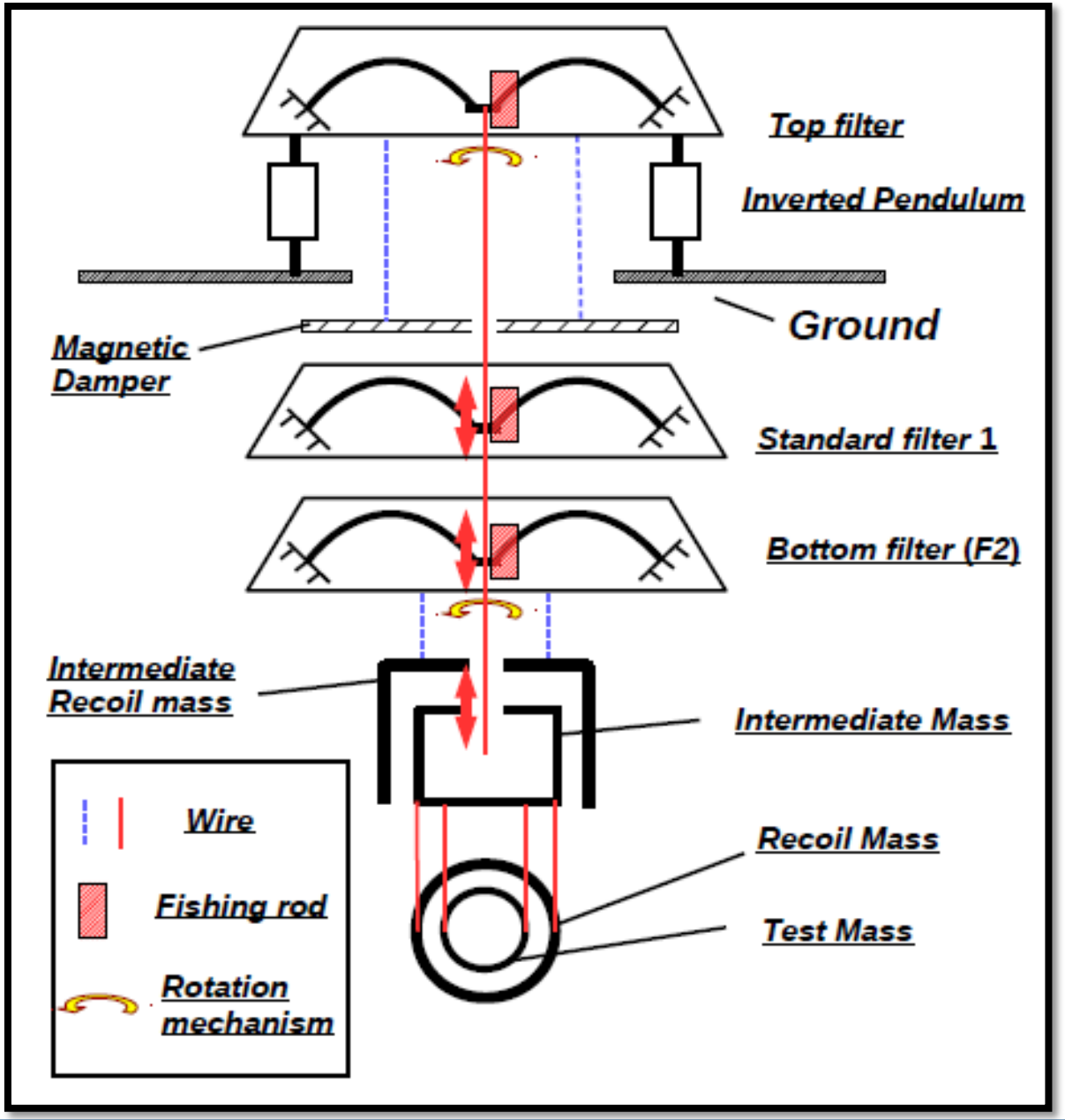
TypeB


Top filter
Inverted Pendulum
Ground
Magnetic Damper
Standard filter 1
Bottom filter (F2)
Intermediate Recoil mass
Intermediate Mass
Wire
Fishing rod
Rotation mechanism
Recoil Mass
Test Mass

Mechanical response

Calculated by SUMCON (and Simulink)

SUMCON in Mathematica
spension odel structor

SUMCON Version:1.32

About SUMCON | Version Info | Reflesh

New Model | Load Model | Save Model | TypeB1¥150723_TypeB1_Proto.m

TypeBp with IP 160205

Model Construction | Calculation Result | Export Model

Model Basic Information

Degrees of Freedom:

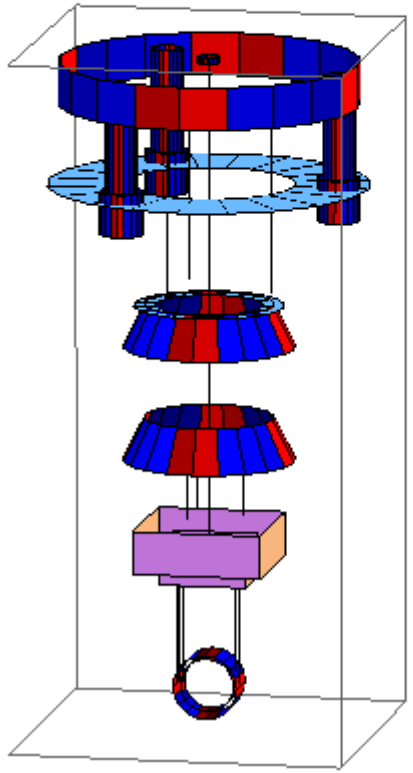
45 State Variables
6 Input Variables
3 Float Variables

Ground Position:

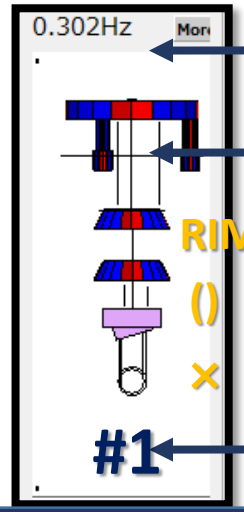
xg → 0. yg → 0. zg → 0. pitchg → 0. yawg → 0. rollg → 0.

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

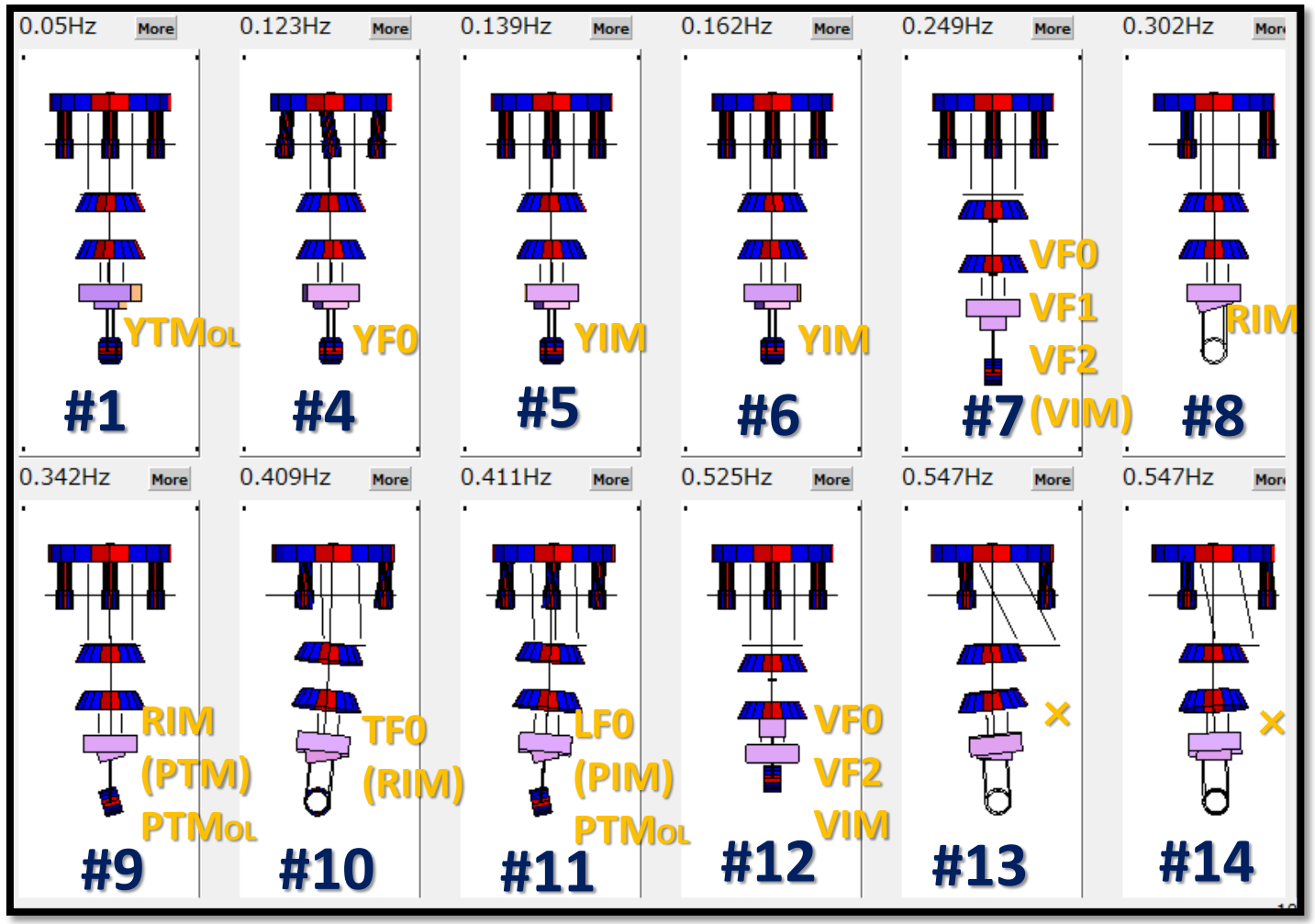
Sensing / Excitation point

Hardly seen/excited

Cannot be seen/excited

Eigen mode number

Eigen Mode Shape



#1 : YWholeChain

#2 : LF0 LF0

#3 : TF0 TF0

#4 : YF0

#5 : YPayload

#6 : YPaylaod

#7 : VPaylaod
(VF1, VF2, VPayload)

#8 : RPayload
(RIM)

#9 : PPayload
(PIM)

#10 : TPendulum

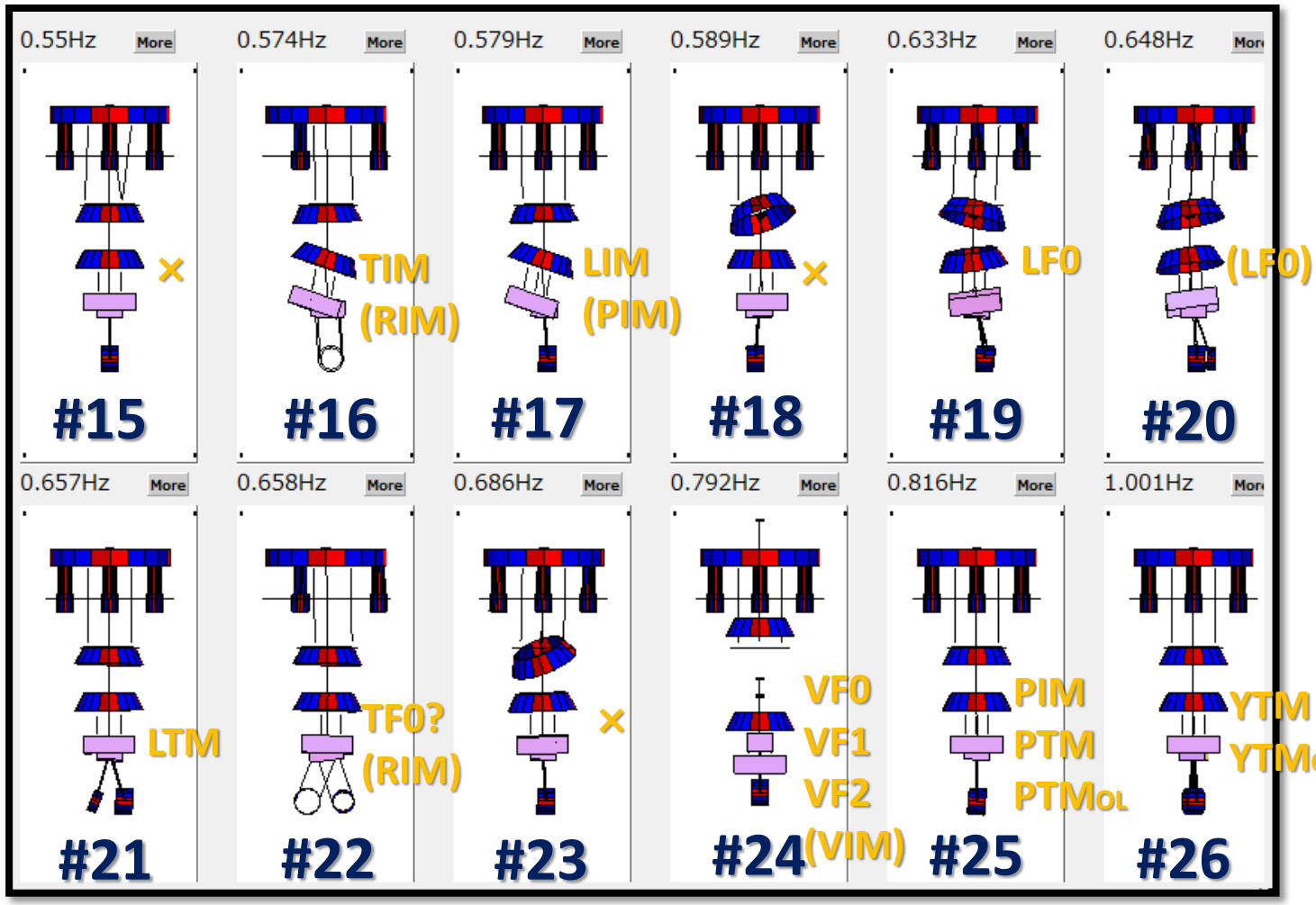
#11 : LPendulum

#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

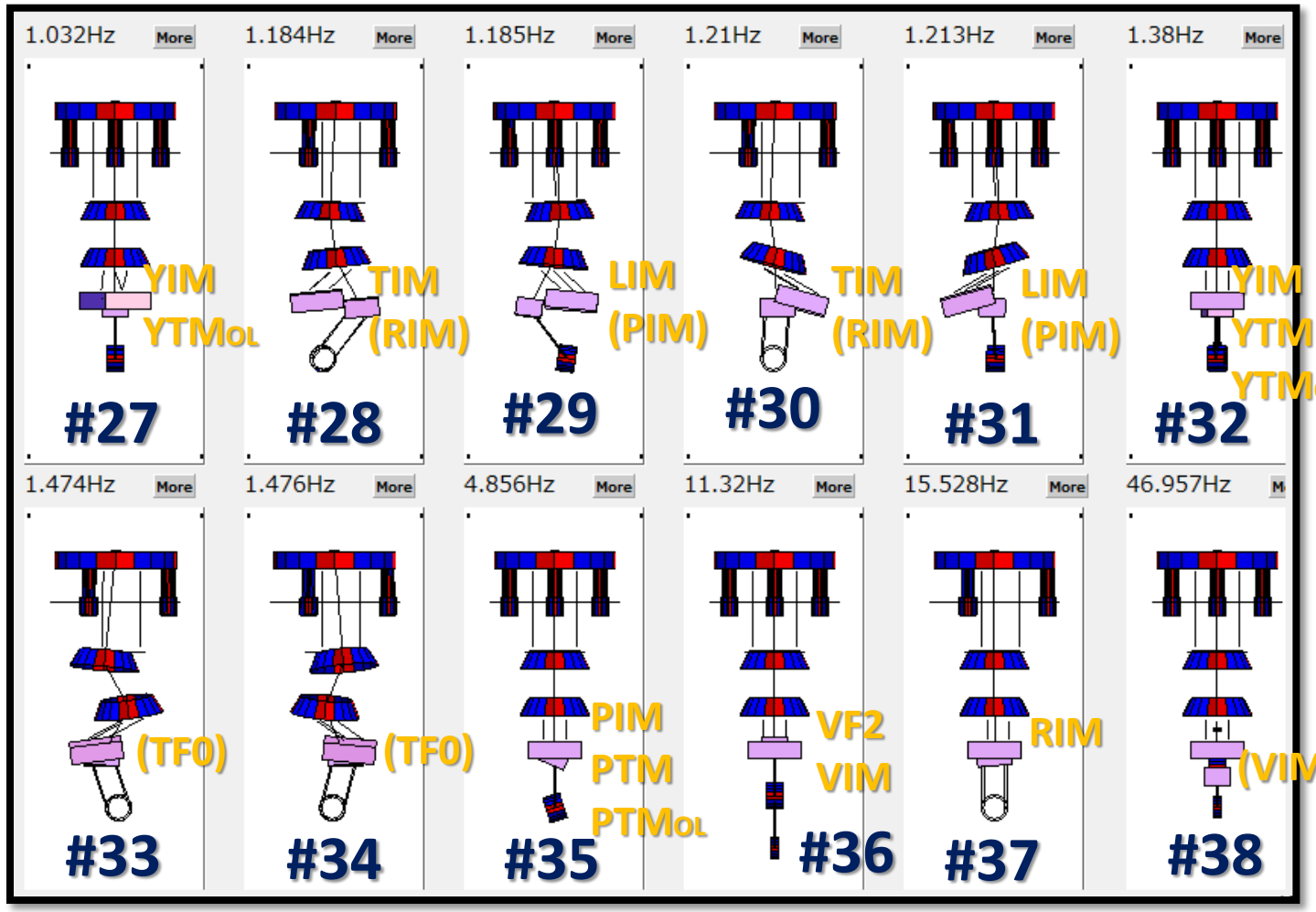
#23 : PF1

#24 : GAS
(VF1)

#25 : PTM

#26 : YTM
(YTM, -YRM)

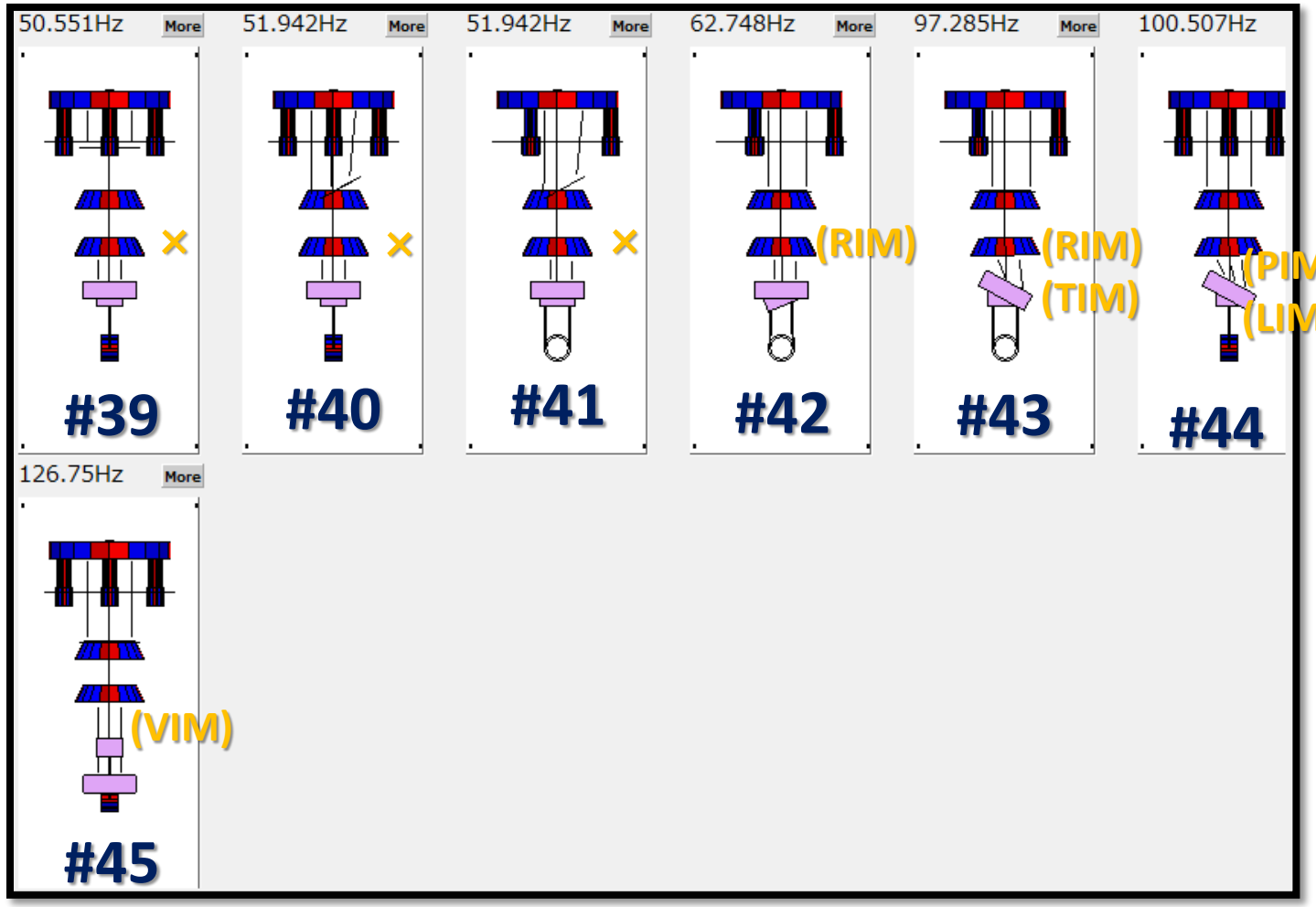
Eigen Mode Shape



#27 : YIR
#28 : TIM
#29 : LIM
#30 : TIR
#31 : LIR
#32 : YTM
(YTM, YRM)

#33 : Pendulum
#34 : Pendulum
#35 : PIM, PRM
#36 : VTM
#37 : RTM
#38 : VRM

Eigen Mode Shape



#39 : VMD

#40 : PMD

#41 : RMD

#42 : RIM, RRM

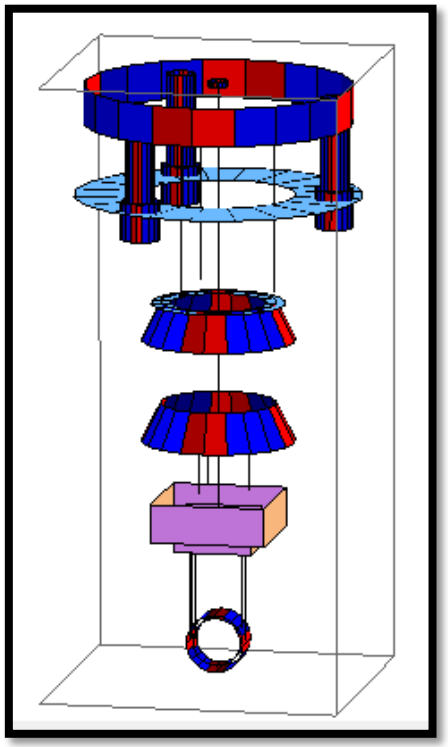
#43 : RIR

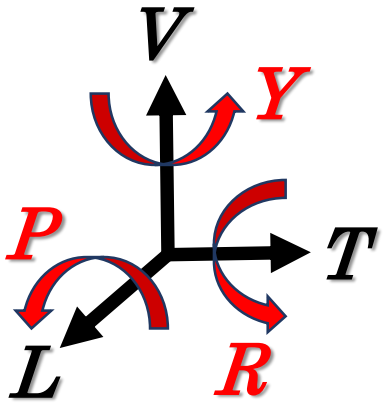
#44 : PIR

#45 : VIR

Force Transfer Functions

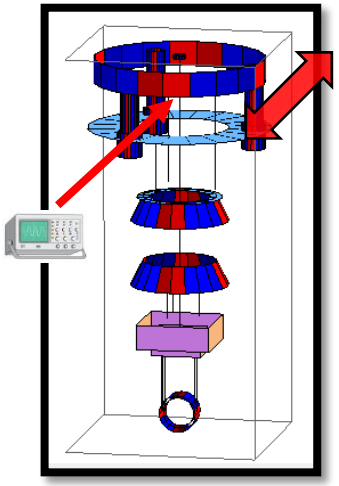
(, which can be measured, with No ctrl)

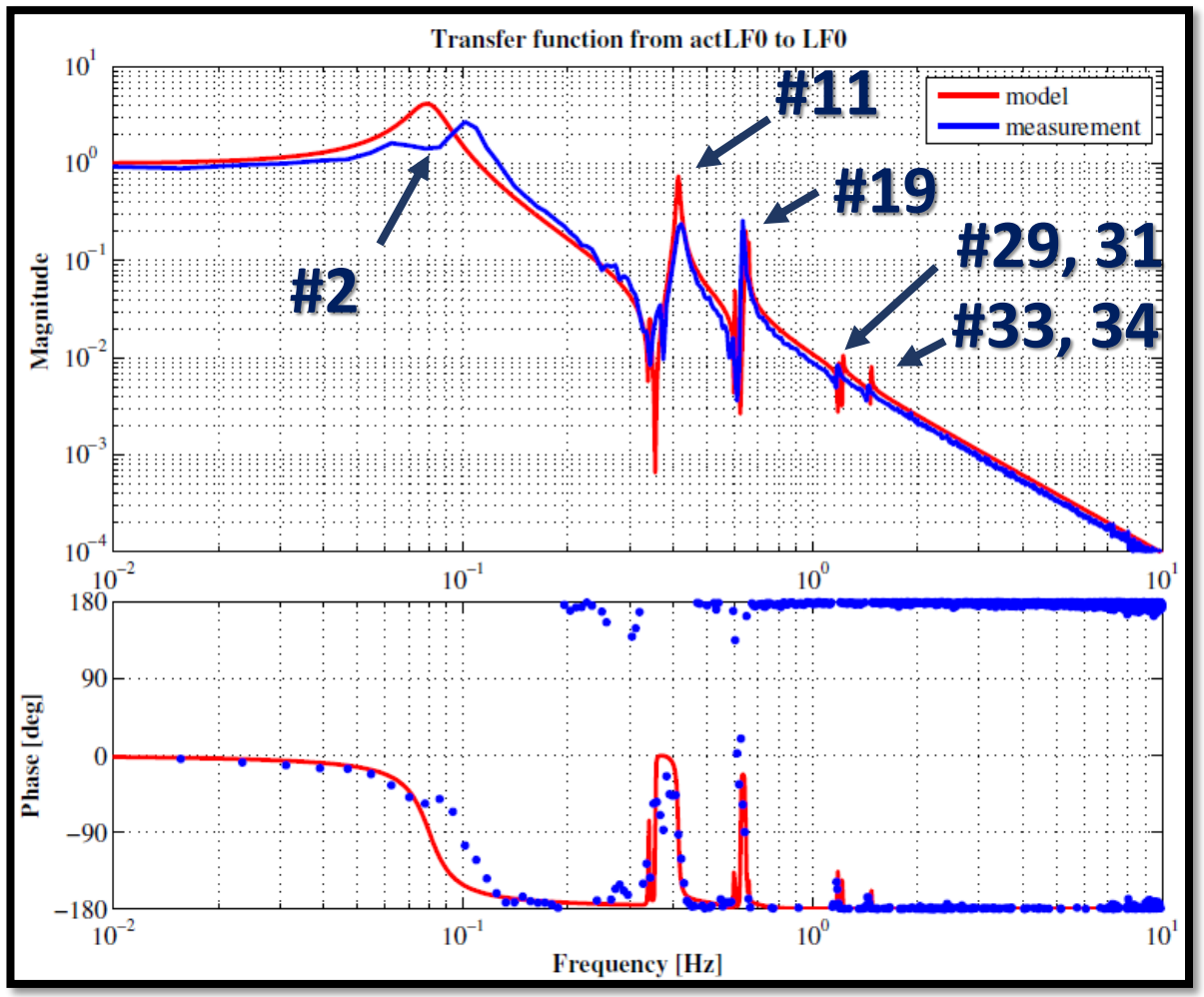




Force Transfer Function

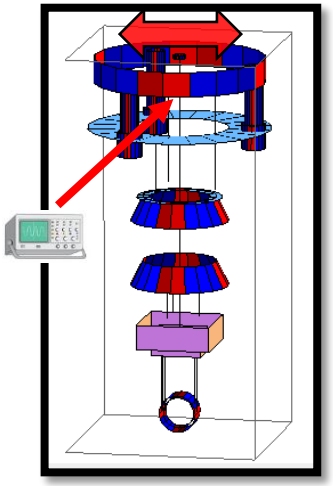
LVDT_LF0 / actLF0

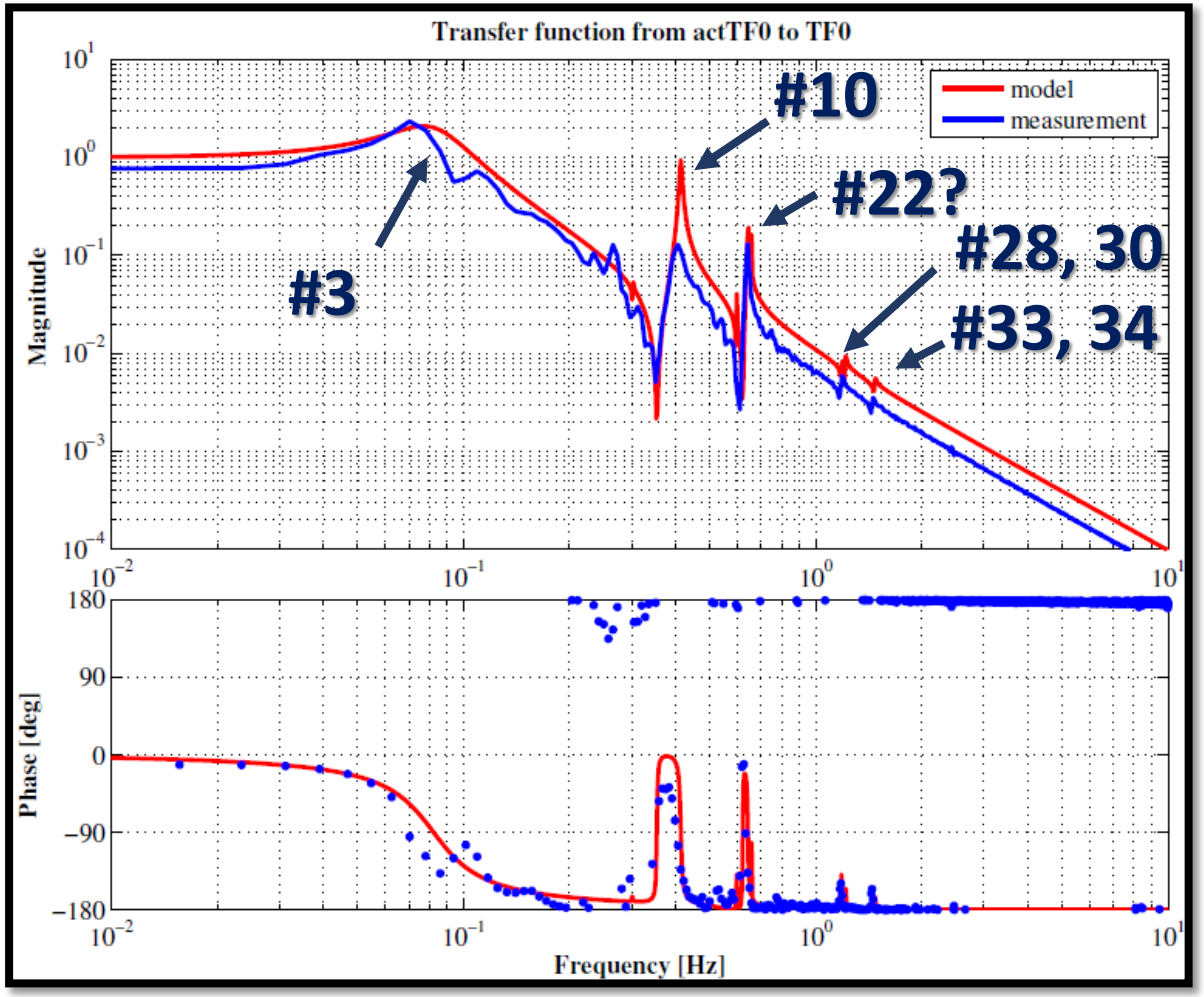




Force Transfer Function

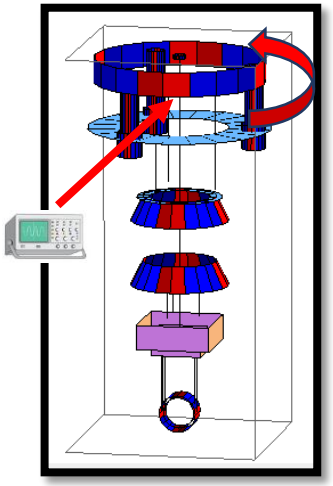
LVDT_TF0 / actTF0

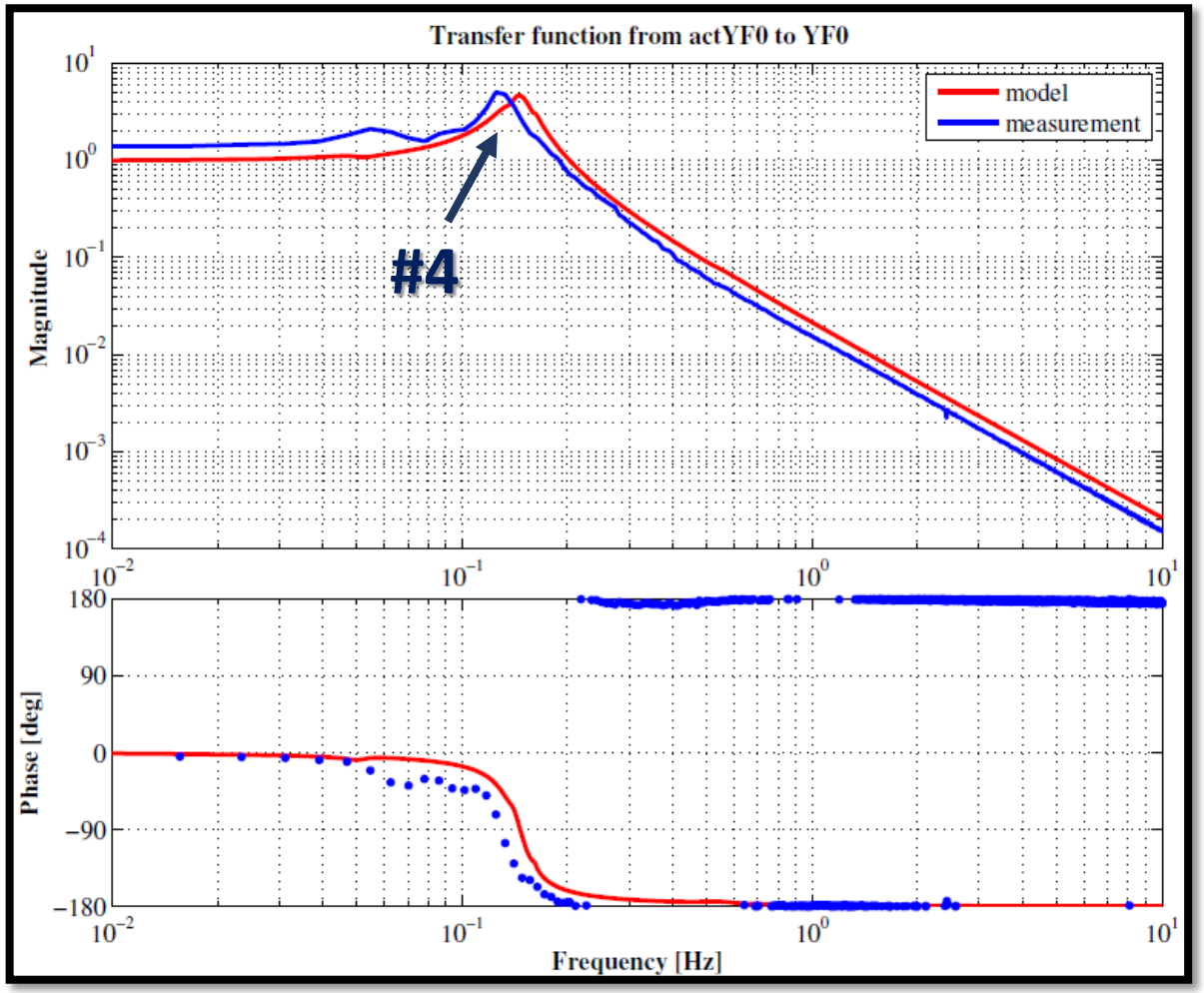




Force Transfer Function

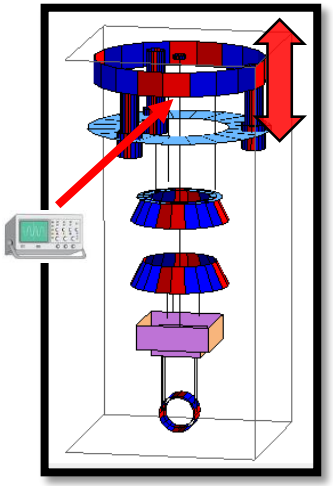
LVDT_YF0 / actYF0

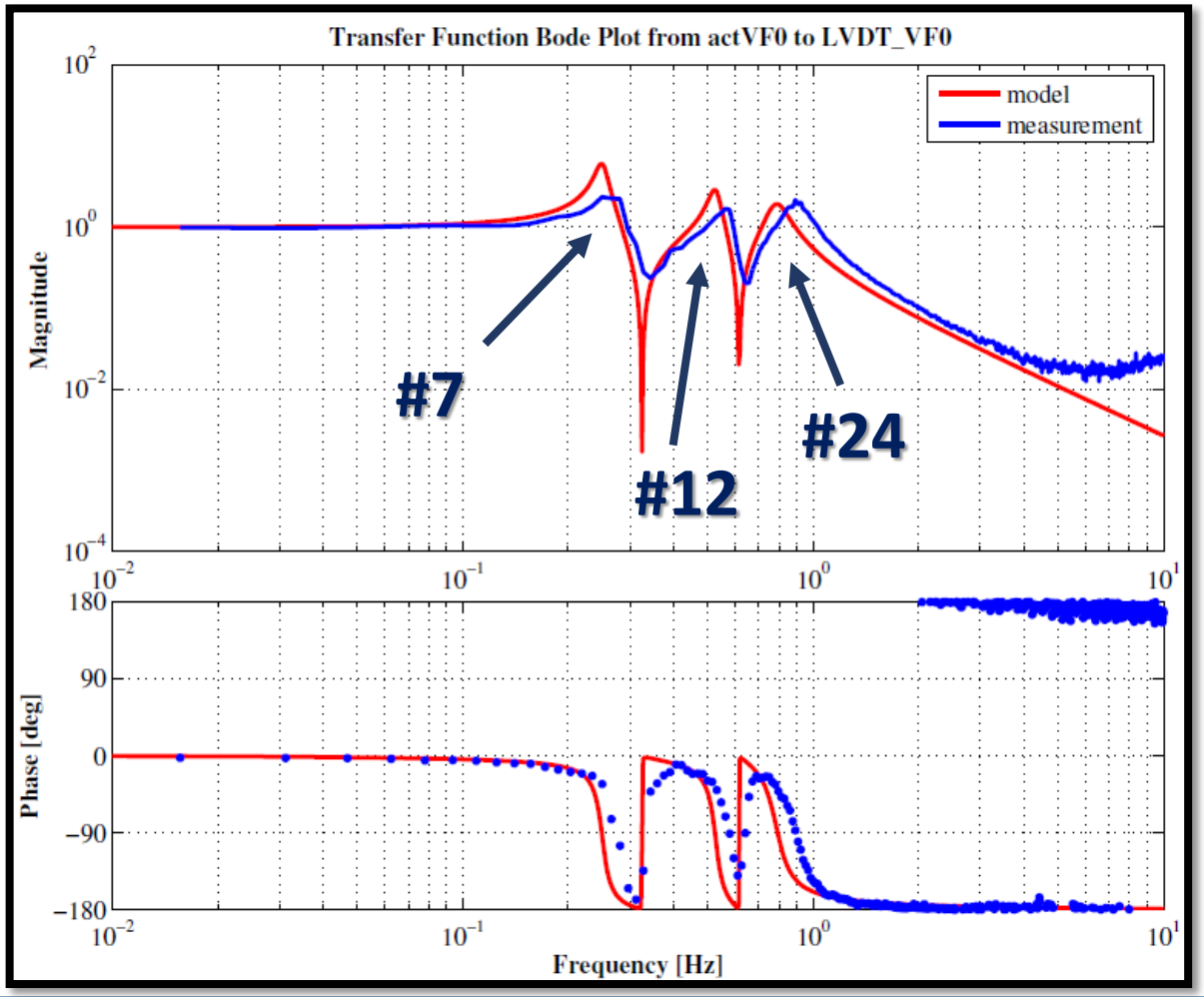




Force Transfer Function

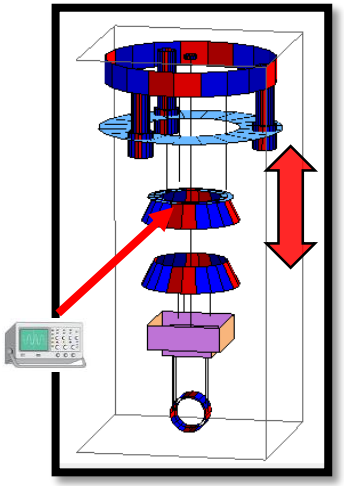
LVDT_VF0 / actVF0

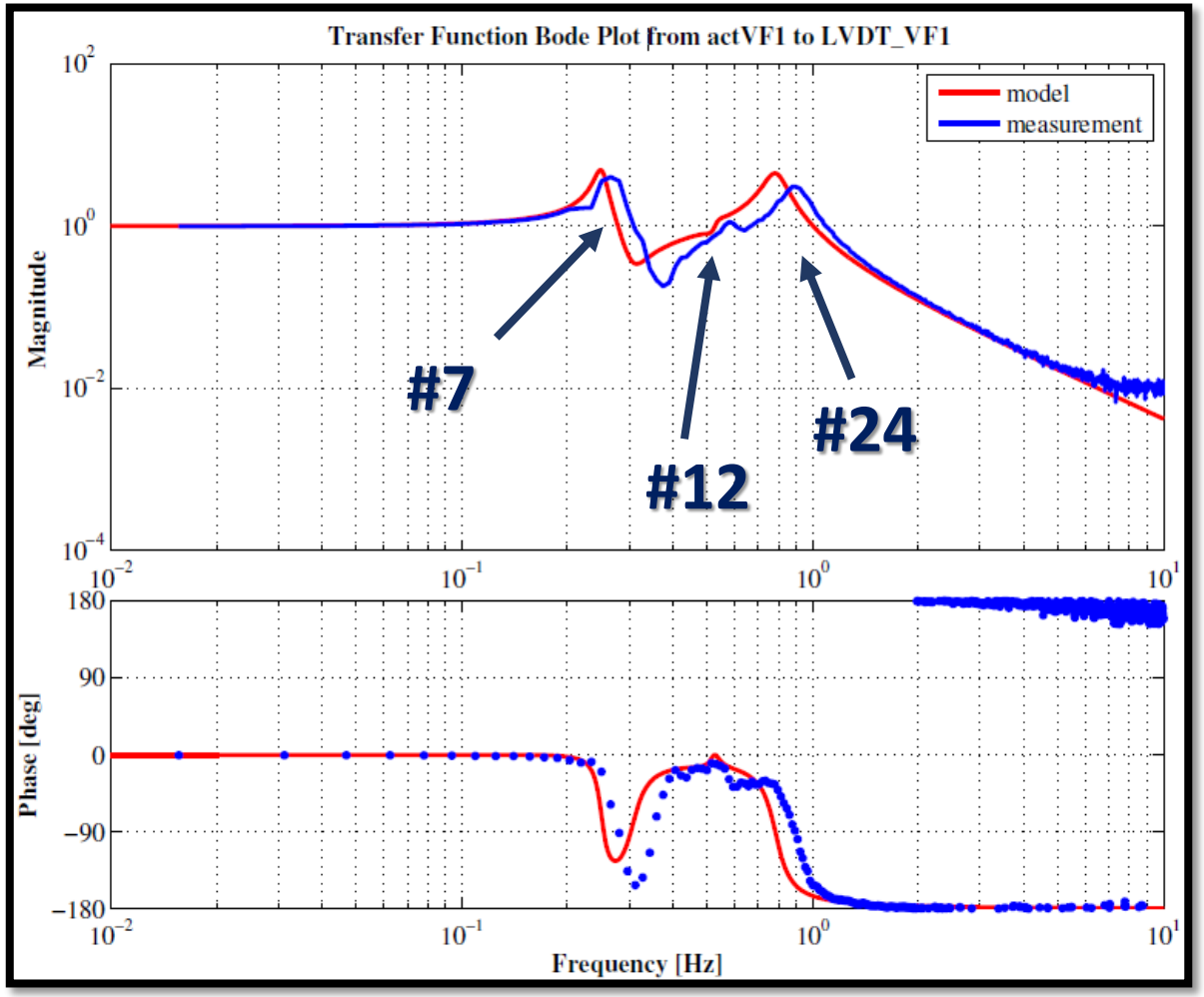




Force Transfer Function

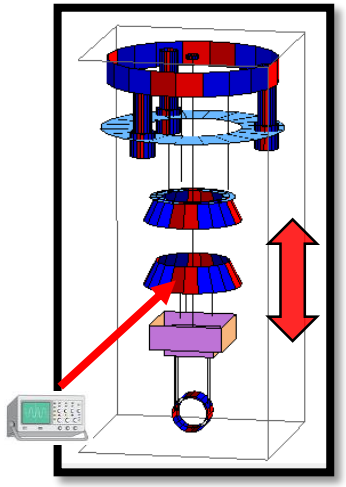
LVDT_VF1 / actVF1





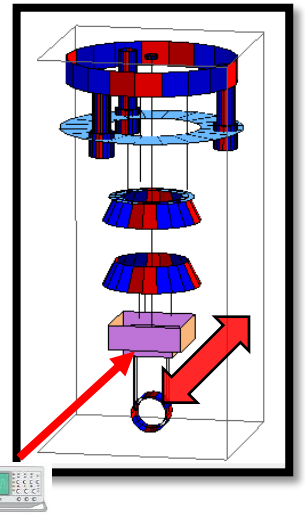
Force Transfer Function

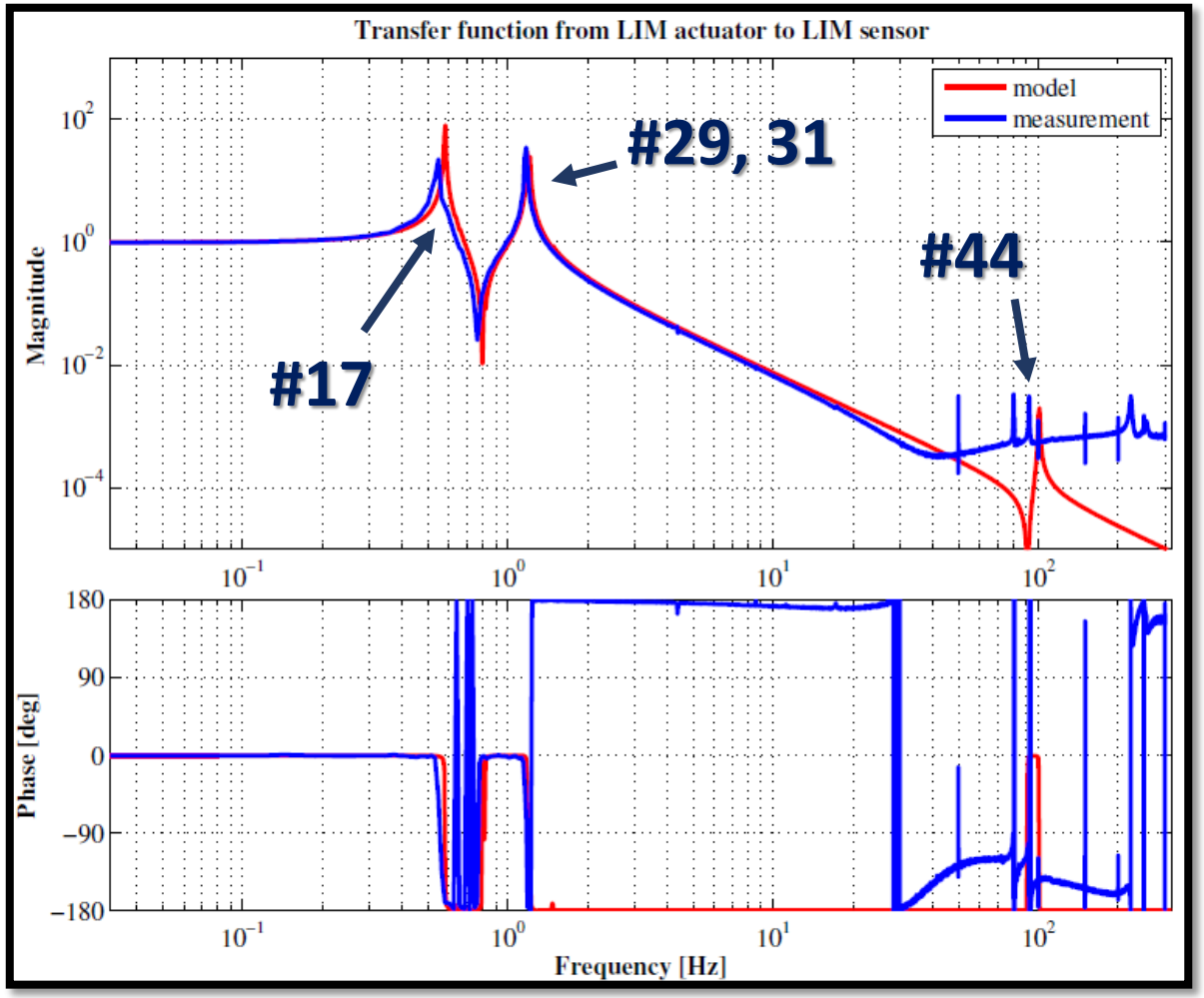
LVDT_VF2 / actVF2



Force Transfer Function

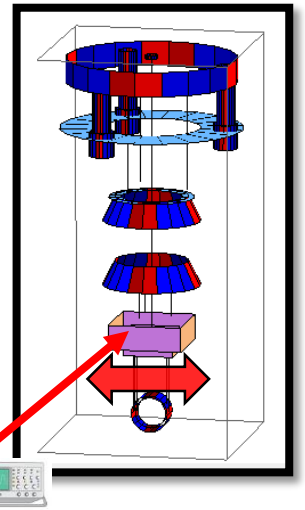
OSEM_LIM / actLIM

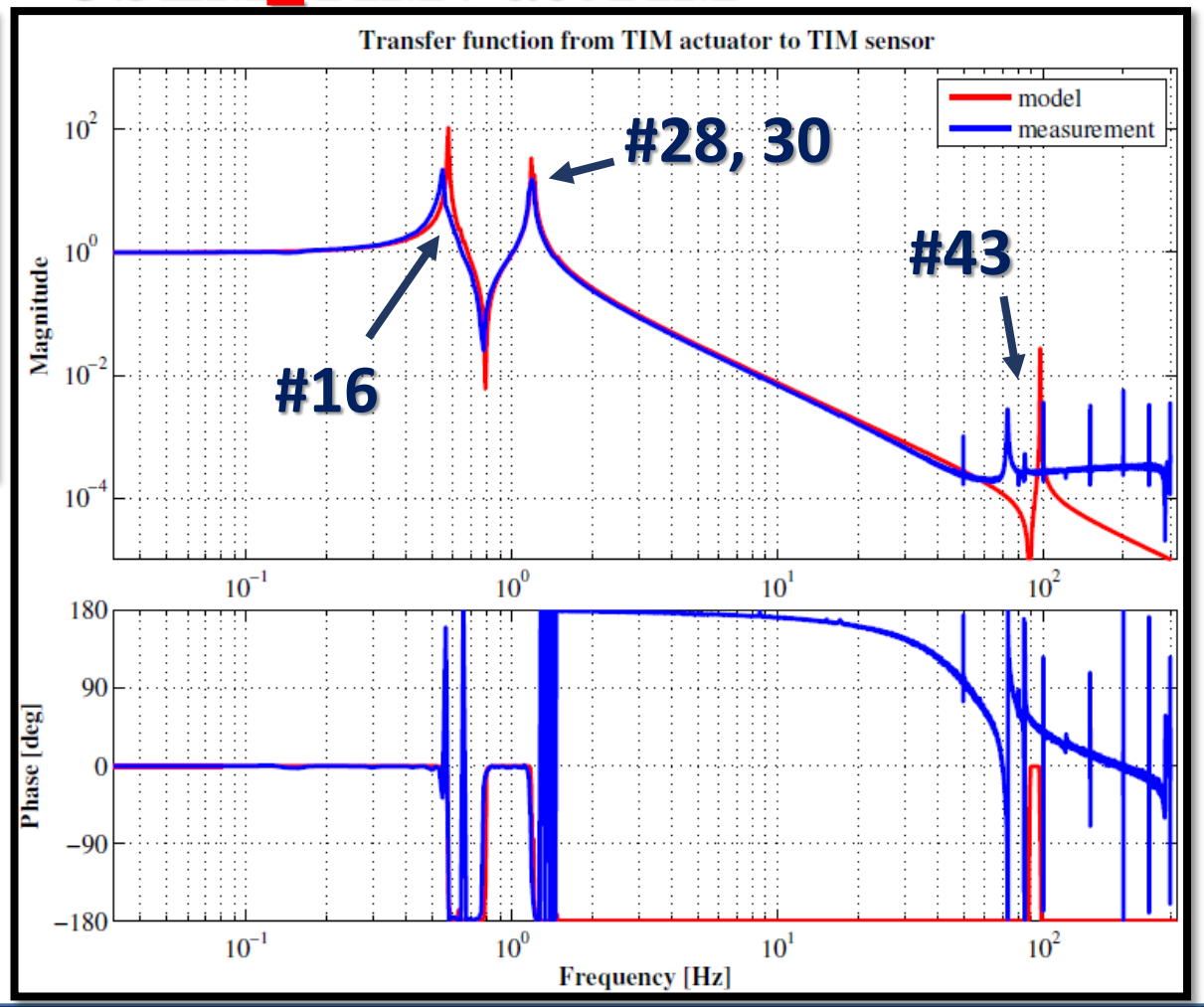




Force Transfer Function

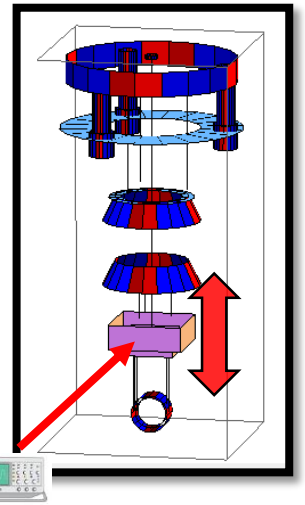
OSEM_TIM / actTIM

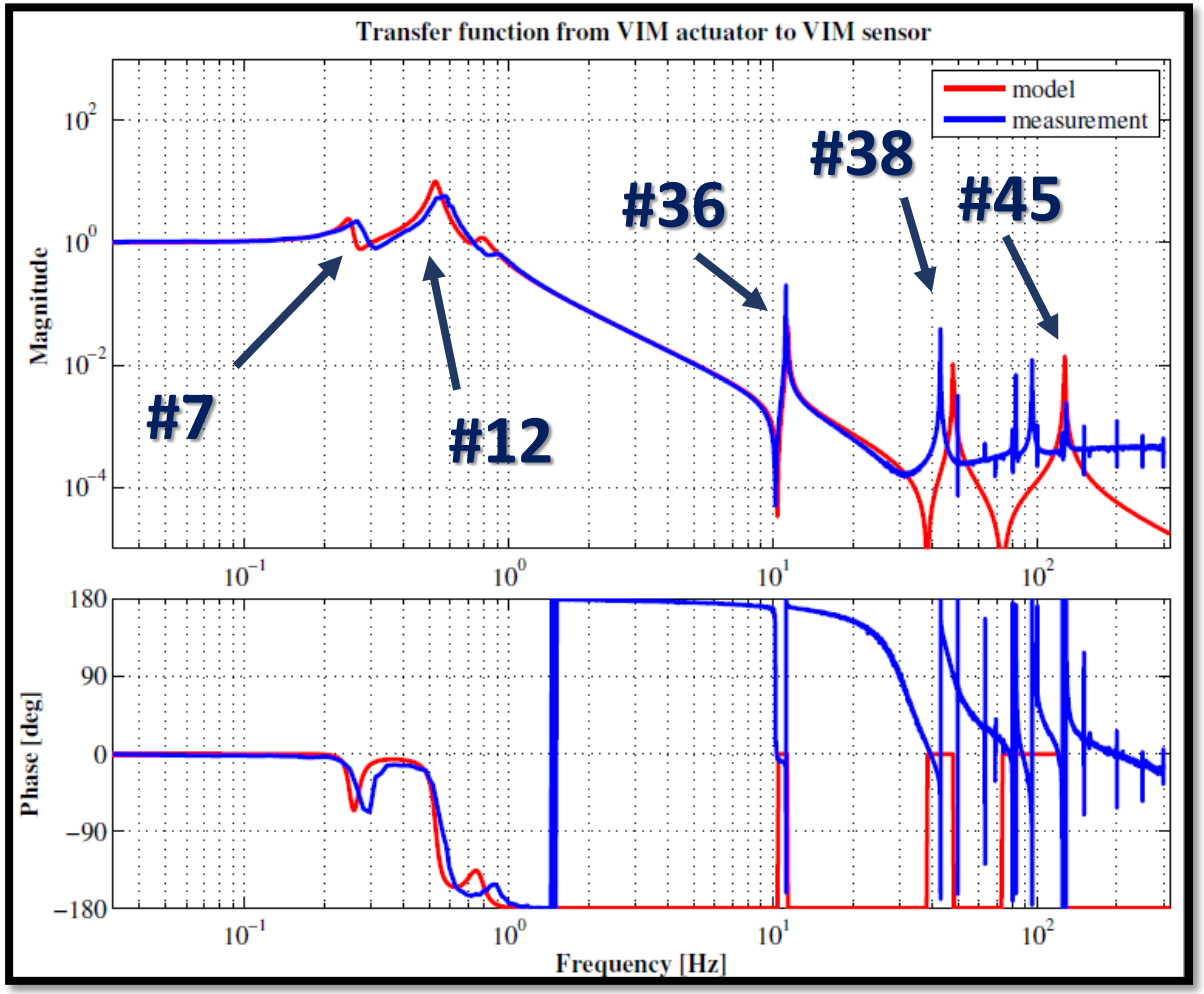




Force Transfer Function

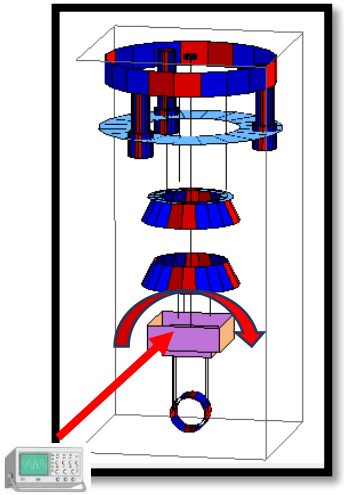
OSEM_VIM / actVIM

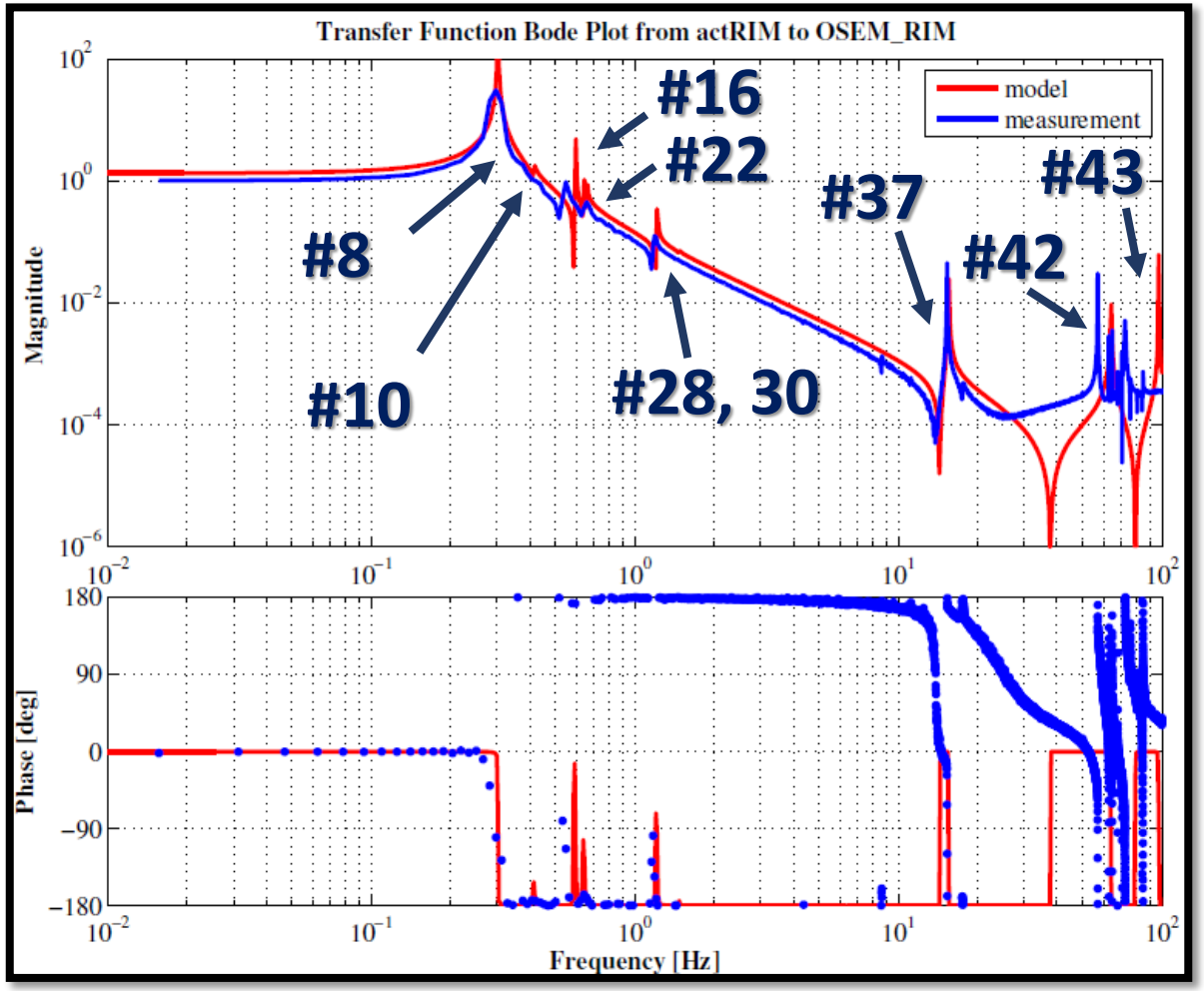




Force Transfer Function

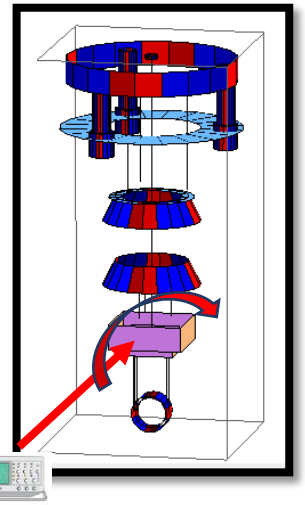
OSEM_RIM / actRIM

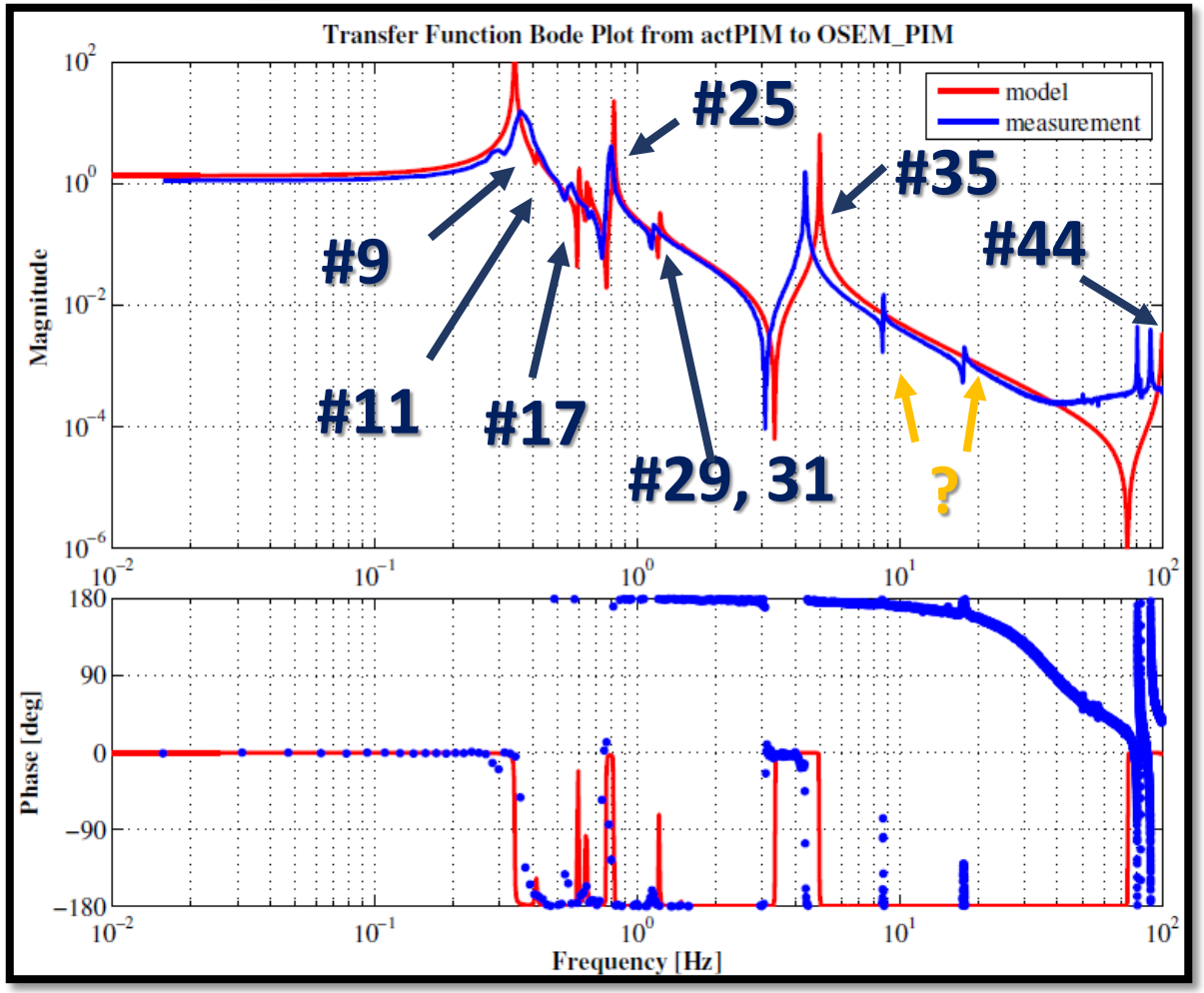




Force Transfer Function

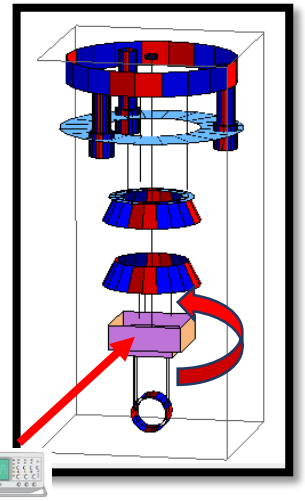
OSEM_PIM / actPIM

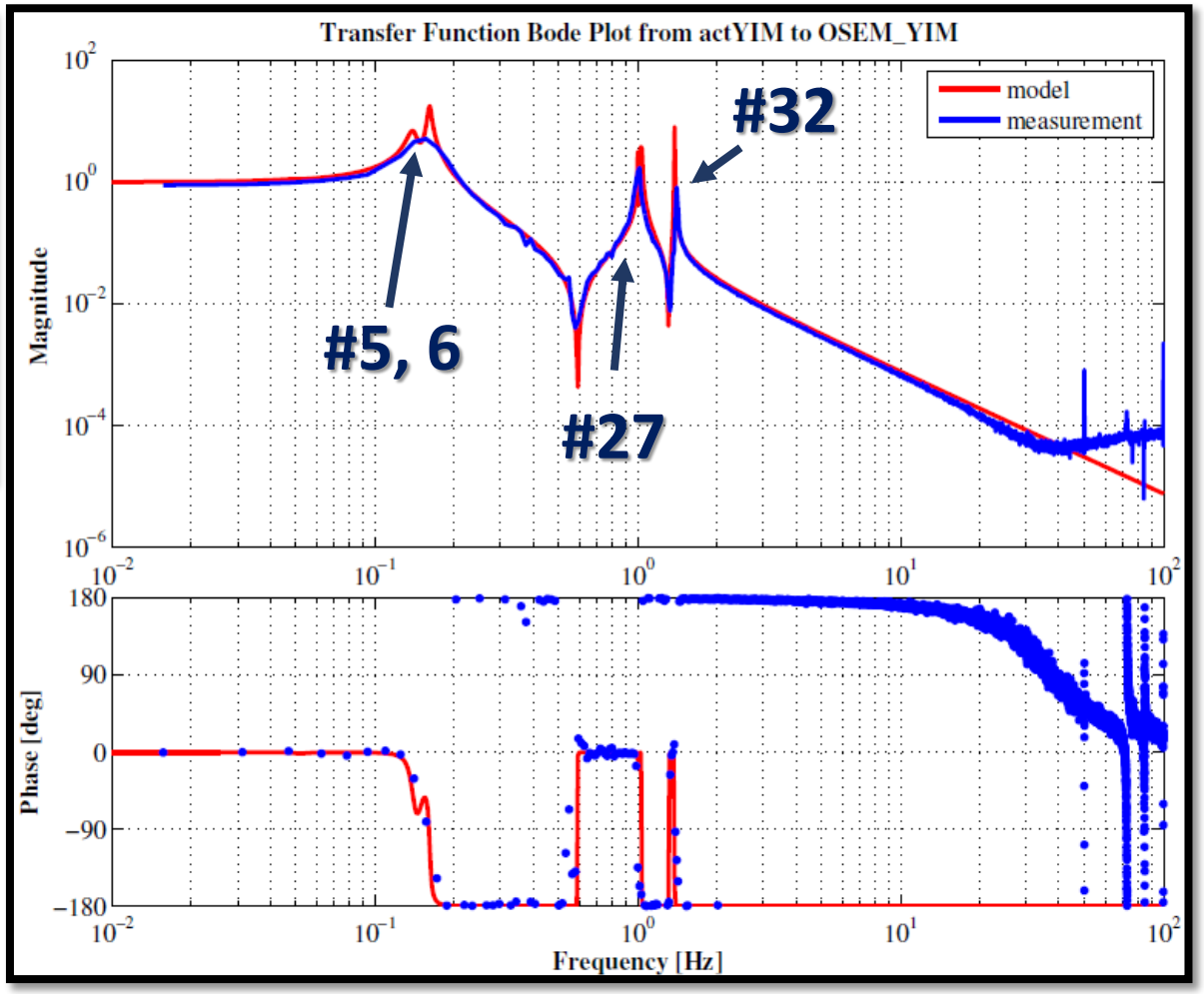




Force Transfer Function

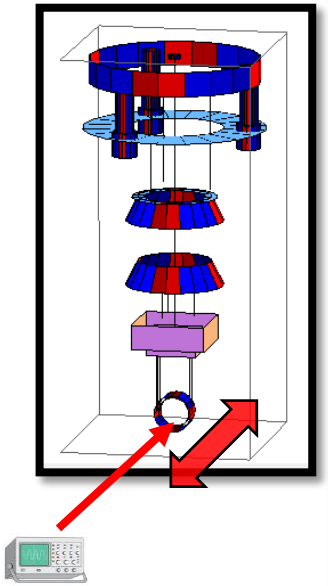
OSEM_YIM / actYIM

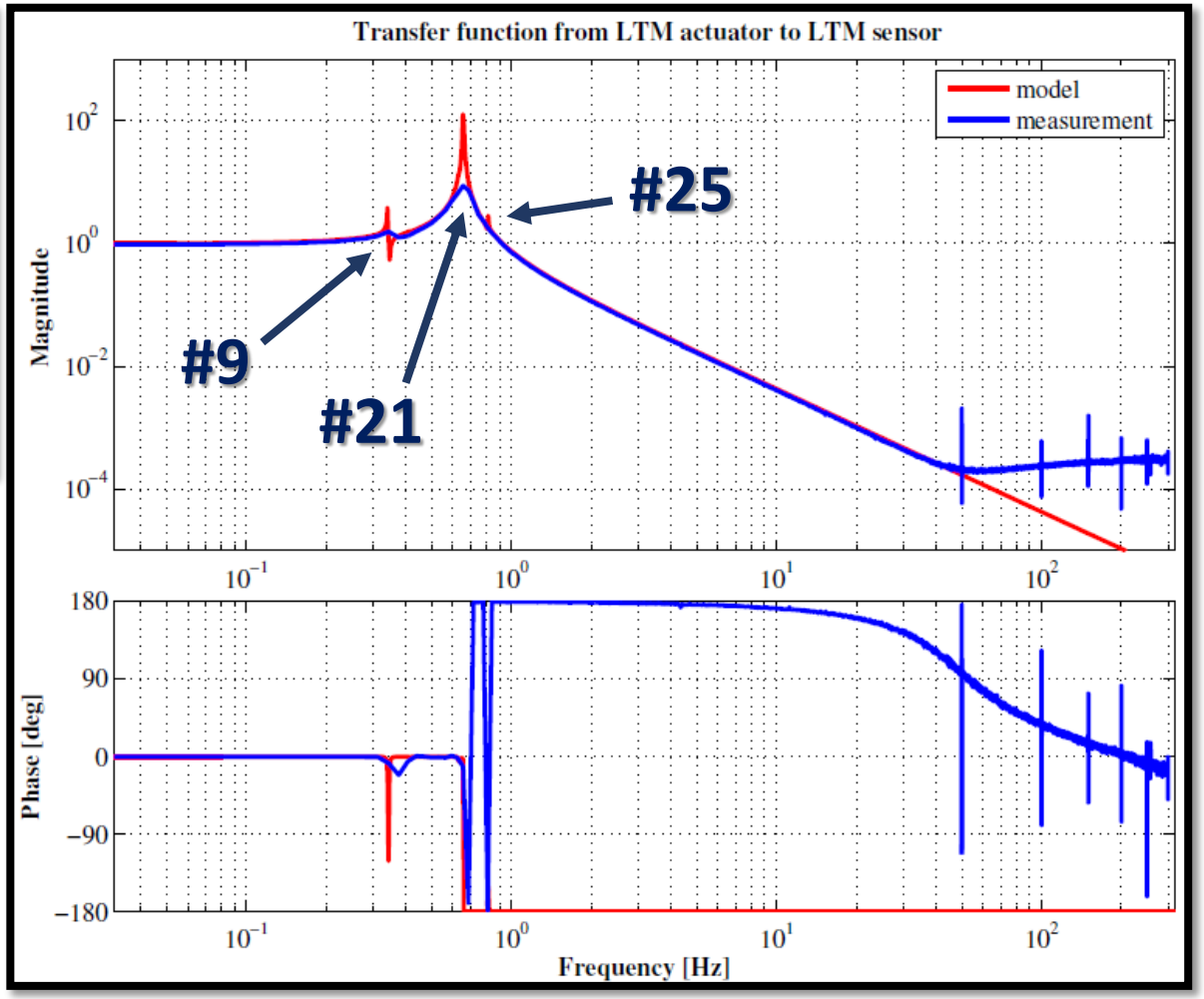




Force Transfer Function

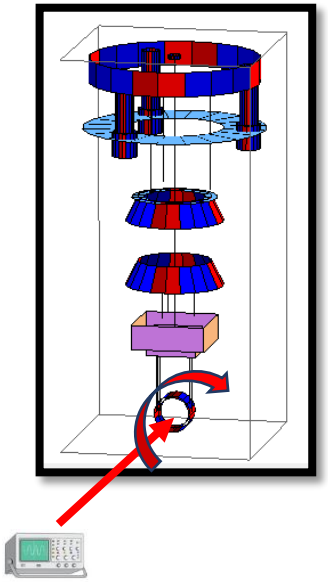
OSEM_LTM / actLTM

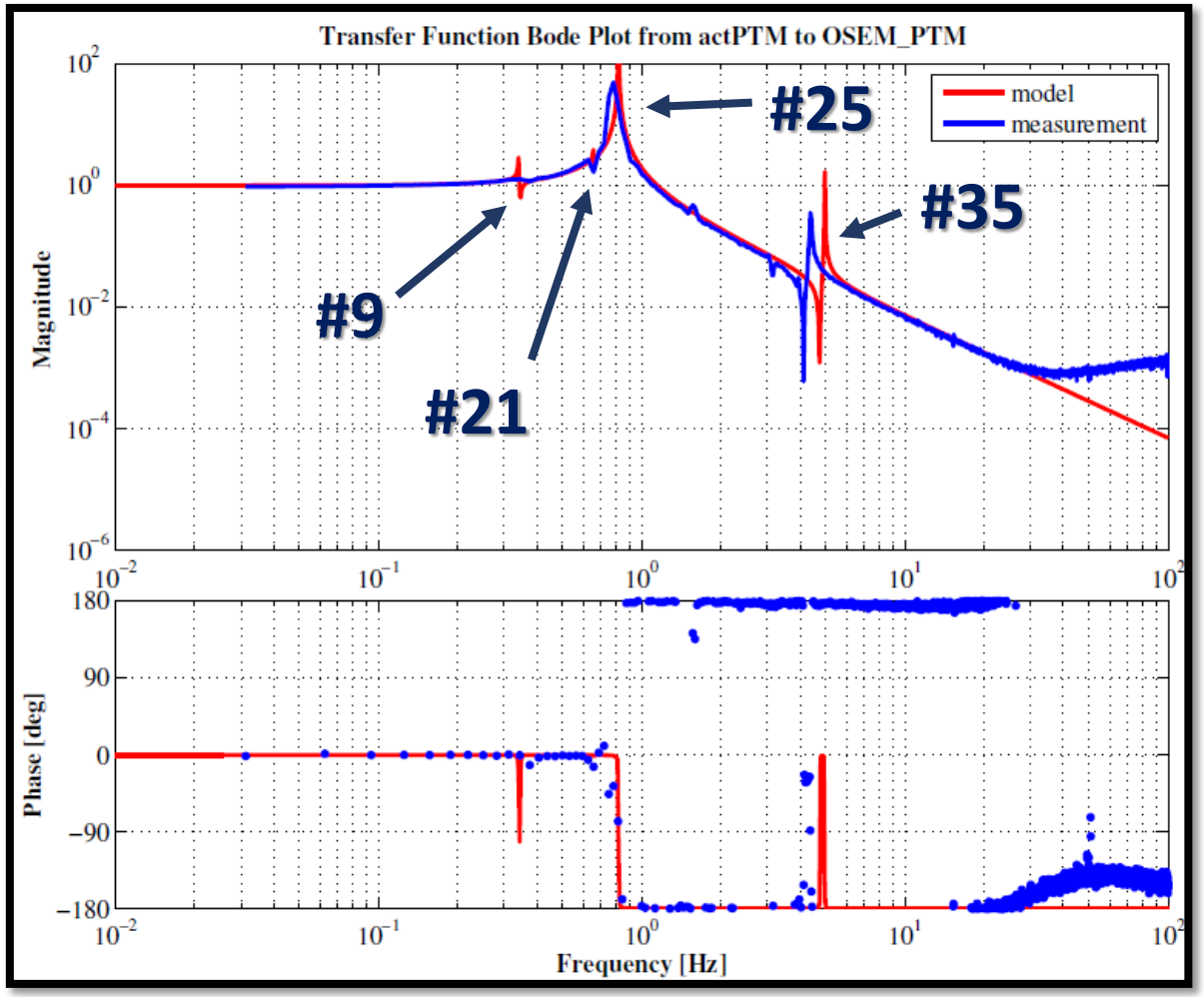




Force Transfer Function

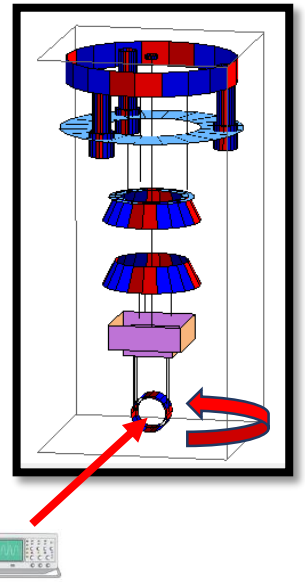
OSEM_PTM / actPTM

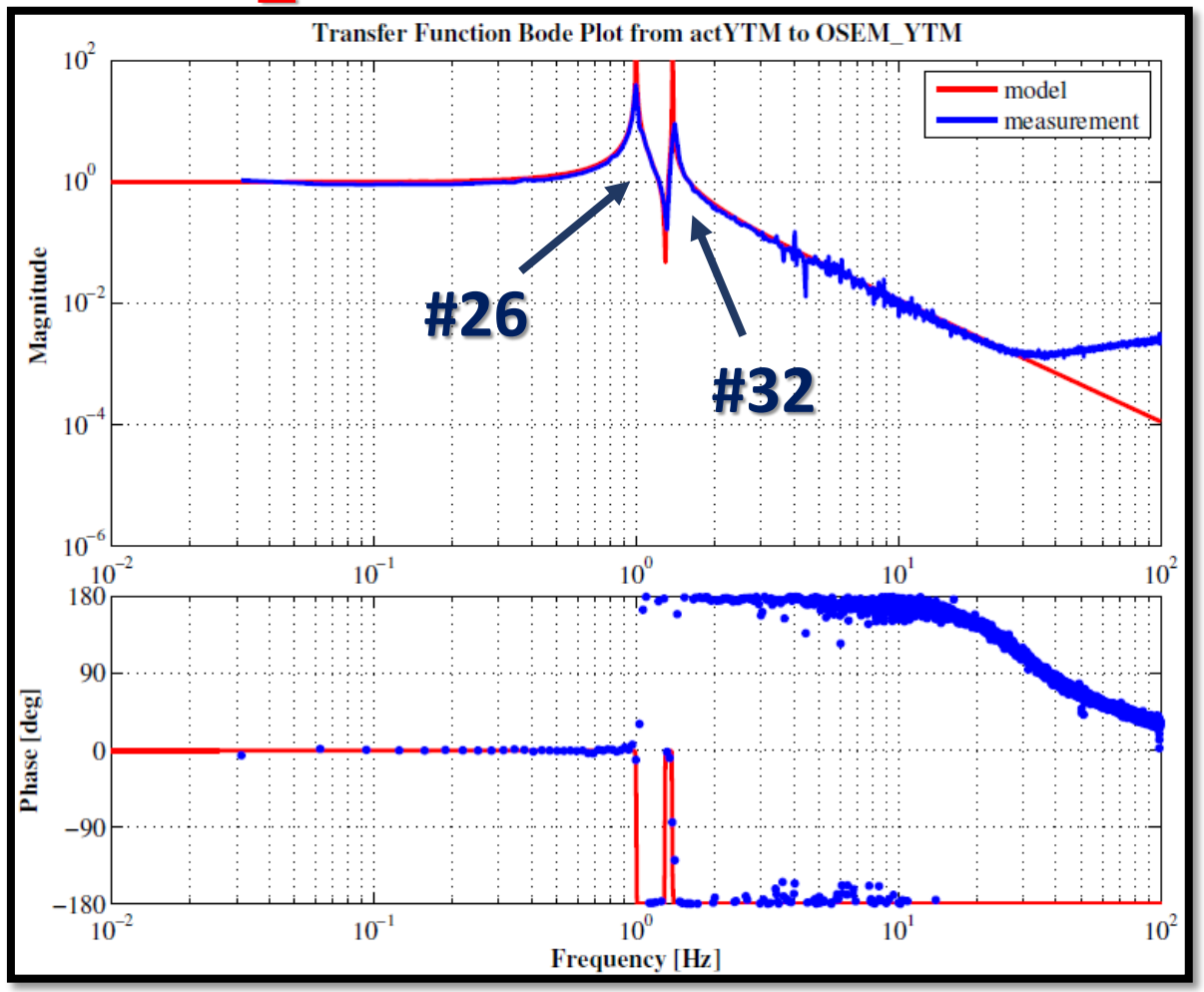




Force Transfer Function

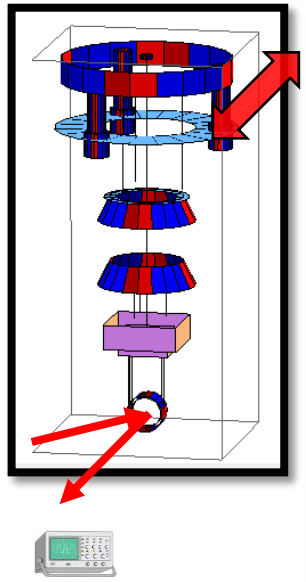
OSEM_YTM / actYTM

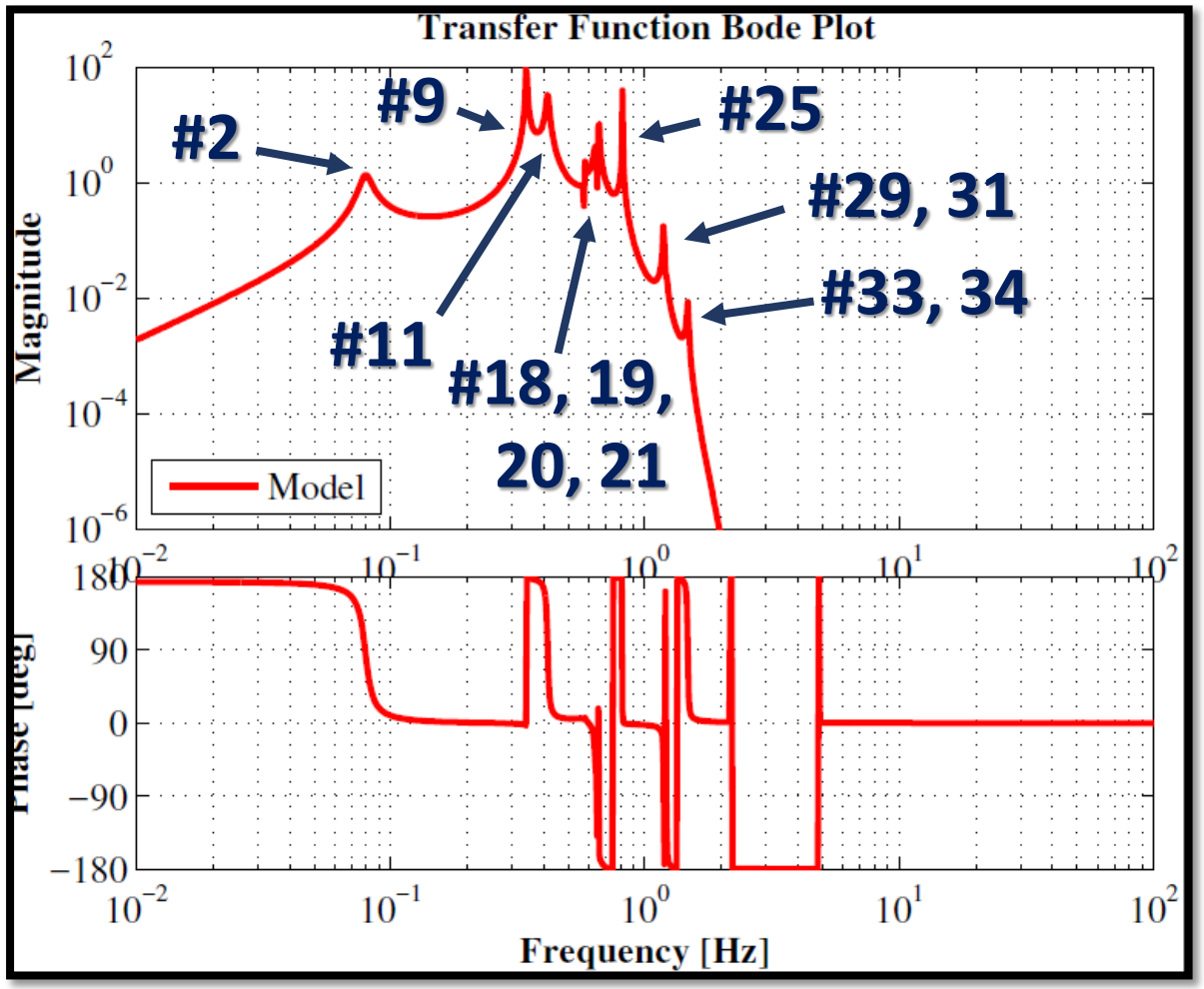




Force Transfer Function

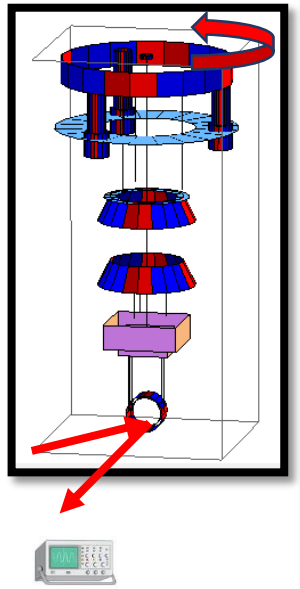
OpLev_PTM / actLF0

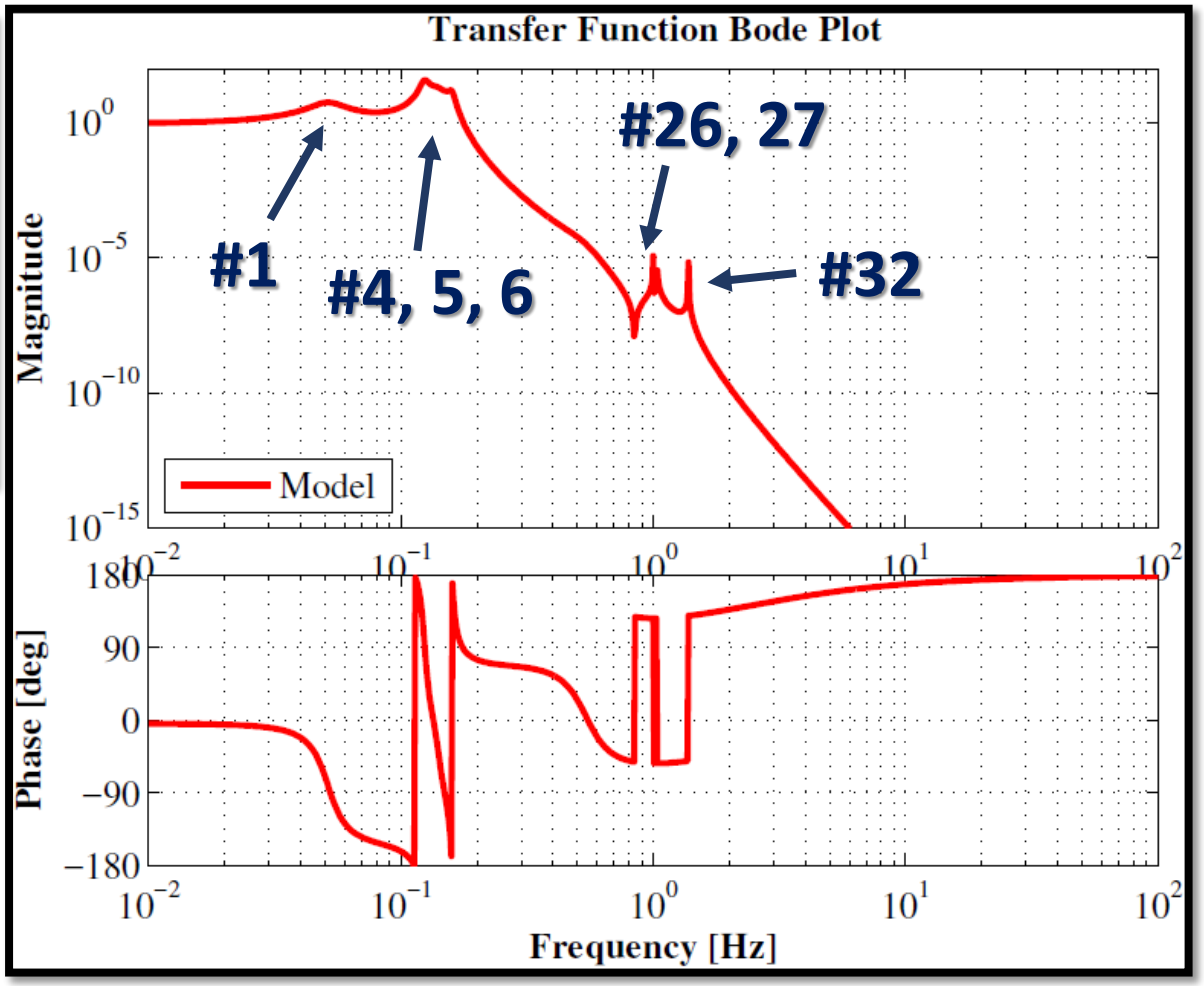




Force Transfer Function

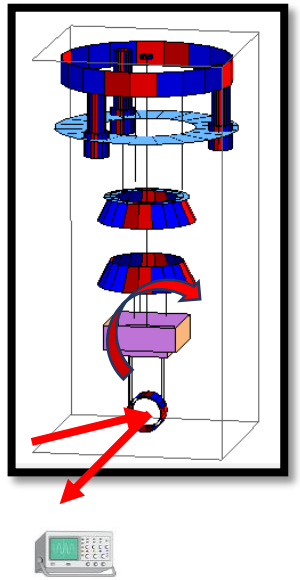
OpLev_YTM / actYF0

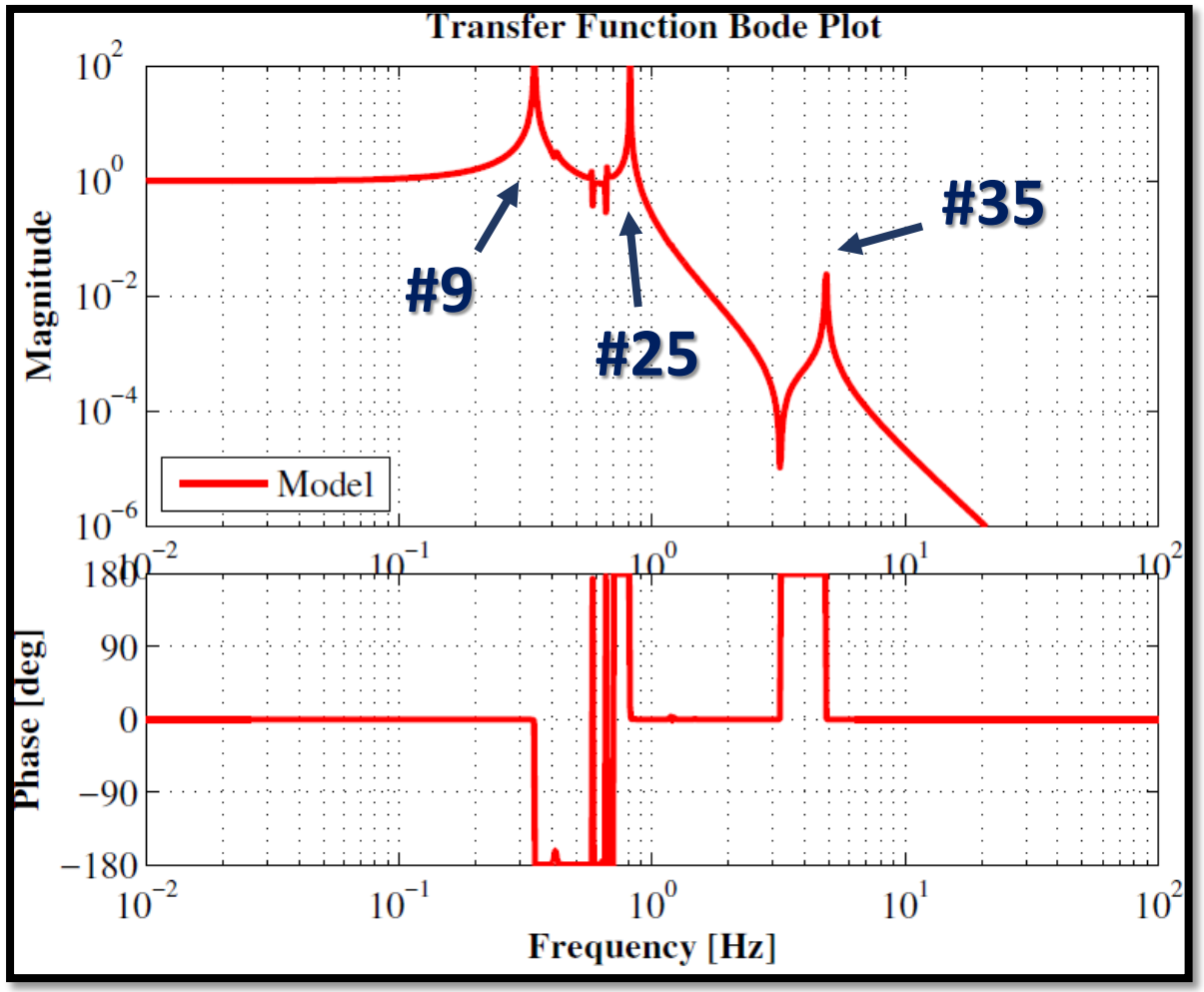




Force Transfer Function

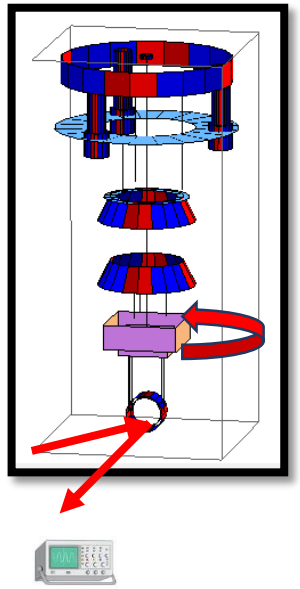
OpLev_PTM / actPIM

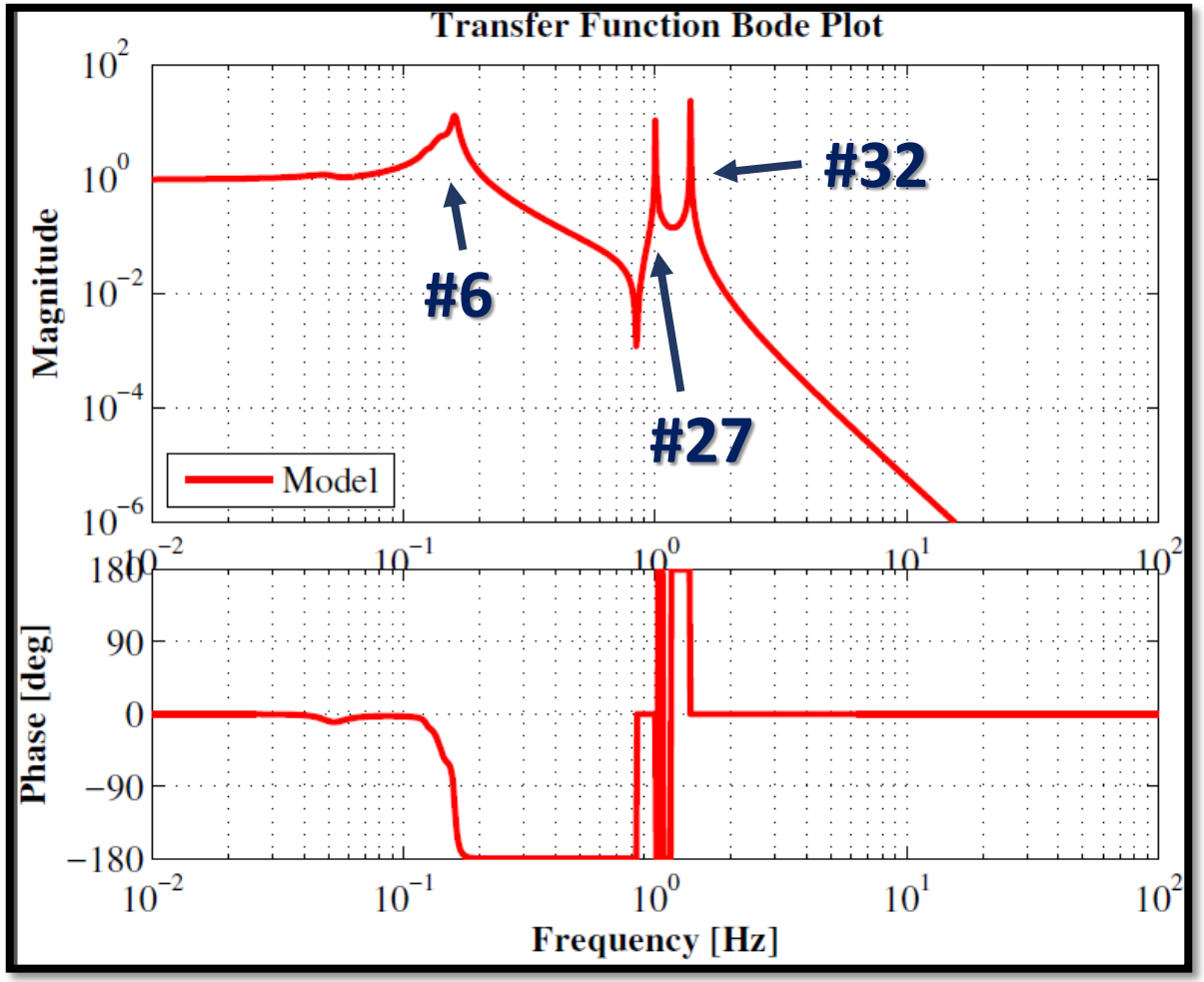




Force Transfer Function

OpLev_YTM / actYIM





Spectra

without control

using 90 percentile seismic noise

❖ From http://gwdoc.icrr.u-tokyo.ac.jp/DocDB/0039/T1503908/002/TypeBpDesign.pdf

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.

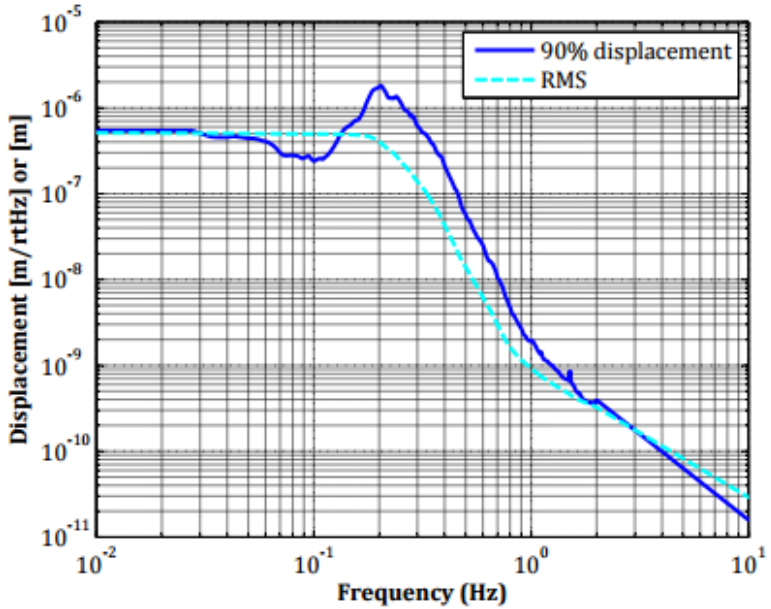


Figure 1: The high-level seismic displacement in Kamioka.

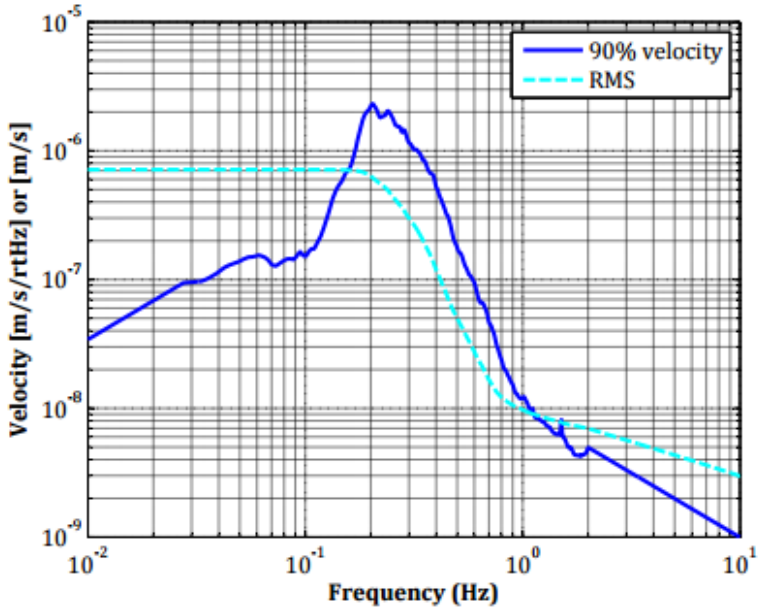
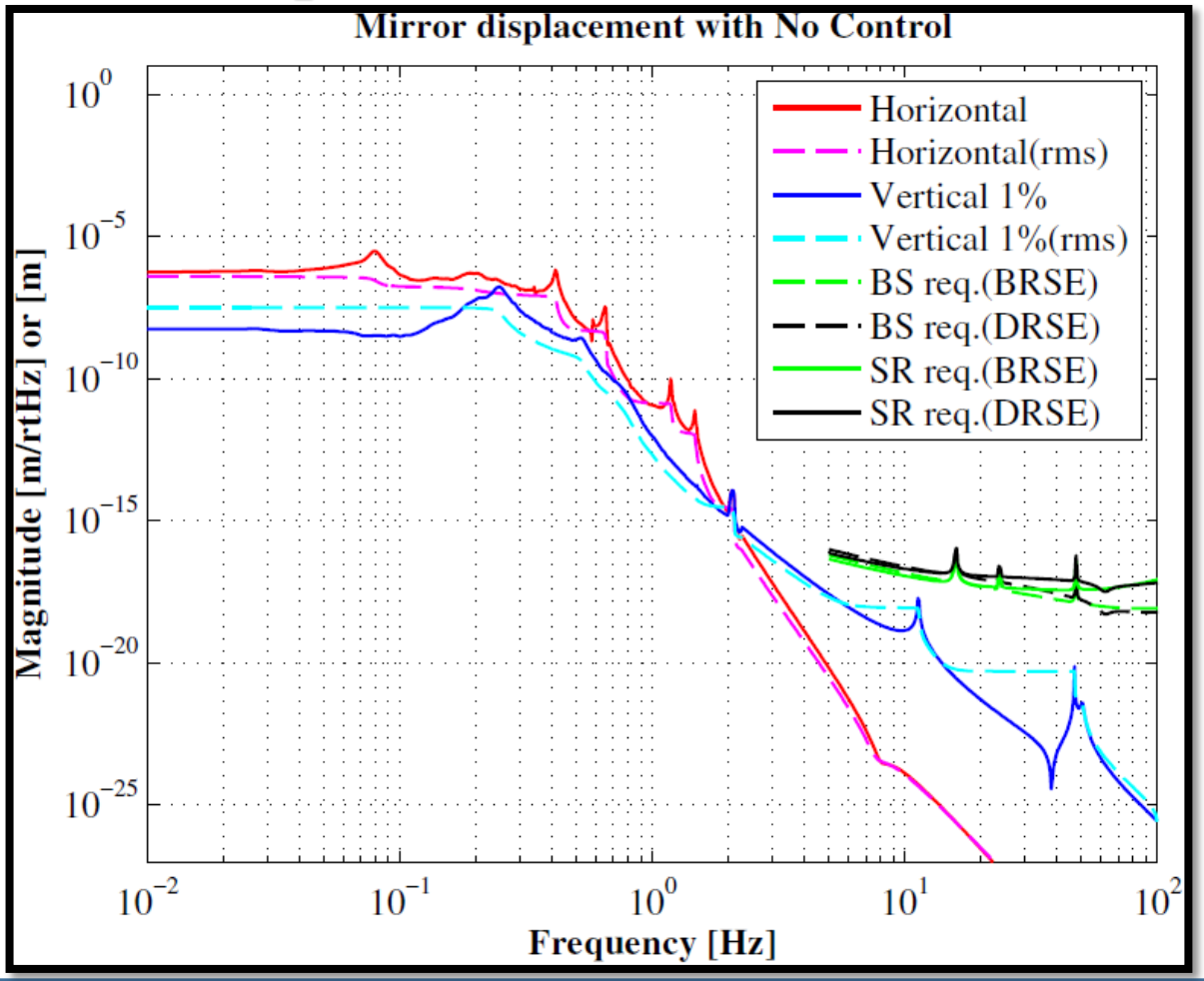


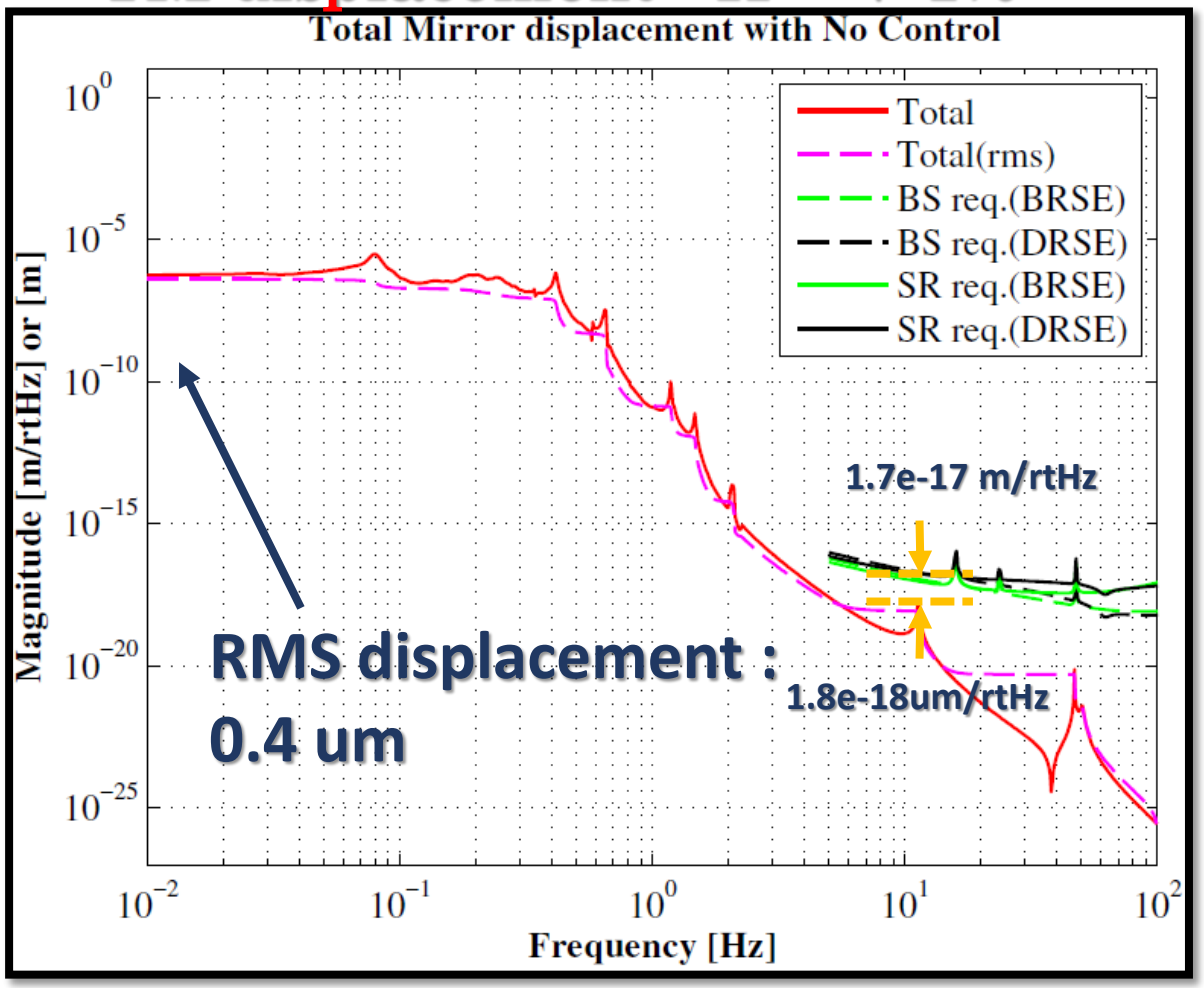
Figure 2: The high-level seismic velocity in Kamioka.

Spectra without ctrl

TM displacement : H and V 1%

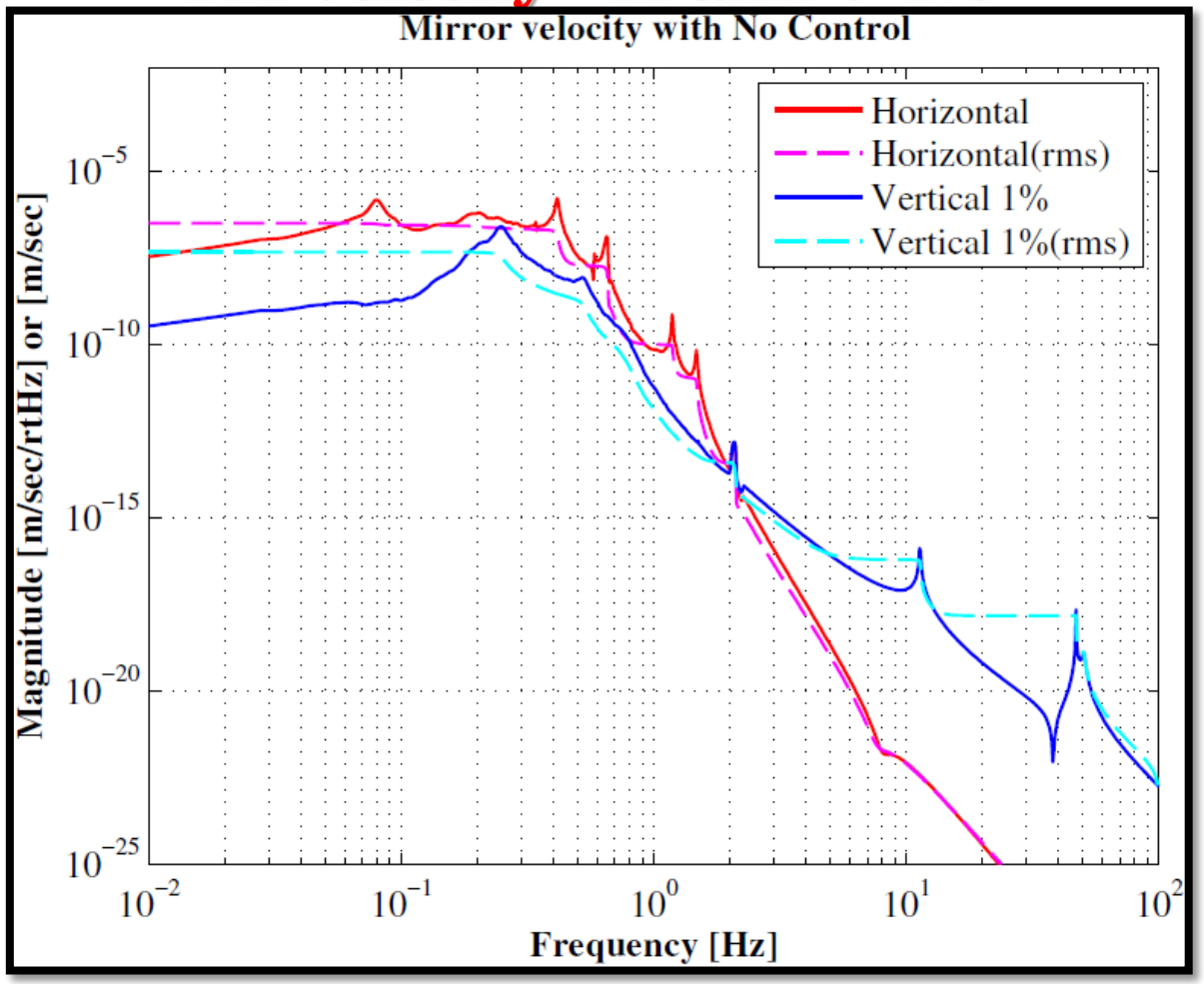


TM displacement : H + V 1%

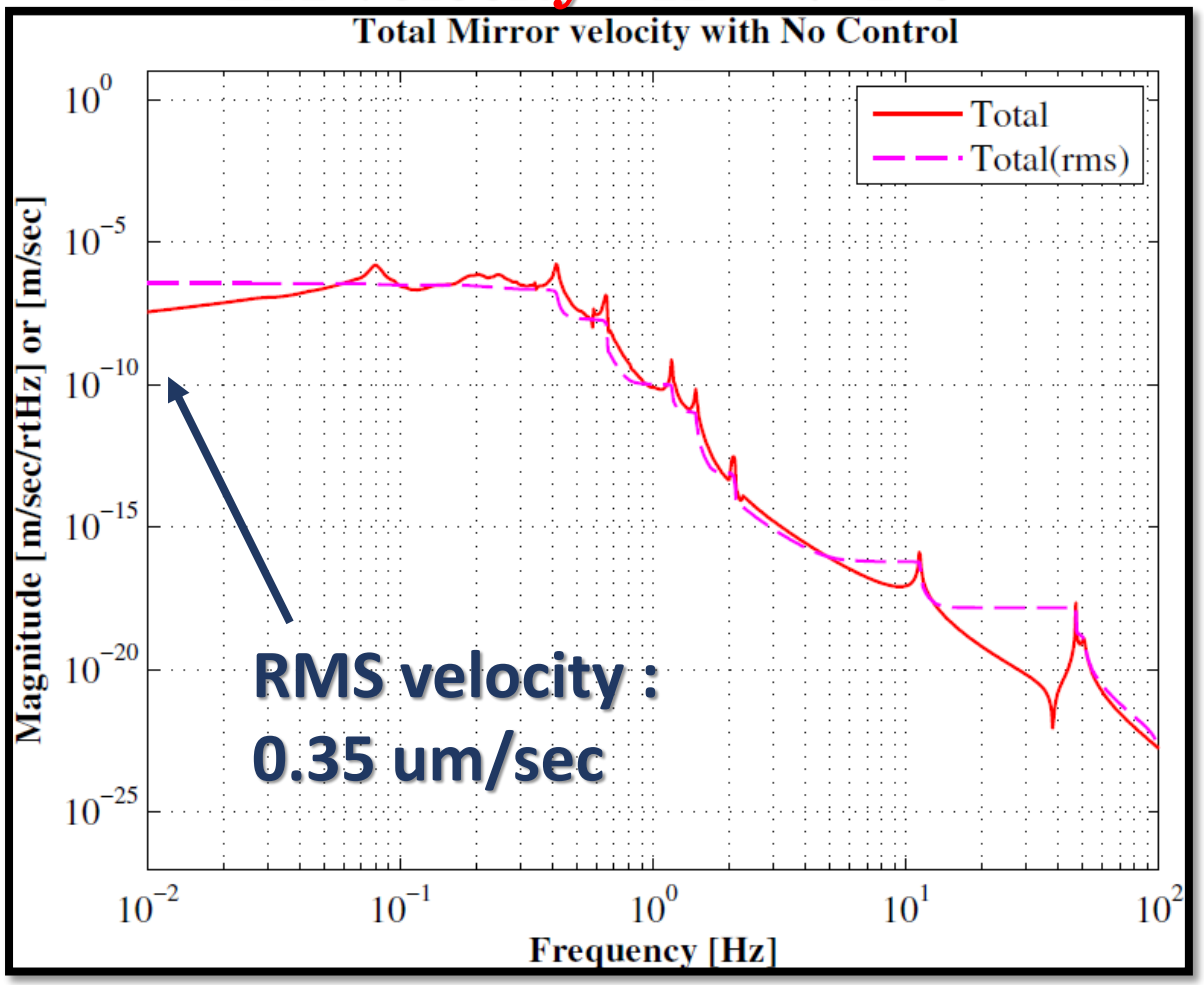


Spectra without ctrl

TM velocity : H and V 1%

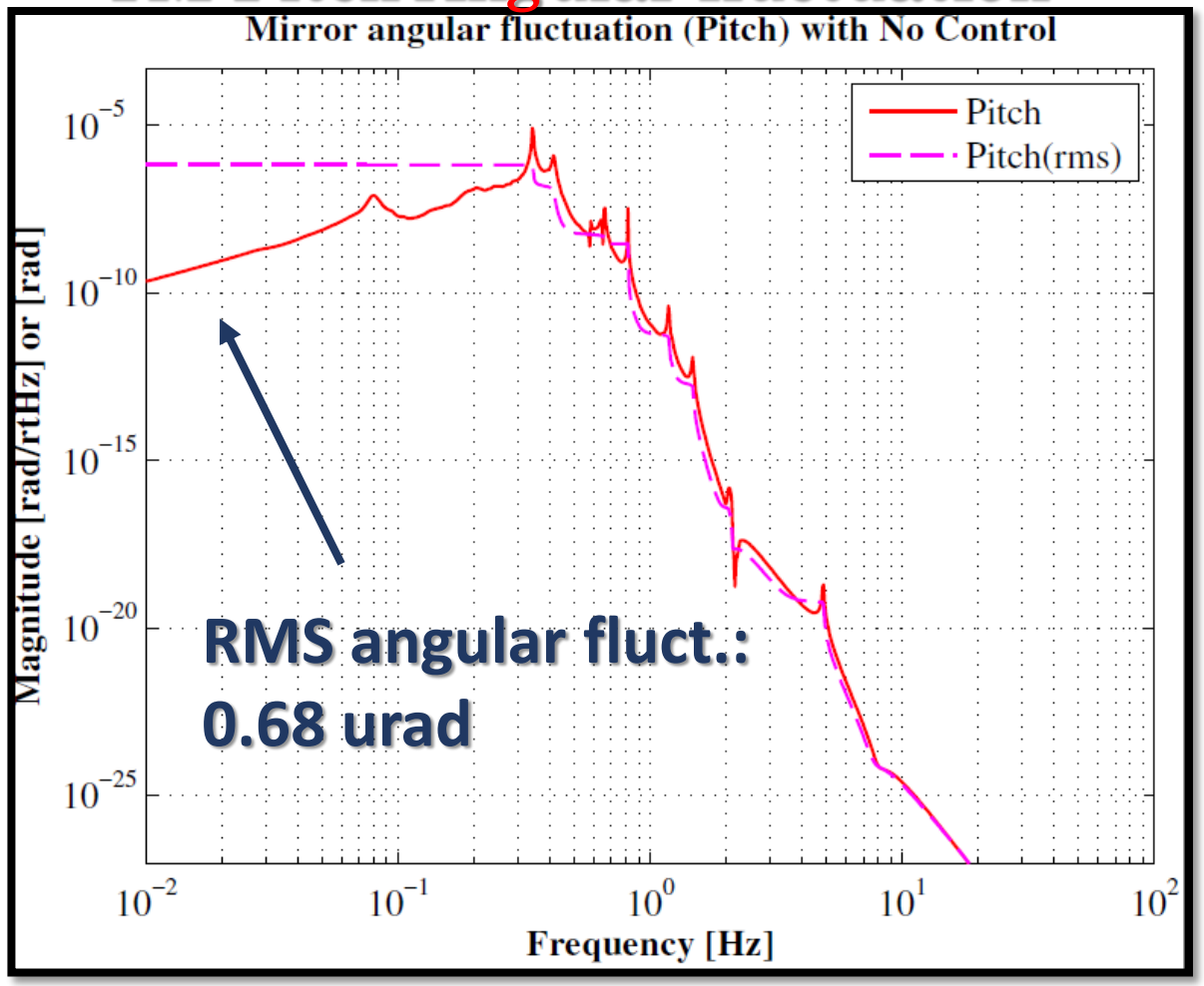


TM velocity : H + V 1%



Spectra without ctrl

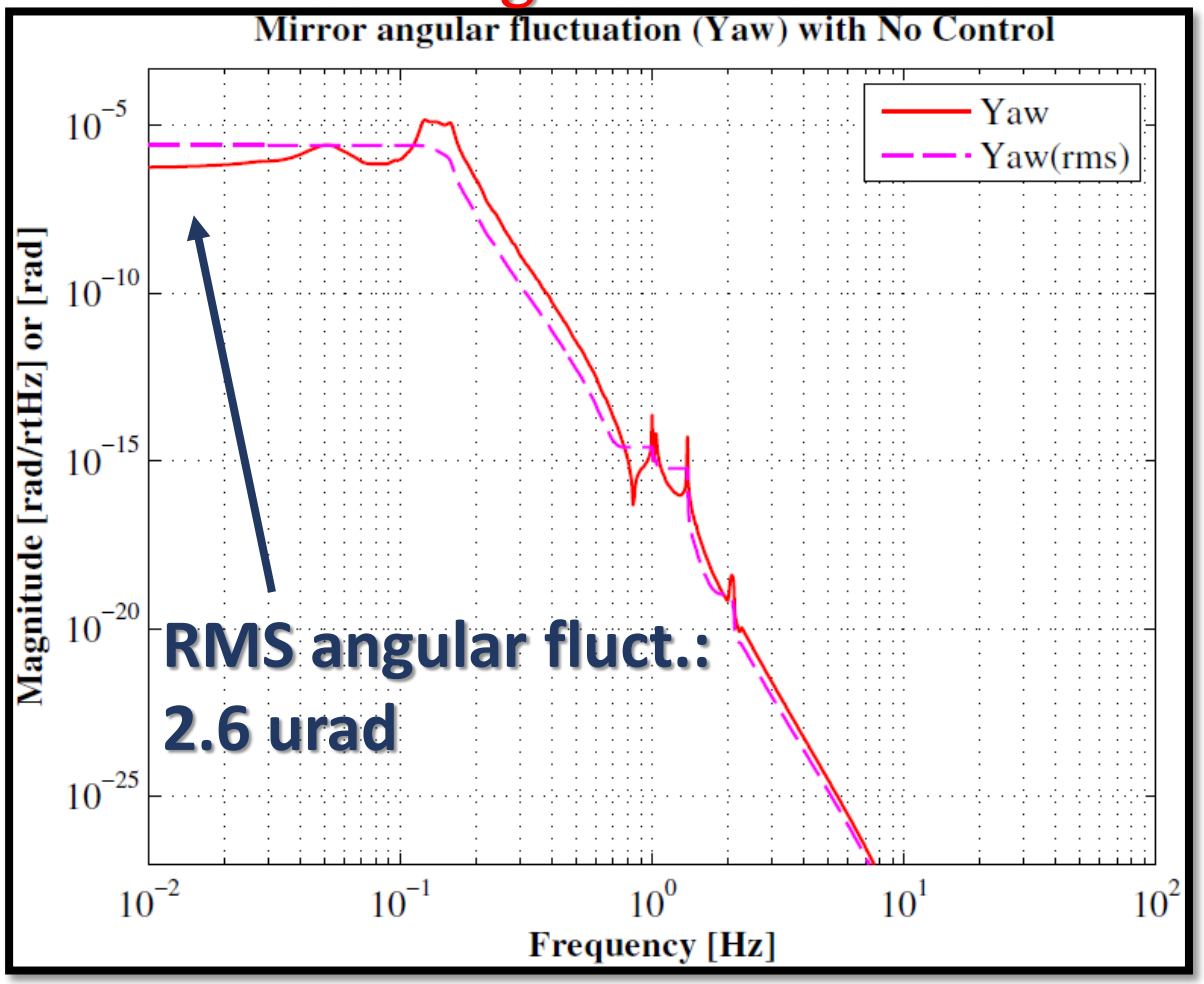
TM Pitch Angular fluctuation



TM Pitch fluctuation excited by Longitudinal GND motion

Spectra without ctrl

TM Yaw Angular fluctuation

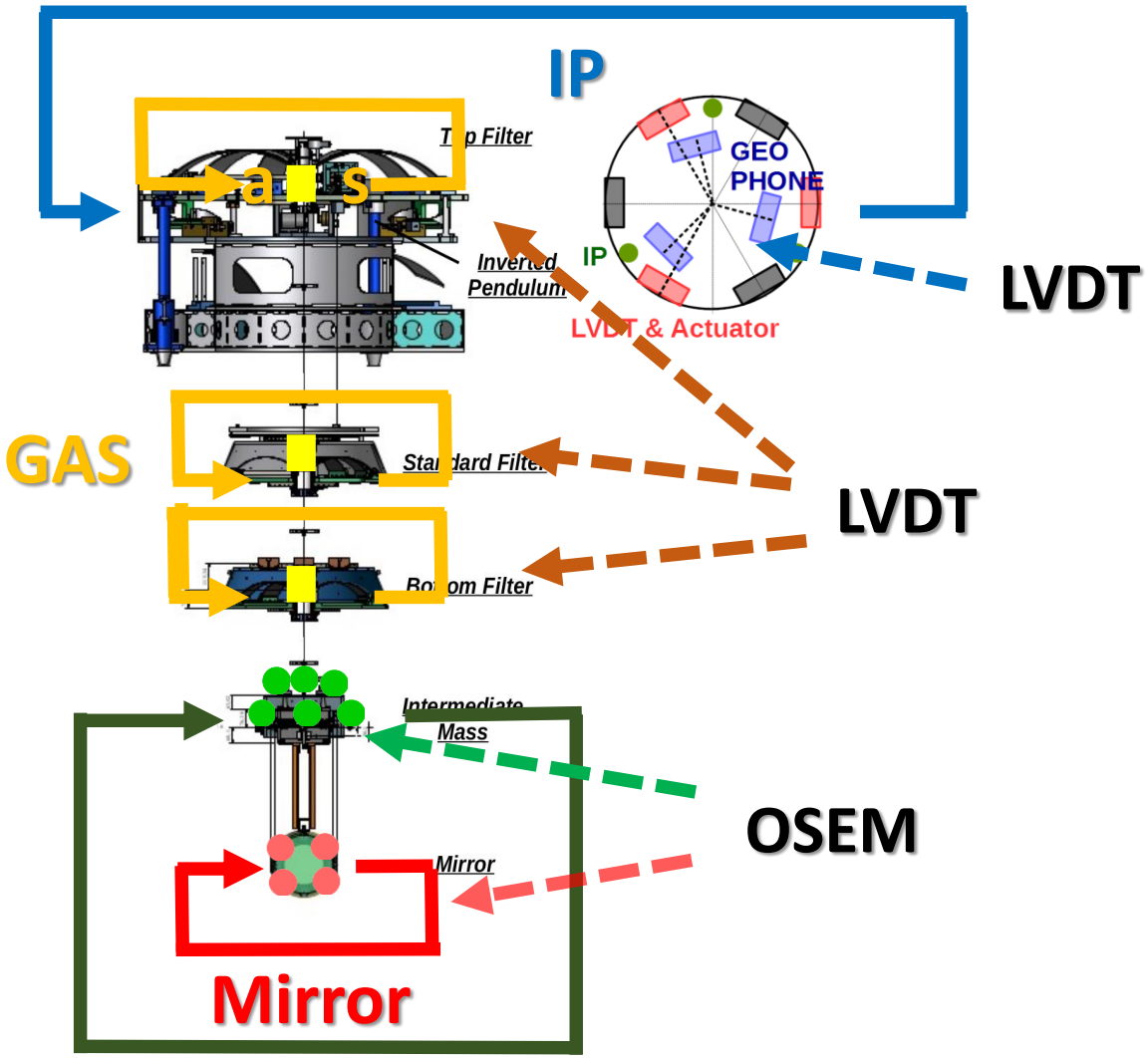


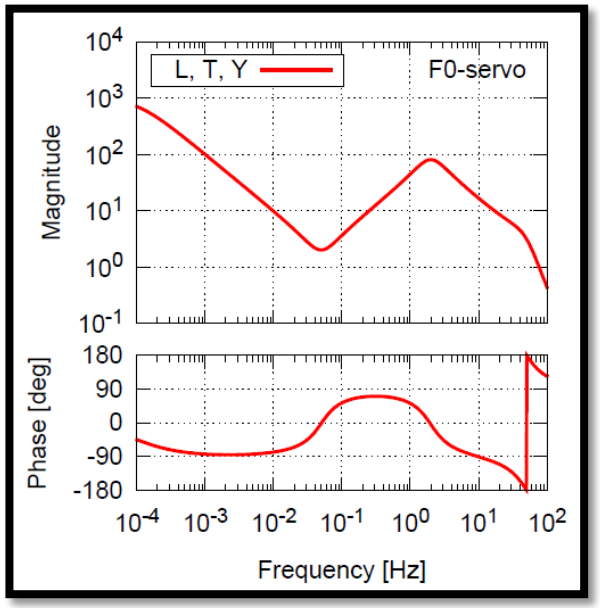
TM Yaw fluctuation excited by Yaw GND motion

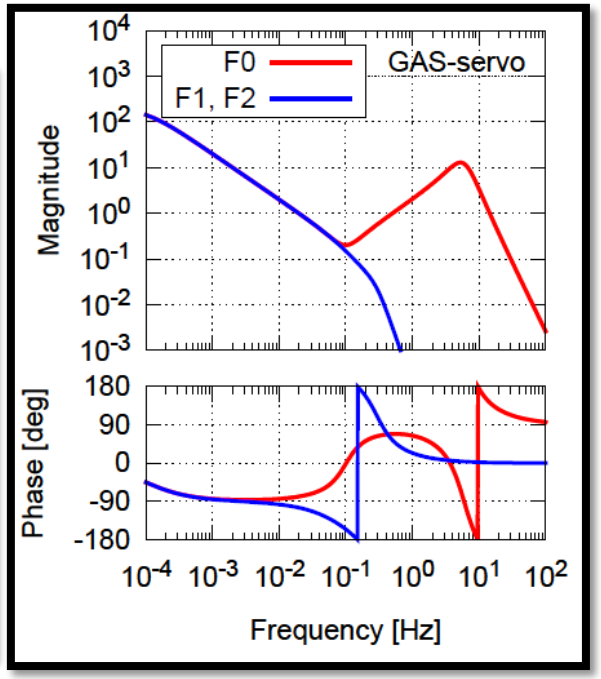
Control Simulation Results

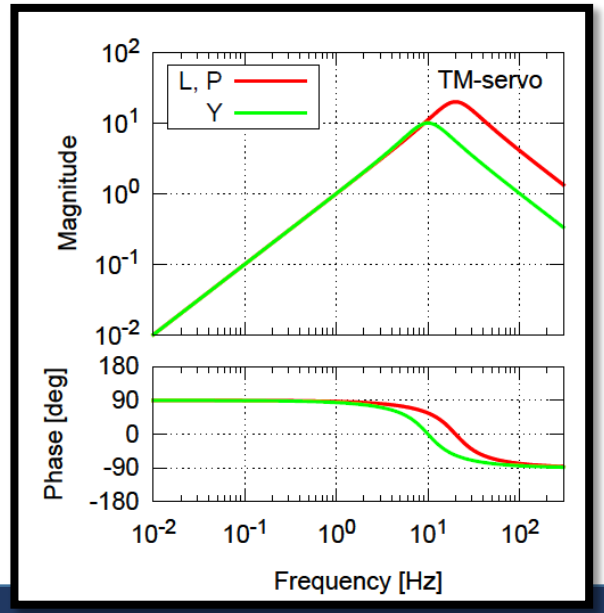
Filter shape

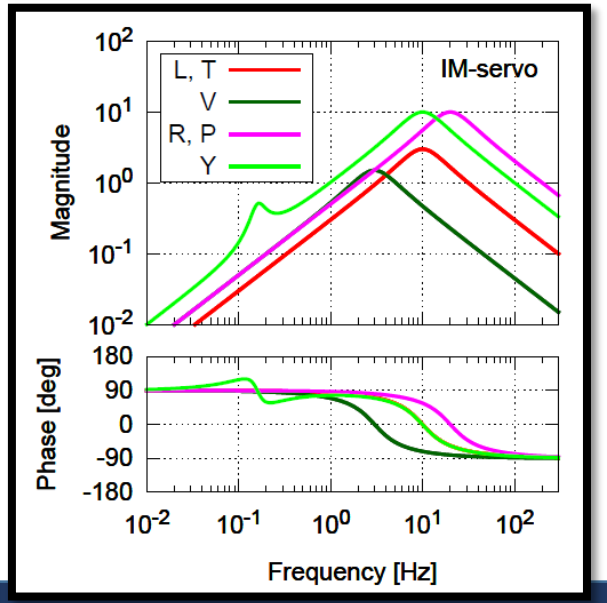
In “damping” phase











Filter shape

In “Lock acquisition” phase

Filter shape

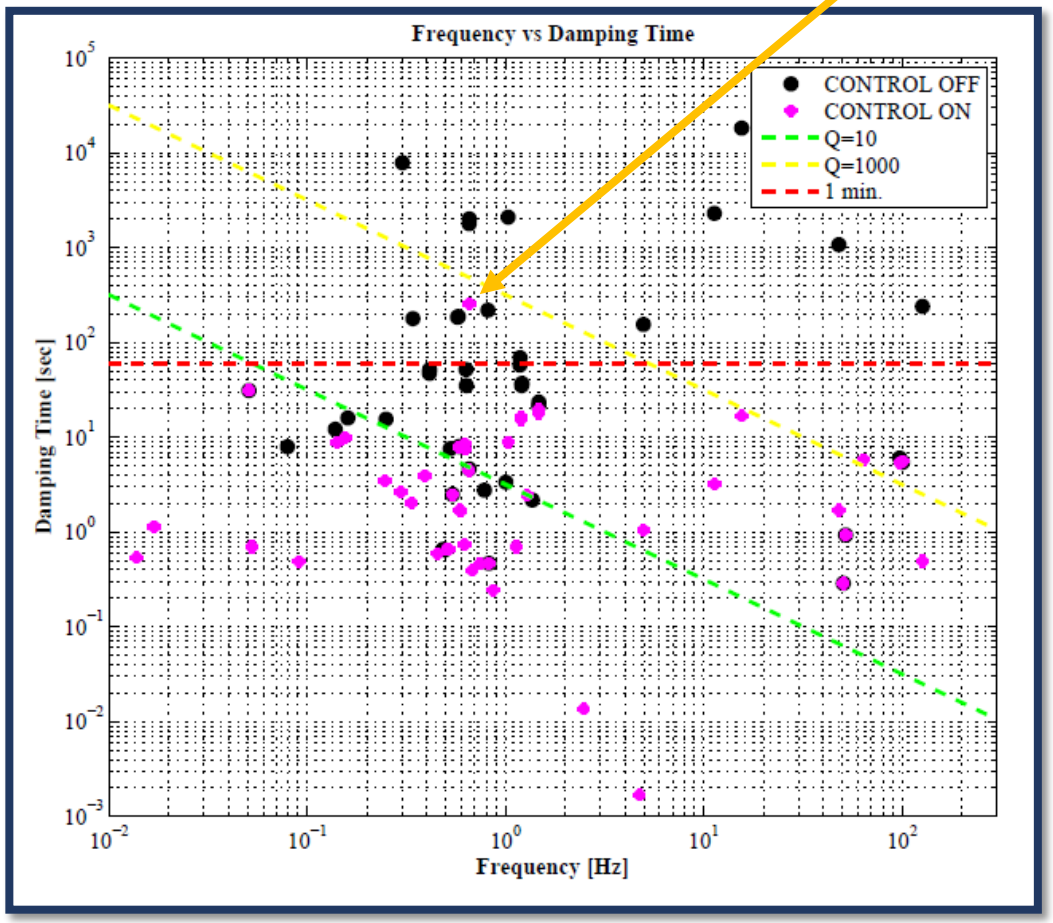
In “Observation” phase

OLTF

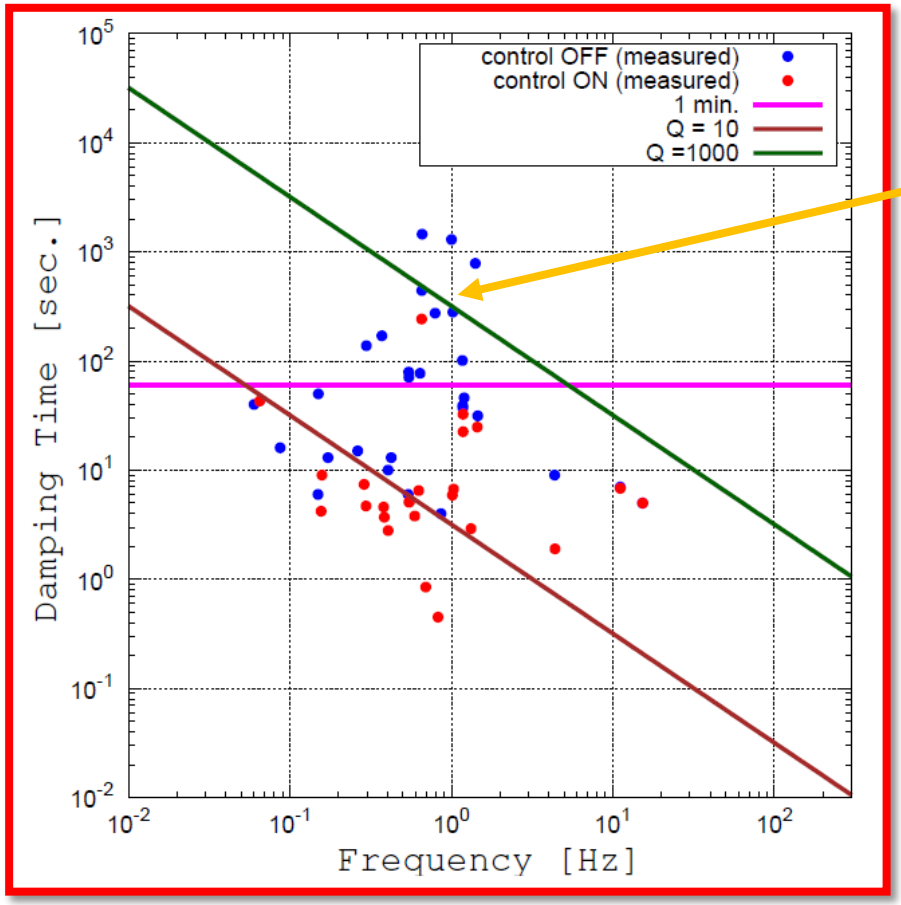
CLTF

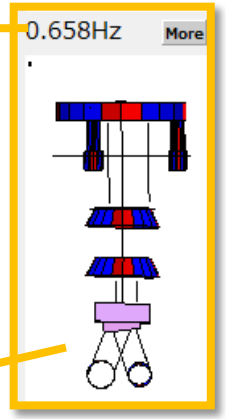
Q factor in damping control

Simulated result



Measured result





Impulse response