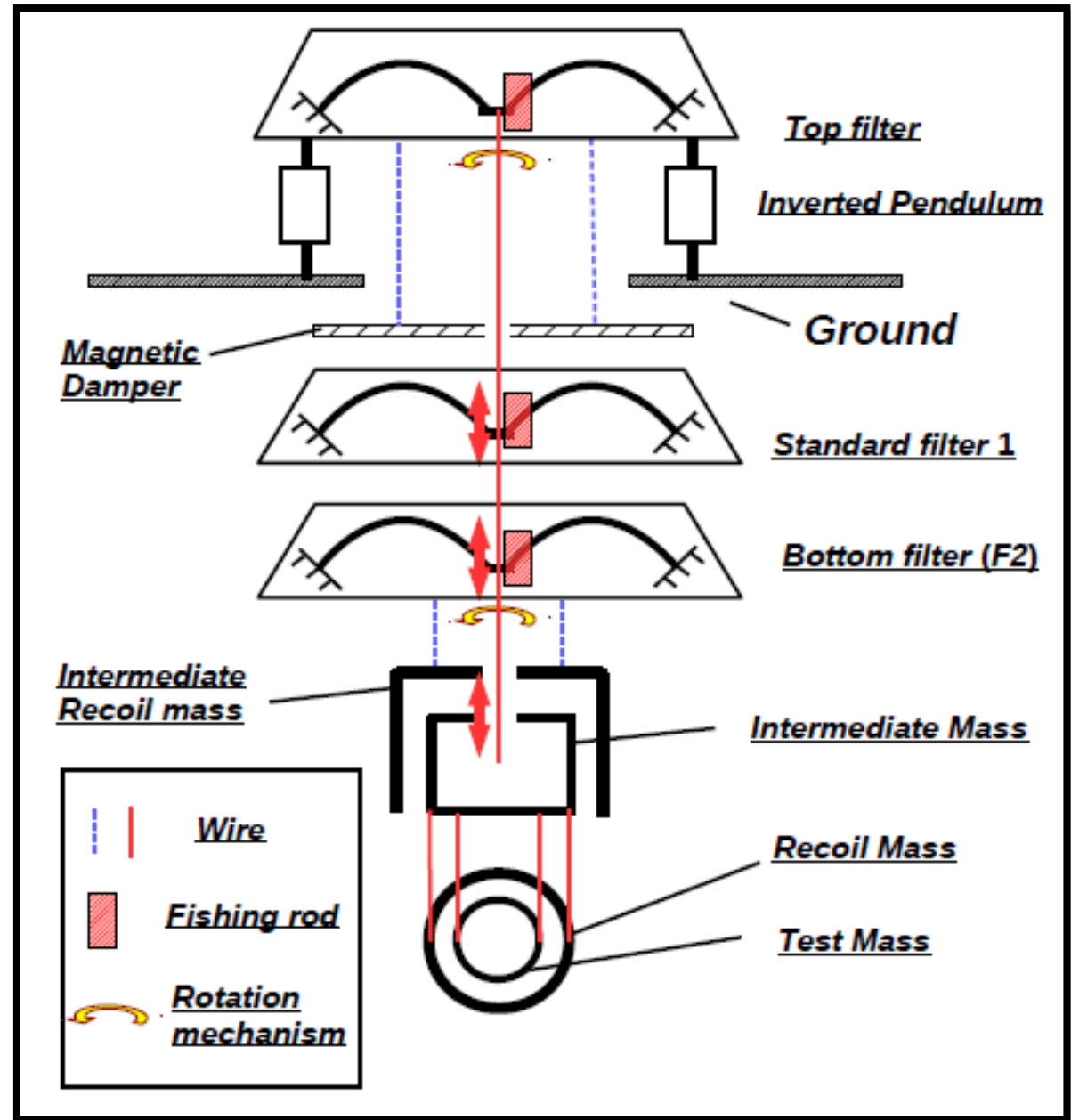
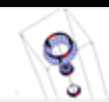


TypeB



Mechanical response

Calculated by SUMCON (and Simulink)



TypeBp with IP 160205

Model Basic Information

Degrees of Freedom:

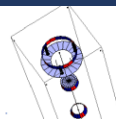
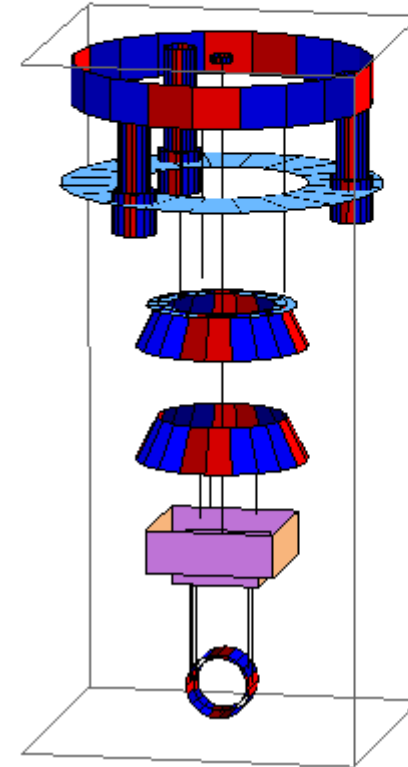
45 State Variables
6 Input Variables
3 Float Variables

Ground Position:

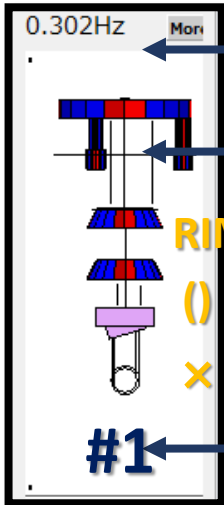
xg → 0. yg → 0. zg → 0. pitchg → 0. yawg → 0. rollg → 0.

Equilibrium Point:

xF0 → 0.	zF0 → 0.	yawF0 → 0.	xMD → 0.	yMD → -0.572	zMD → 0.
pitchMD → 0.	yawMD → 0.	rollMD → 0.	xF1 → 0.	yF1 → -0.665	zF1 → 0.
pitchF1 → 0.	yawF1 → 0.	rollF1 → 0.	xF2 → 0.	yF2 → -1.1984	zF2 → 0.
pitchF2 → 0.	yawF2 → 0.	rollF2 → 0.	xIR → 0.	yIR → -1.6936	zIR → 0.
pitchIR → 0.	yawIR → 0.	rollIR → 0.	xIM → 0.	yIM → -1.7699	zIM → 0.
pitchIM → 0.	yawIM → 0.	rollIM → 0.	xRM → 0.	yRM → -2.3569	zRM → 0.
pitchRM → 0.	yawRM → 0.	rollRM → 0.	xTM → 0.	yTM → -2.3569	zTM → 0.
pitchTM → 0.	yawTM → 0.	rollTM → 0.	hGAS0 → 0.	hGAS1 → 0.	hGAS2 → 0.



Eigen Mode List



Resonance frequency

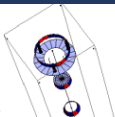
Eigen mode shape

RIM Sensing / Excitation point

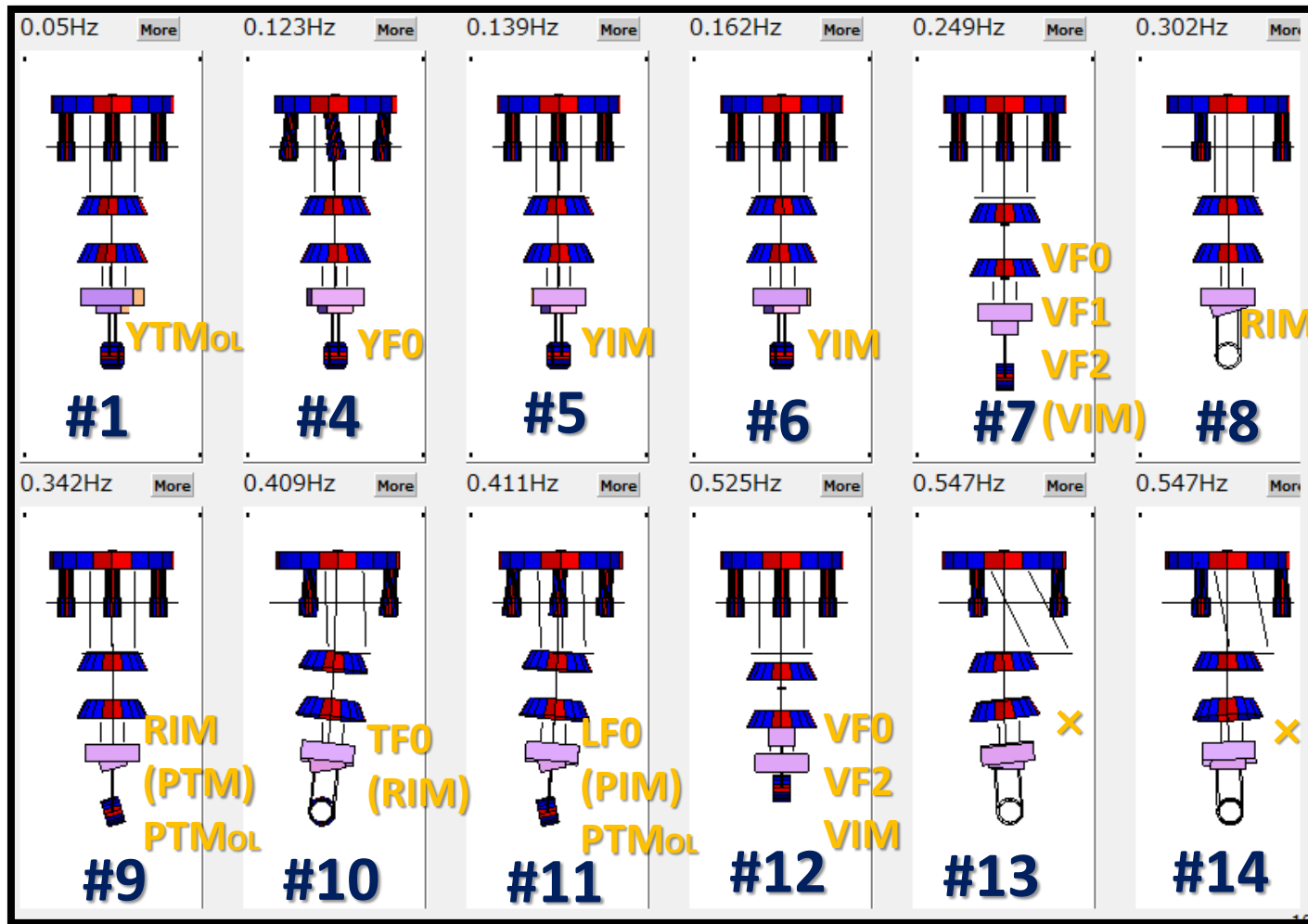
() Hardly seen/excited

x Cannot be seen/excited

#1 Eigen mode number



Eigen Mode Shape



#1 : YWholeChain

#2 : LF0 LF0

#3 : TF0 TF0

#4 : YF0

#5 : YPayload

#6 : YPayload

#7 : VPayload
(VF1, VF2, VPayload)

#8 : RPayload
(RIM)

#9 : PPayload
(PIM)

#10 : TPendulum

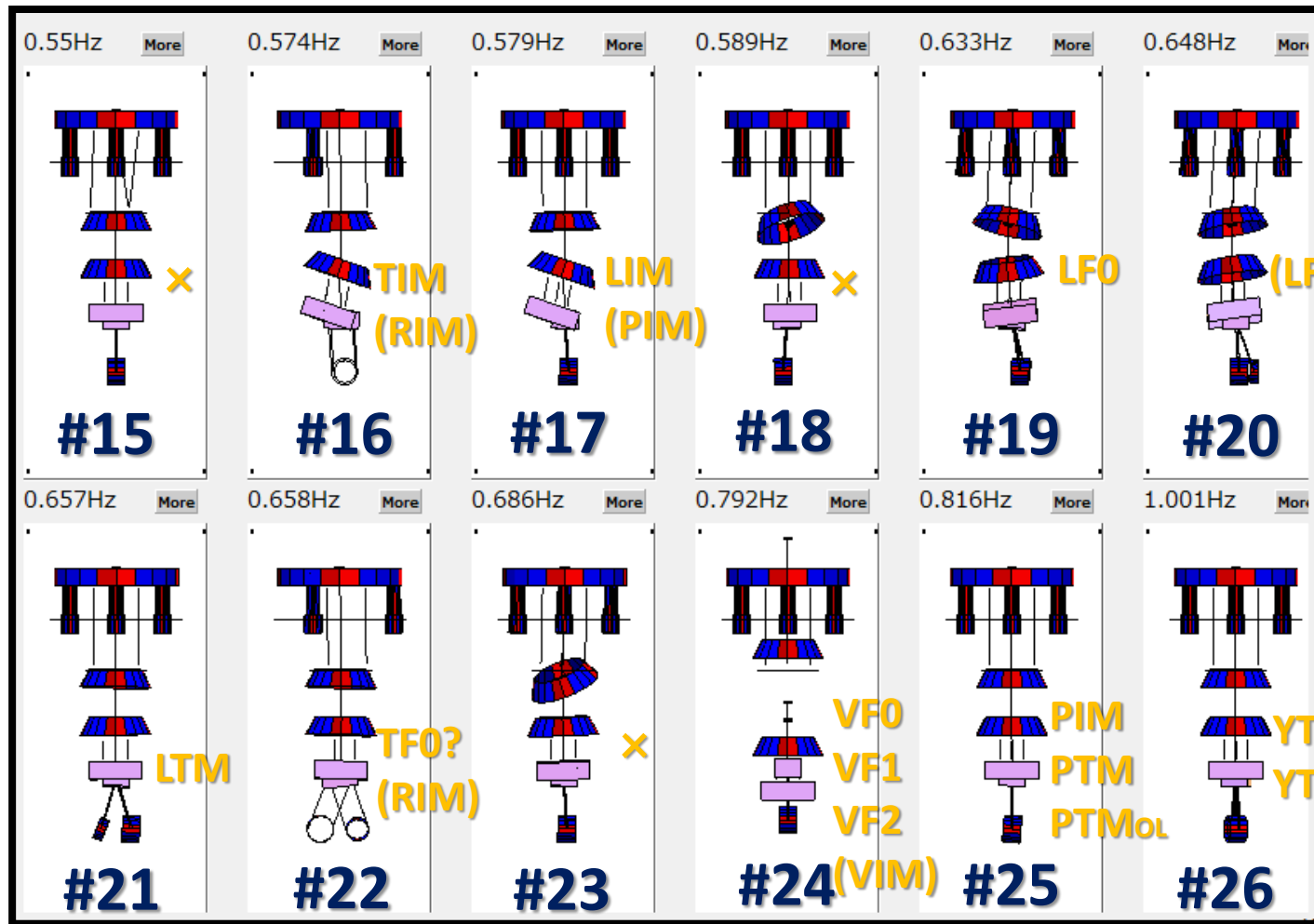
#11 : LPendulum

#12 : Vpayload
(VF1, VF2, -VPayload)

#13 : TMD

#14 : LMD

Eigen Mode Shape



#15 : YMD

#16 : RF2

#17 : PF2

#18 : PF1

#19 : Pendulum

#20 : Pendulum

#21 : LTM

#22 : TTM

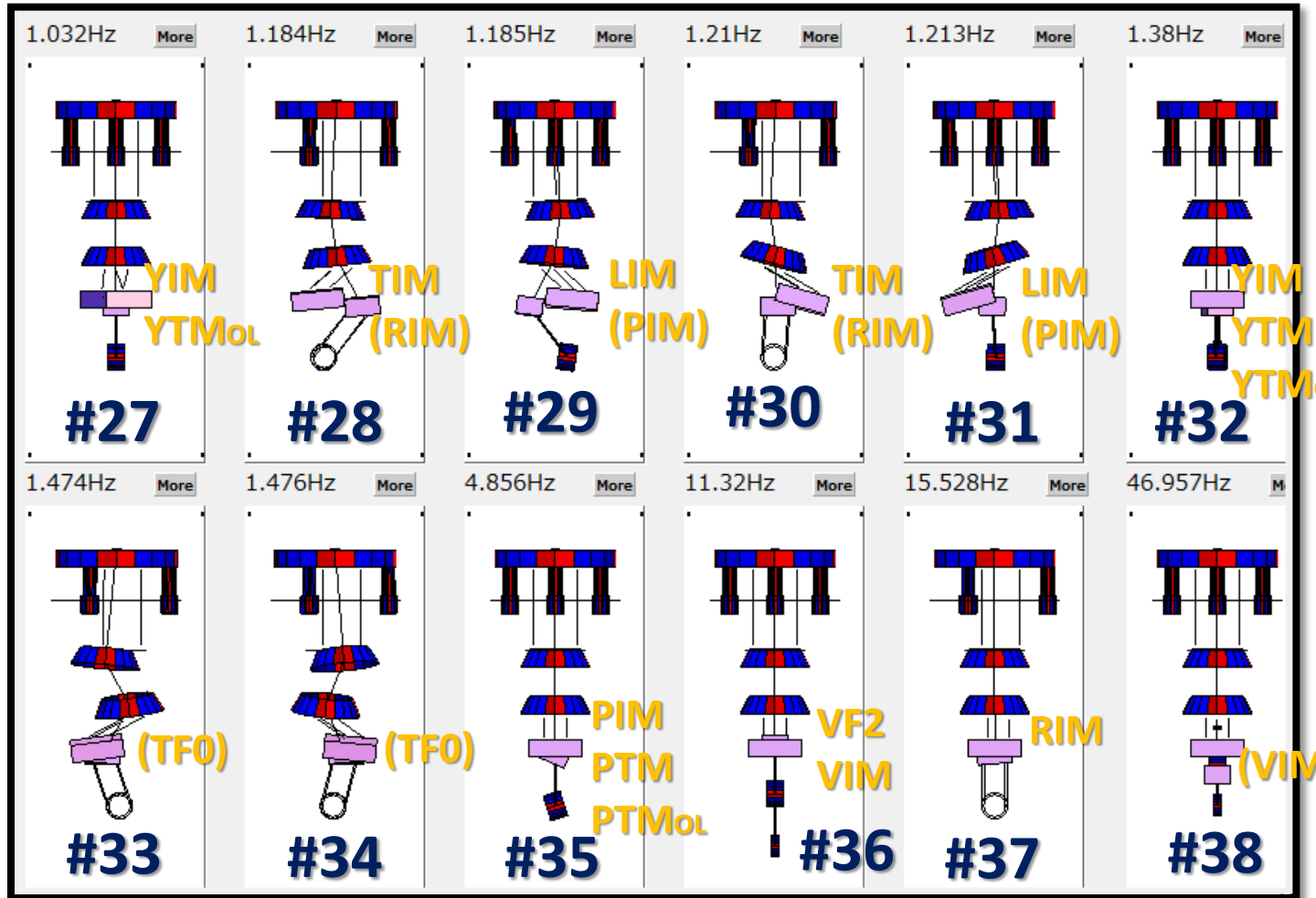
#23 : PF1

#24 : GAS
(VF1)

#25 : PTM

#26 : YTM
(YTM, -YRM)

Eigen Mode Shape



#27 : YIR

#33 : Pendulum

#28 : TIM

#34 : Pendulum

#29 : LIM

#35 : PIM, PRM

#30 : TIR

#36 : VTM

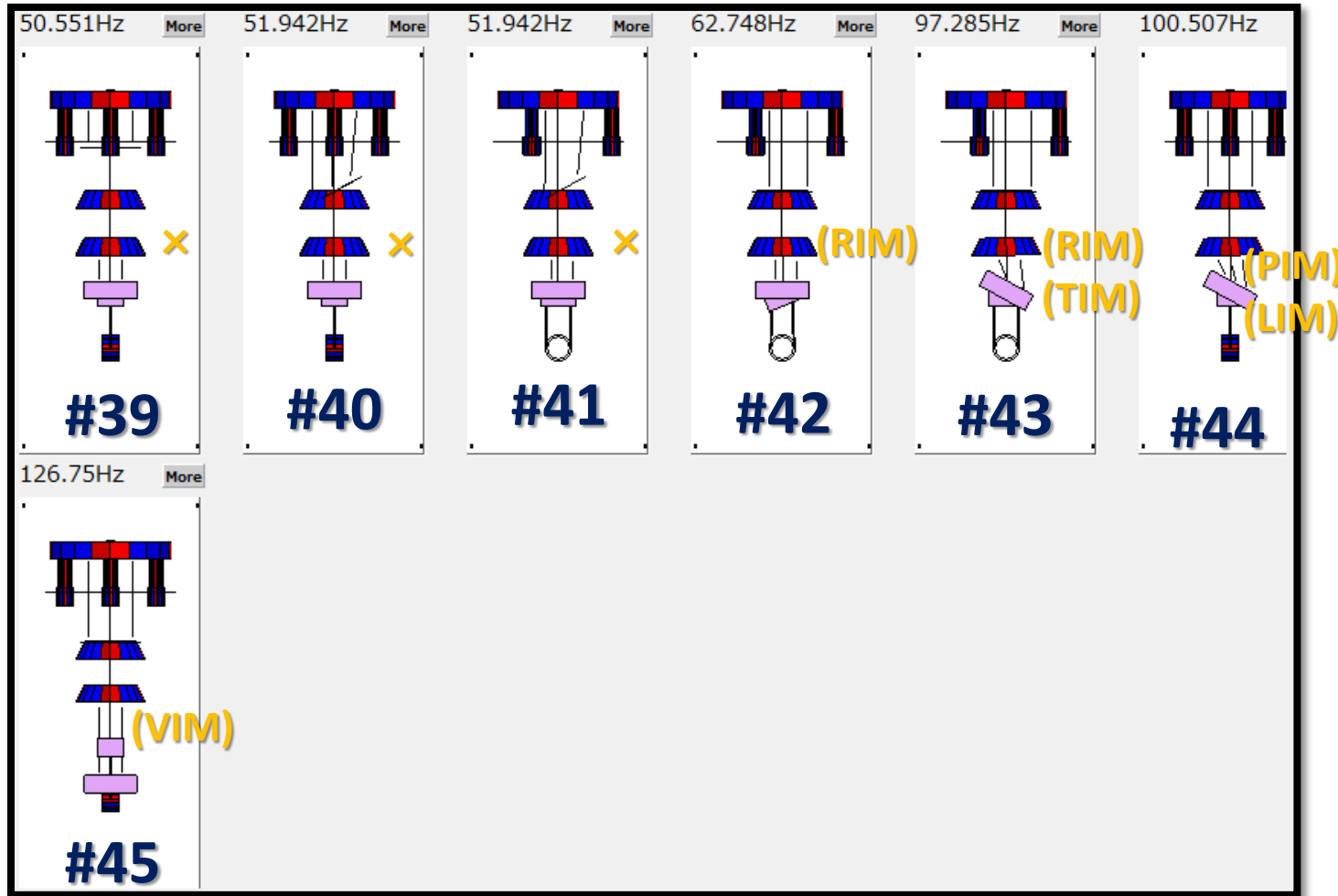
#31 : LIR

#37 : RTM

#32 : YTM
(YTM, YRM)

#38 : VRM

Eigen Mode Shape



#39 : VMD

#40 : PMD

#41 : RMD

#42 : RIM, RRM

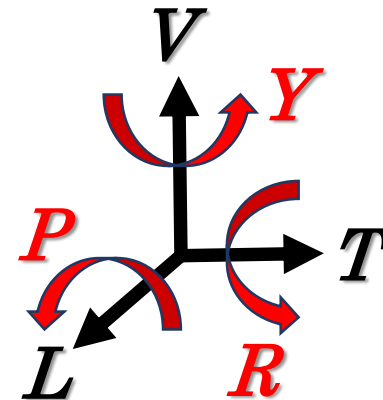
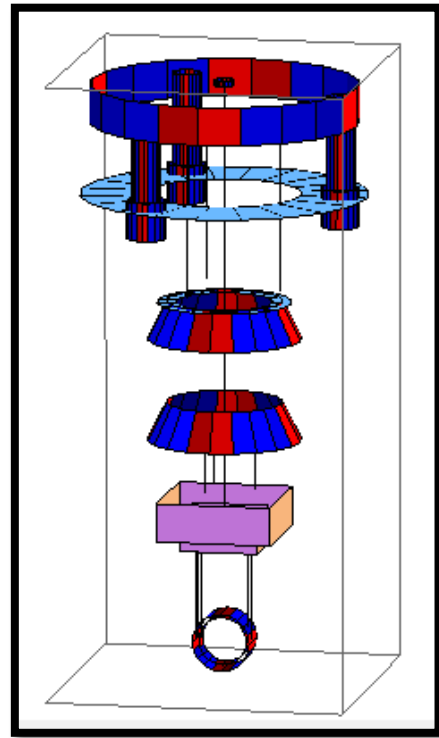
#43 : RIR

#44 : PIR

#45 : VIR

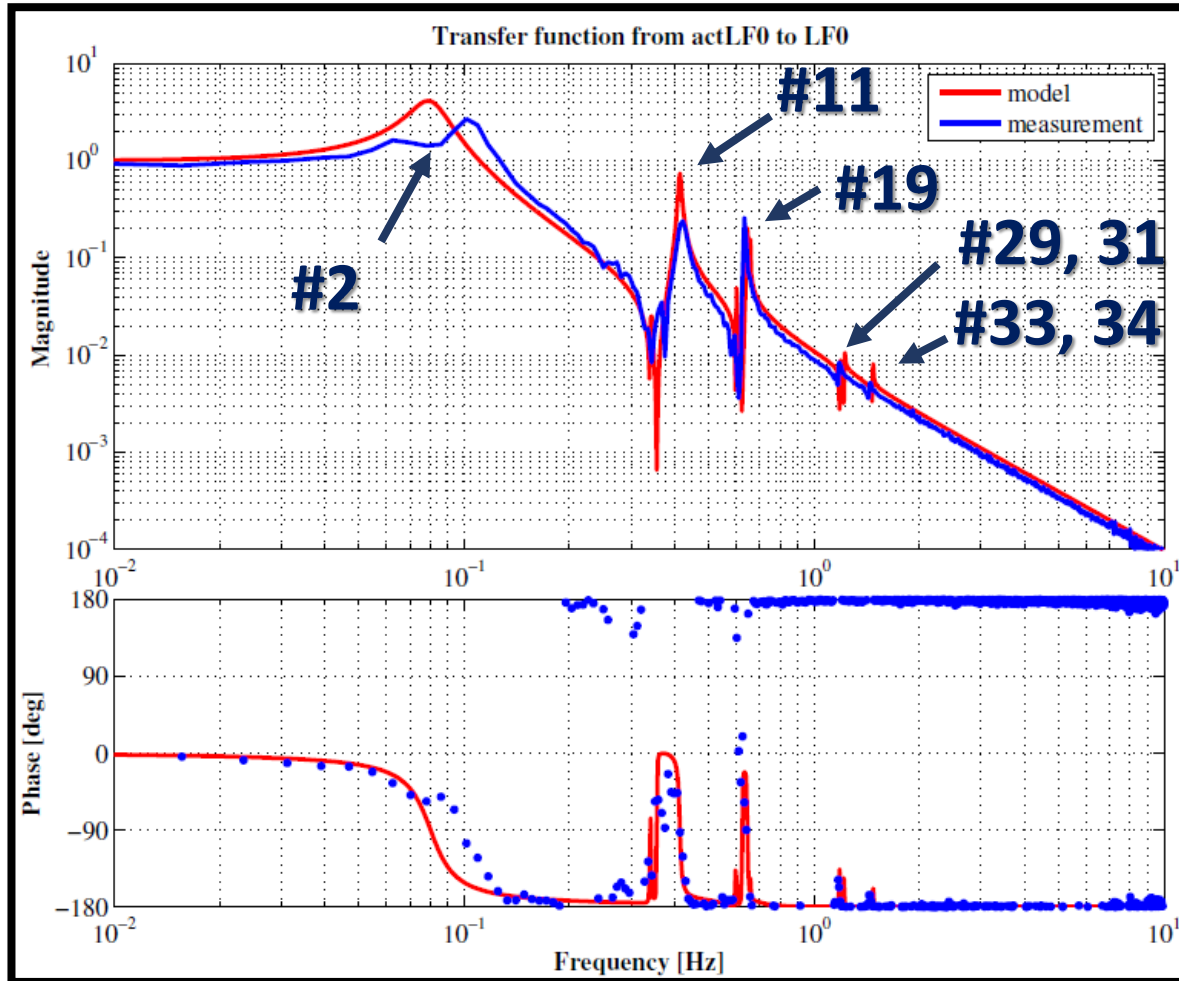
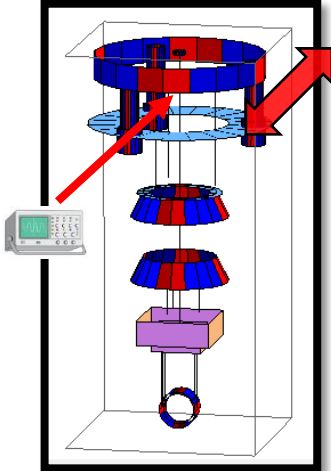
Force Transfer Functions

(, which can be measured, with No ctrl)



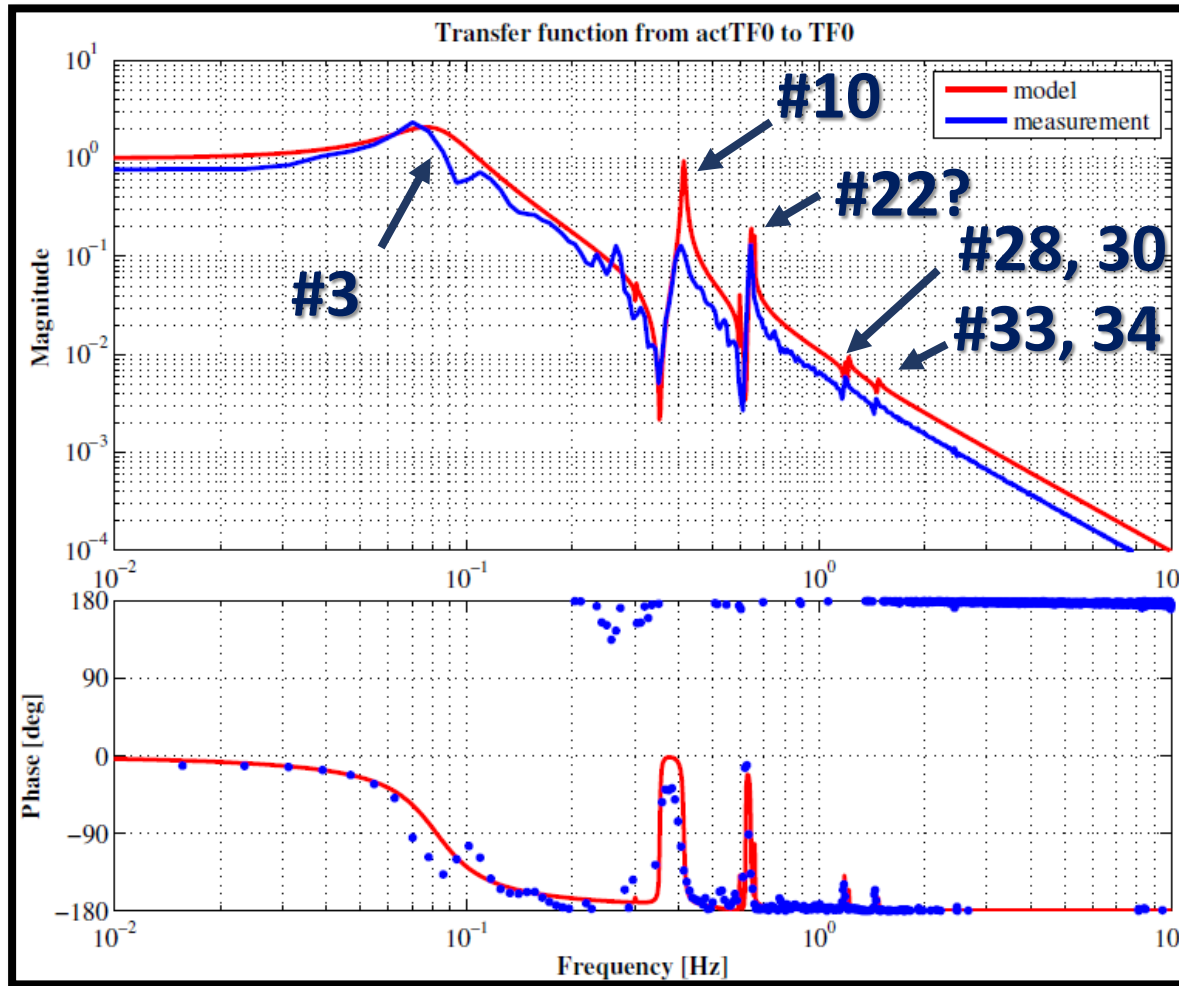
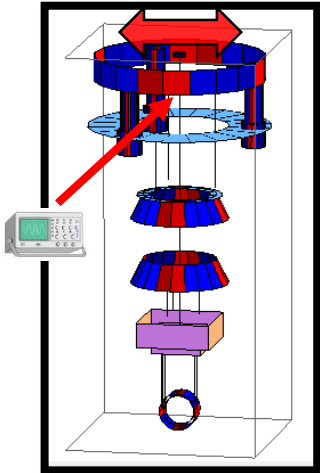
Force Transfer Function

LVDT_LF0 / actLF0



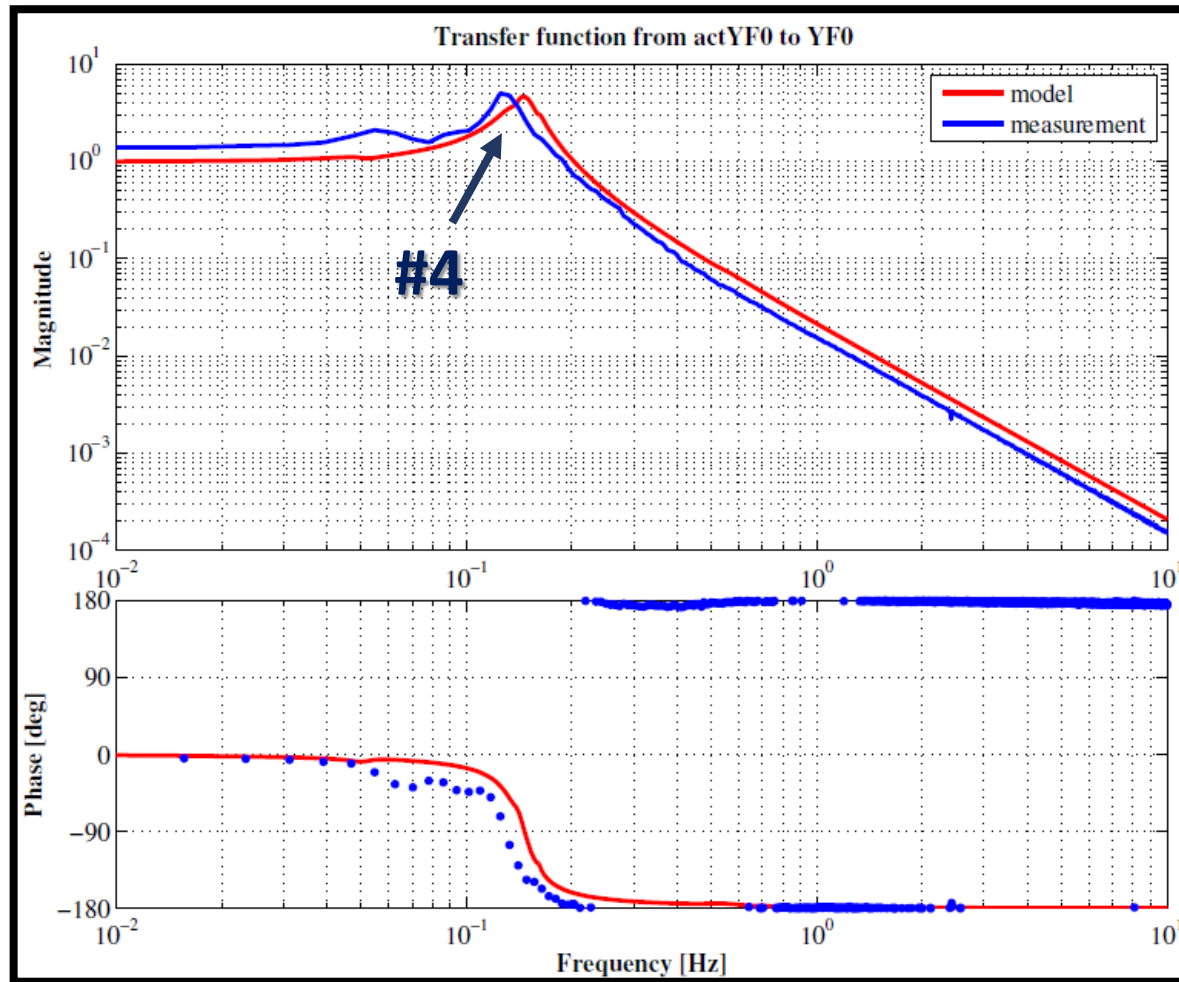
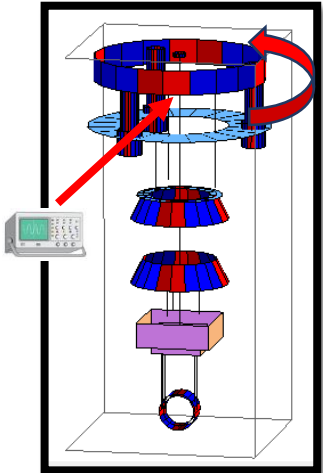
Force Transfer Function

LVDT_TF0 / actTF0



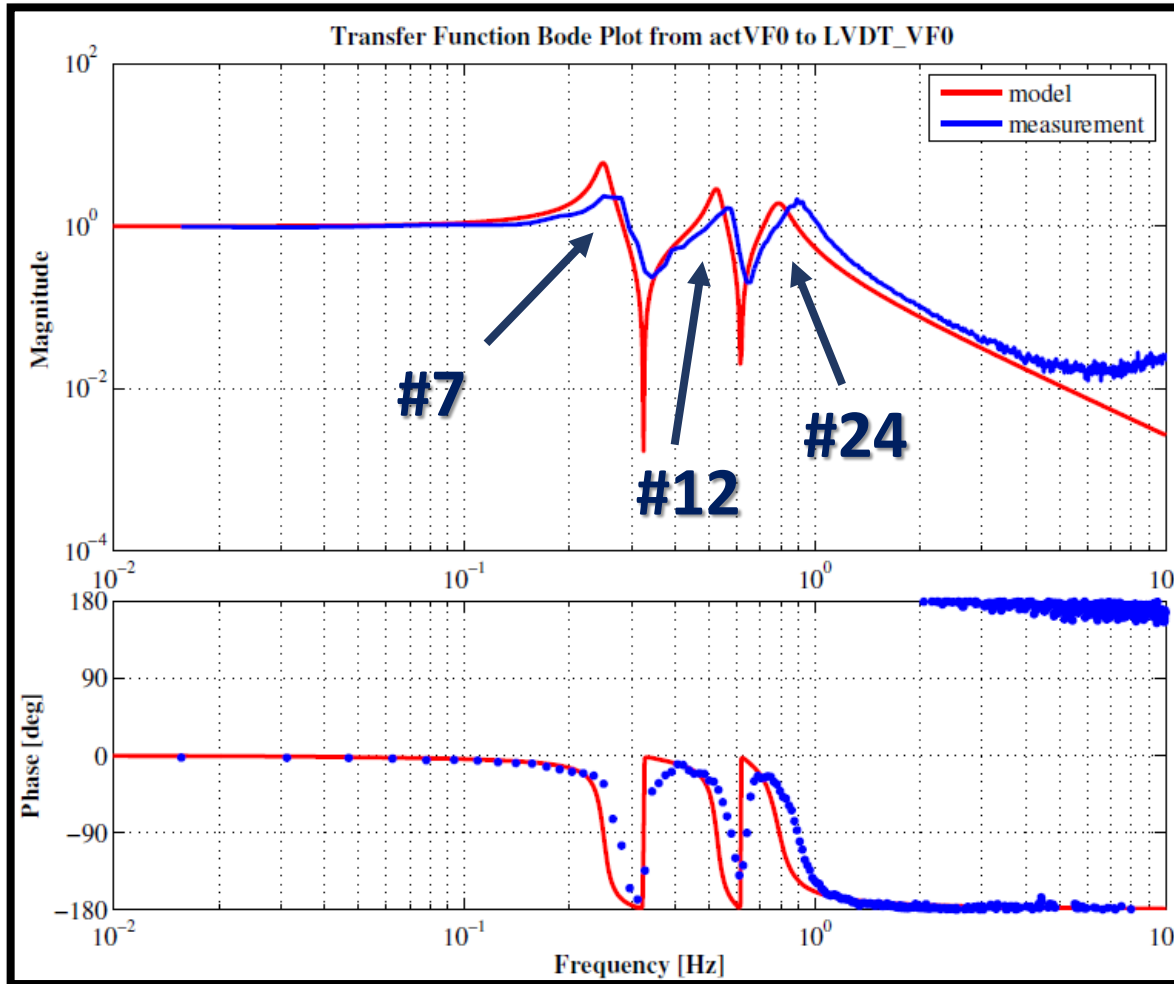
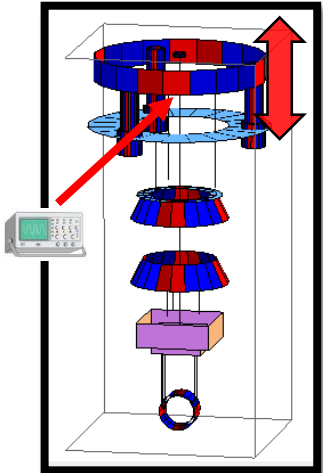
Force Transfer Function

LVDT_YF0 / actYF0



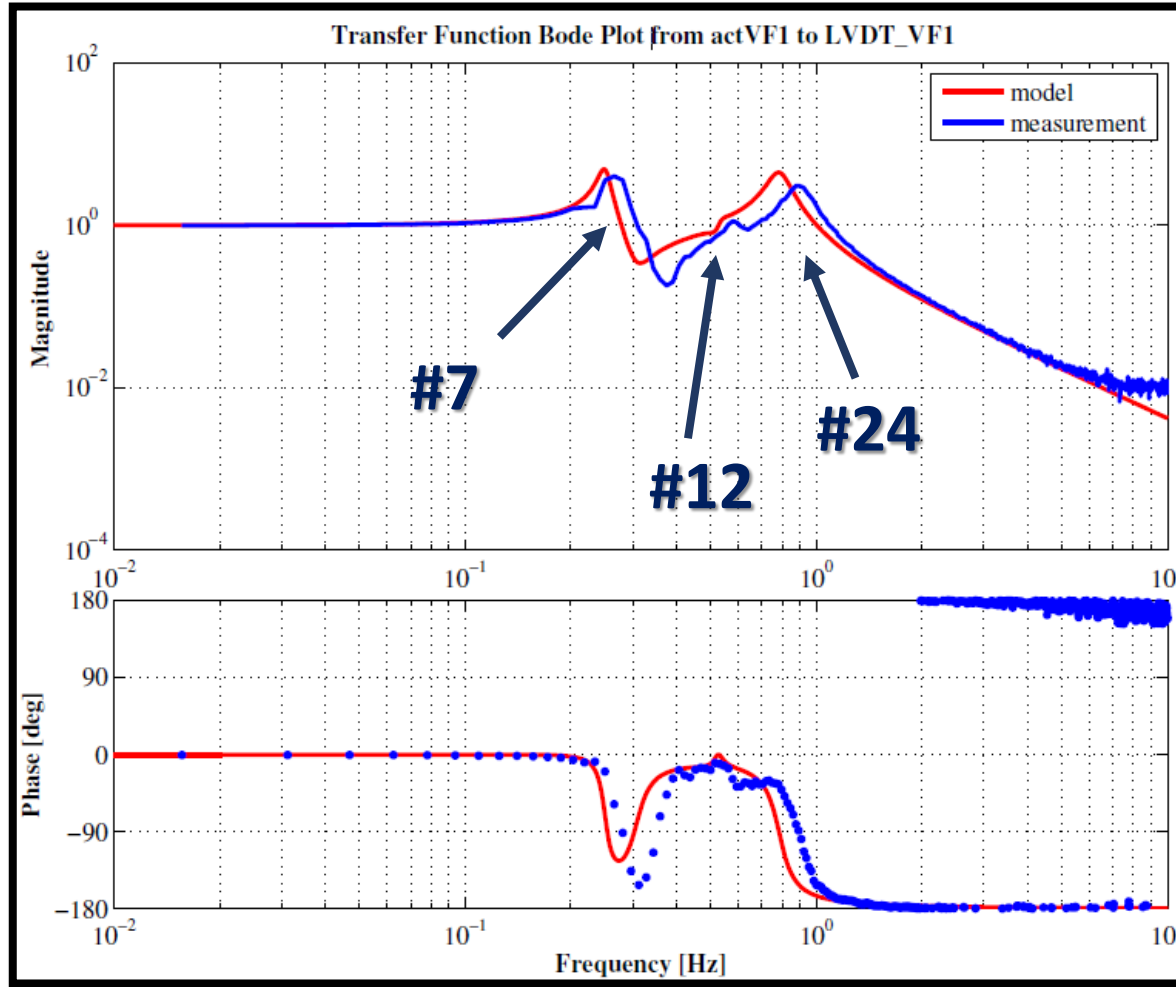
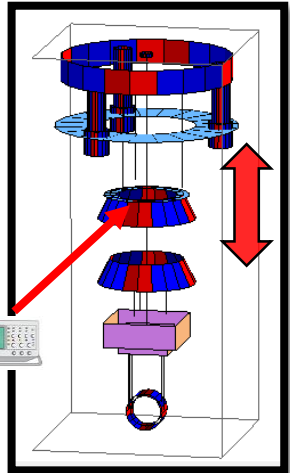
Force Transfer Function

LVDT_VF0 / actVF0



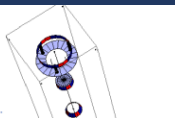
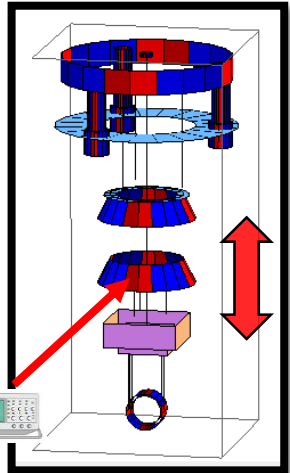
Force Transfer Function

LVDT_VF1 / actVF1



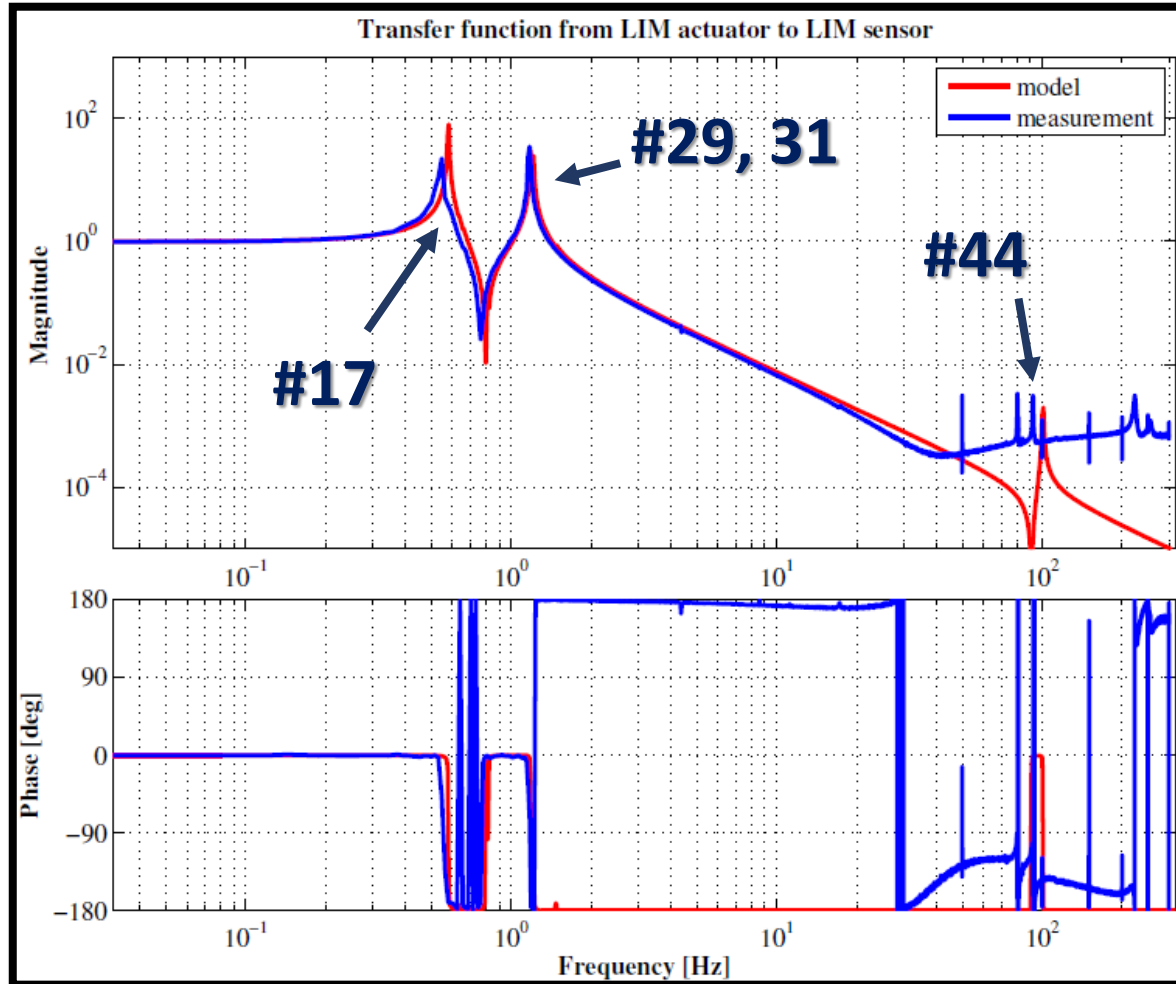
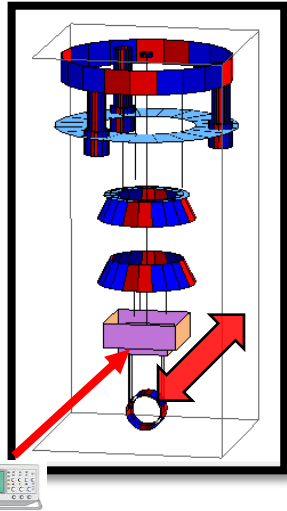
Force Transfer Function

$$LVDT_VF2 / actVF2$$



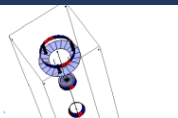
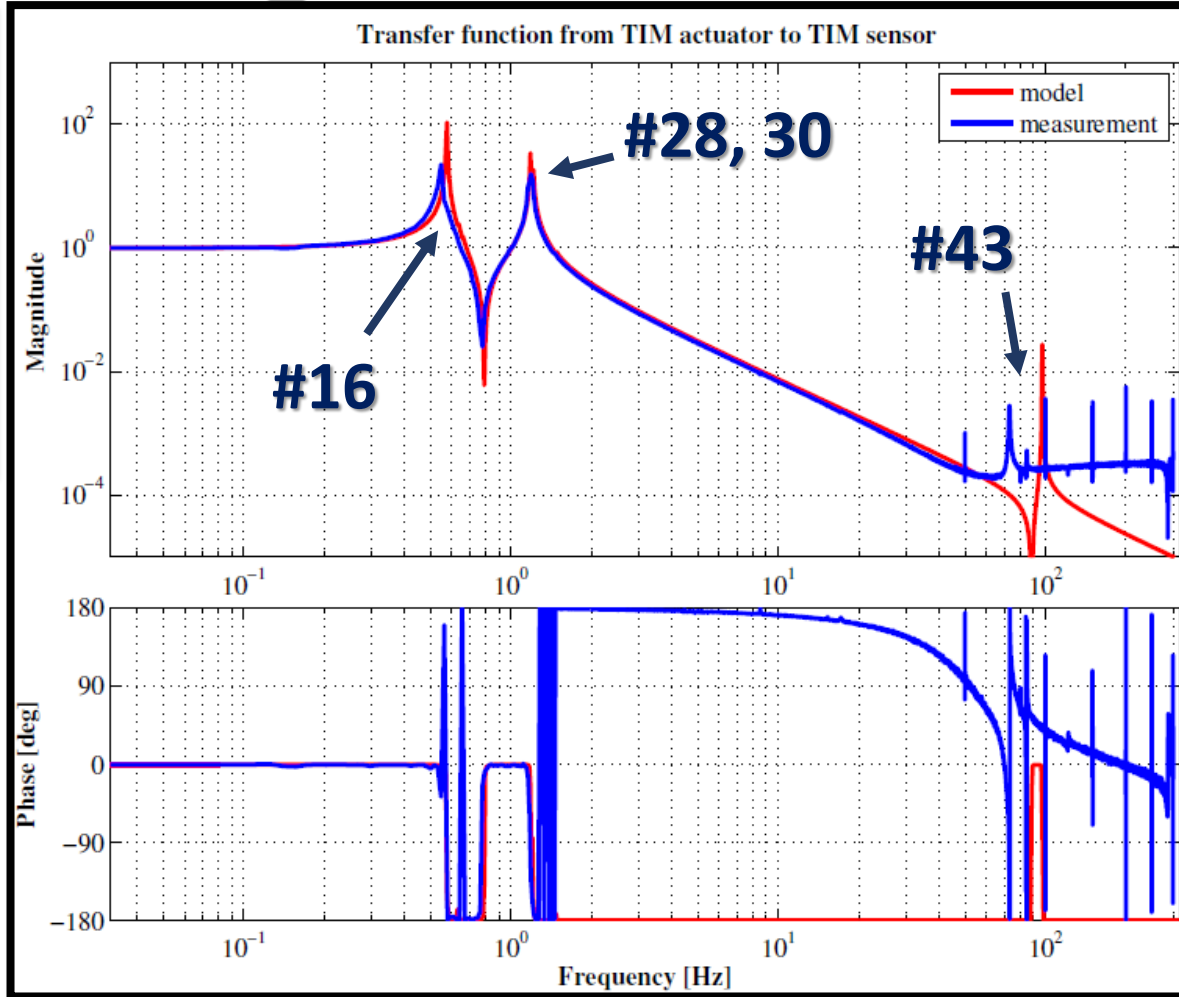
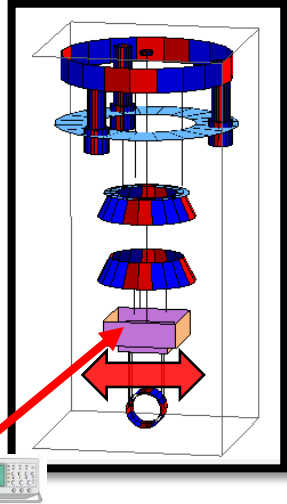
Force Transfer Function

OSEM_LIM / actLIM



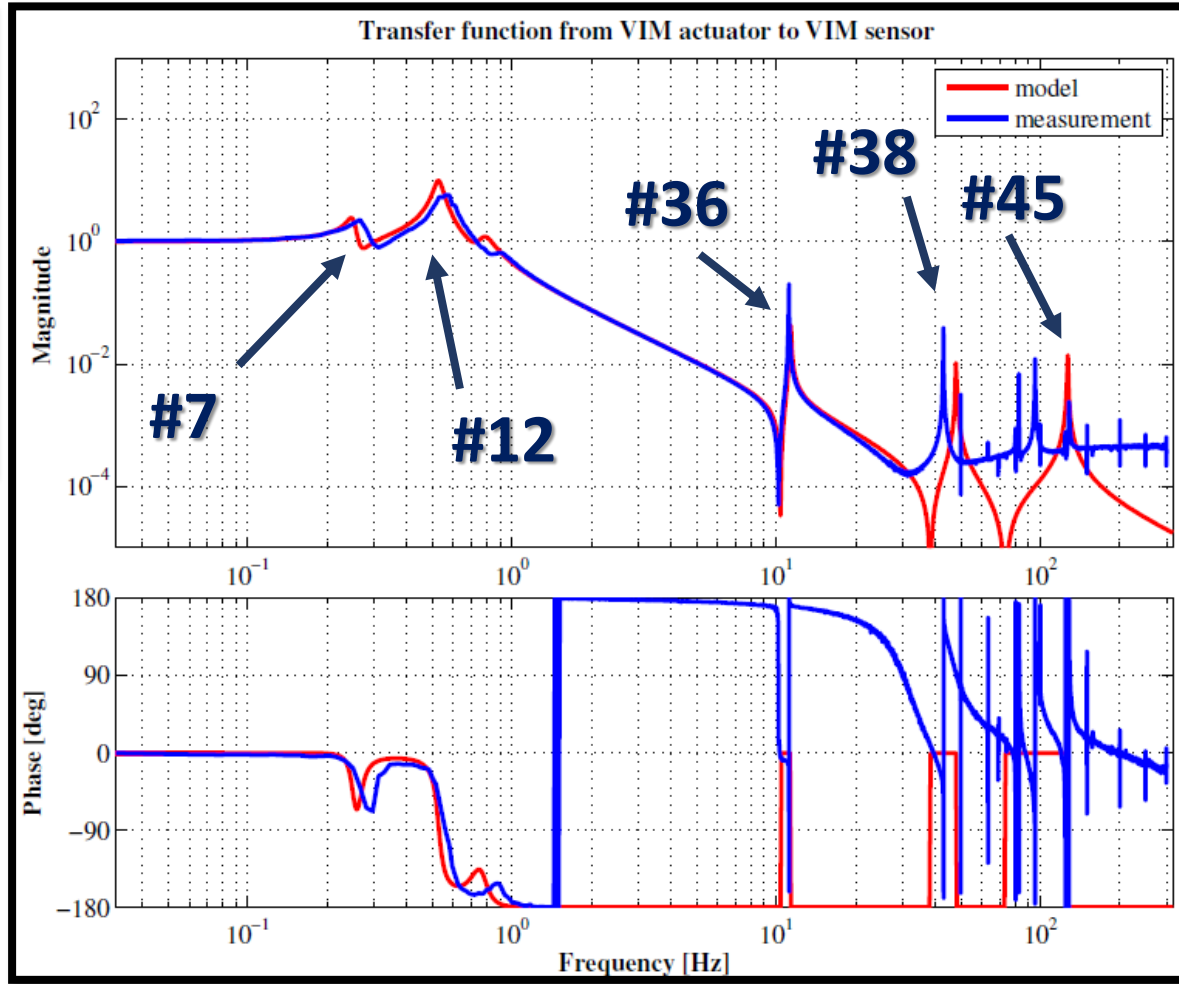
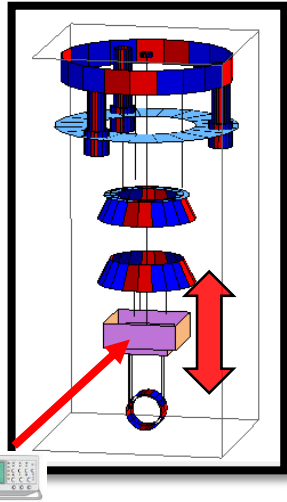
Force Transfer Function

OSEM_TIM / actTIM



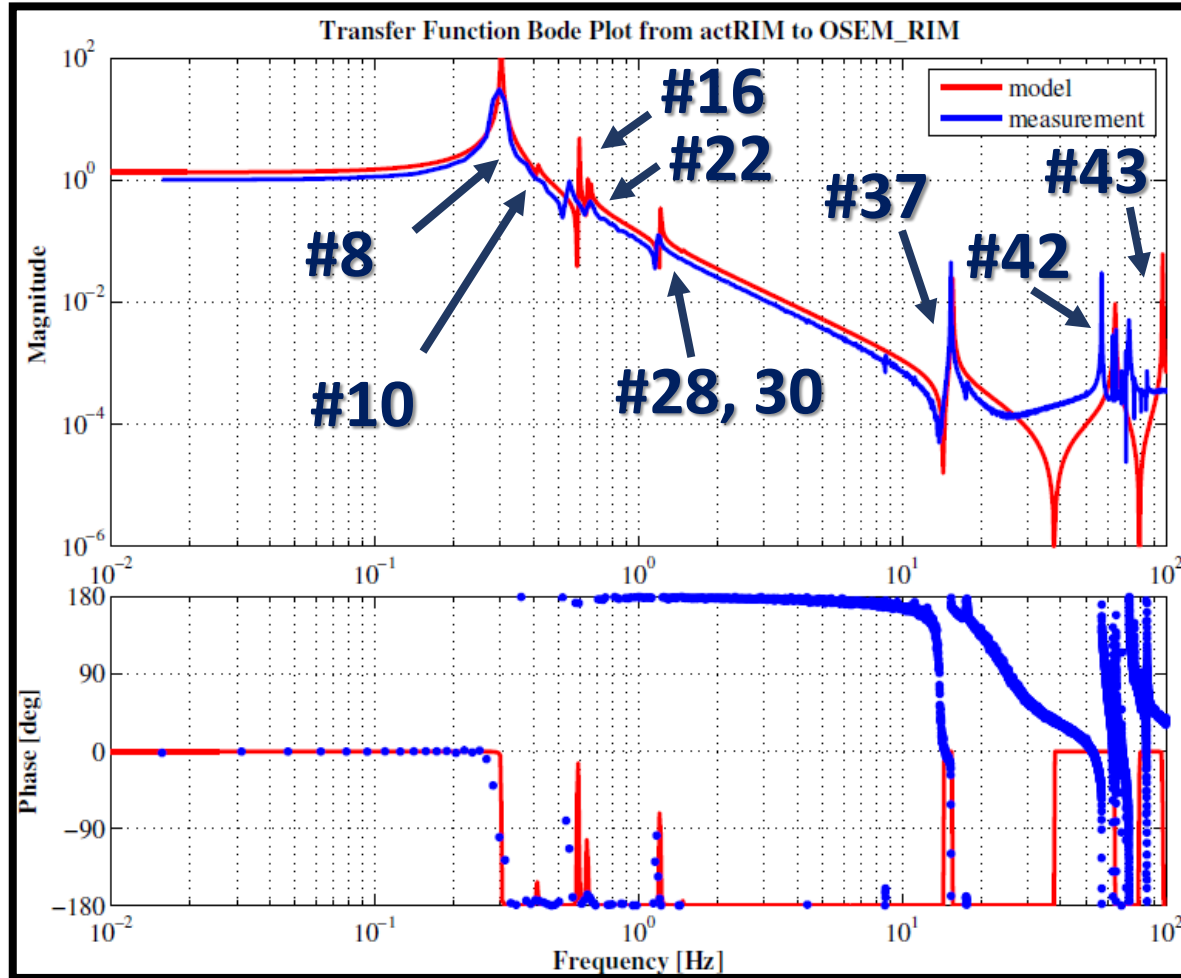
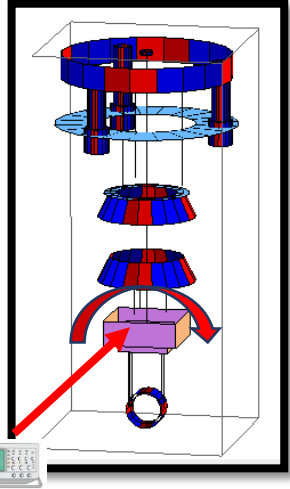
Force Transfer Function

OSEM_VIM / actVIM



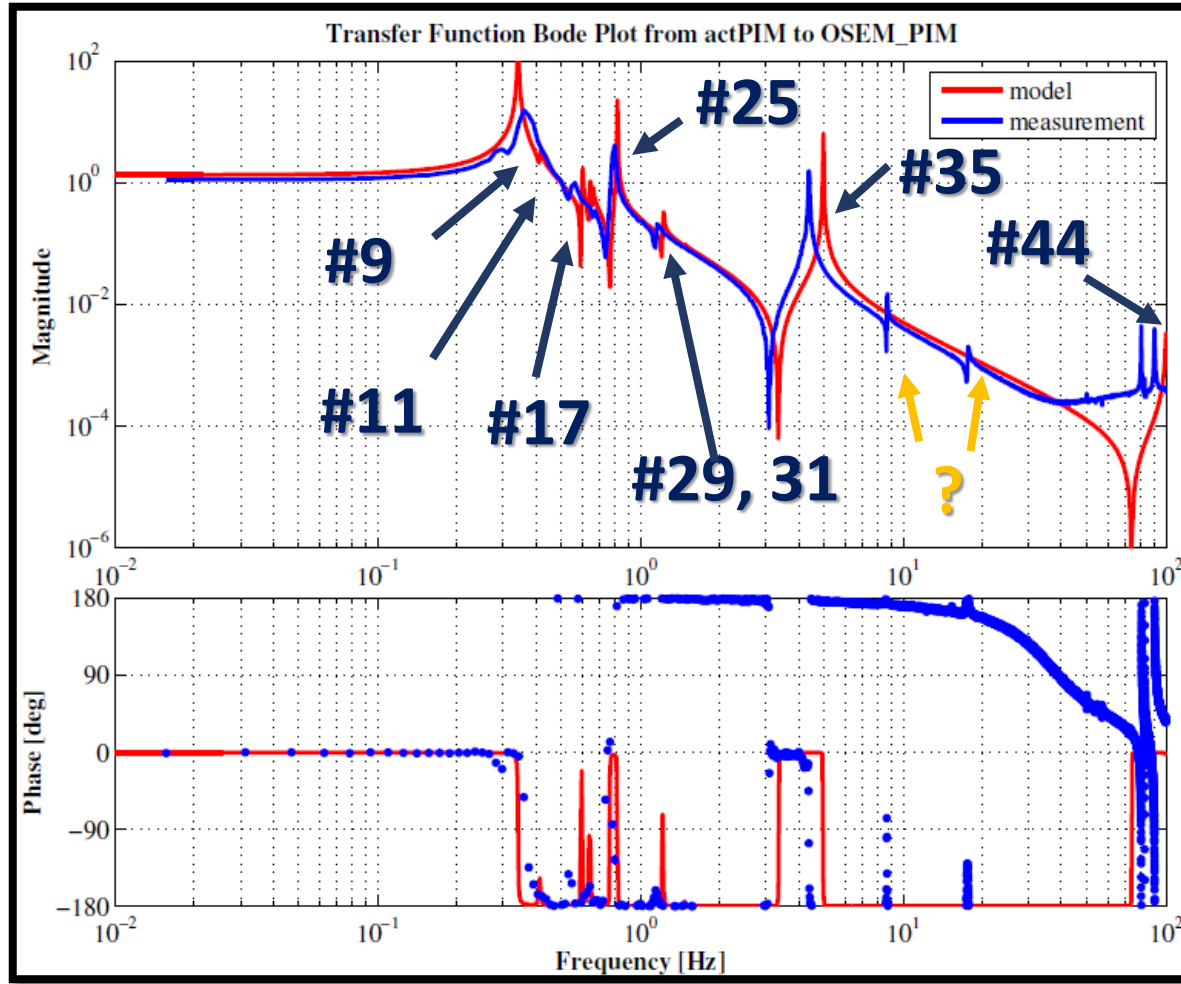
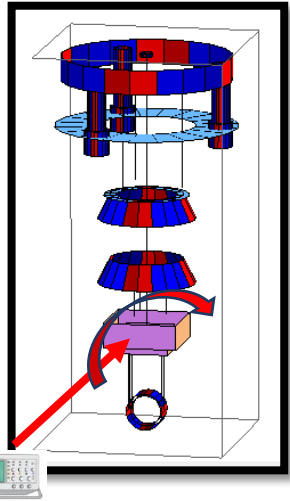
Force Transfer Function

OSEM_RIM / actRIM



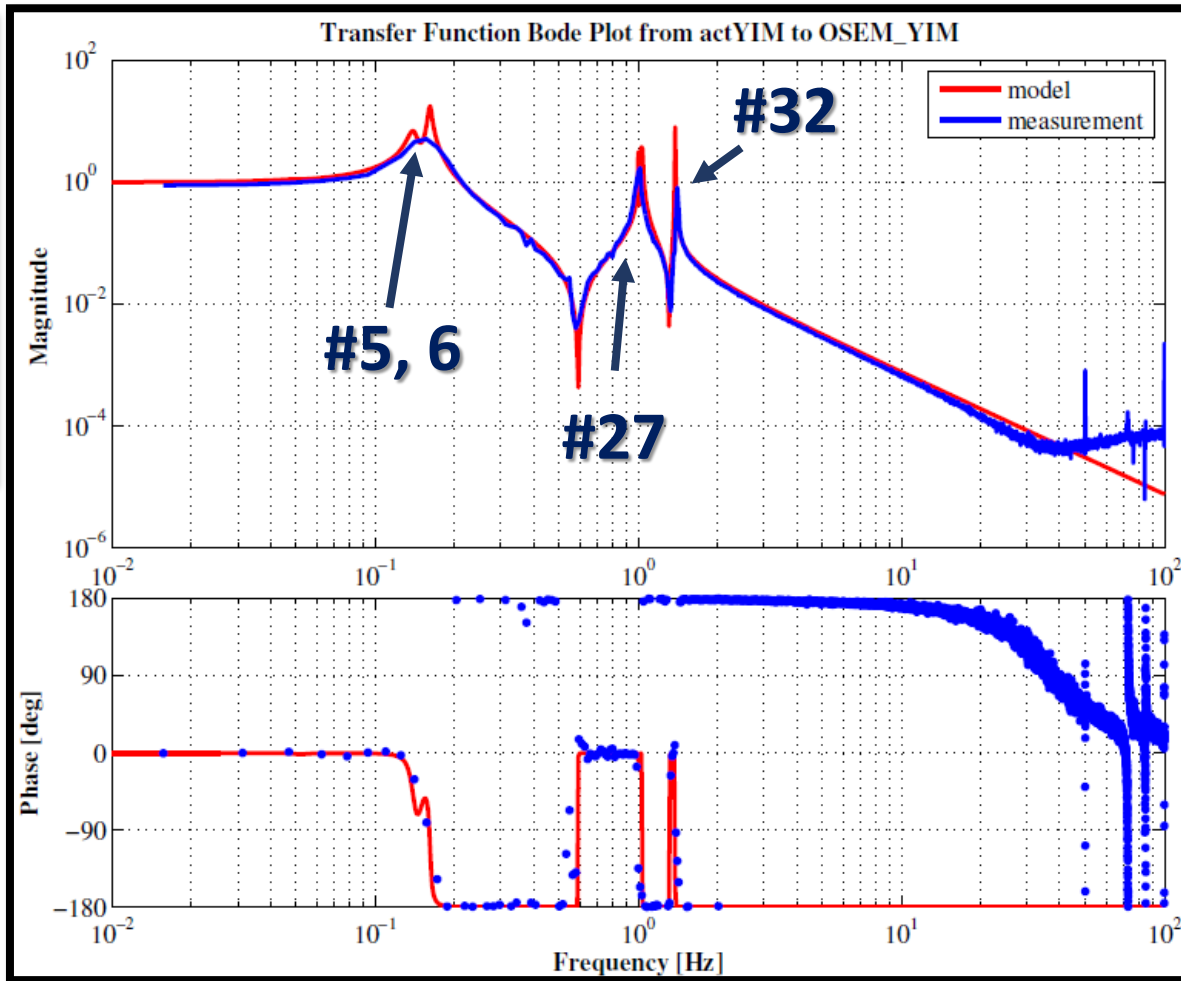
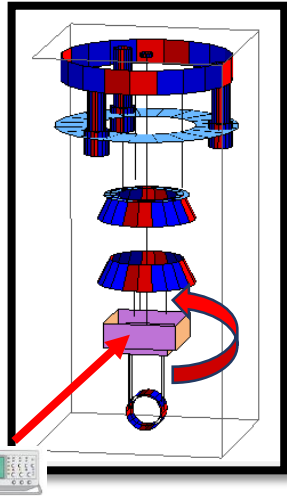
Force Transfer Function

OSEM_PIM / actPIM



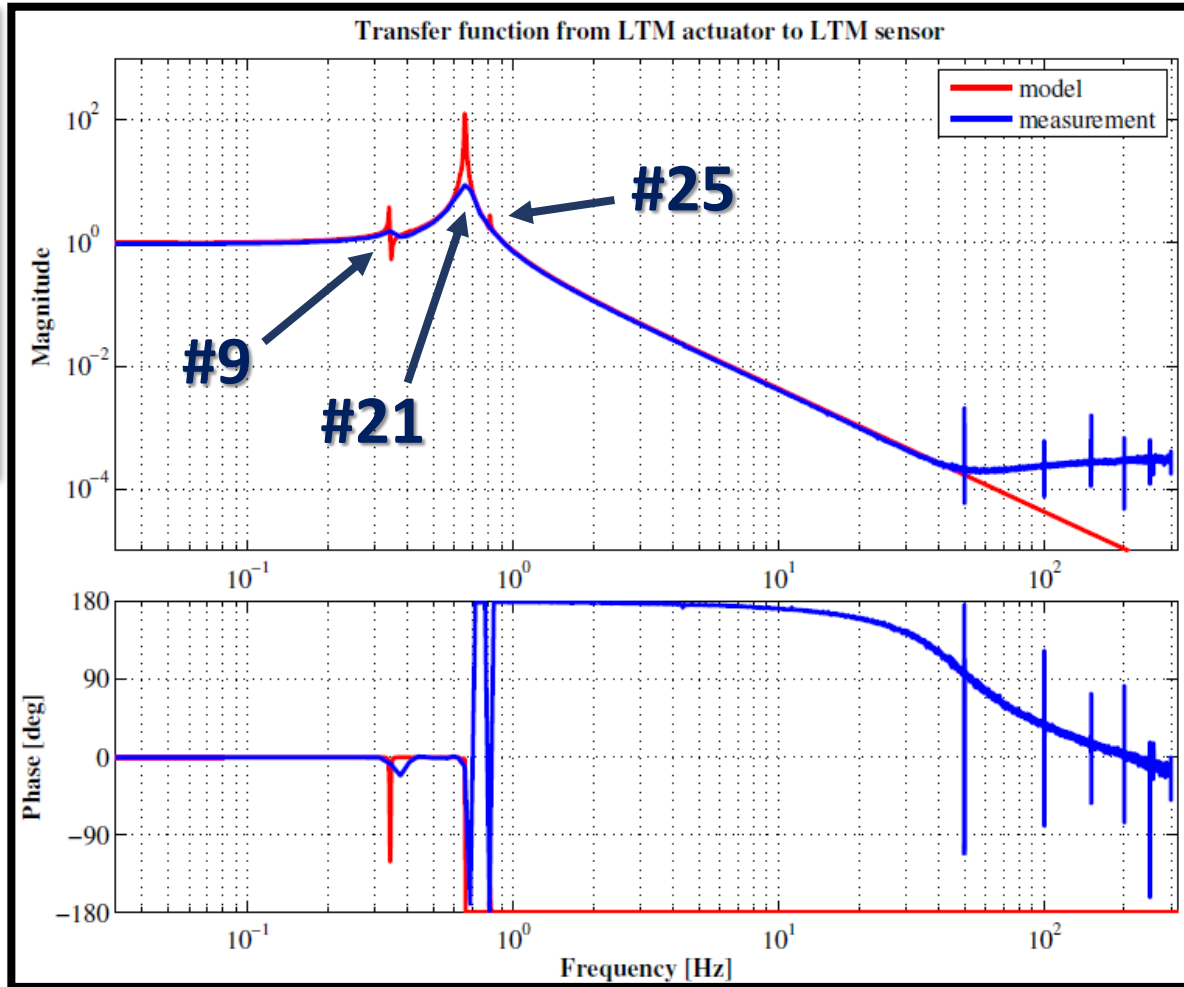
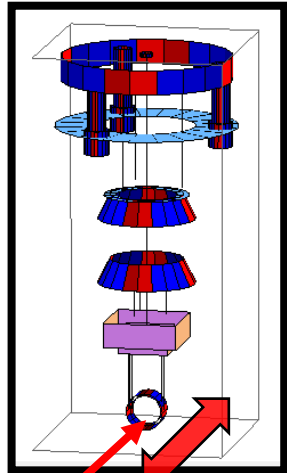
Force Transfer Function

OSEM_YIM / actYIM



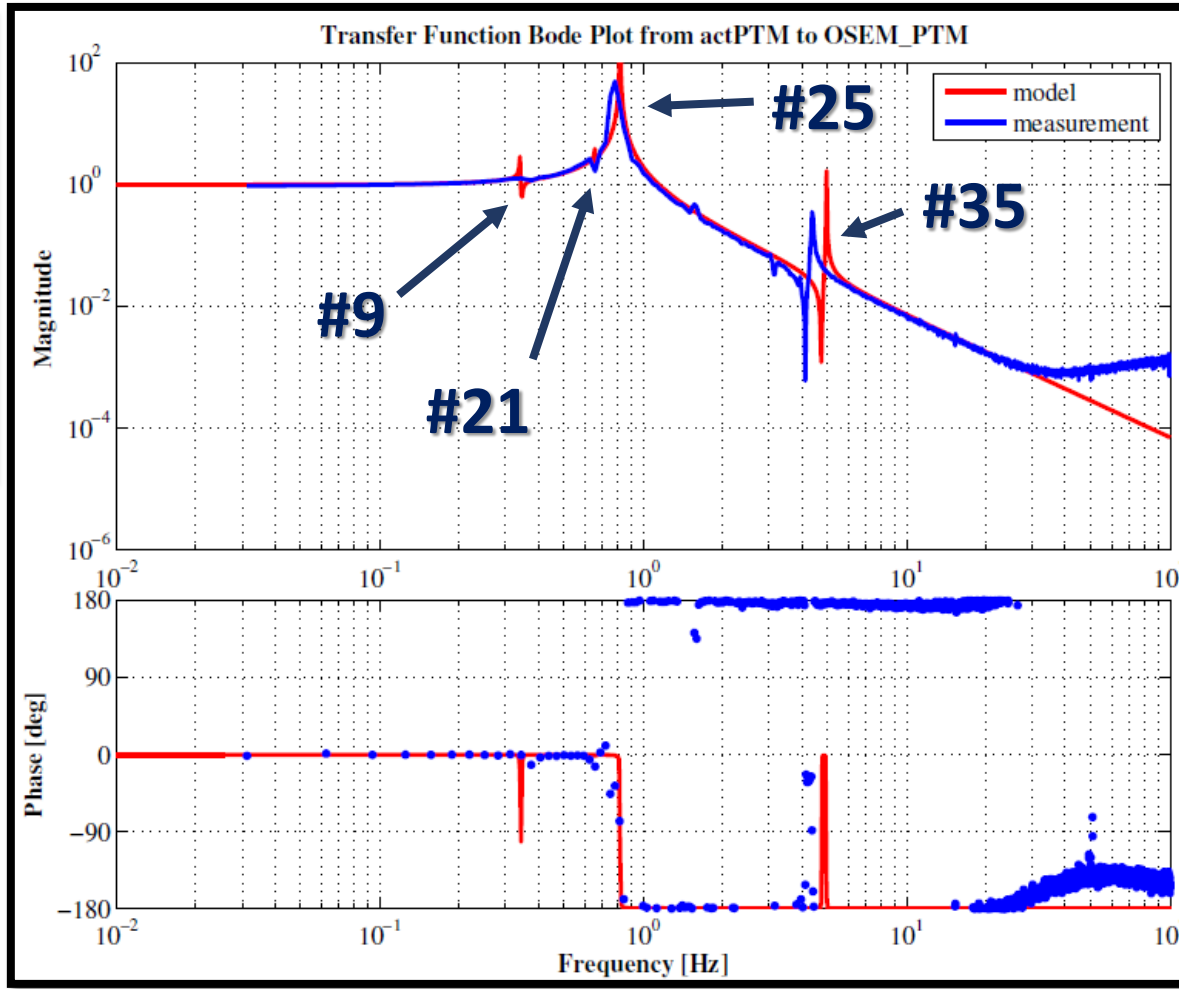
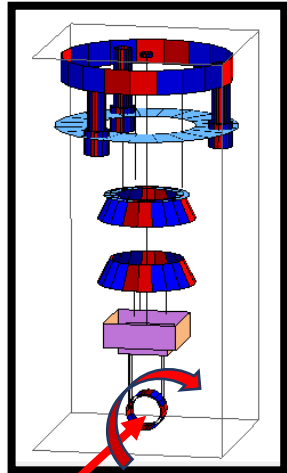
Force Transfer Function

OSEM_LTM / actLTM



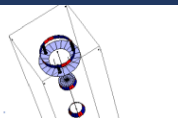
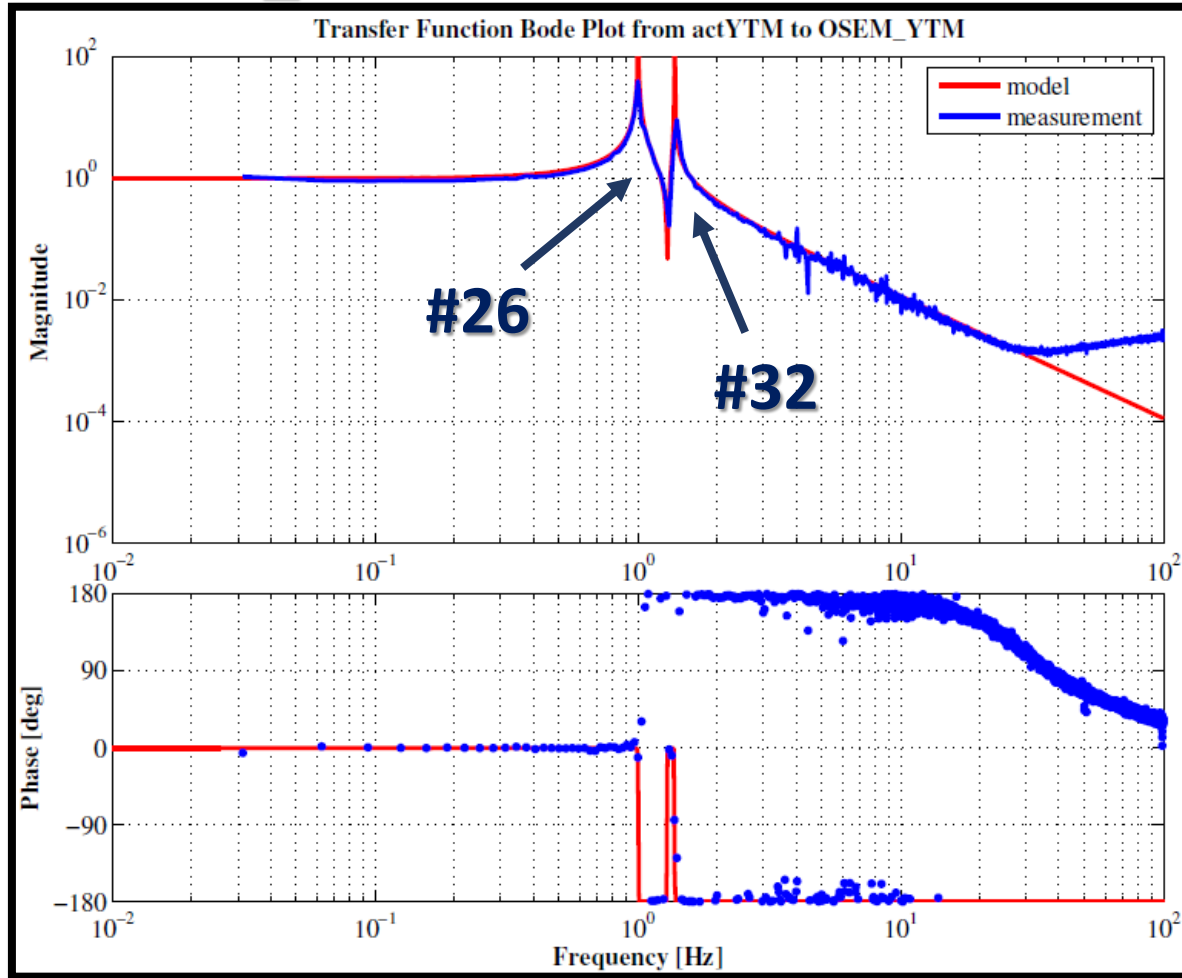
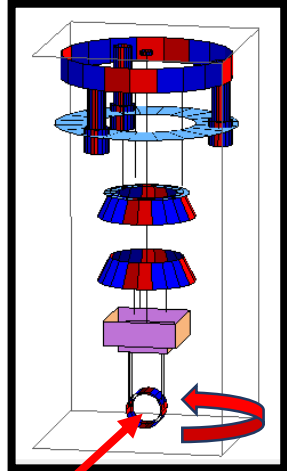
Force Transfer Function

OSEM_PTM / actPTM



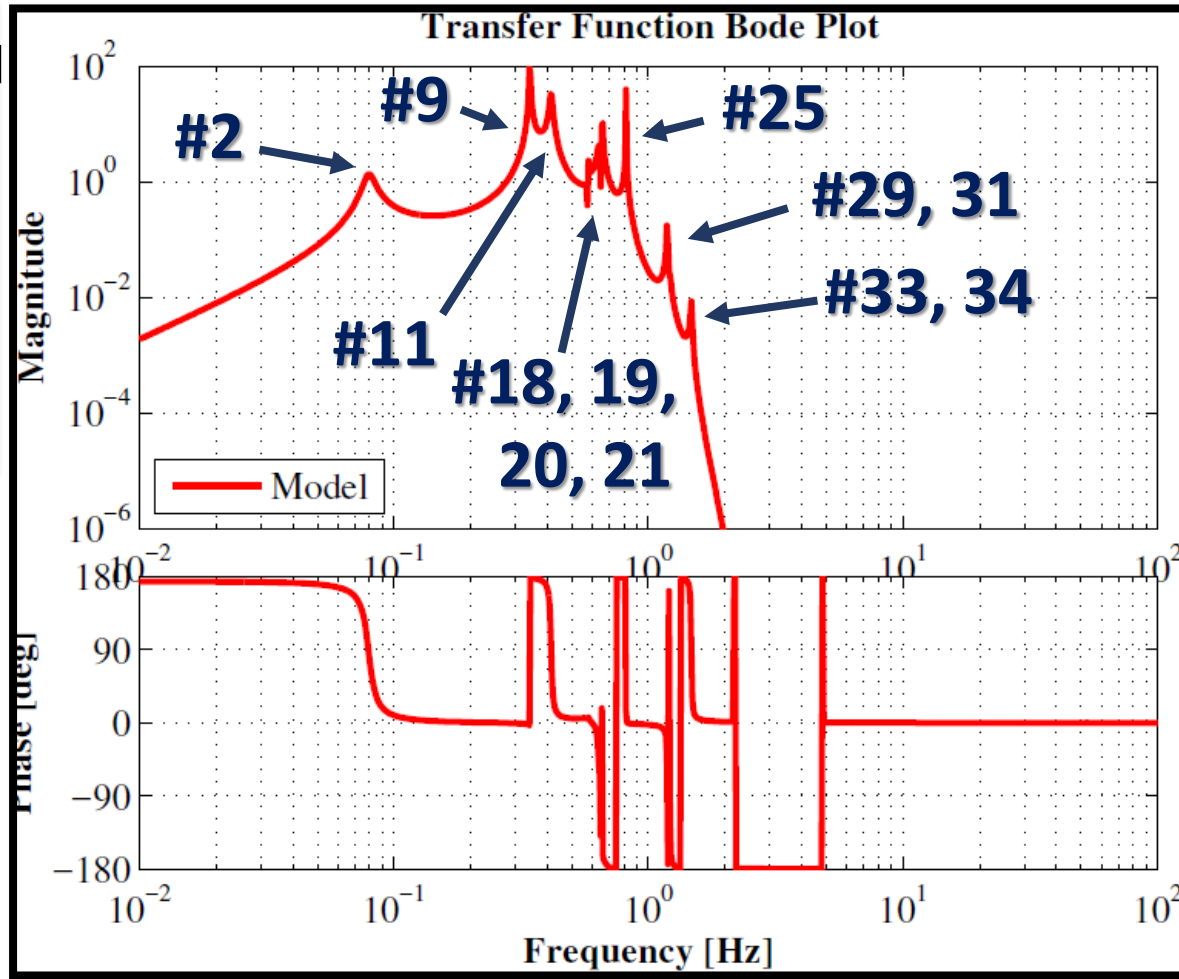
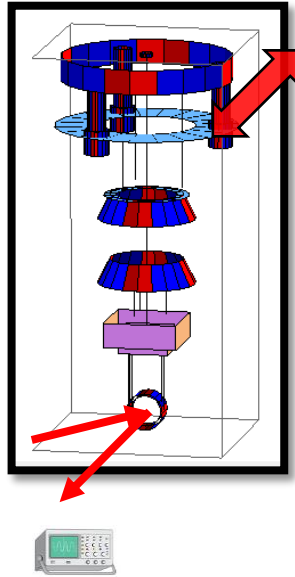
Force Transfer Function

OSEM_YTM / actYTM



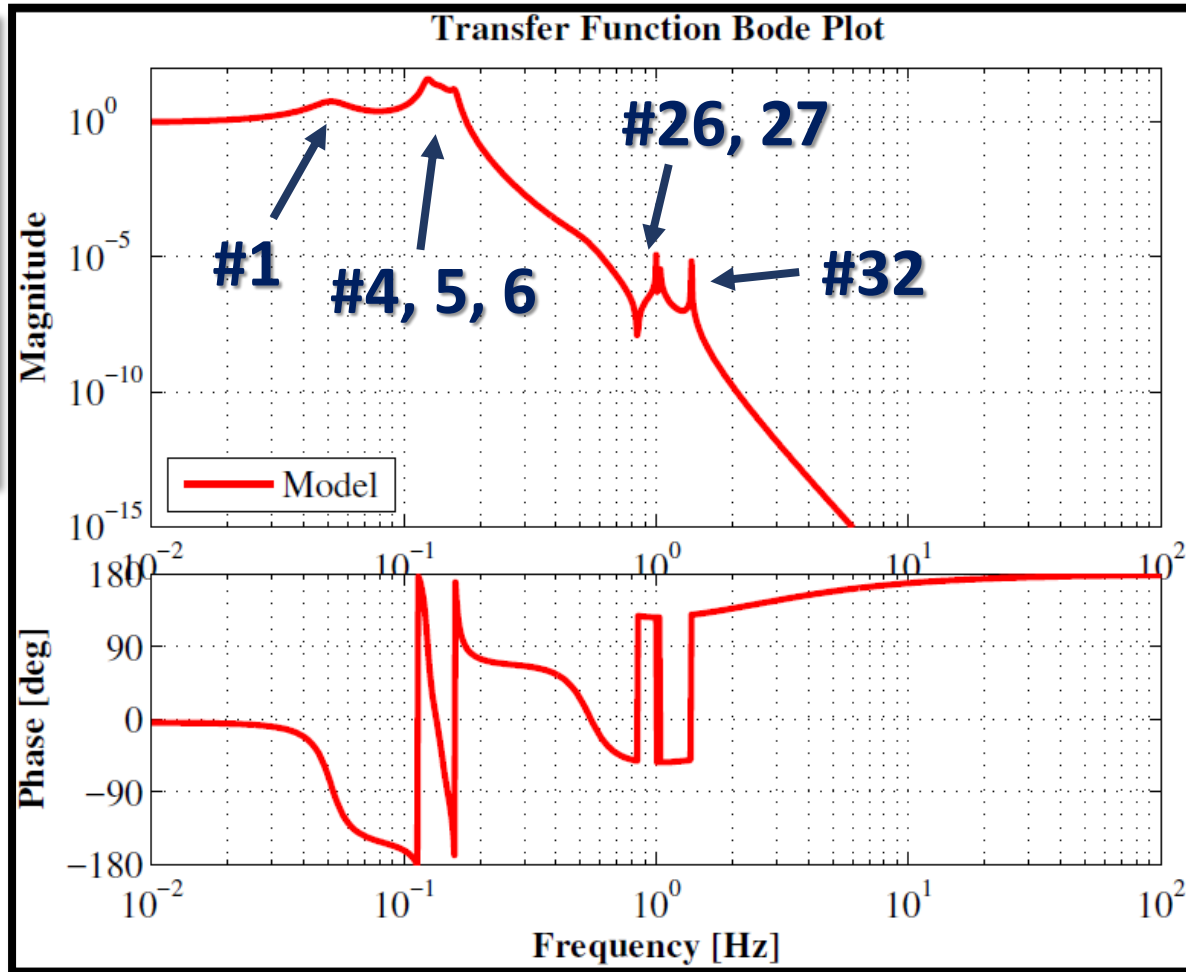
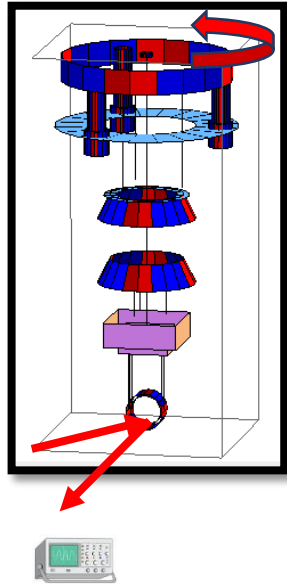
Force Transfer Function

OpLev_PTМ / actLF0



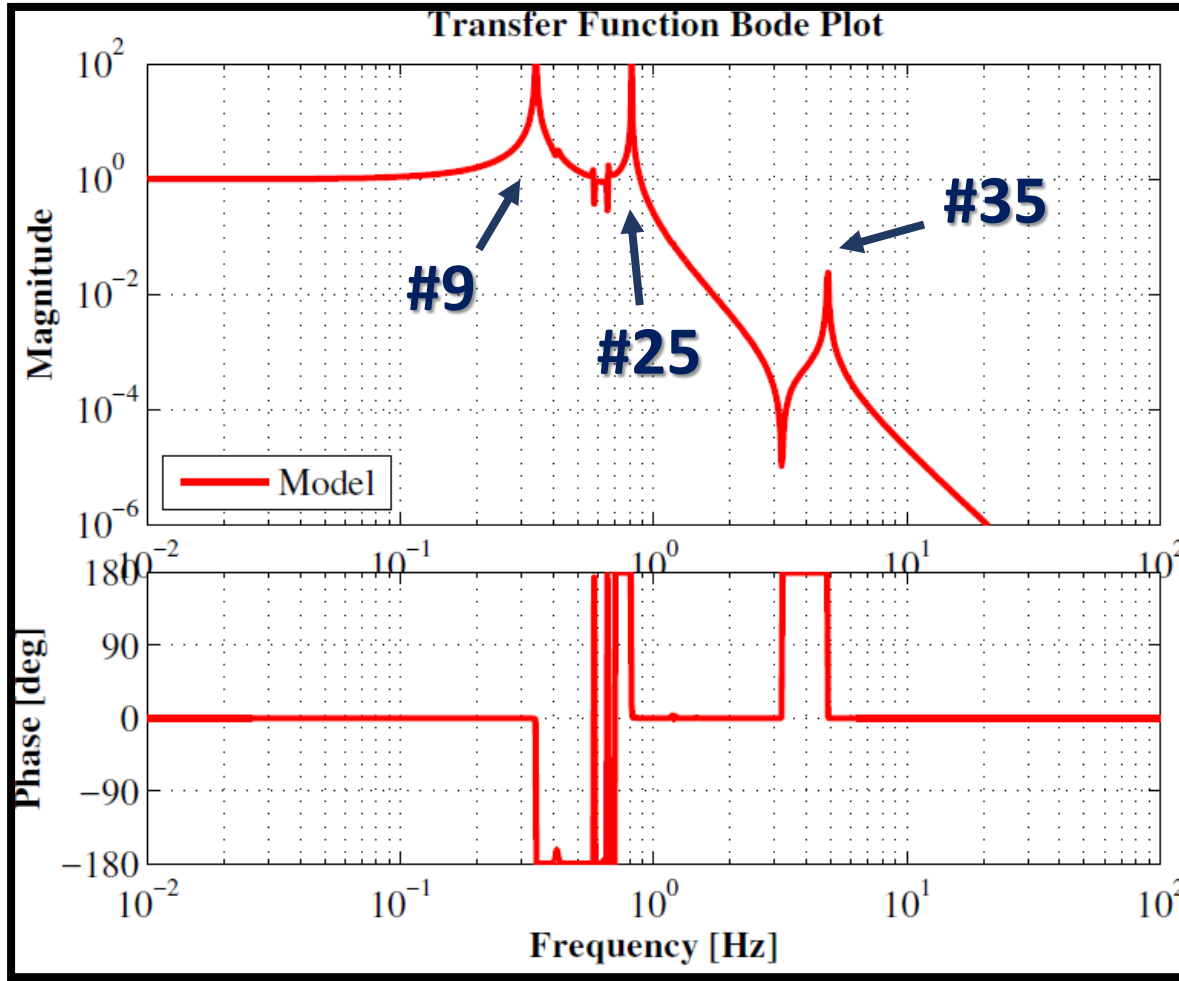
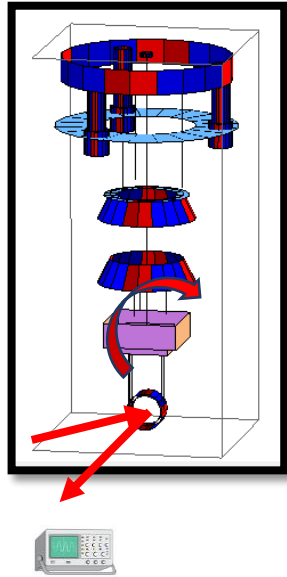
Force Transfer Function

OpLev_YTM / actYF0



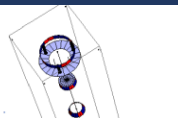
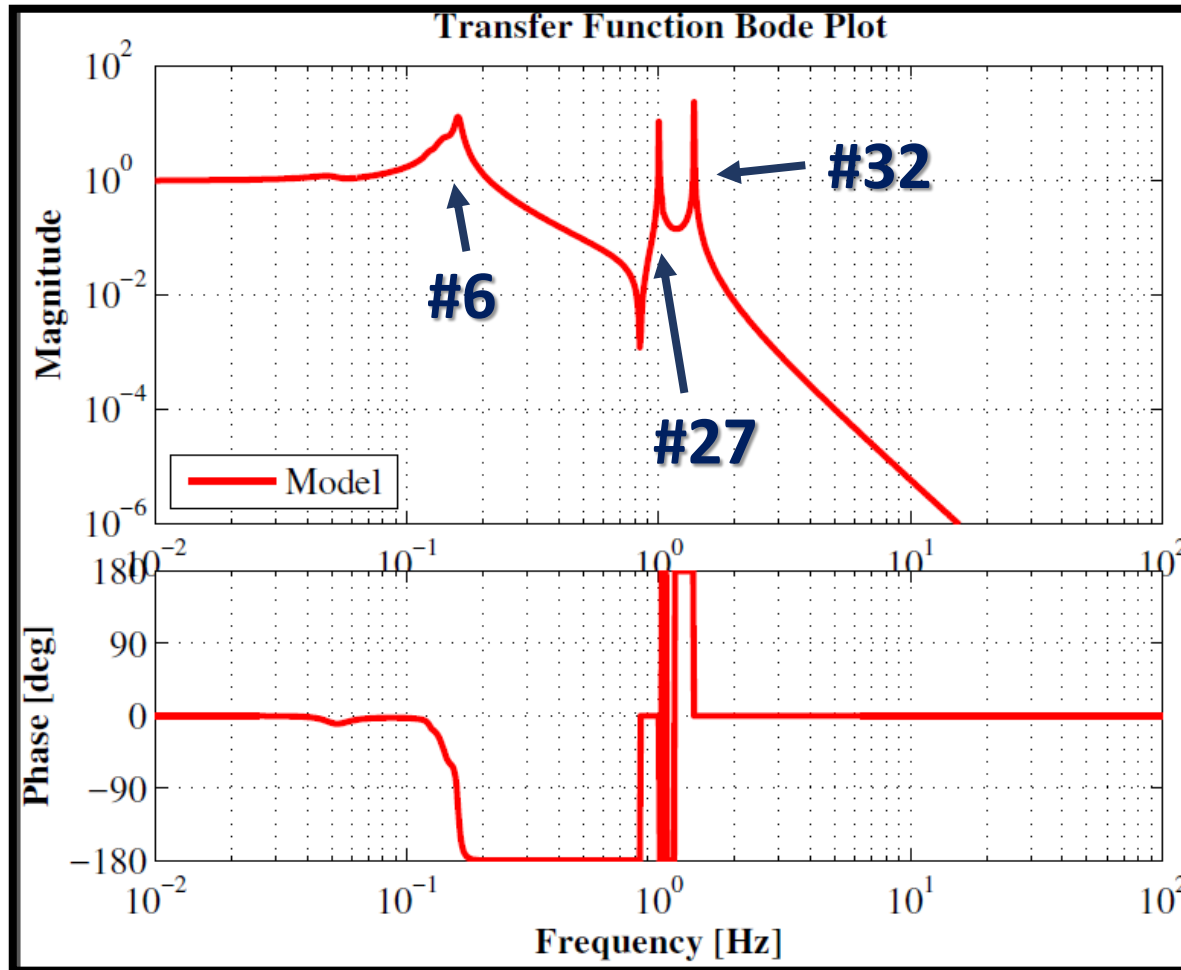
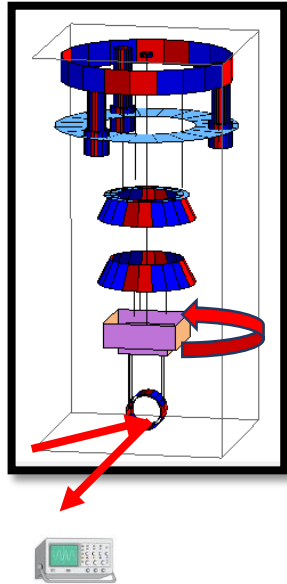
Force Transfer Function

OpLev_PTМ / actPIM



Force Transfer Function

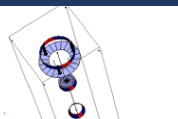
OpLev_YTM / actYIM



Spectra

without control

using 90 percentile seismic noise





2 Seismic noise level at the Kamioka site

The seismic displacement and velocity we used is shown in Fig.2 and ??[2]. This is the one called high-noise model. The seismic displacement in Kamioka is below this level for 90 % of time.

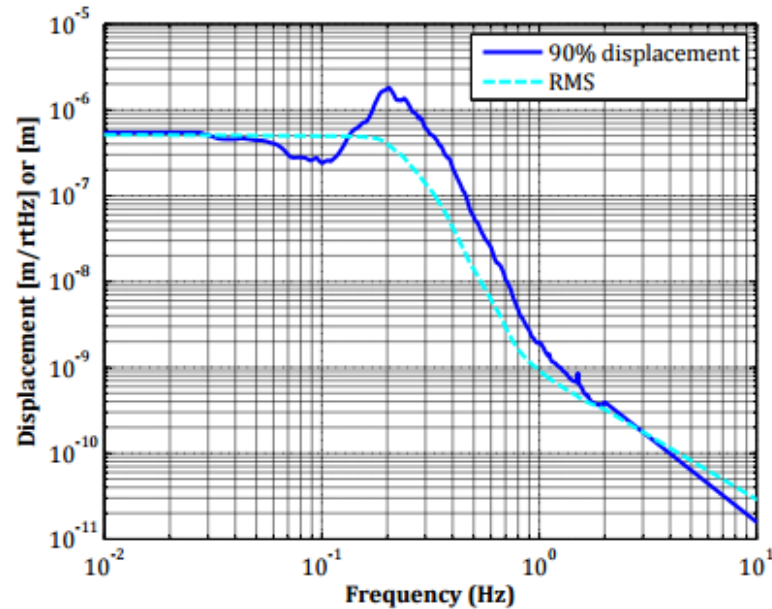


Figure 1: The high-level seismic displacement in Kamioka.

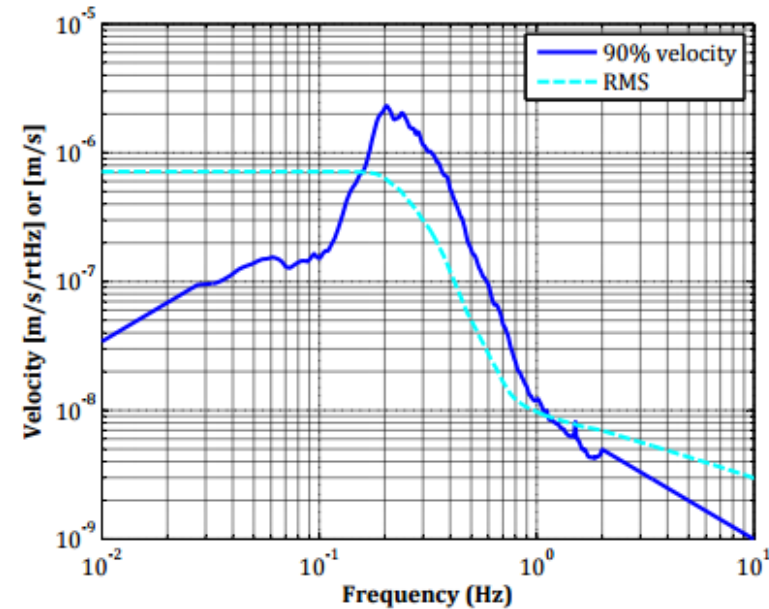
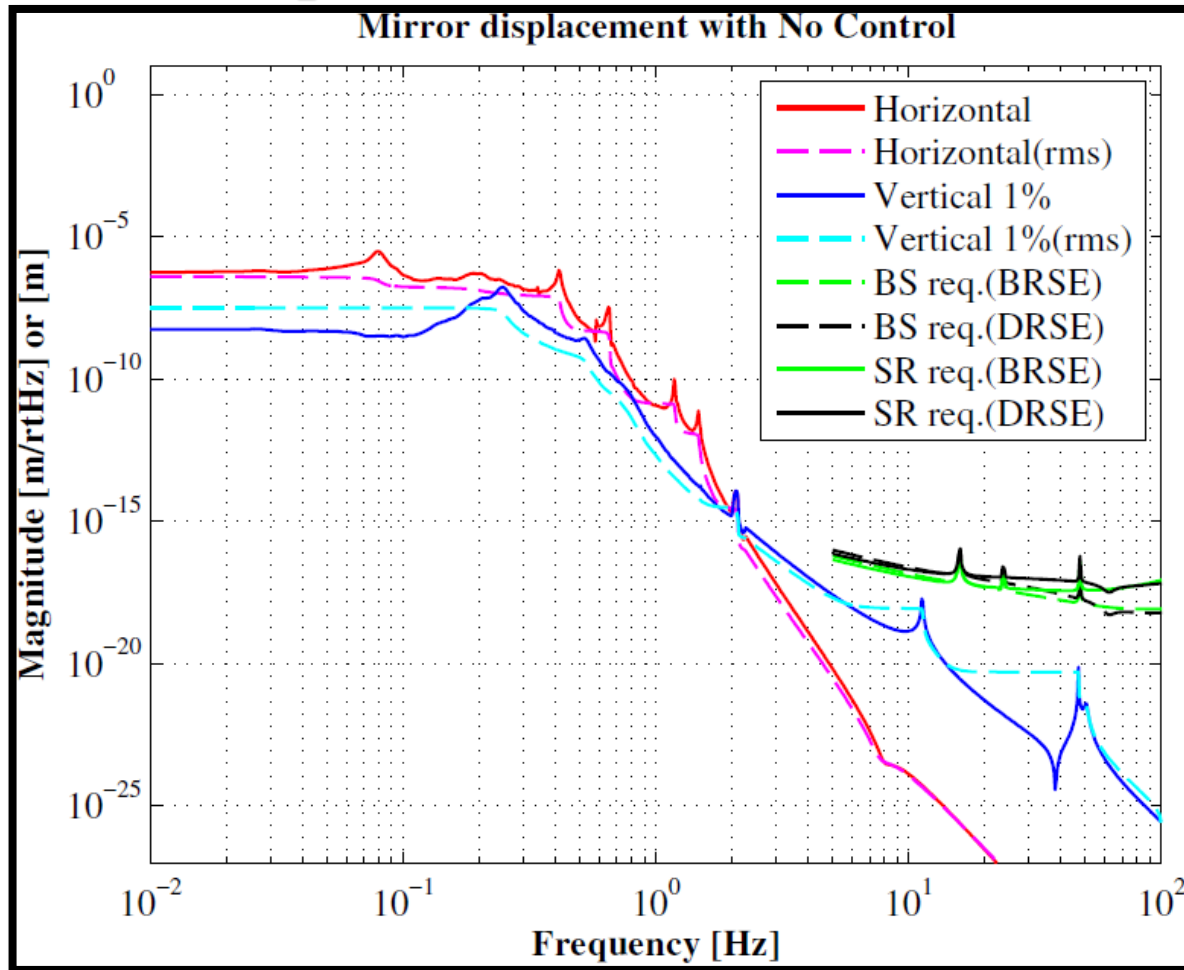


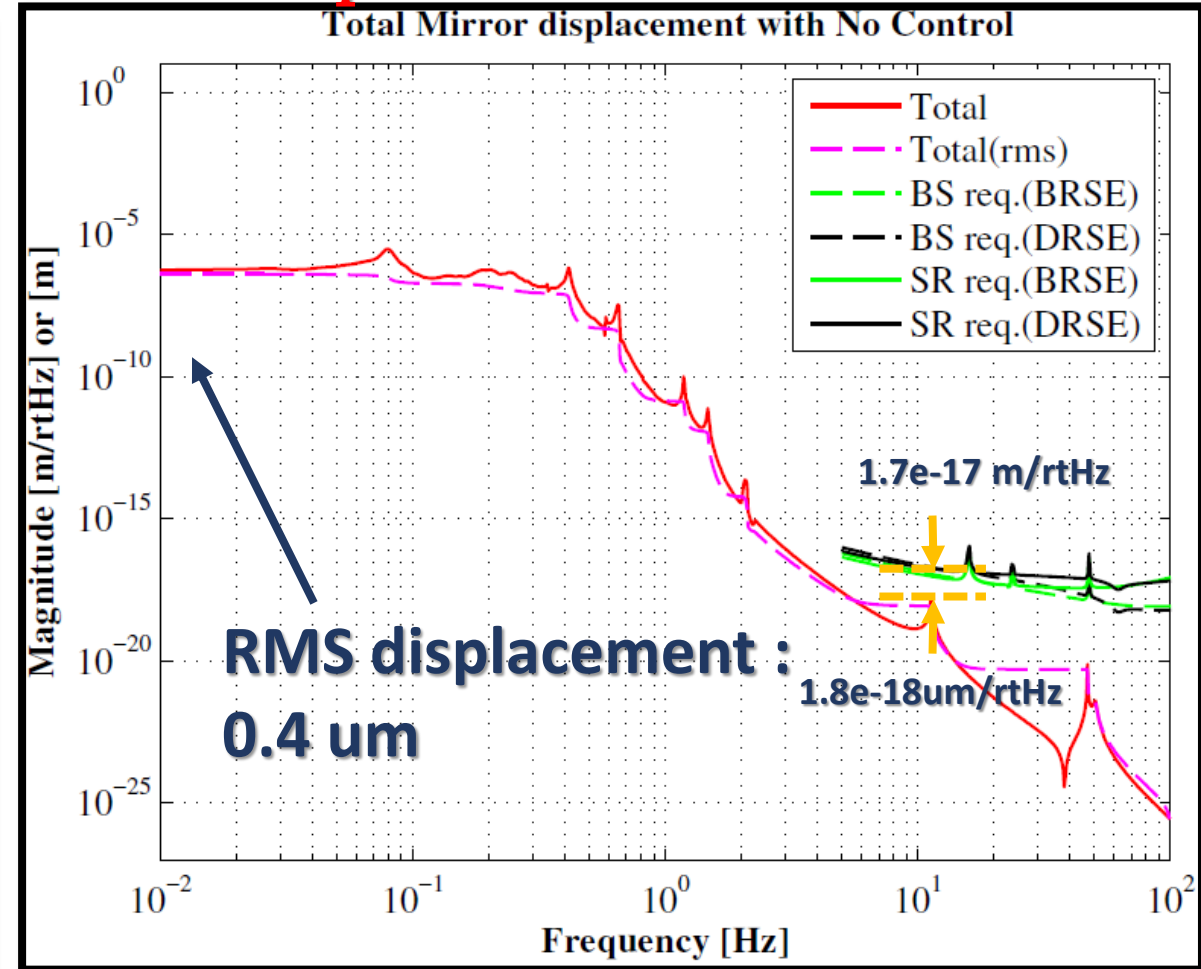
Figure 2: The high-level seismic velocity in Kamioka.

Spectra without ctrl

TM displacement : H and V 1%

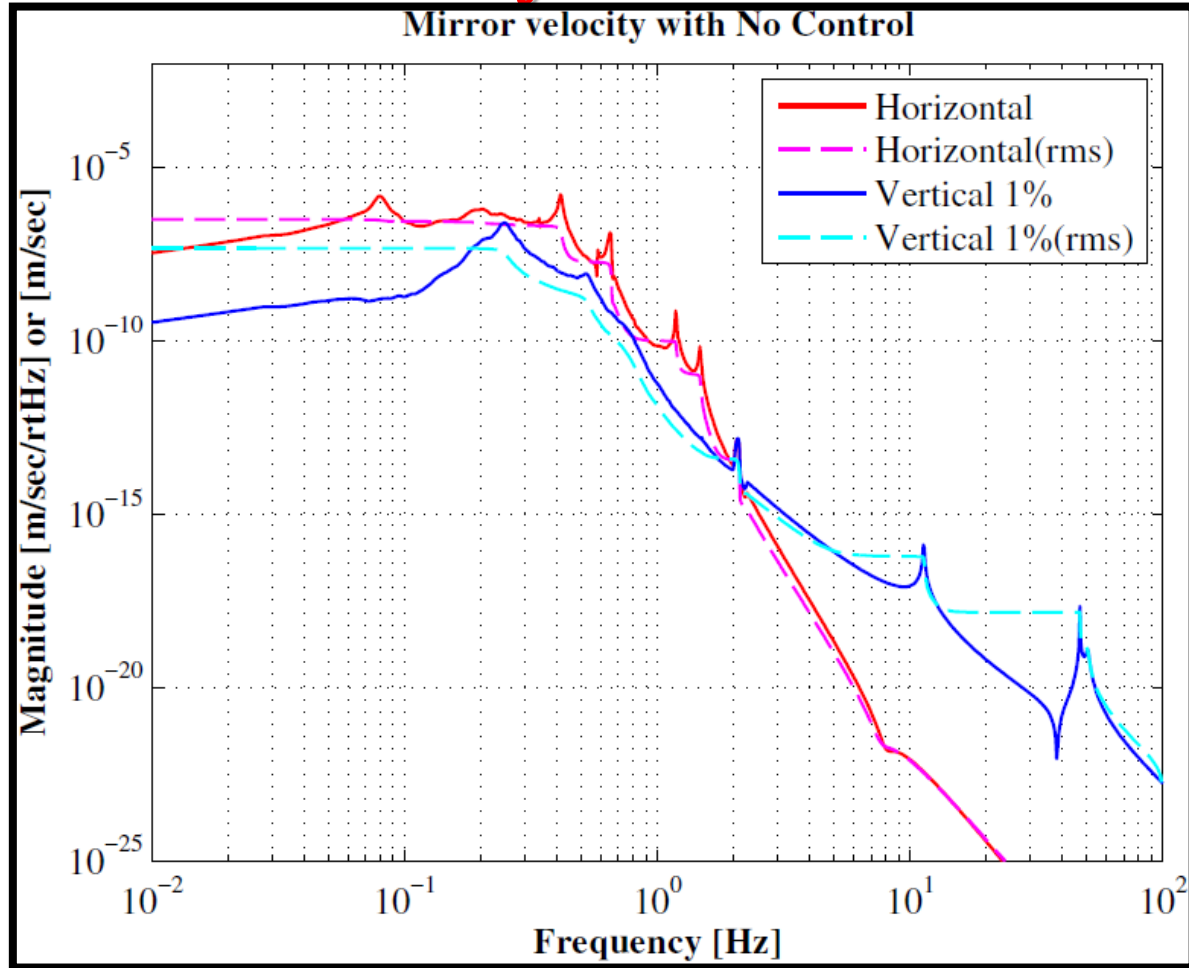


TM displacement : H + V 1%

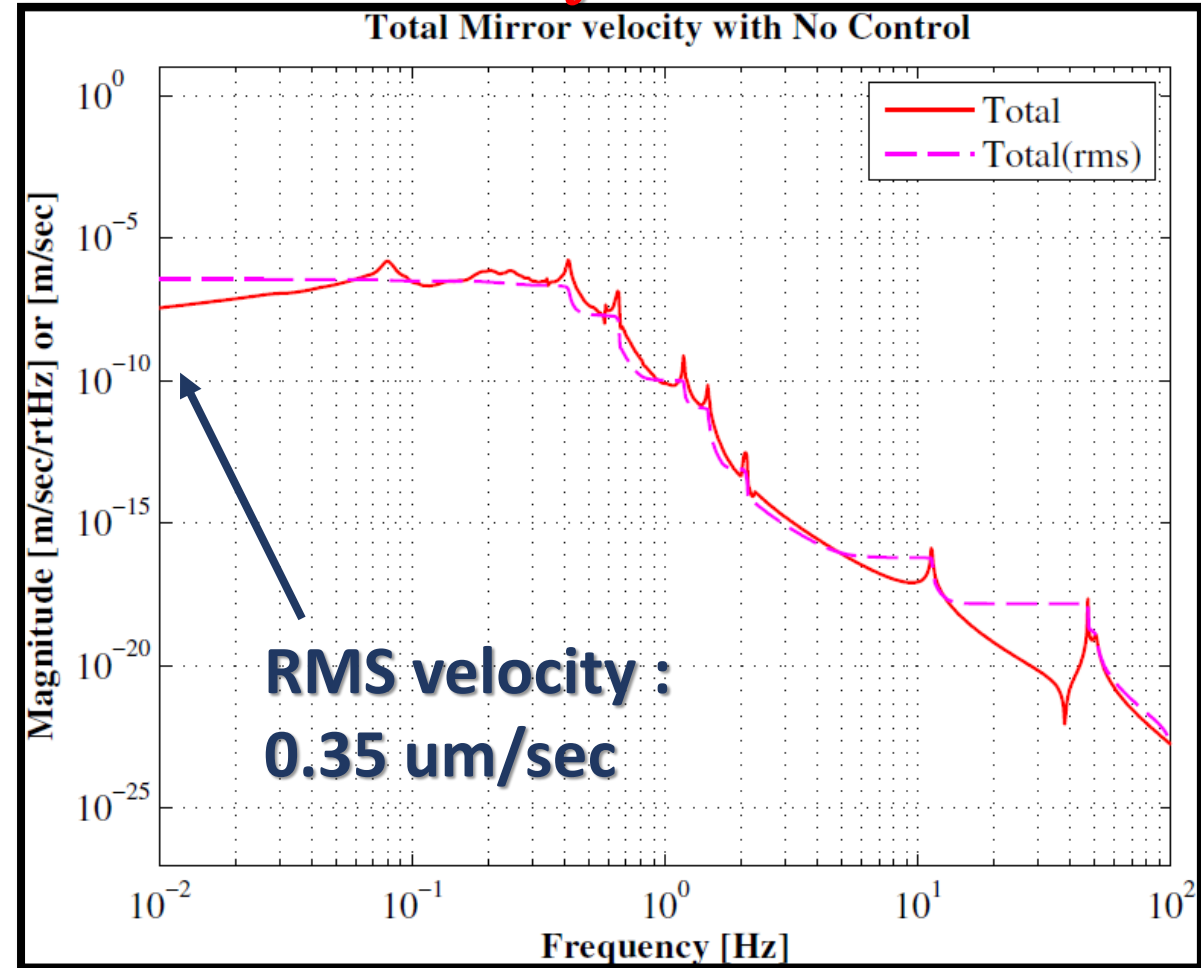


Spectra without ctrl

TM velocity : H and V 1%

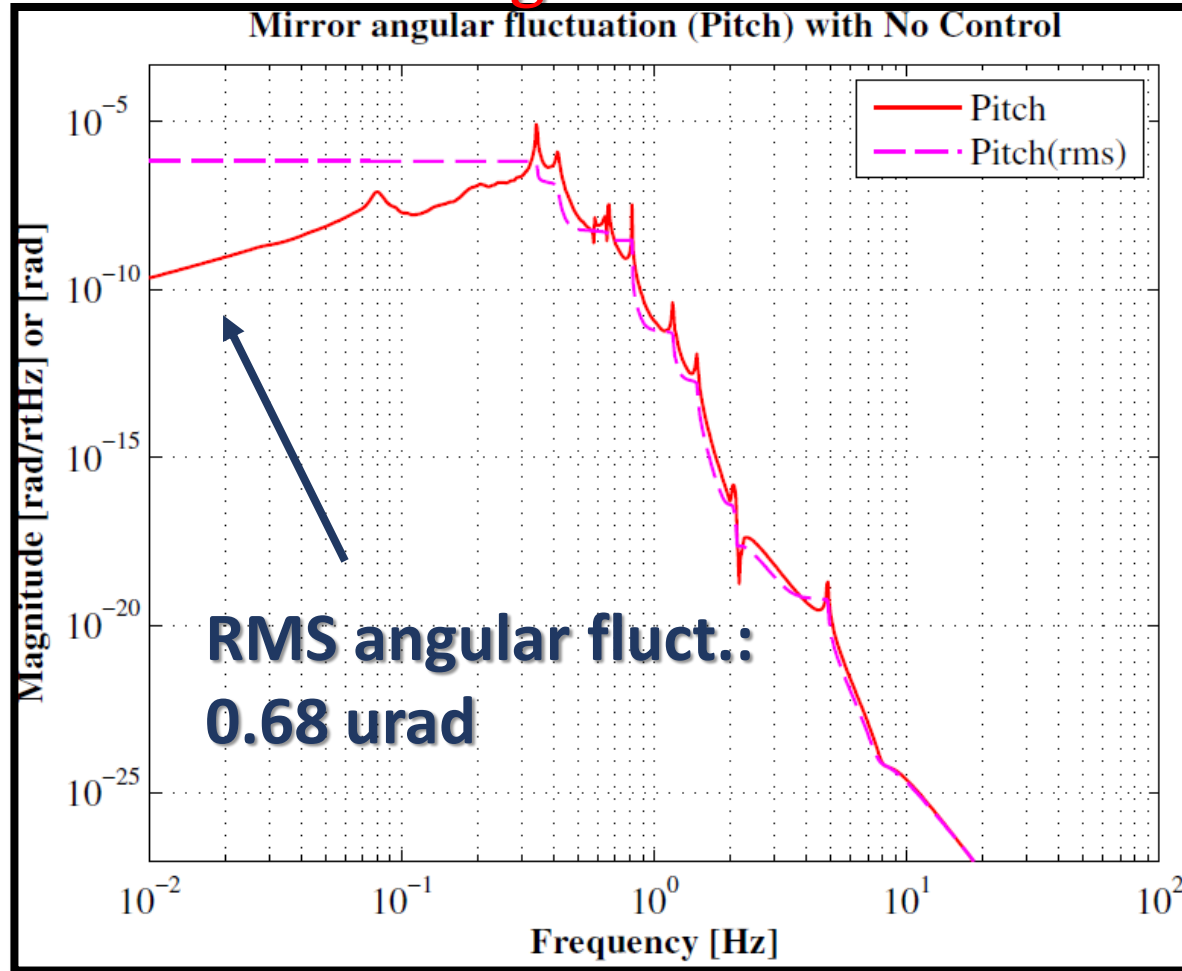


TM velocity : H + V 1%



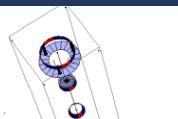
Spectra without ctrl

TM Pitch Angular fluctuation

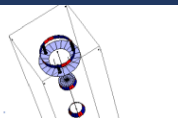


TM **Pitch** fluctuation
excited by **Longitudinal** GND motion

Spectra without ctrl

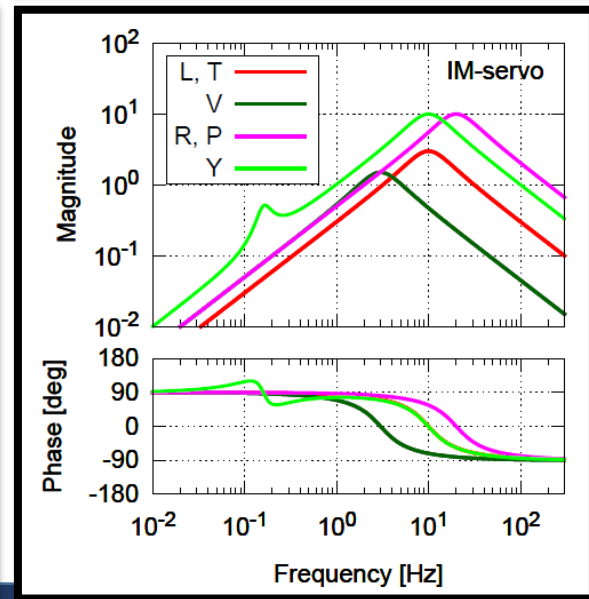
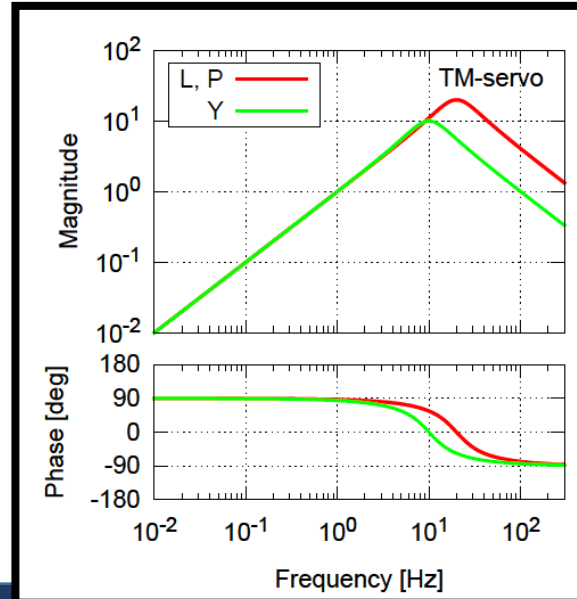
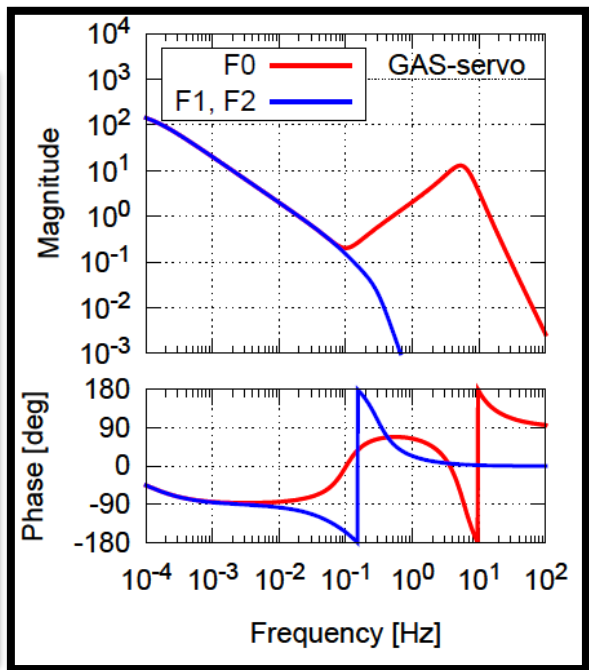
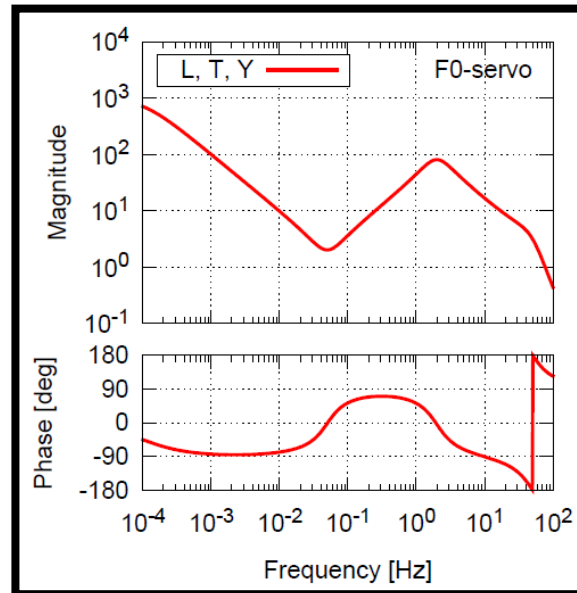
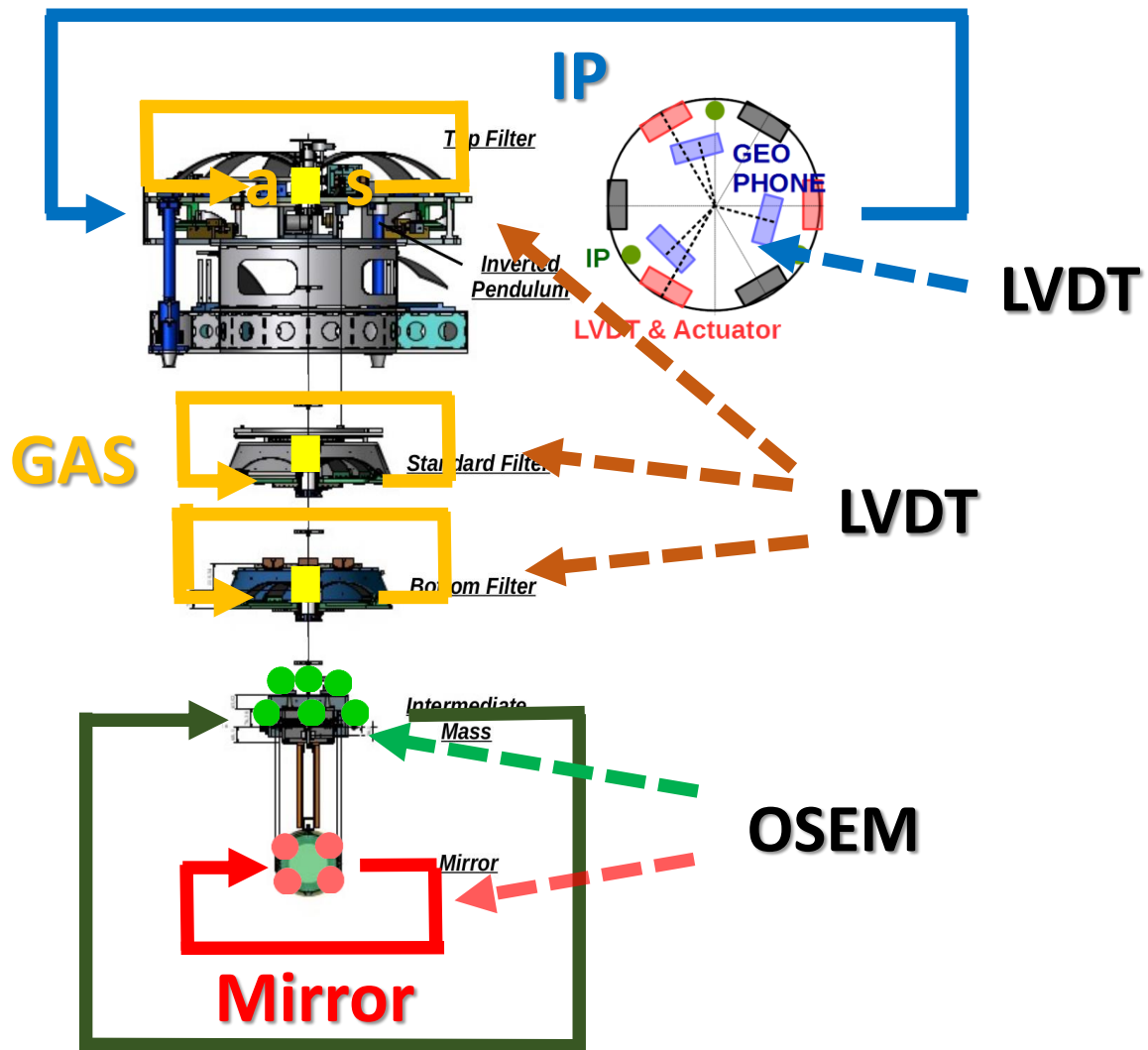


Control Simulation Results



Filter shape

In "damping" phase



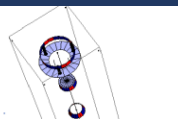
Filter shape

In “Lock acquisition” phase

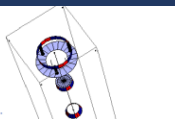
Filter shape

In "Observation" phase

OLTF

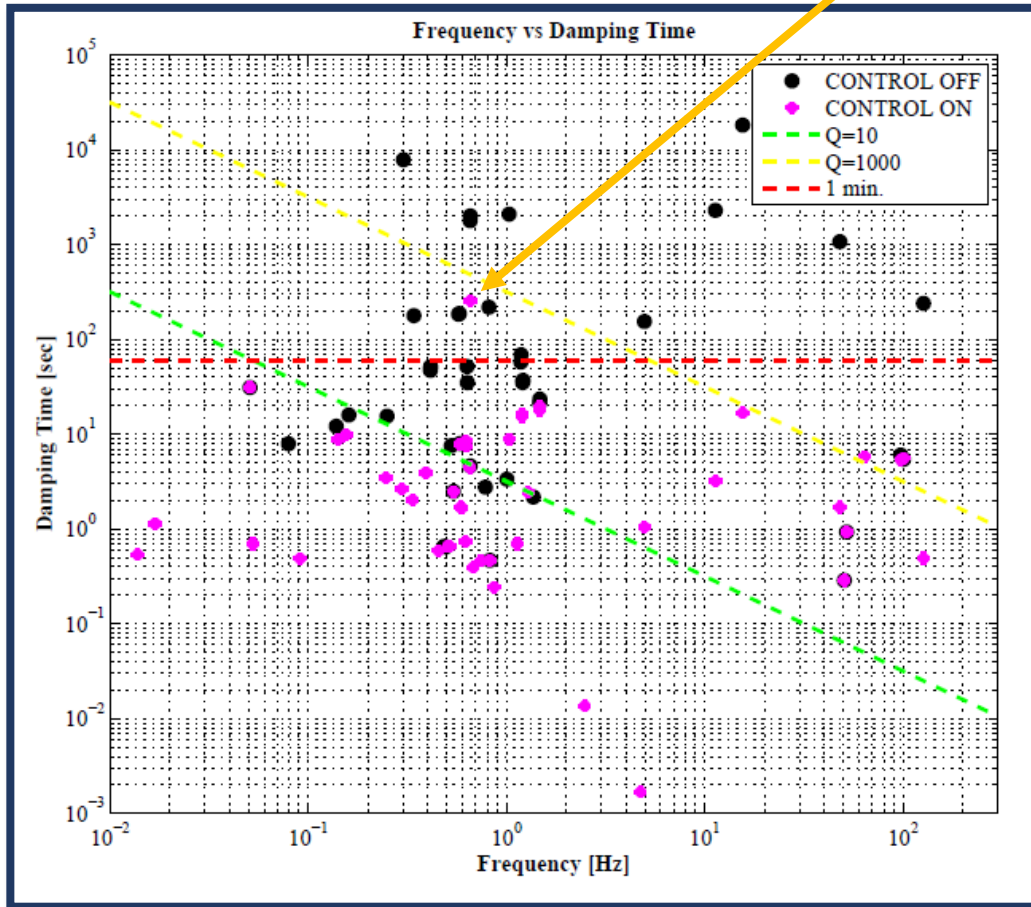


CLTF

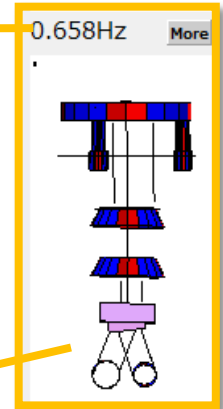
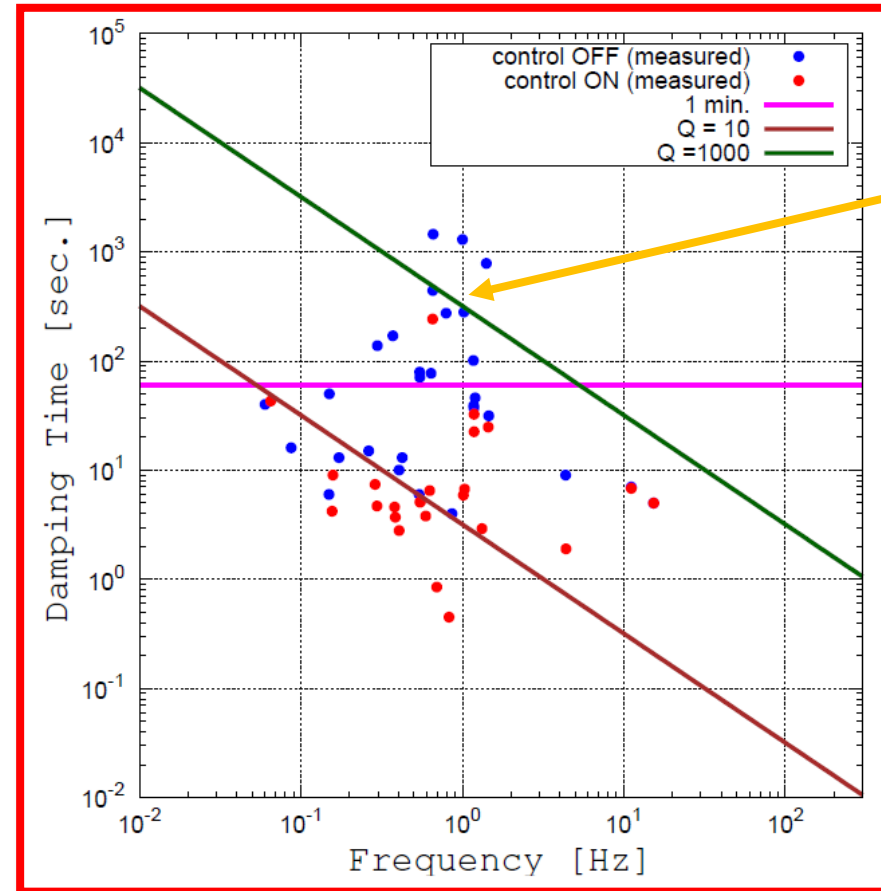


Q factor in damping control

Simulated result



Measured result



Impulse response