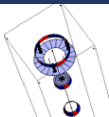
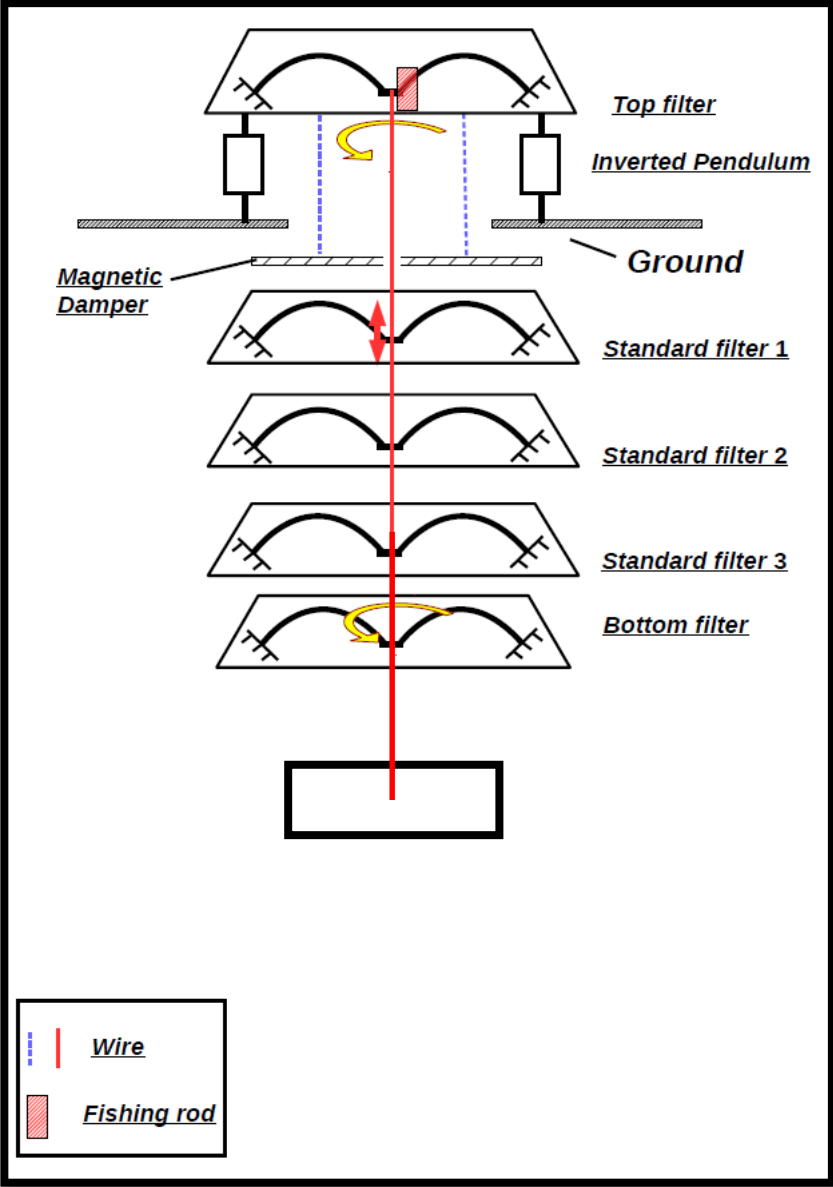
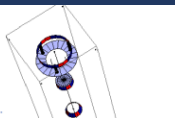


# TypeA with dummy mass



# Mechanical response

## Calculated by SUMCON (and Simulink)



**SUMCON** in *Mathematica*  
spension odel structor

SUMCON Version: 1.32  
About SUMCON Version Info Refresh

New Model Load Model Save Model 160401\_TypeA\_wDM\_0kv1.m **TypeA\_wDM\_kov1**

Model Construction Calculation Result Export Model


**Model Basic Information**

**Degrees of Freedom:**  
 39 State Variables  
 6 Input Variables  
 5 Float Variables

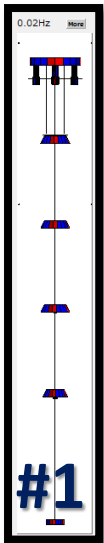
**Ground Position:**  
 xg → 0. yg → 0. zg → 0. pitchg → 0. yawg → 0. rollg → 0.

**Equilibrium Point:**

xFO → 0.	zFO → 0.	yawFO → 0.	xMD → 0.	yMD → -1.557	zMD → 0.
pitchMD → 0.	yawMD → 0.	rollMD → 0.	xF1 → 0.	ySF1 → -1.6993	zSF1 → 0.
pitchSF1 → 0.	yawSF1 → 0.	rollSF1 → 0.	xF2 → 0.	ySF2 → -4.0526	zSF2 → 0.
pitchSF2 → 0.	yawSF2 → 0.	rollSF2 → 0.	xF3 → 0.	ySF3 → -6.3991	zSF3 → 0.
pitchSF3 → 0.	yawSF3 → 0.	rollSF3 → 0.	xBF → 0.	yBF → -8.7668	zBF → 0.
pitchBF → 0.	yawBF → 0.	rollBF → 0.	xDM → 0.	yDM → -12.3531	zDM → 0.
pitchDM → 0.	yawDM → 0.	rollDM → 0.	hGAS0 → -0.0433	hGAS1 → -0.0533	hGAS2 → -0.0665
hGAS3 → -0.0876	hGAS4 → -0.1263				

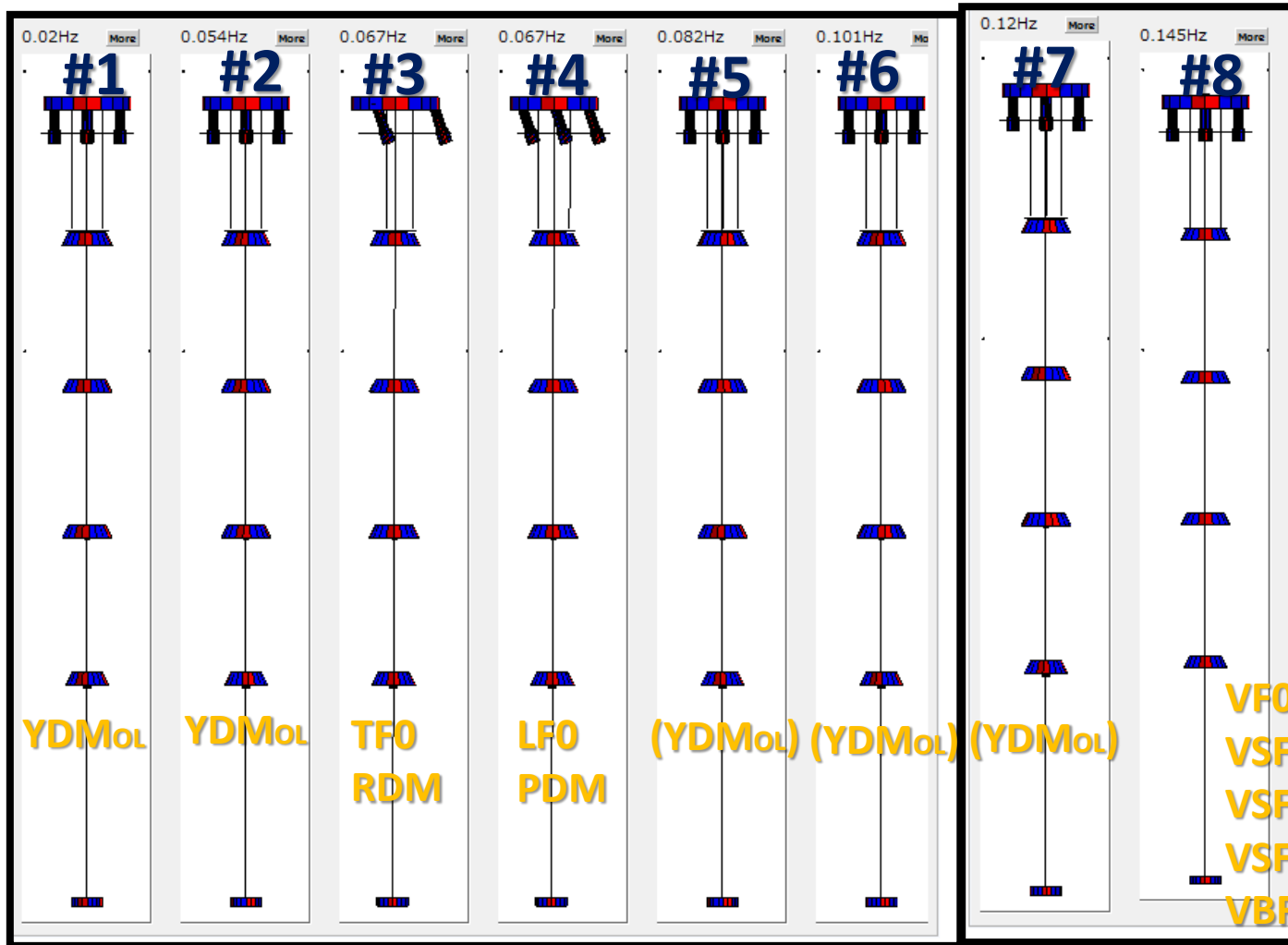


# Eigen Mode List



- ← 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 : YDM

#3 : TF0

#4 : LFO

#5 : YDM

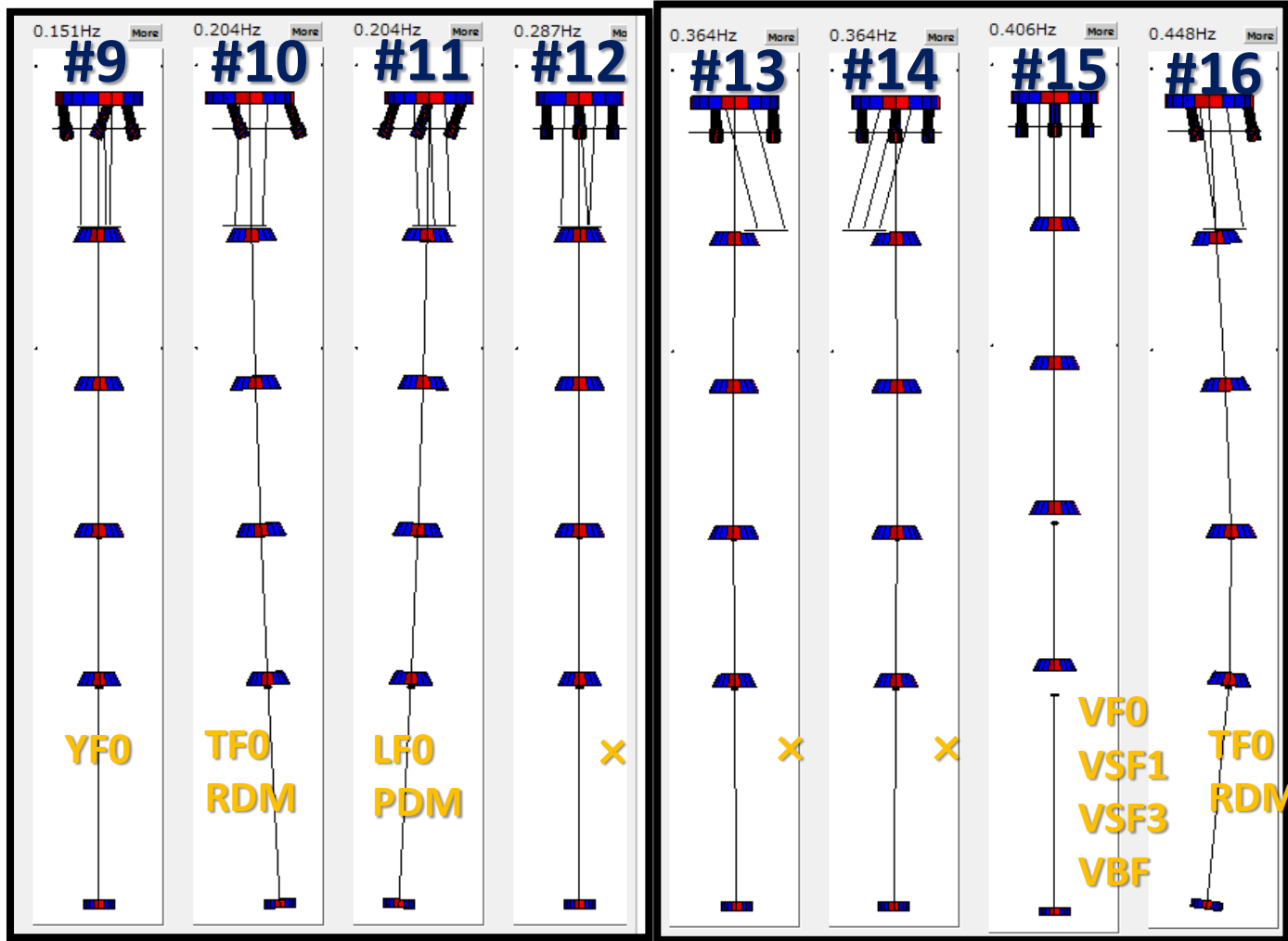
#6 : YBF

#7 : YSF2

#8 : VDM

VF0  
VSF1  
VSF2  
VSF3  
VBF

# Eigen Mode Shape



#9 : YDM

#10 : TMD

#11 : LMD

#12 : YMD

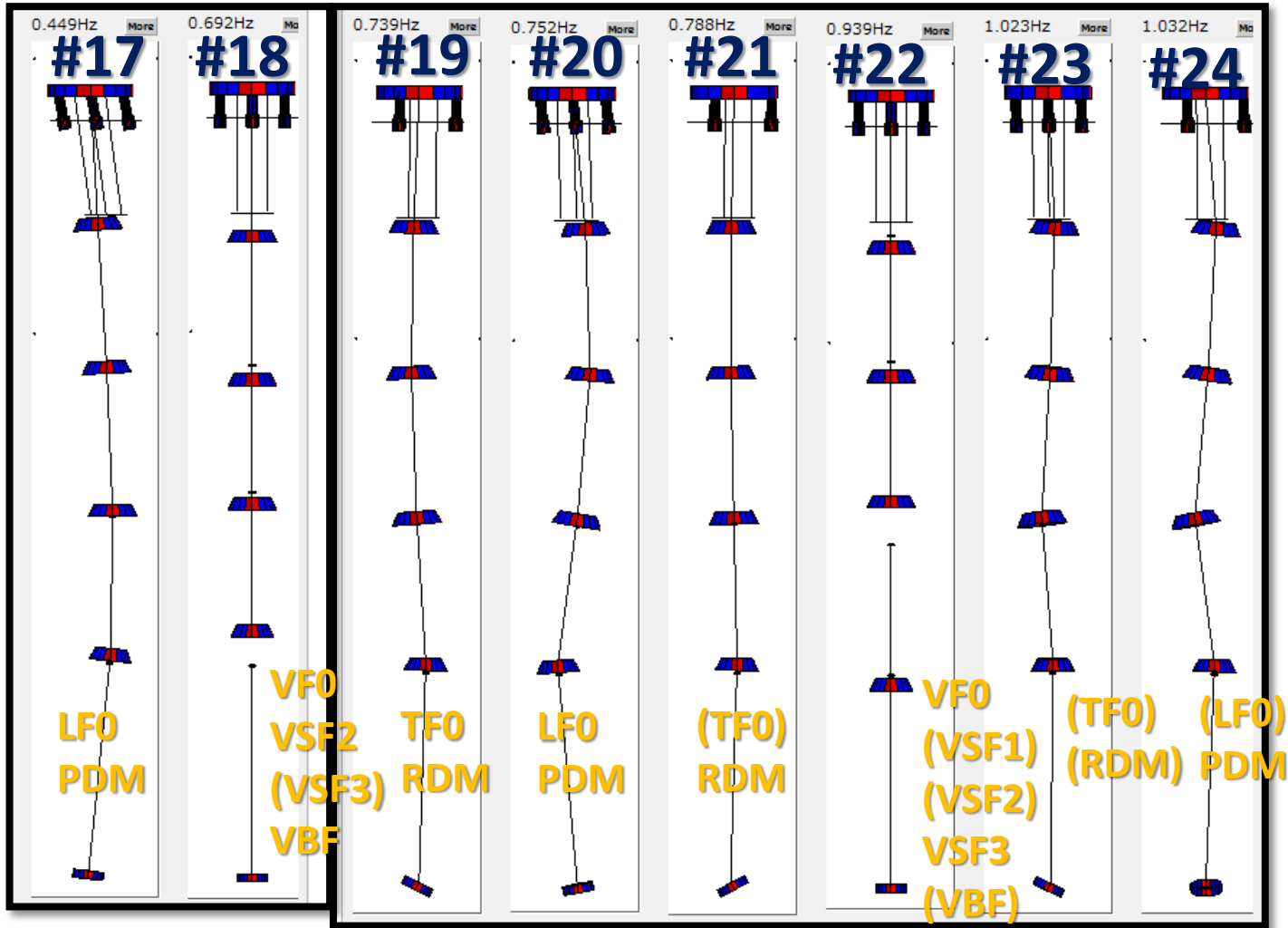
#13 : TMD

#14 : LMD

#15 : VSF3

#16 : TSF3

# Eigen Mode Shape



#17 : LSF3

#18 : VBF

#19 : Pendulum

#20 : LBF

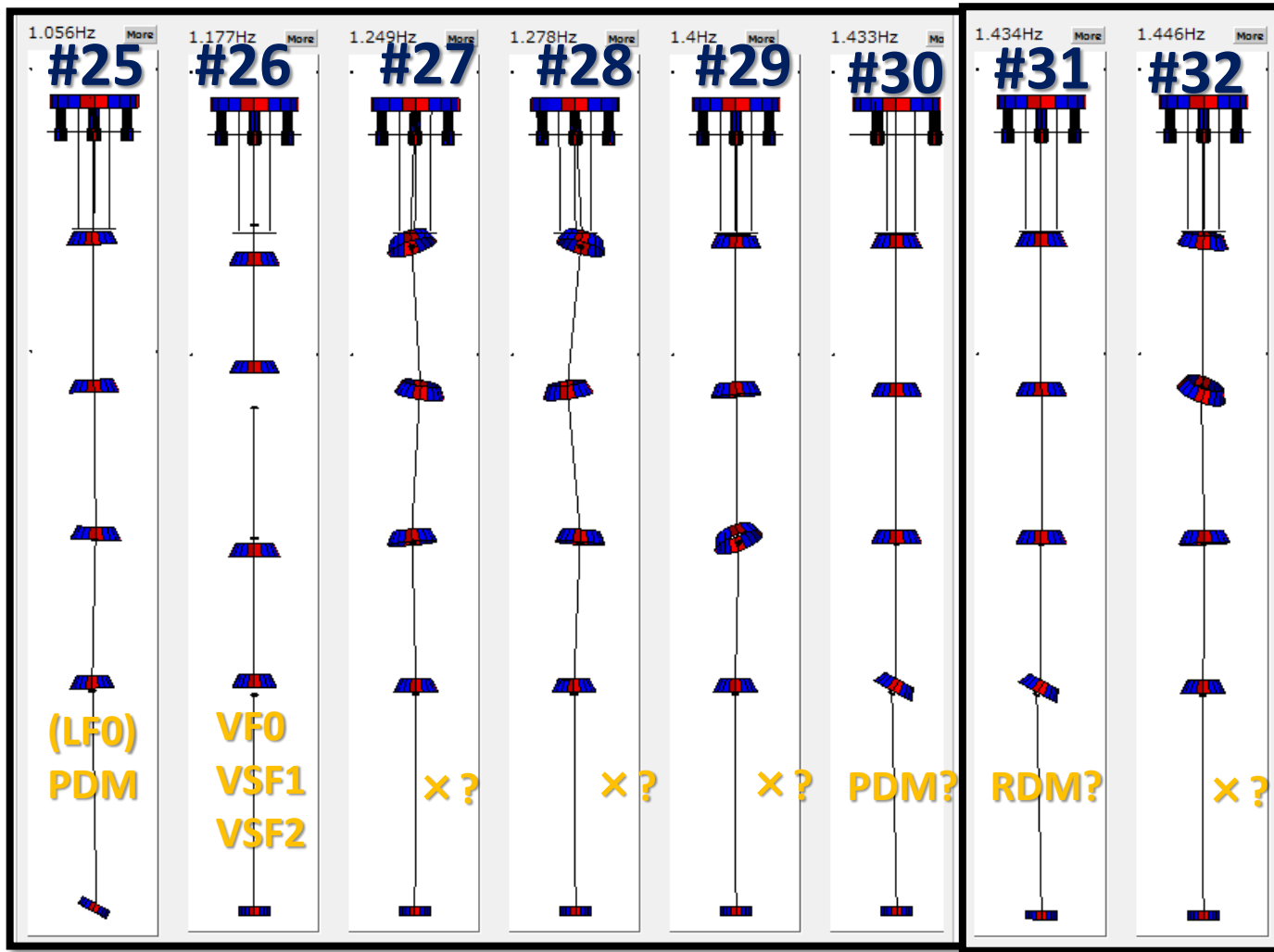
#21 : RDM

#22 : VSF3

#23 : Pendulum

#24 : Pendulum

# Eigen Mode Shape



#25 : PDM

#26 : VSF2

#27 : PSF1, PSF2

#28 : Pendulum

#29: PSF3, RSF3

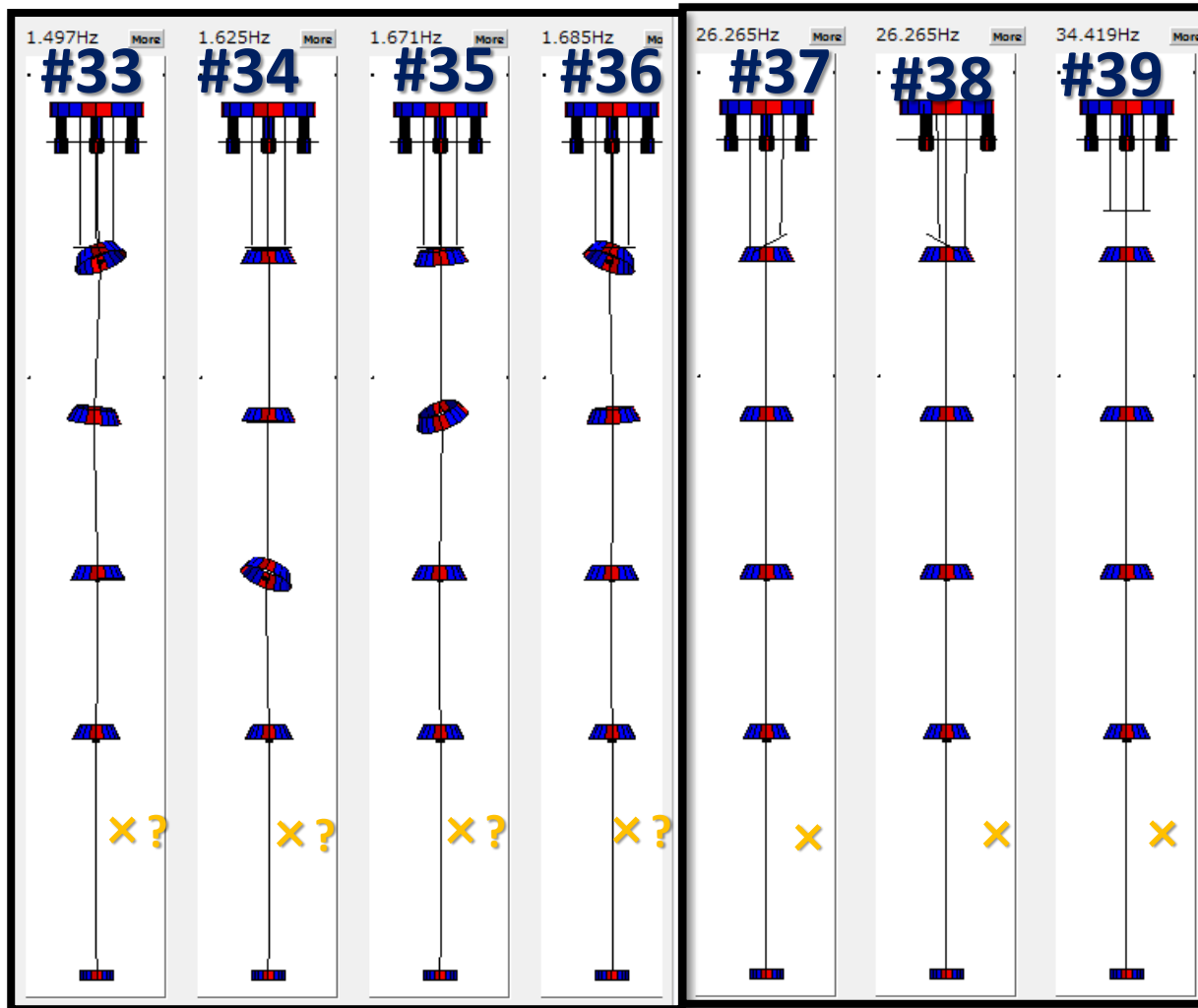
#30 : RBF

#31 : PBF

#32 : PSF2, RSF2



# Eigen Mode Shape



#33 : PSF2, RSF1

#34 : -PSF3, RSF3

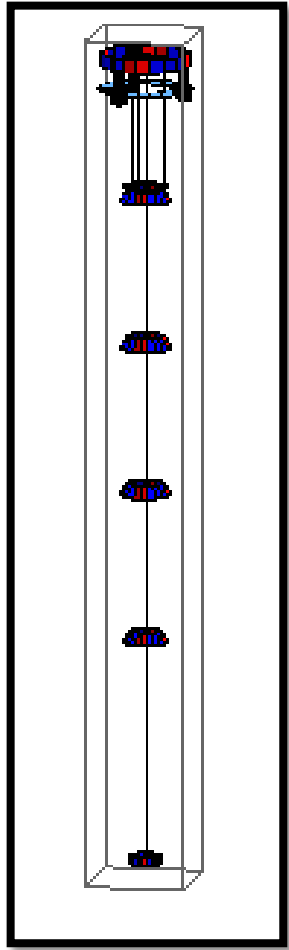
#35 : PSF2, -RSF2

#36 : -PSF1, RSF1

#37 : PMD

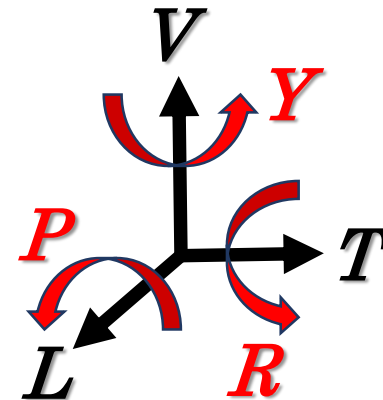
#38 : RMD

#39 : VMD



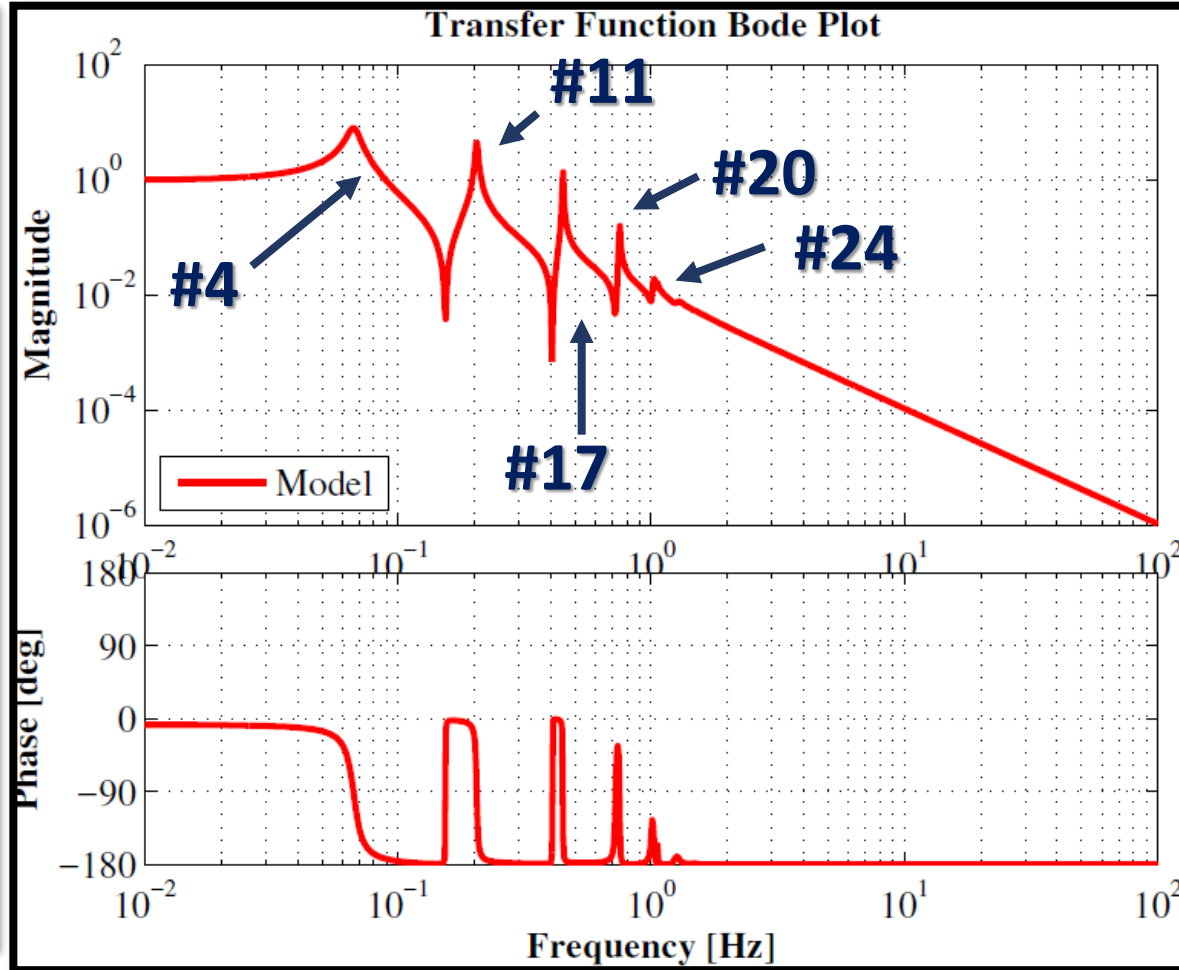
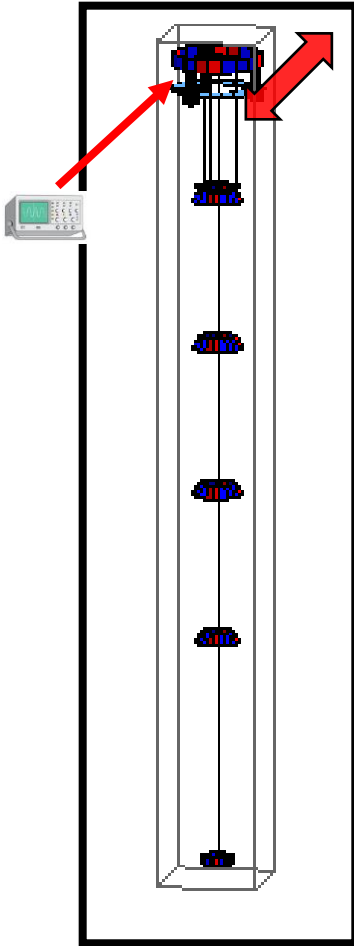
# Force Transfer Functions

(, which can be measured, with No ctrl)



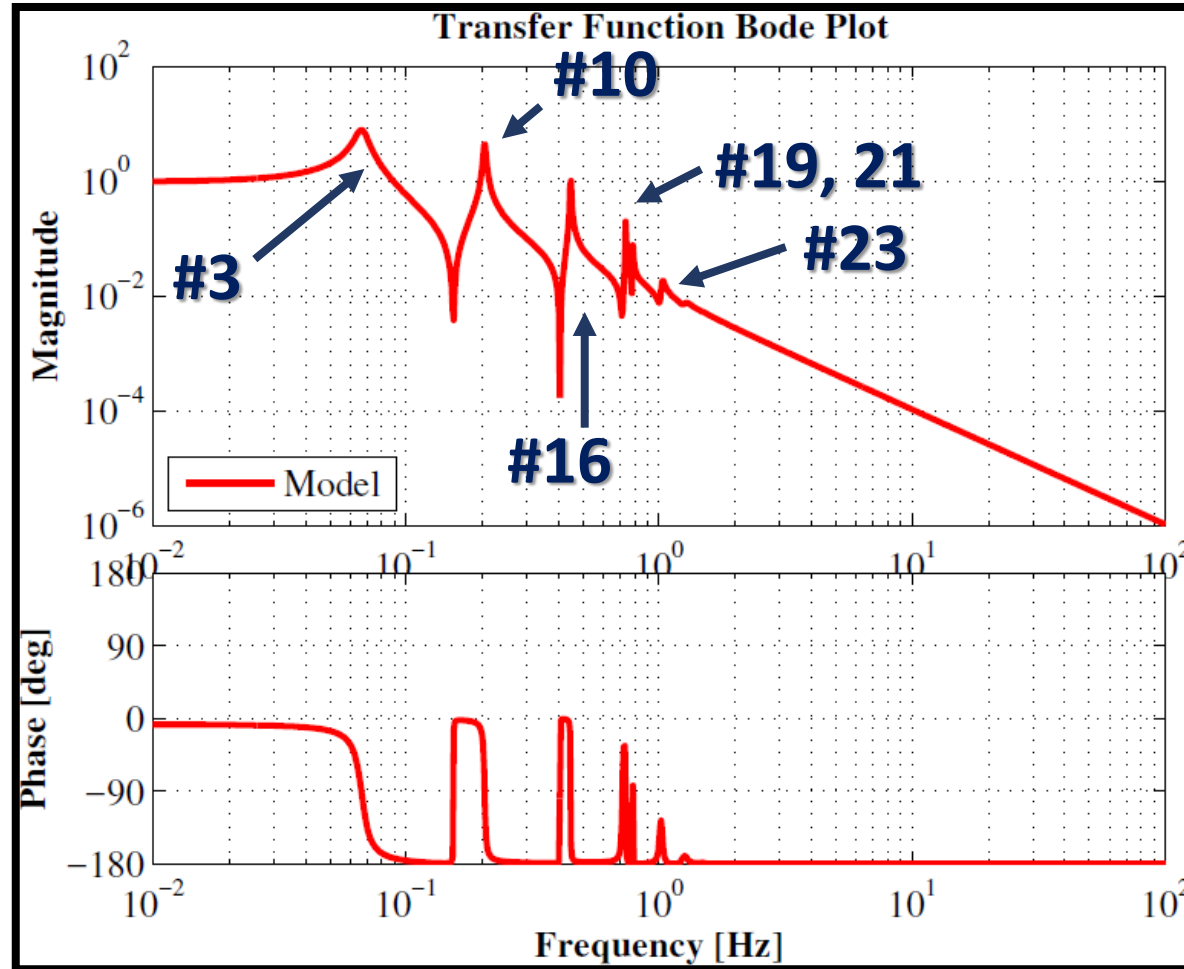
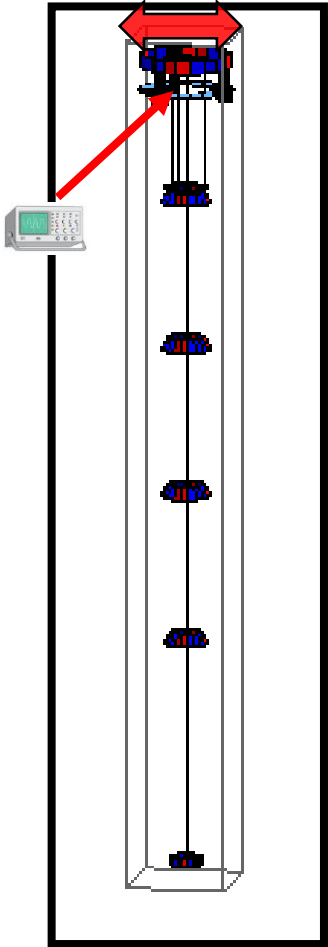
# Force Transfer Function

LVDT\_LF0 / actLF0



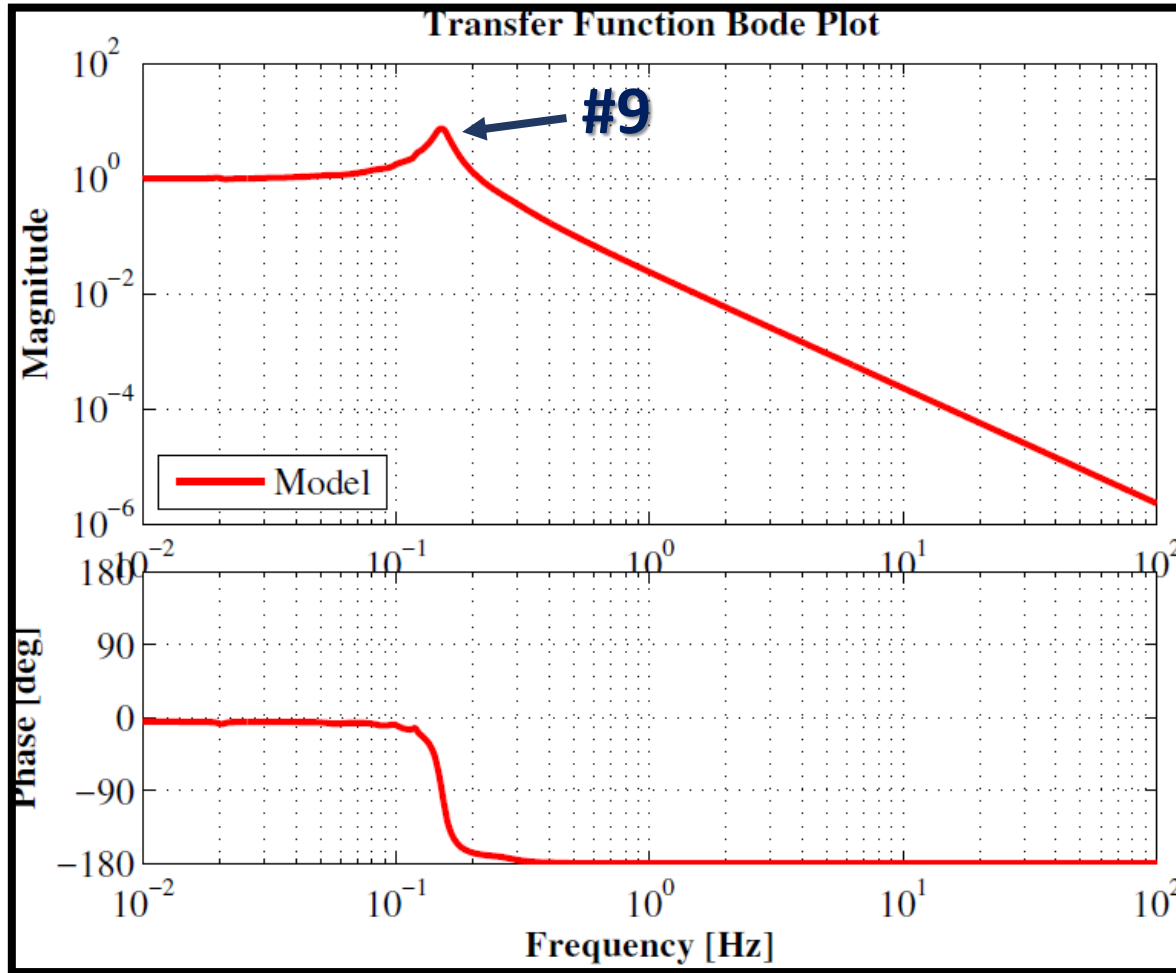
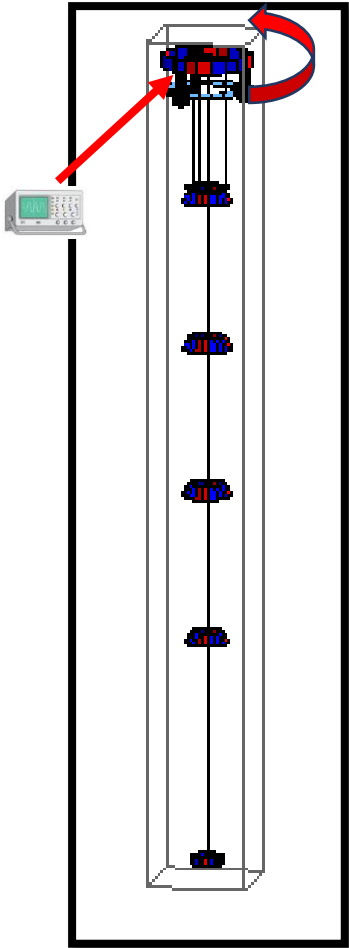
# Force Transfer Function

## LVDT\_TF0 / actTF0



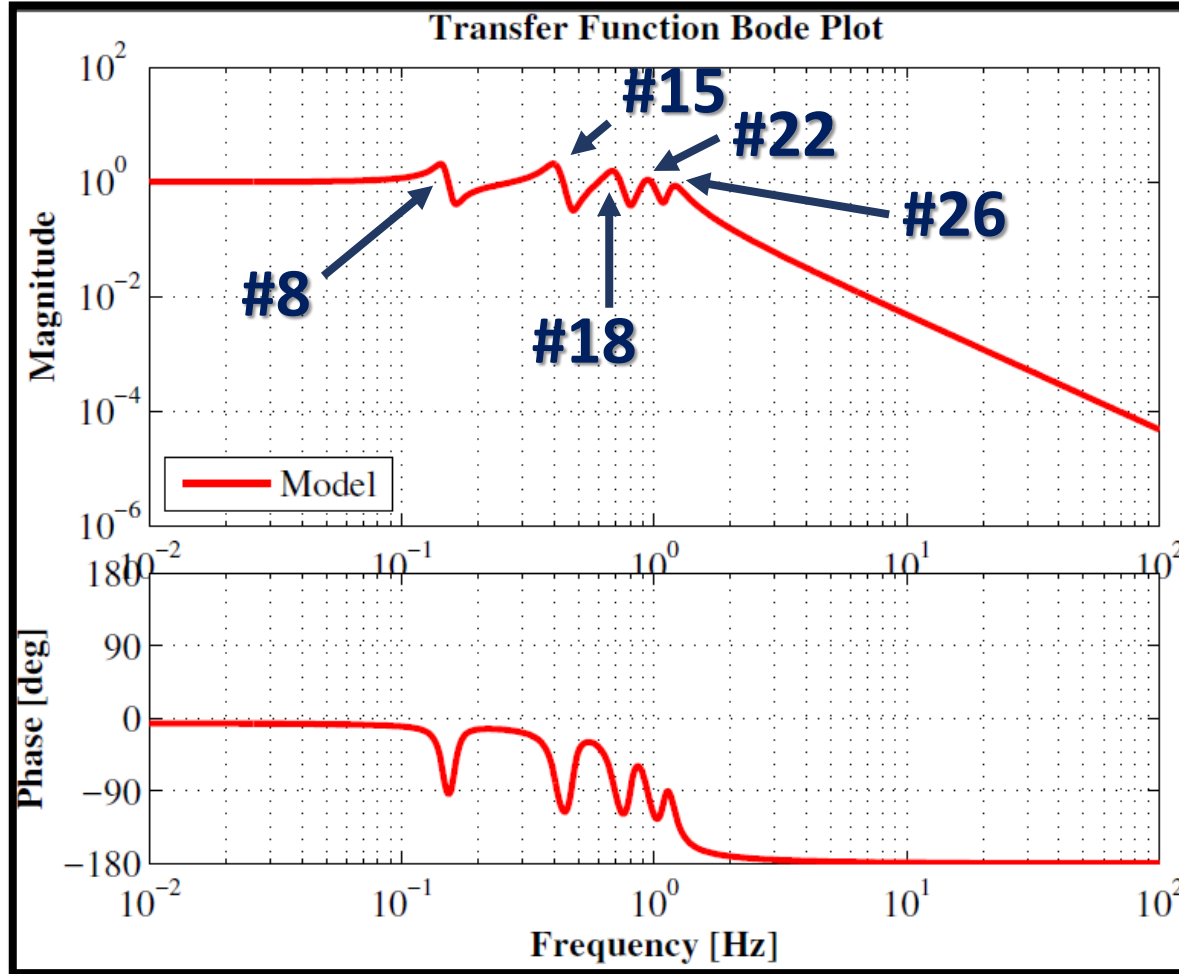
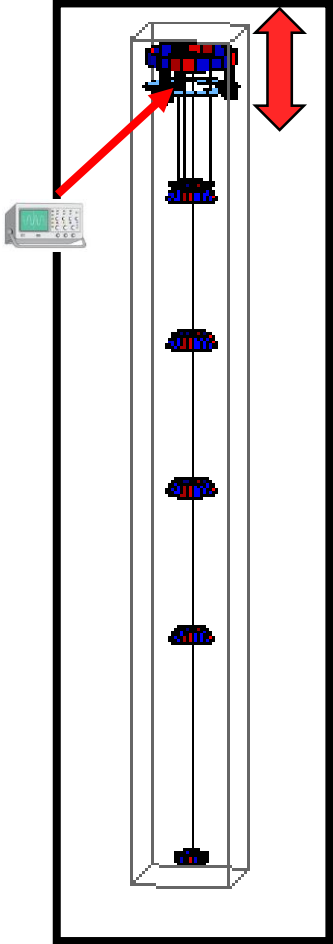
# Force Transfer Function

**LVDT\_YF0 / actYF0**



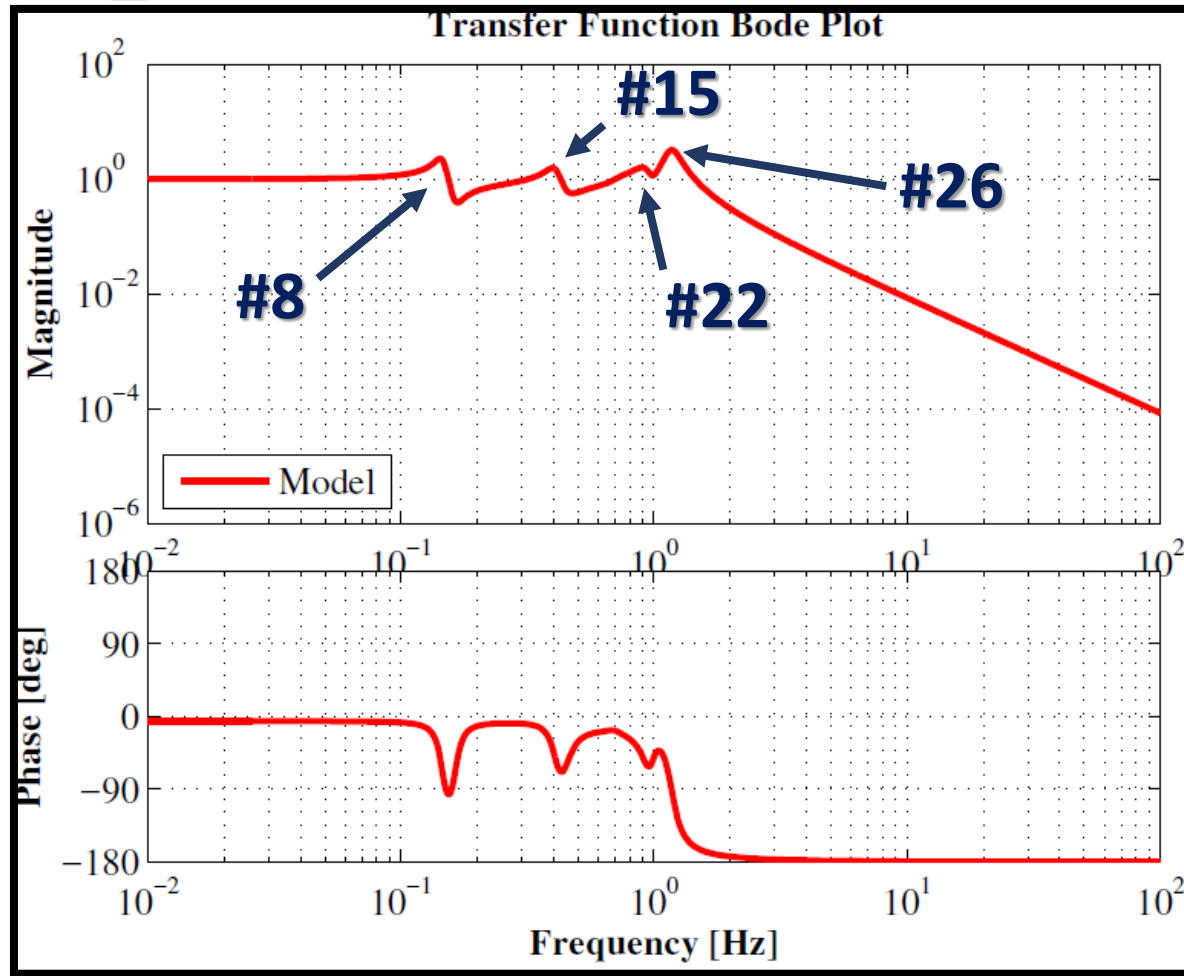
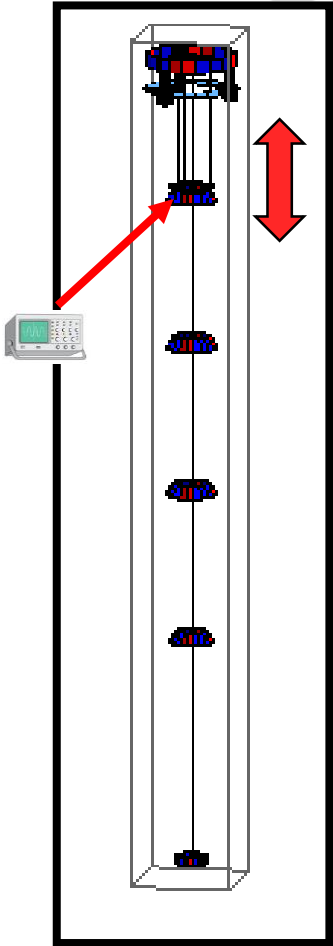
# Force Transfer Function

LVDT\_VF0 / actVF0



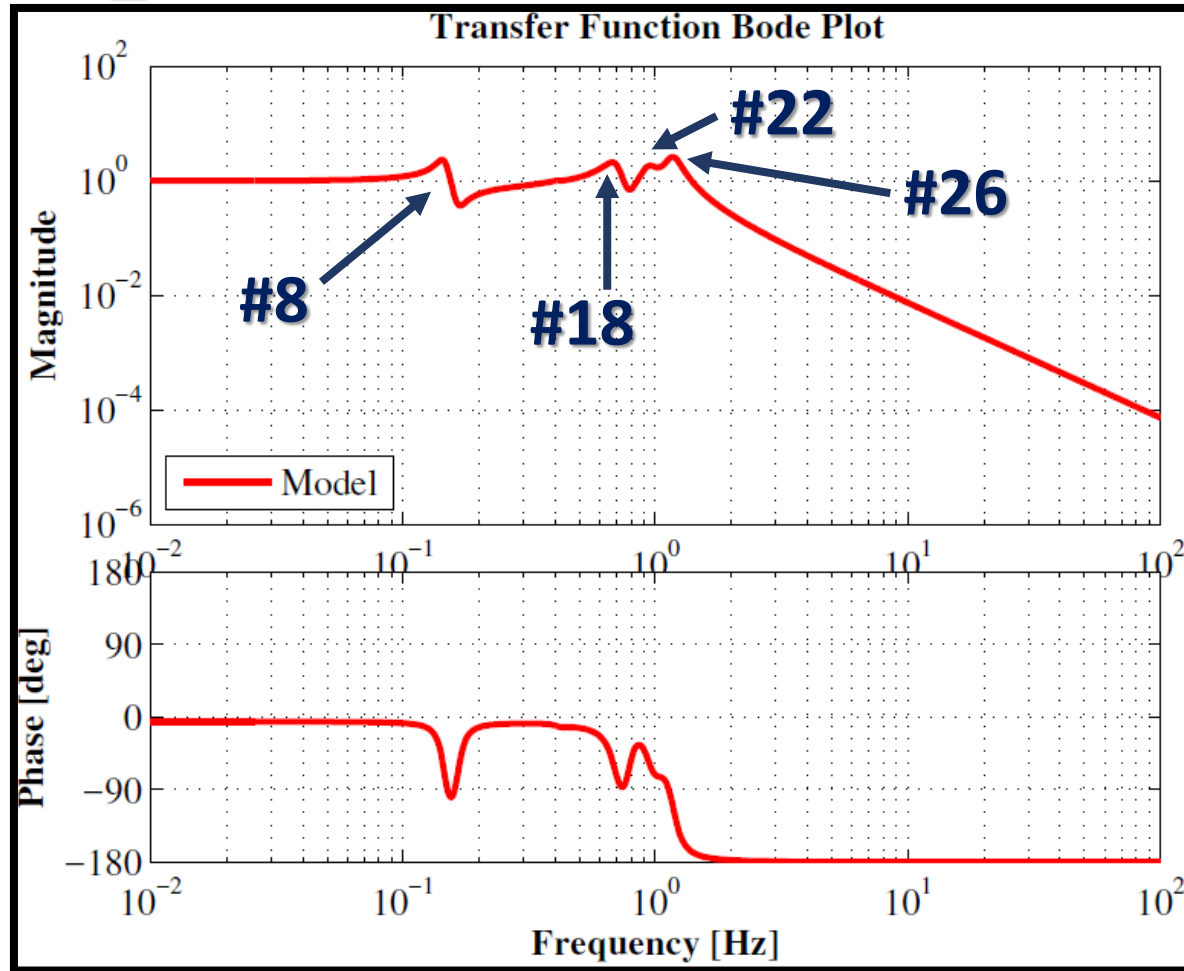
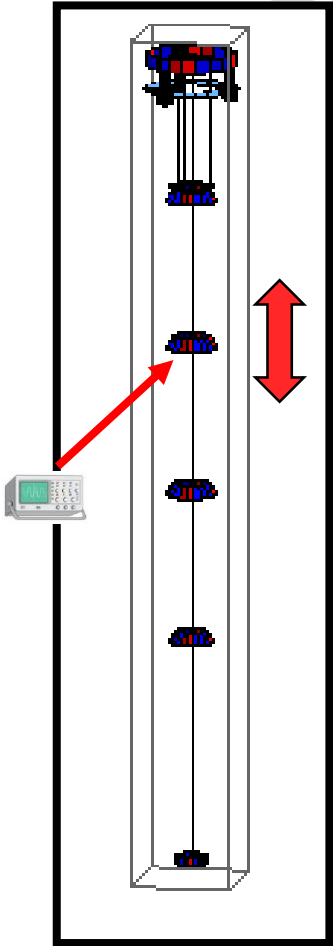
# Force Transfer Function

LVDT\_VSF1 / actVSF1



# Force Transfer Function

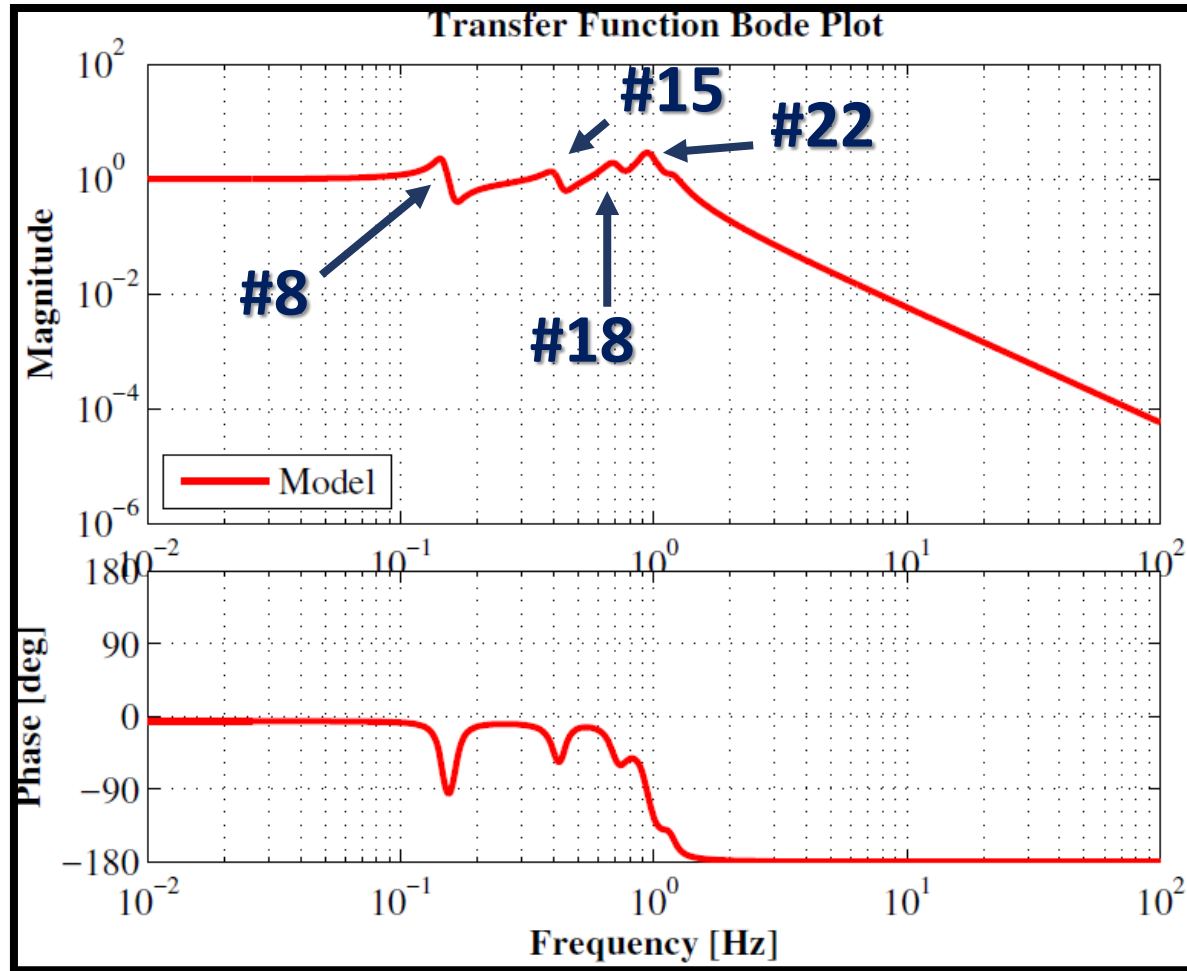
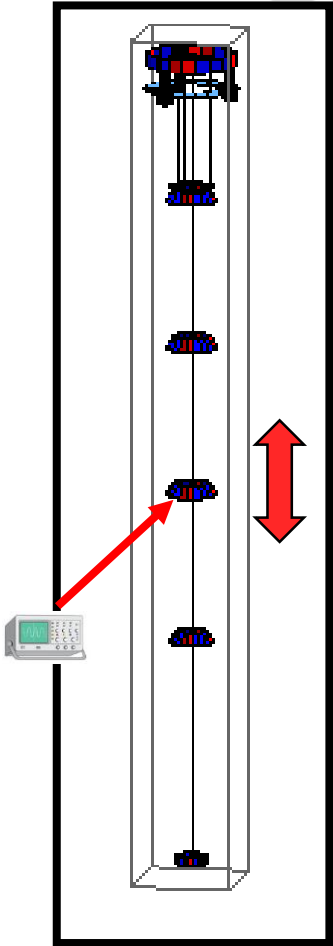
**LVDT\_VSF2 / actVSF2**





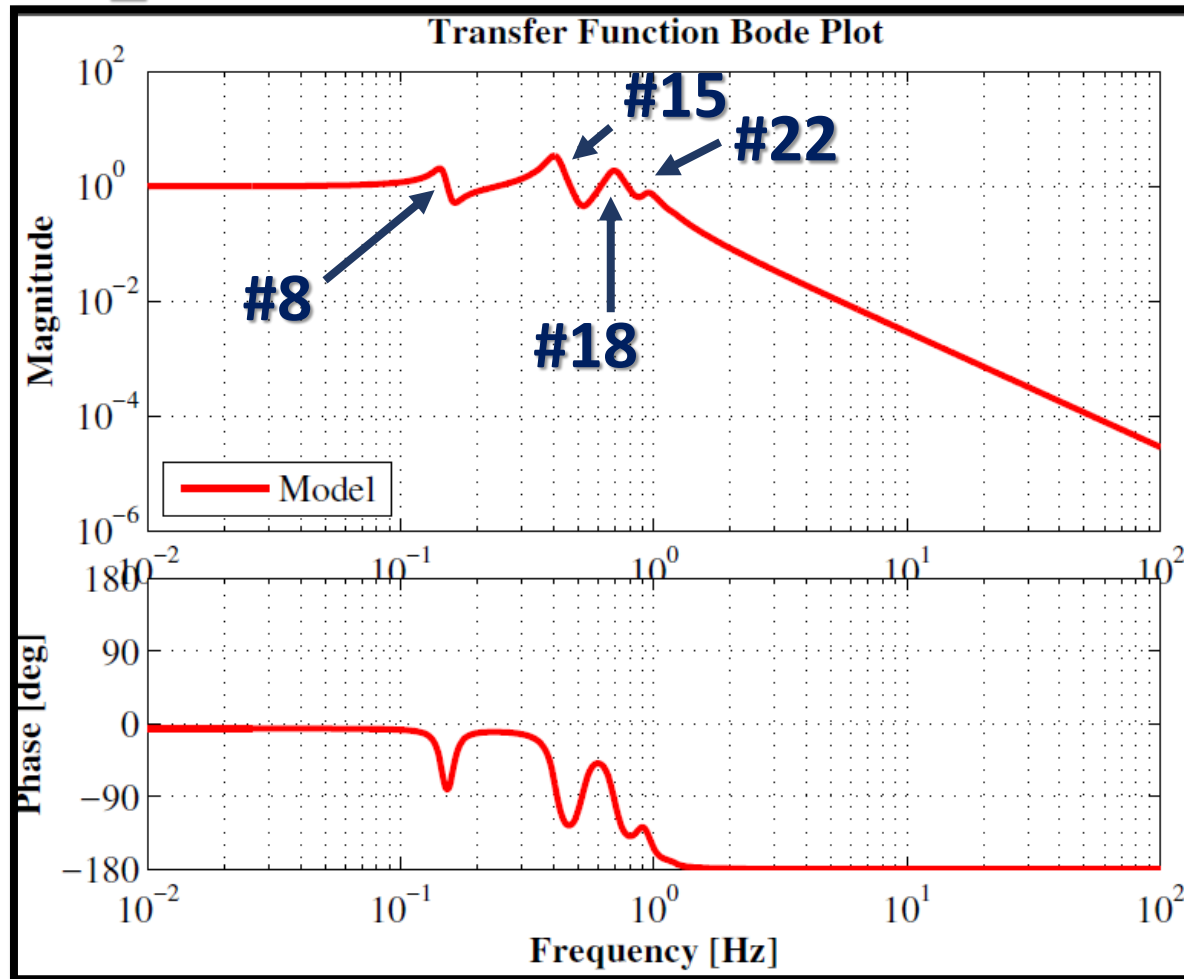
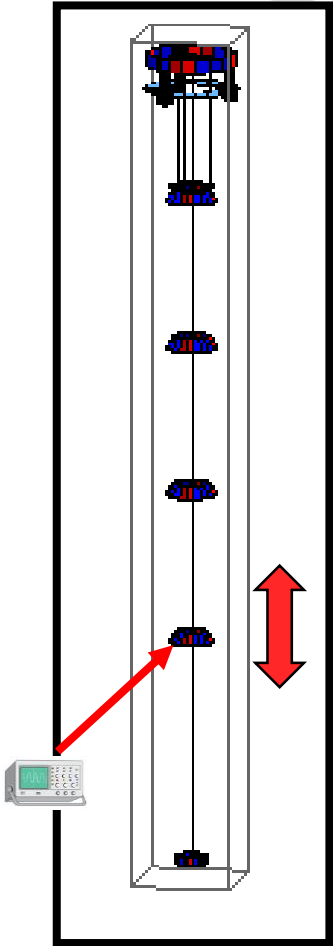
# Force Transfer Function

LVDT\_VSF3 / actVSF3



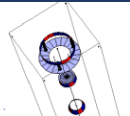
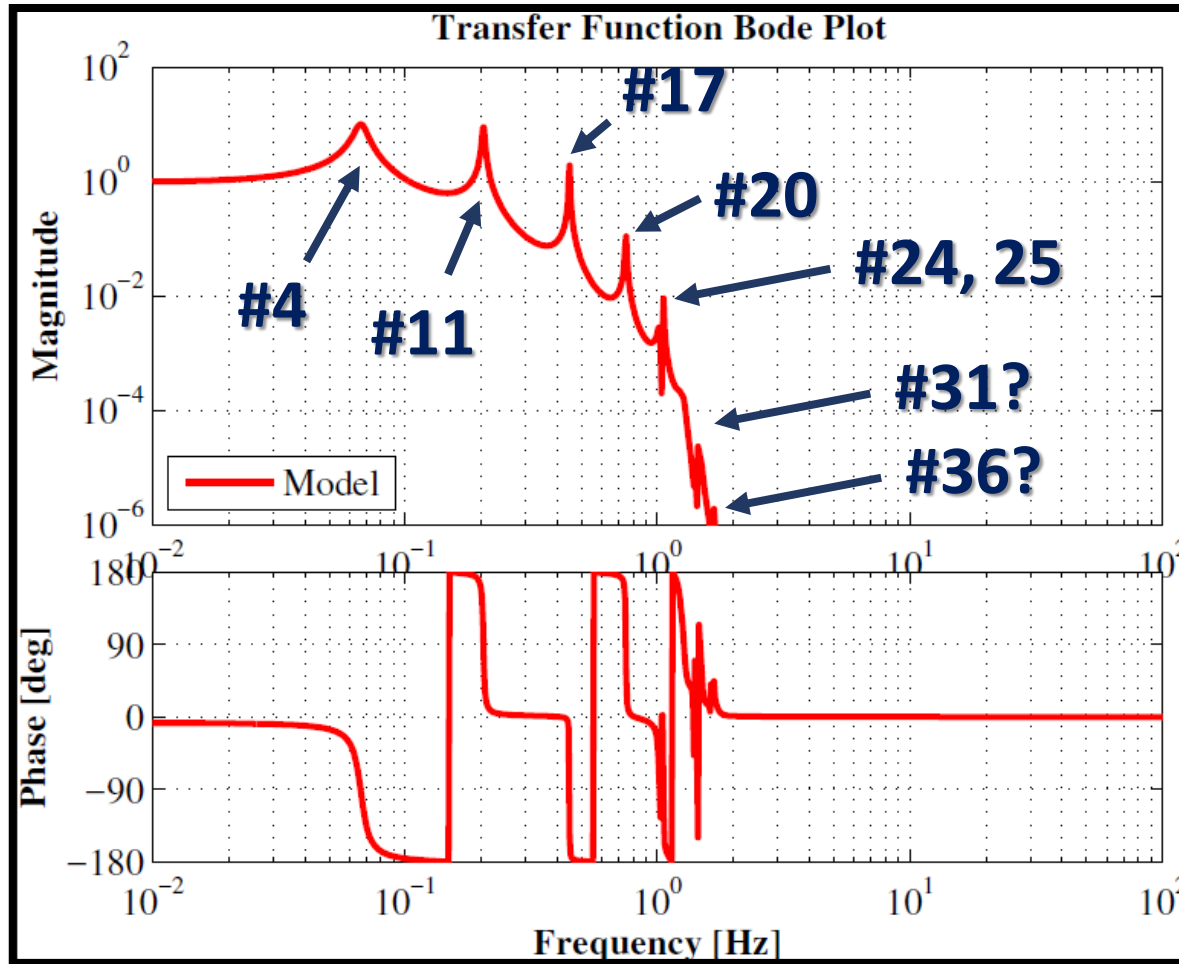
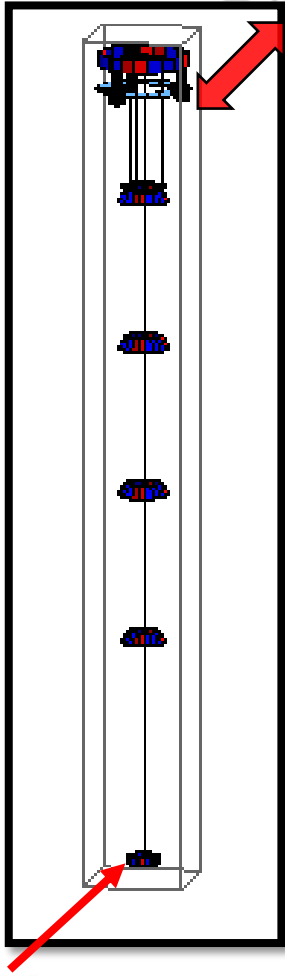
# Force Transfer Function

LVDT\_VBF / actVBF



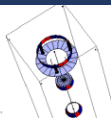
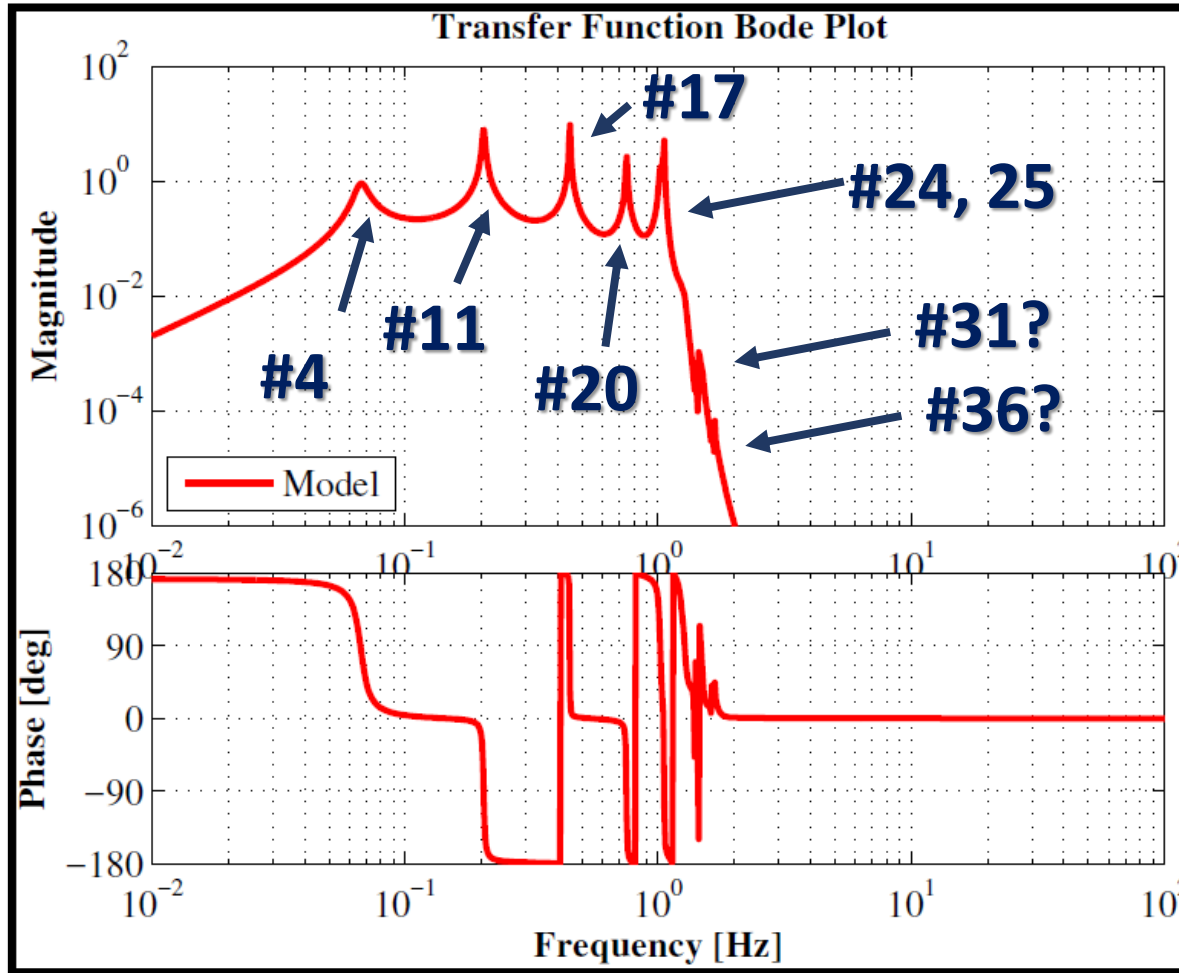
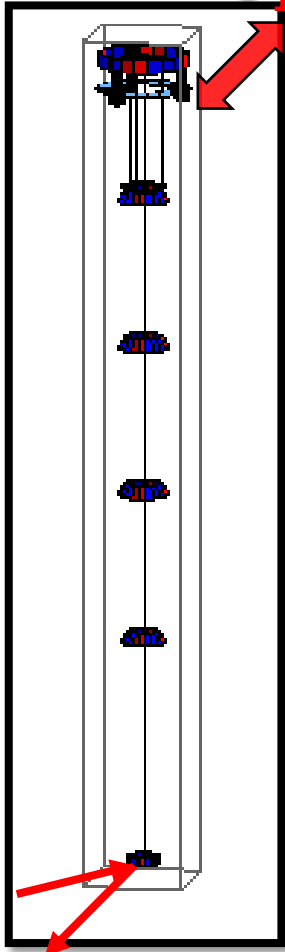
# Force Transfer Function

PS\_LDM / actLFO



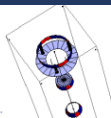
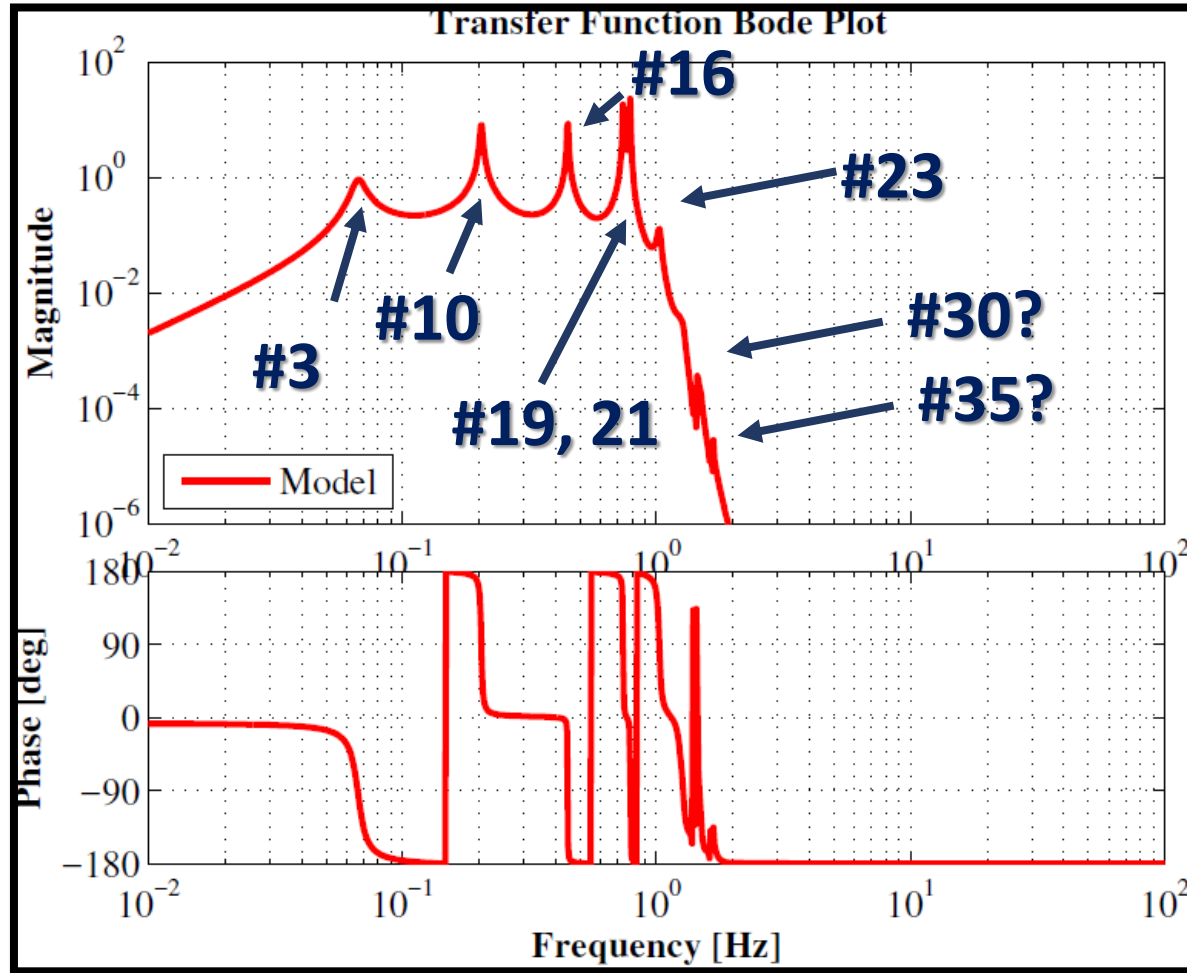
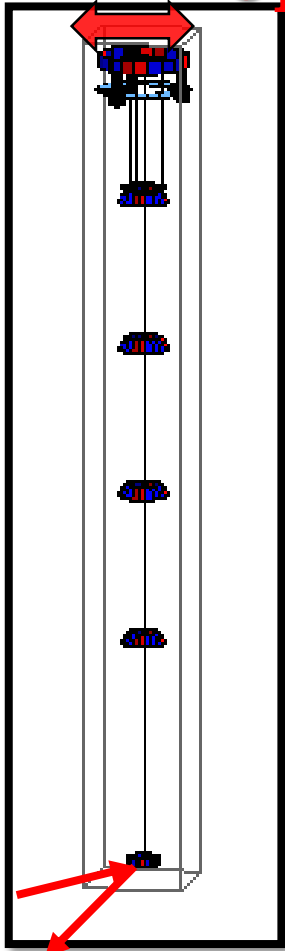
# Force Transfer Function

OpLev\_PDM / actLF0



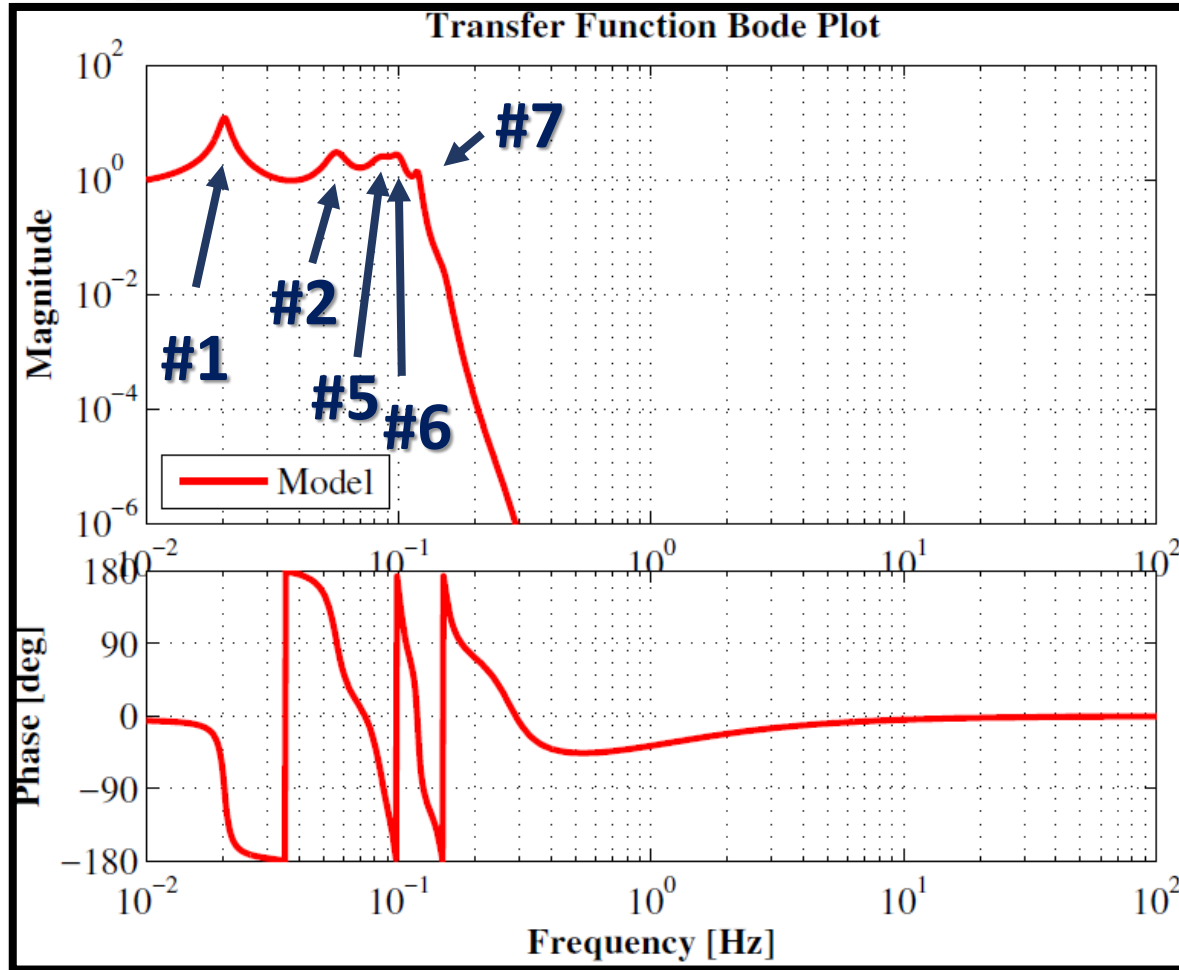
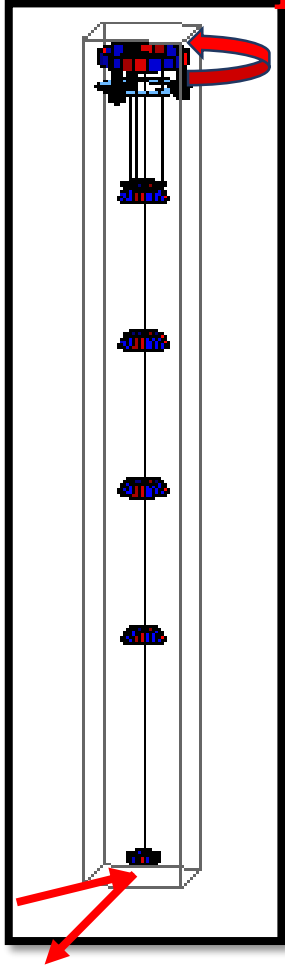
# Force Transfer Function

OpLev\_RDM / actTF0



# Force Transfer Function

OpLev\_YDM / actYF0



# 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.

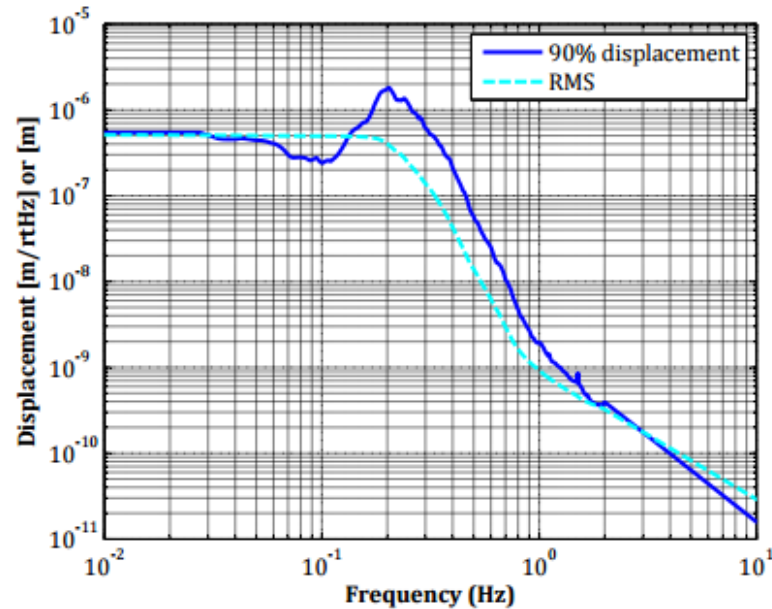


Figure 1: The high-level seismic displacement in Kamioka.

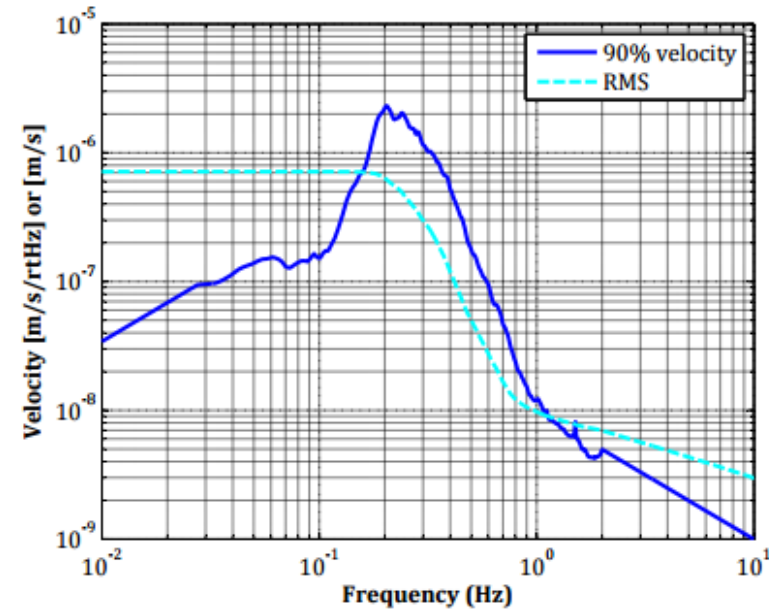
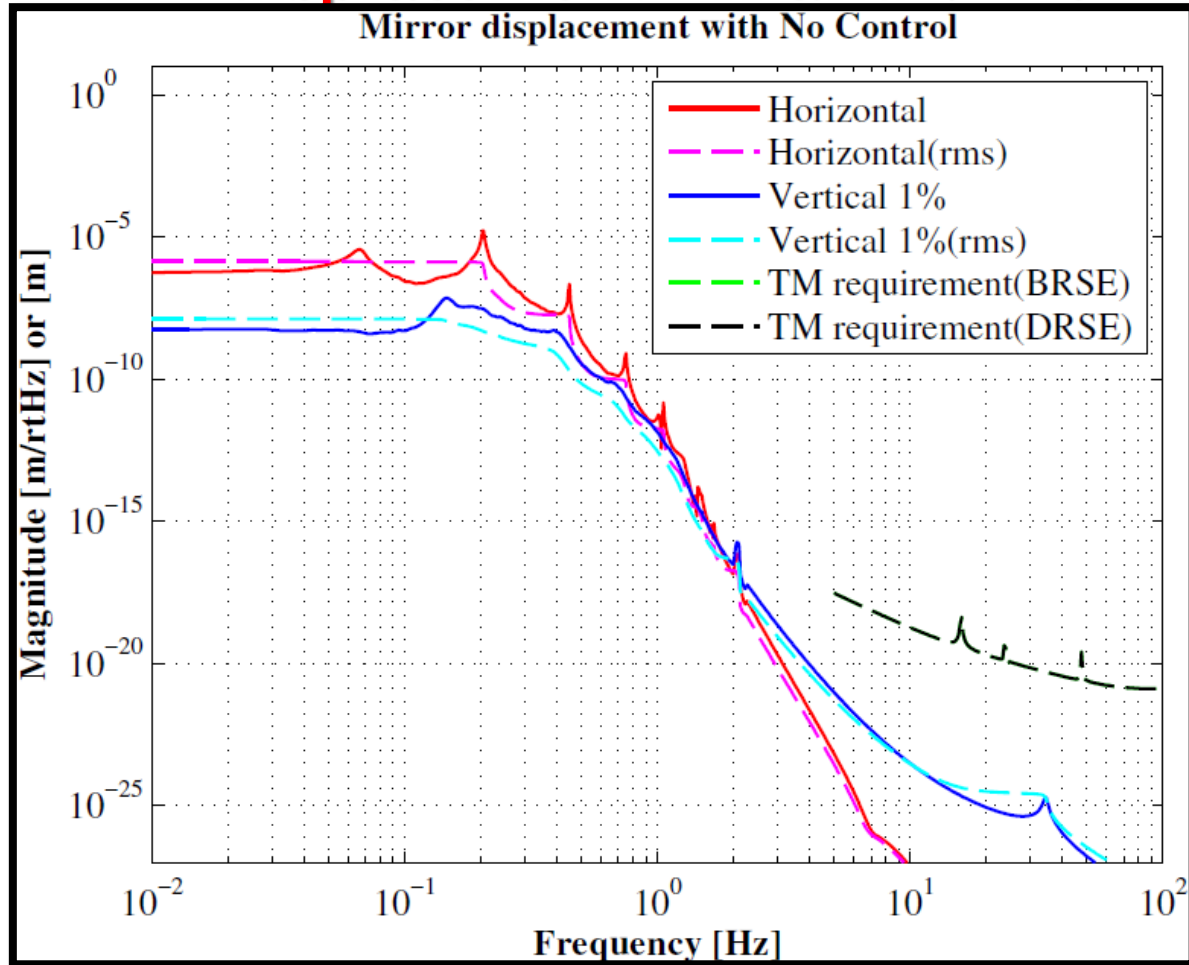


Figure 2: The high-level seismic velocity in Kamioka.

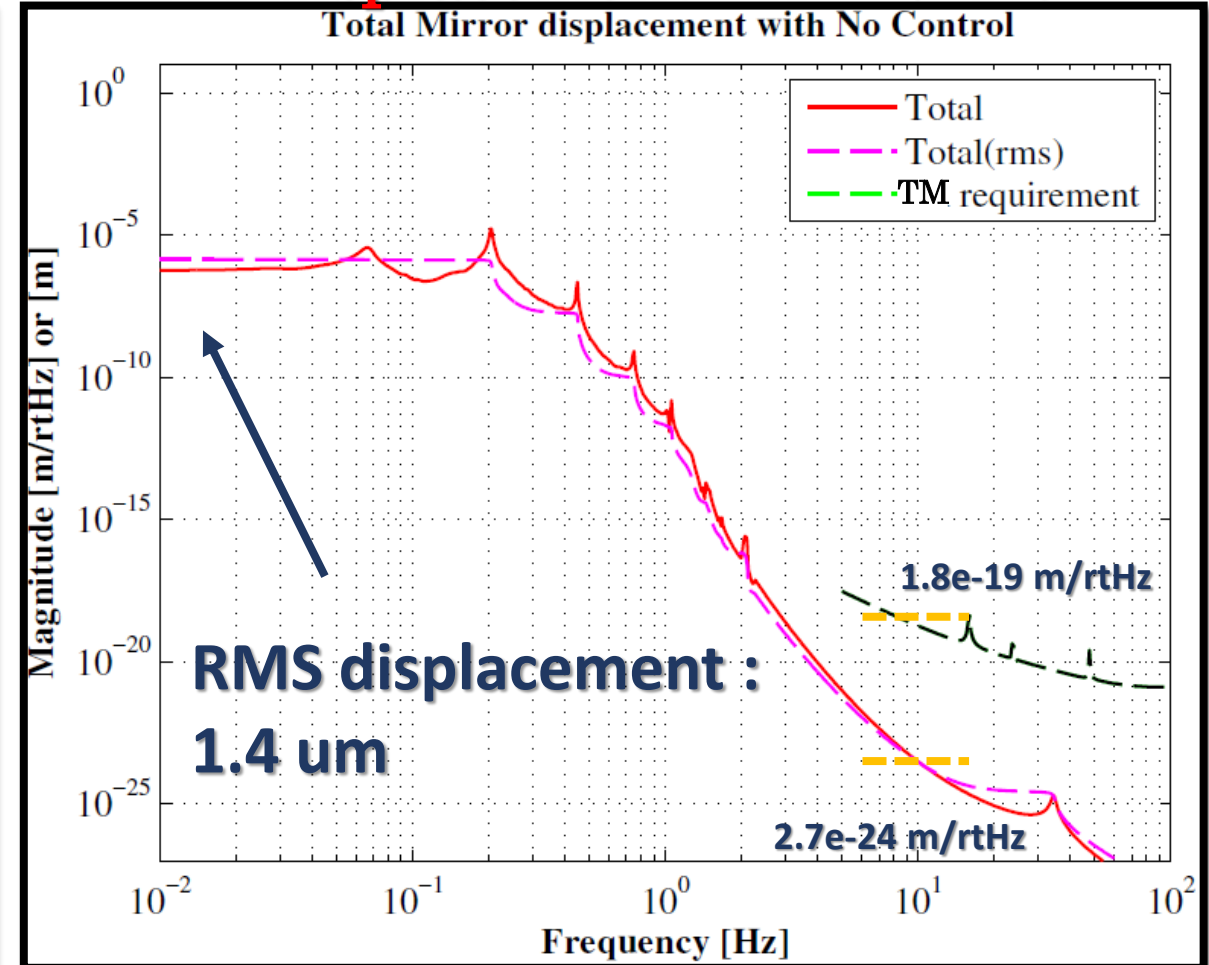


# Spectra without ctrl

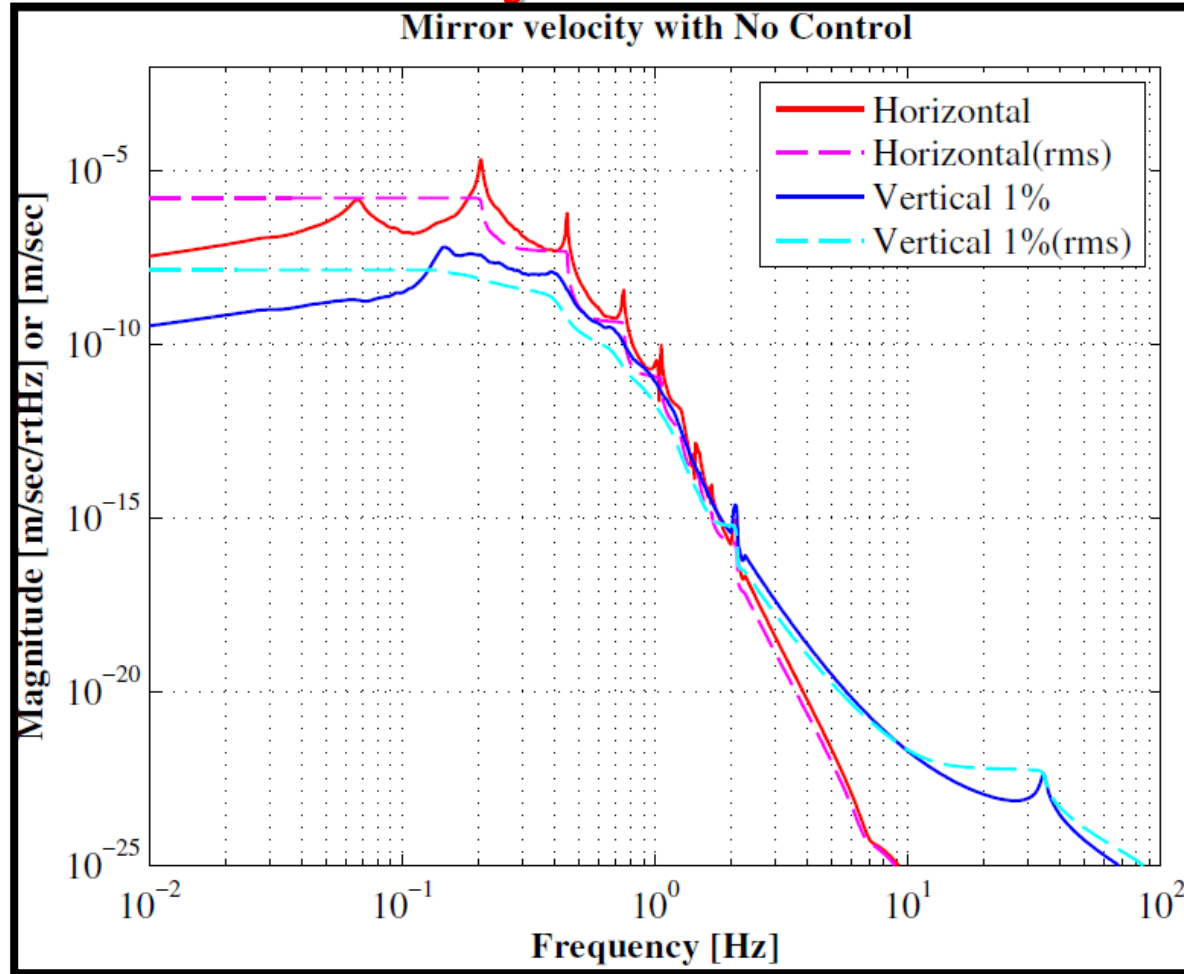
## TM displacement : H and V 1%



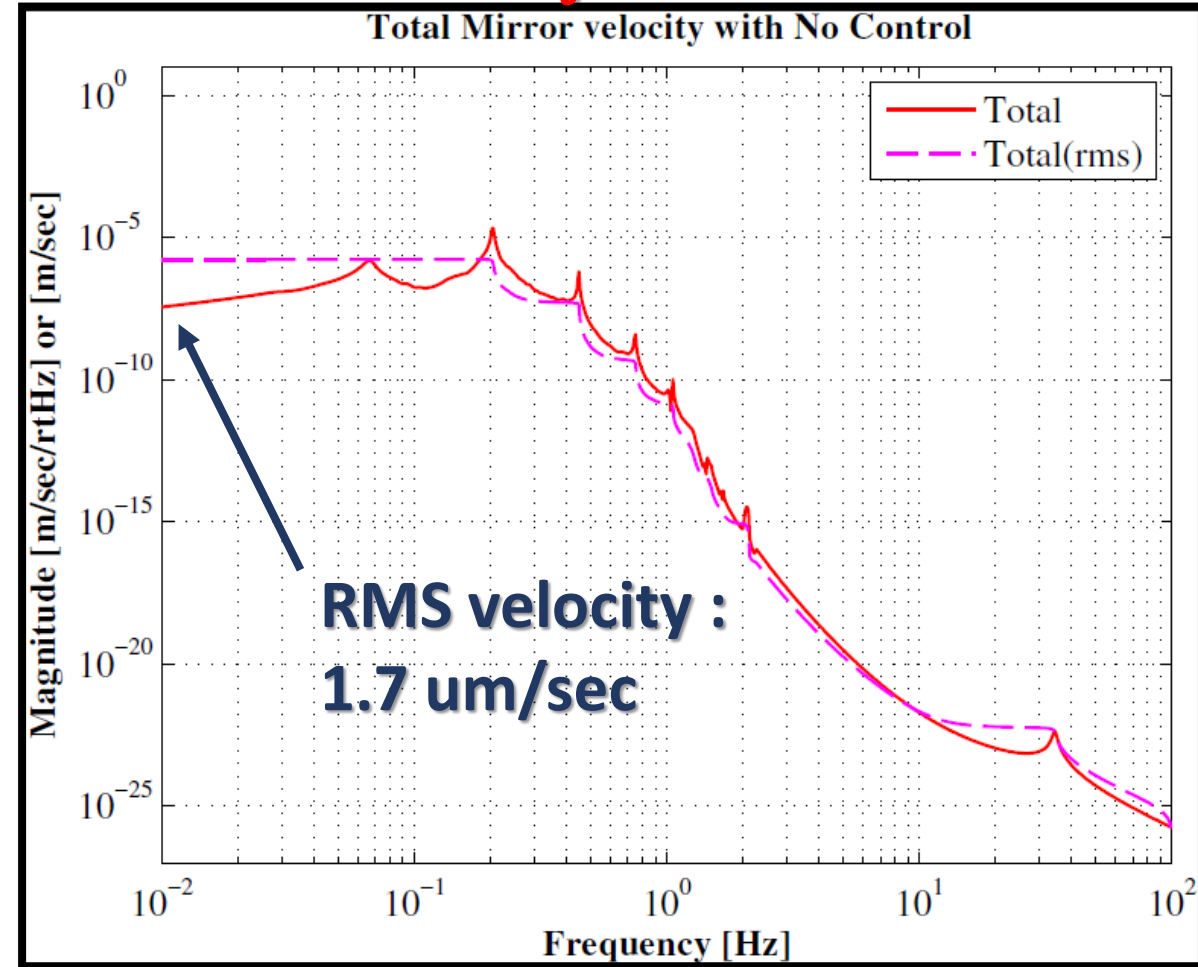
## TM displacement : H + V 1%



## TM velocity : H and V 1%

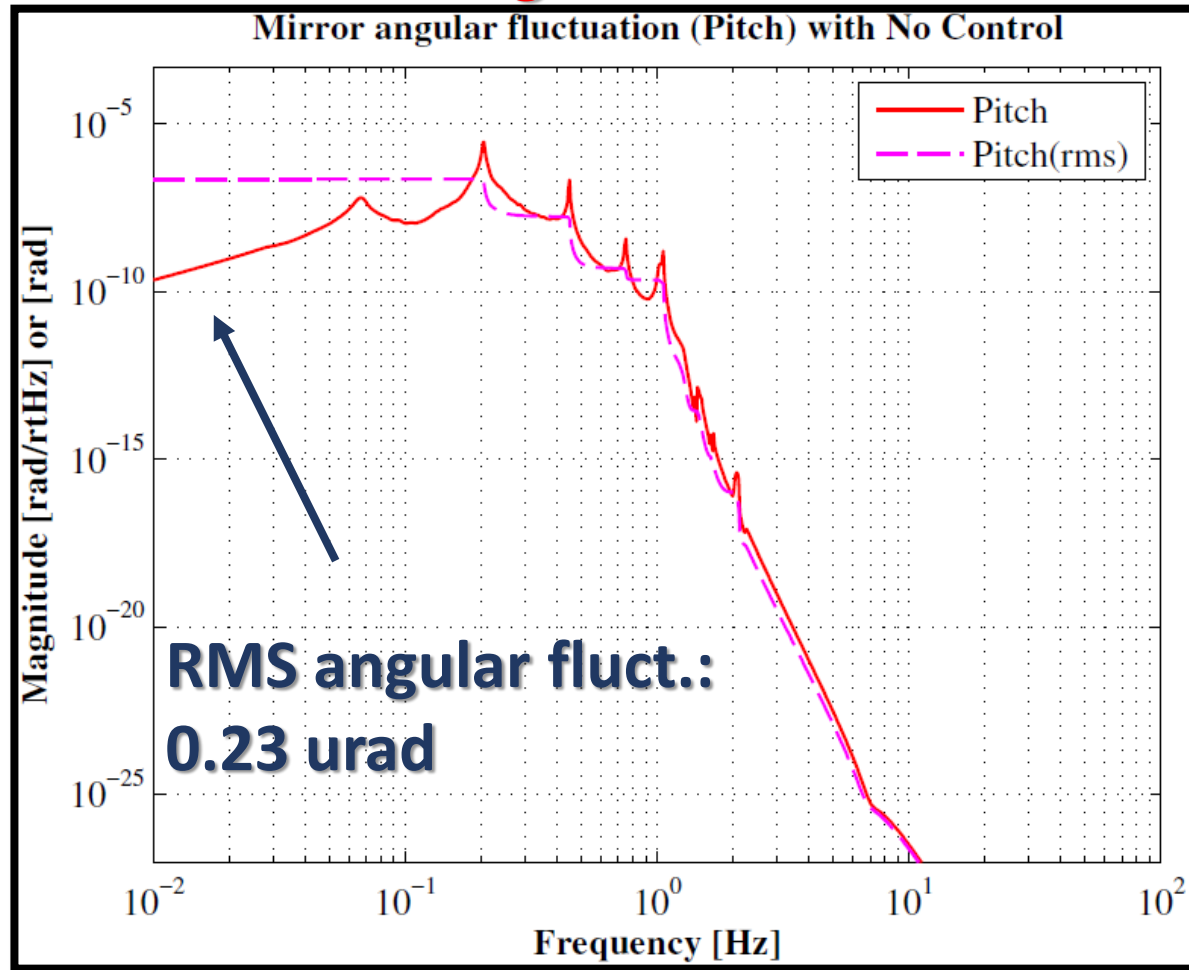


## TM velocity : H + V 1%



# Spectra without ctrl

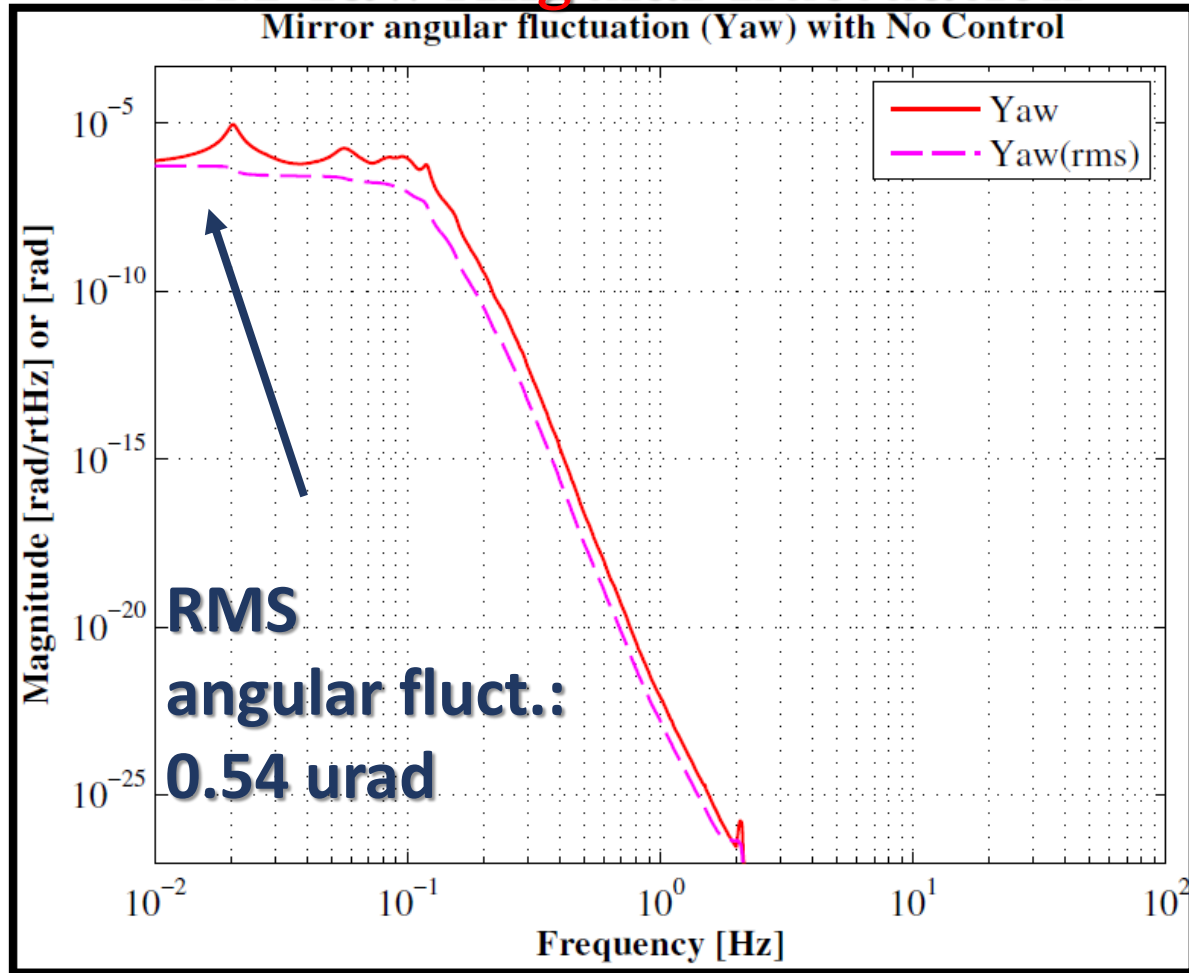
## TM Pitch Angular fluctuation



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

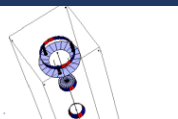
# Spectra without ctrl

## TM Yaw Angular fluctuation



TM **Yaw** fluctuation  
excited by **Yaw** GND motion

# Control Simulation Results



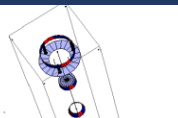
# Filter shape







# Q factor in damping control



# Impulse response