

# Mechanical response

## Calculated by SUMCON (and Simulink)

# ① Measurement vs. SUMCON : TypeBpp\_iKAGRA

Model Construction Calculation Result Export Model

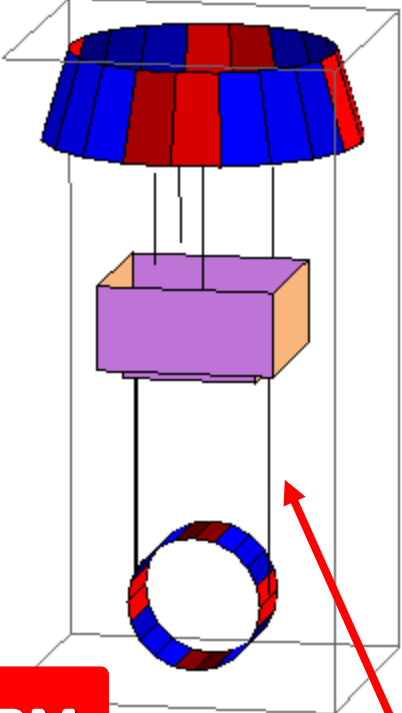
**Model Basic Information**

Degrees of Freedom:  
18 State Variables  
6 Input Variables  
1 Float Variables

Ground Position:  
xF2 → 0.    yF2 → 0.    zF2 → 0.    pitchF2 → 0.    yawF2 → 0.    rollF2 → 0.

Equilibrium Point:  
xIR → 0.    yIR → -0.5026    zIR → 0.    pitchIR → 0.    yawIR → 0.    rollIR → 0.  
xIM → 0.    yIM → -0.5519    zIM → 0.    pitchIM → 0.    yawIM → 0.    rollIM → 0.  
xRM → 0.    yRM → -1.139    zRM → 0.    pitchRM → 0.    yawRM → 0.    rollRM → 0.  
hGAS2 → 0.0269

**TypeBpp\_iKAGRA**



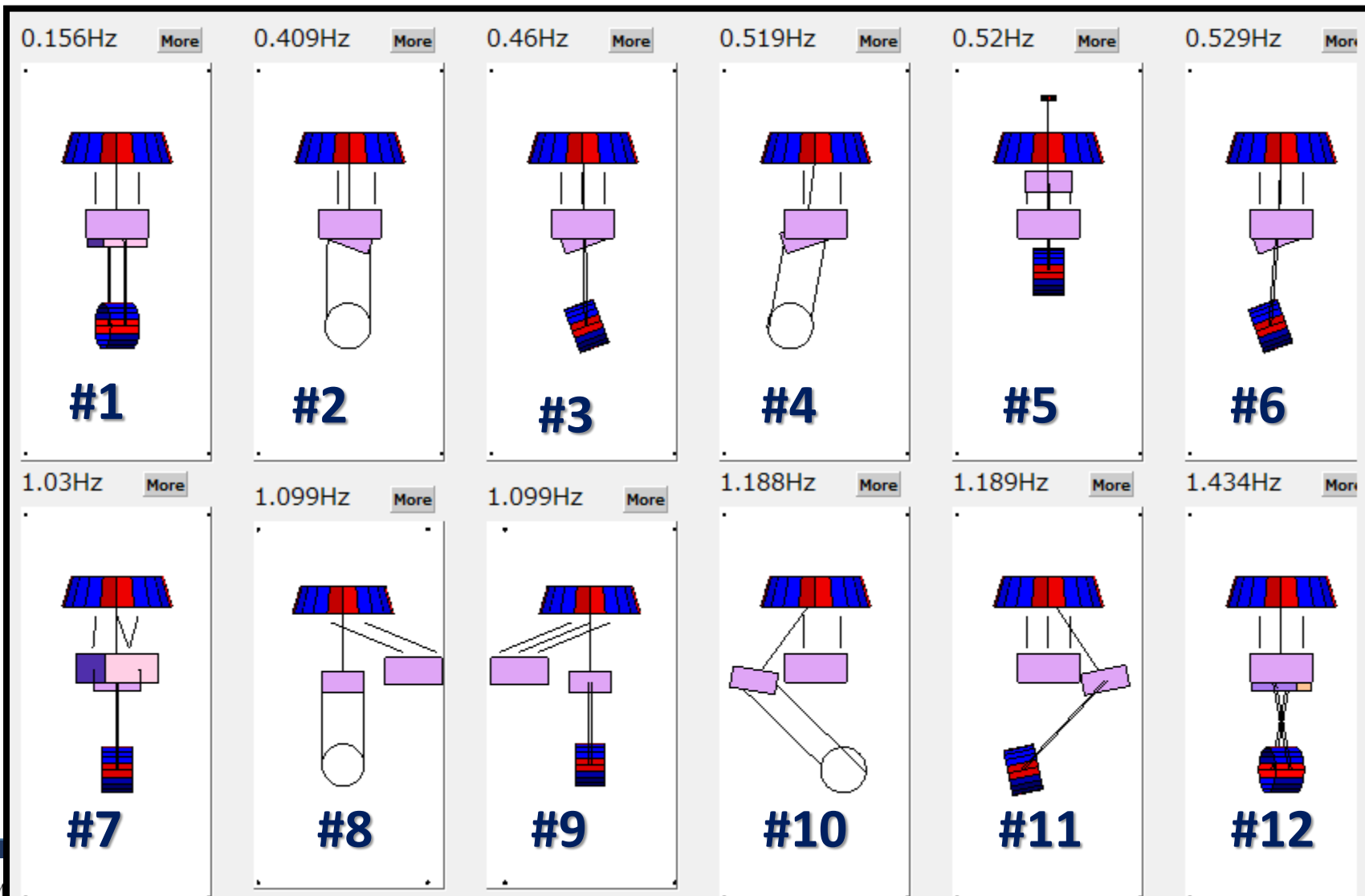
The PR TM fixed to the RM

RM is suspended by 4 wires

# Eigen Mode List

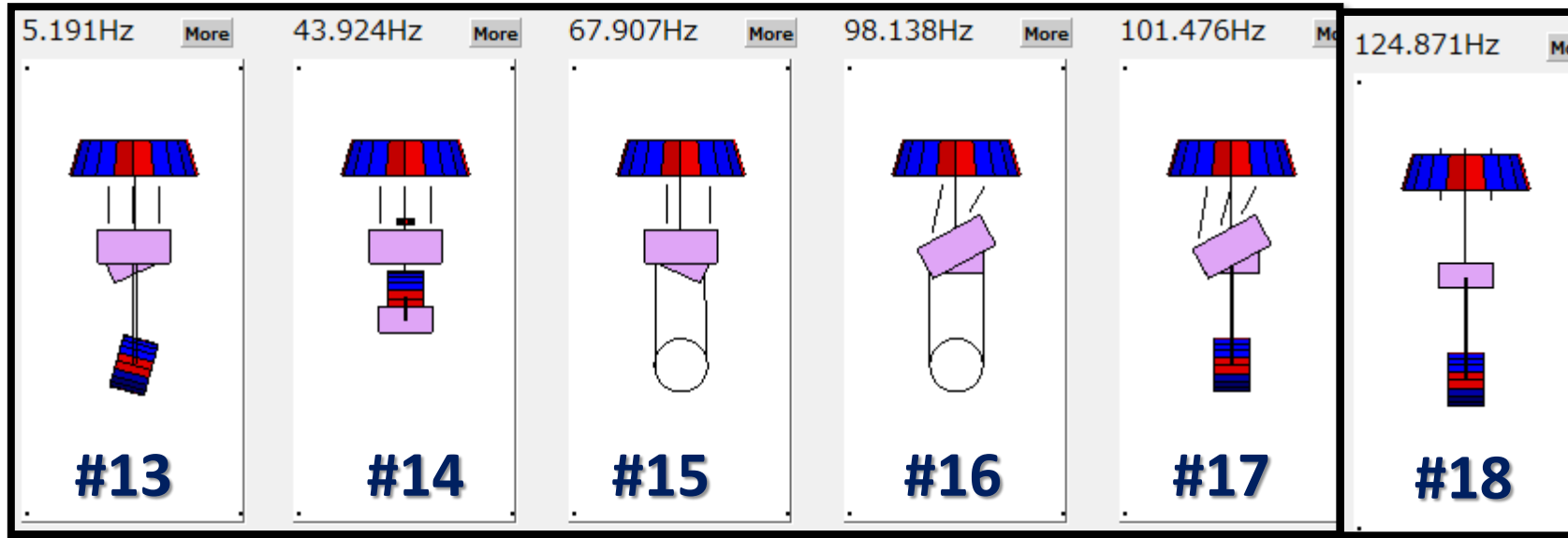
# Eigen Mode Shape

# TypeBpp for iKAGRA (real configuration)



# Eigen Mode Shape

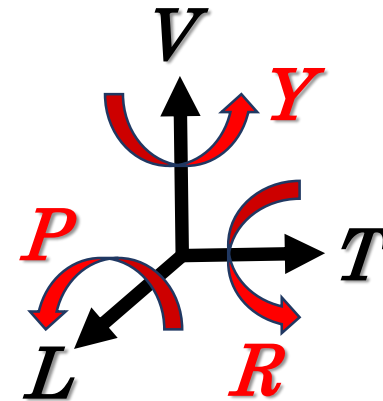
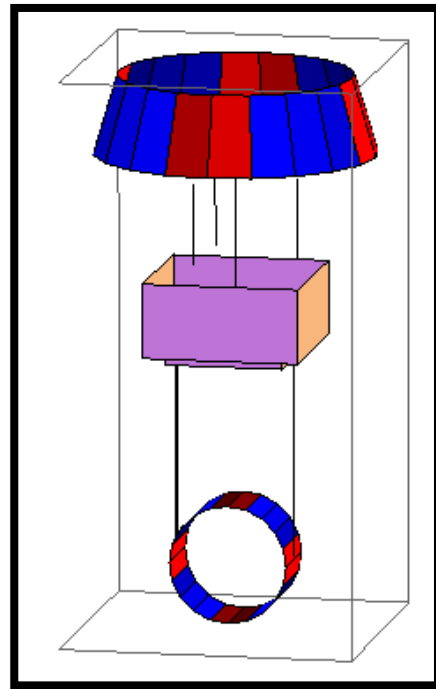
# TypeBpp for iKAGRA (real configuration)



From 160301 measurement:

# Force Transfer Functions with No Ctrl

(, which can be measured and actuated.)



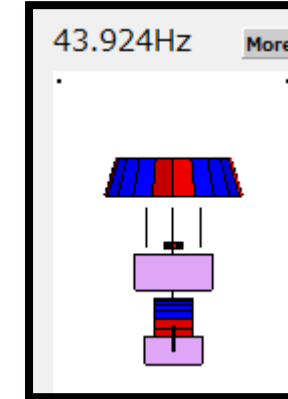
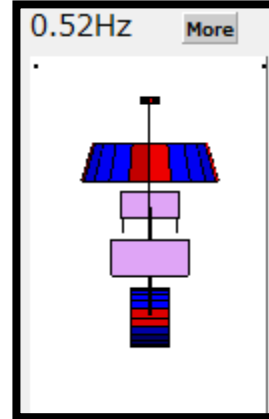
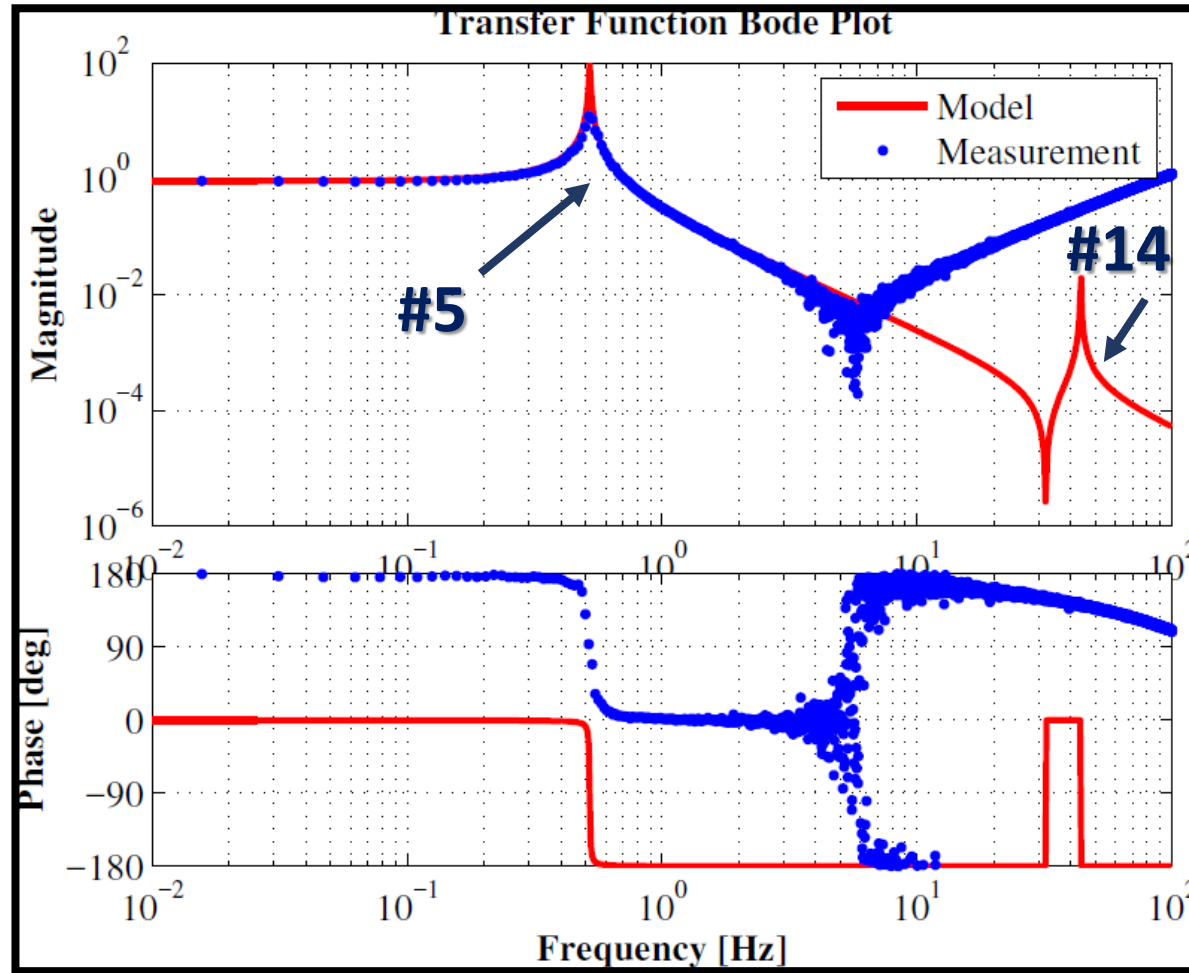
# Force Transfer Function

# TypeBpp for iKAGRA (real configuration)

**LVDT\_VBF / actVBF**

**#5 : GAS**

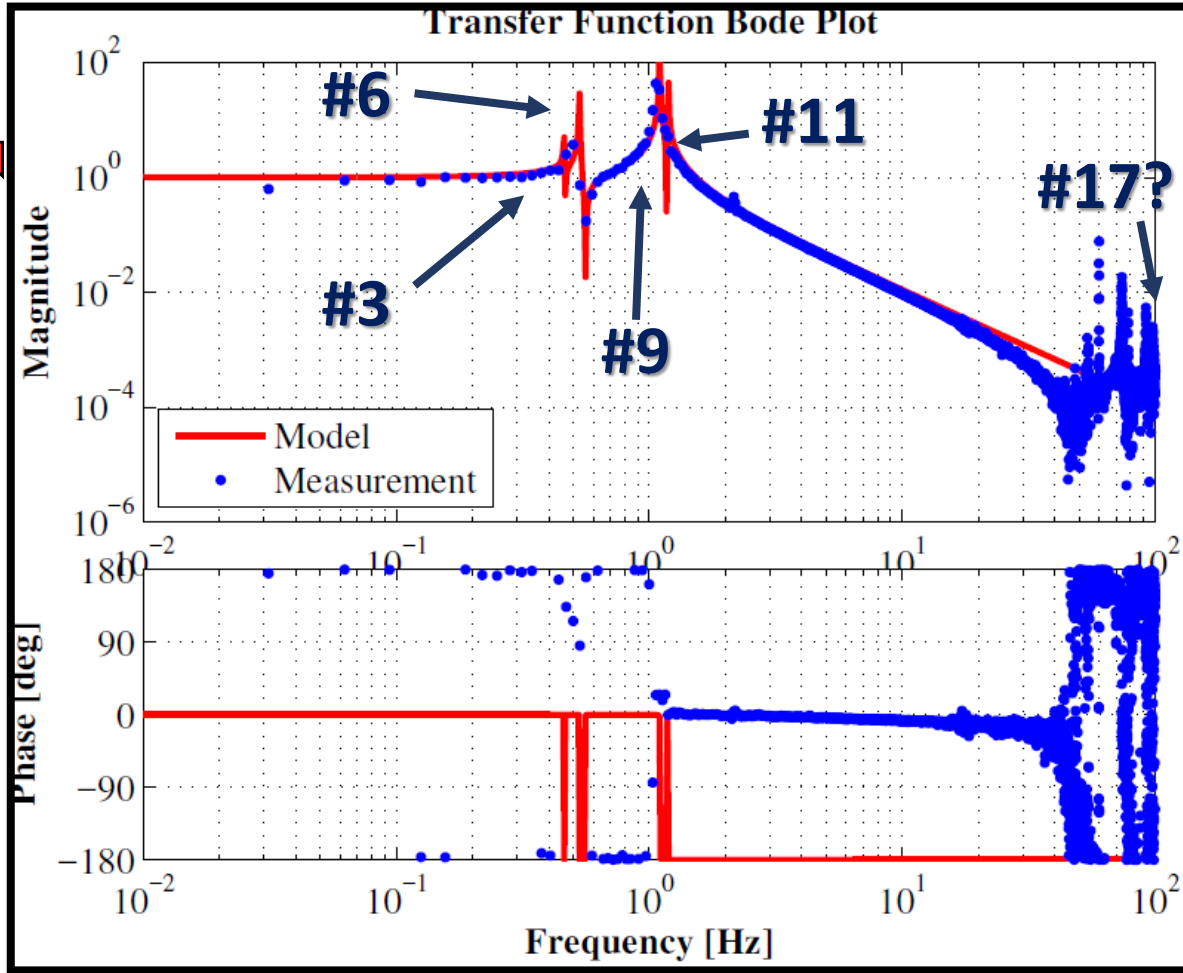
**#14 : VRM**



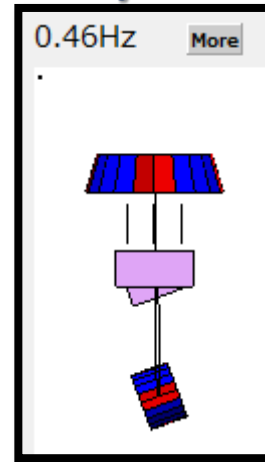
# Force Transfer Function

# TypeBpp for iKAGRA (real configuration)

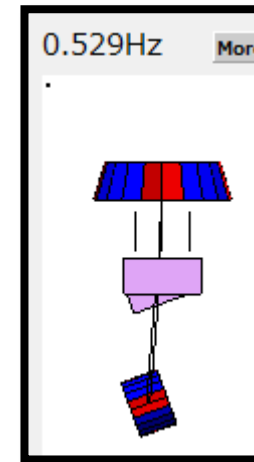
**OSEM\_LIM / actLIM**



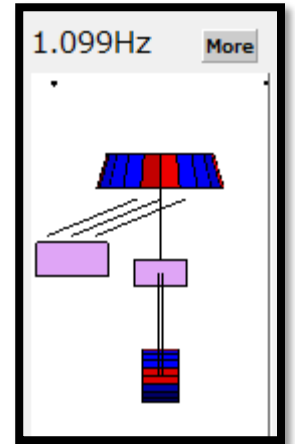
#3 : PIM /PRM



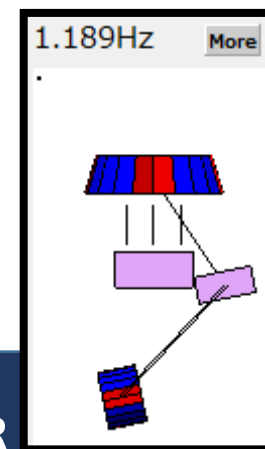
#6 : PIM /PRM



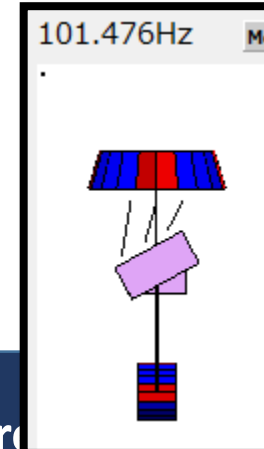
#9 : LIR



#11 : LIM



#17 : RIR ?





# Force Transfer Function

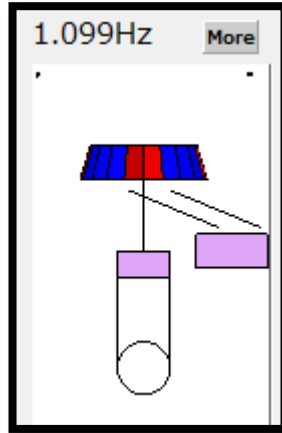
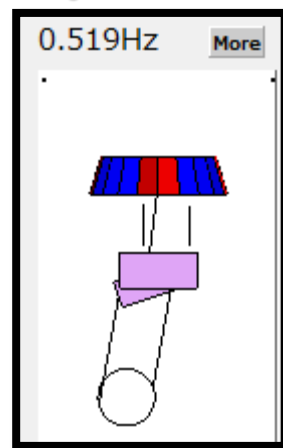
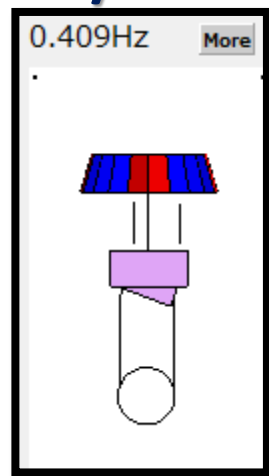
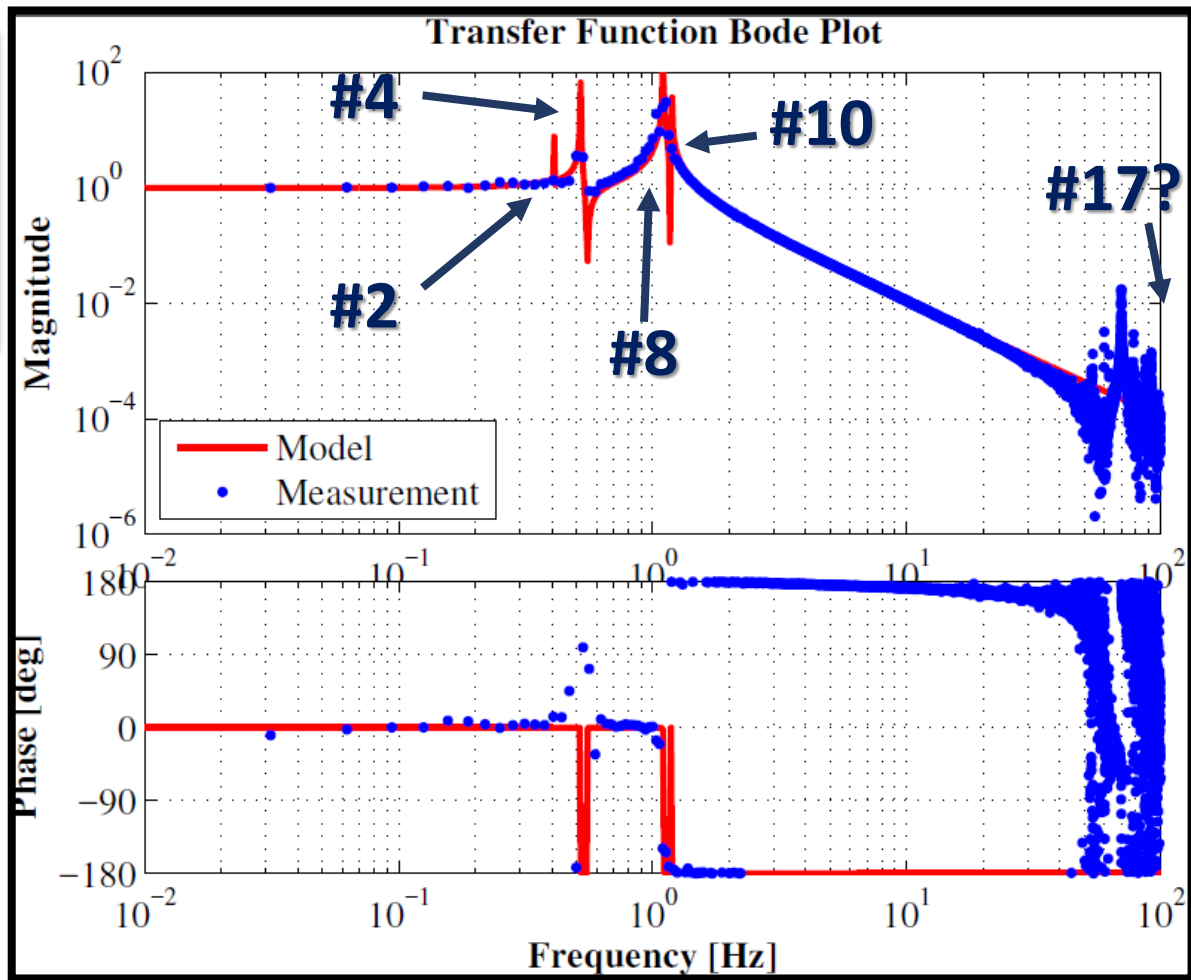
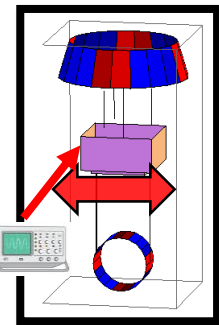
# TypeBpp for iKAGRA (real configuration)

**OSEM\_TIM / actTIM**

#2 : RIM  
/RRM

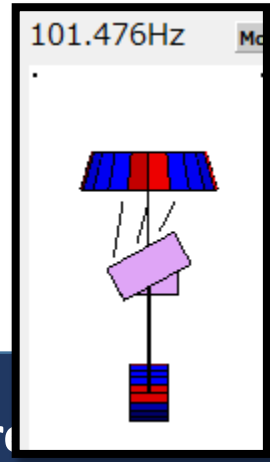
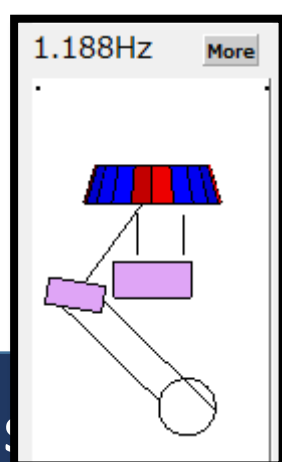
#4 : RIM  
/RRM

#8 : TIR



#10 : TIM

#17 : RIR ?



# Force Transfer Function

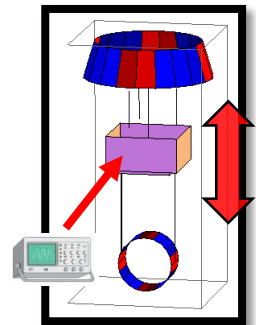
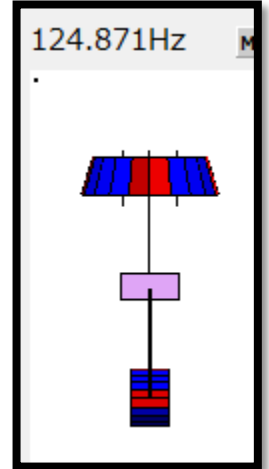
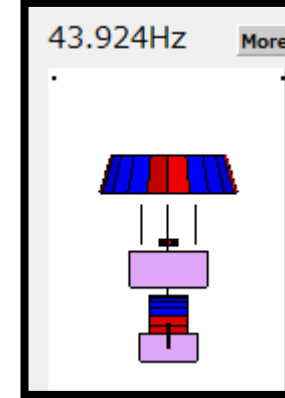
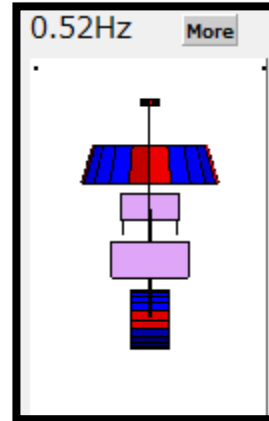
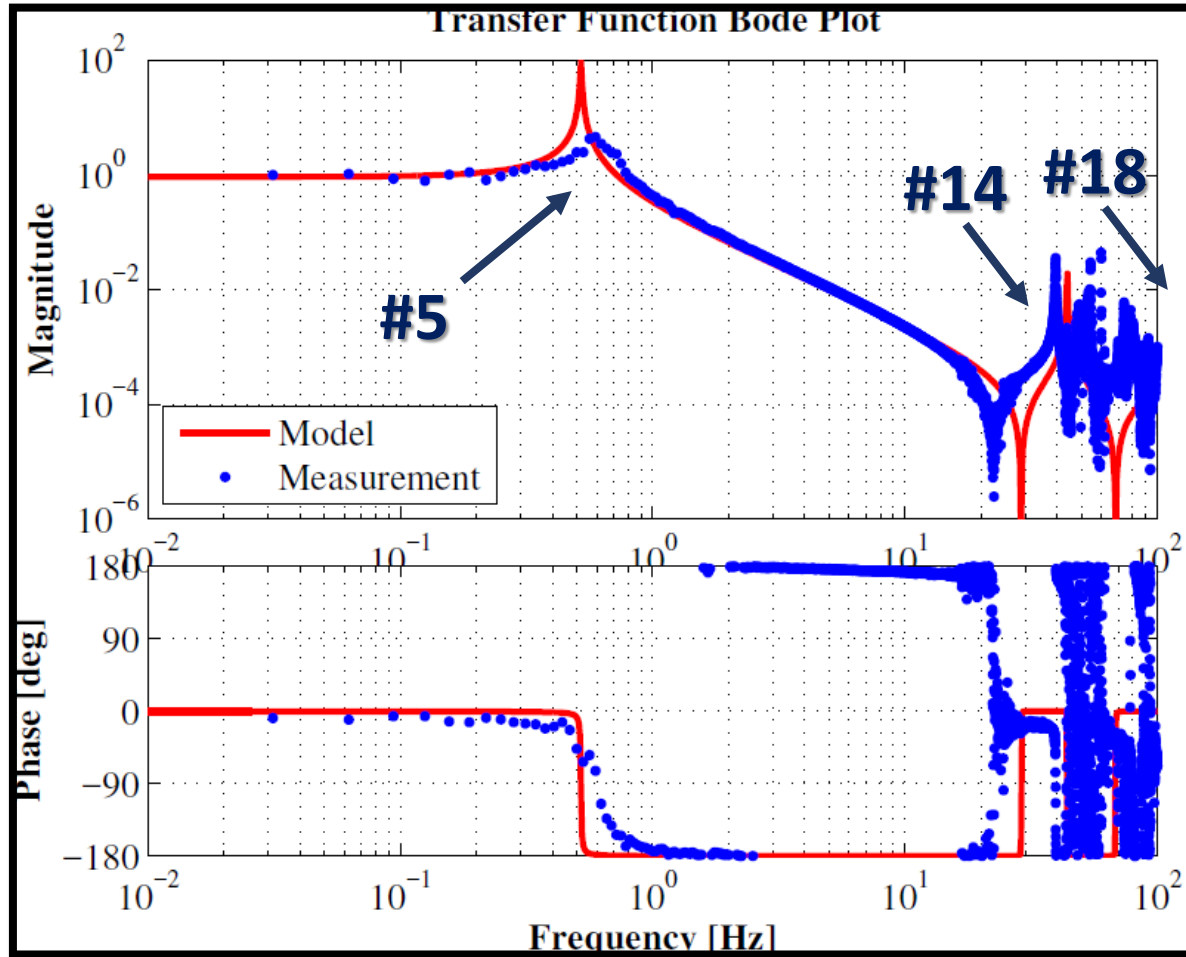
# TypeBpp for iKAGRA (real configuration)

**OSEM\_VIM / actVIM**

**#5 : GAS**

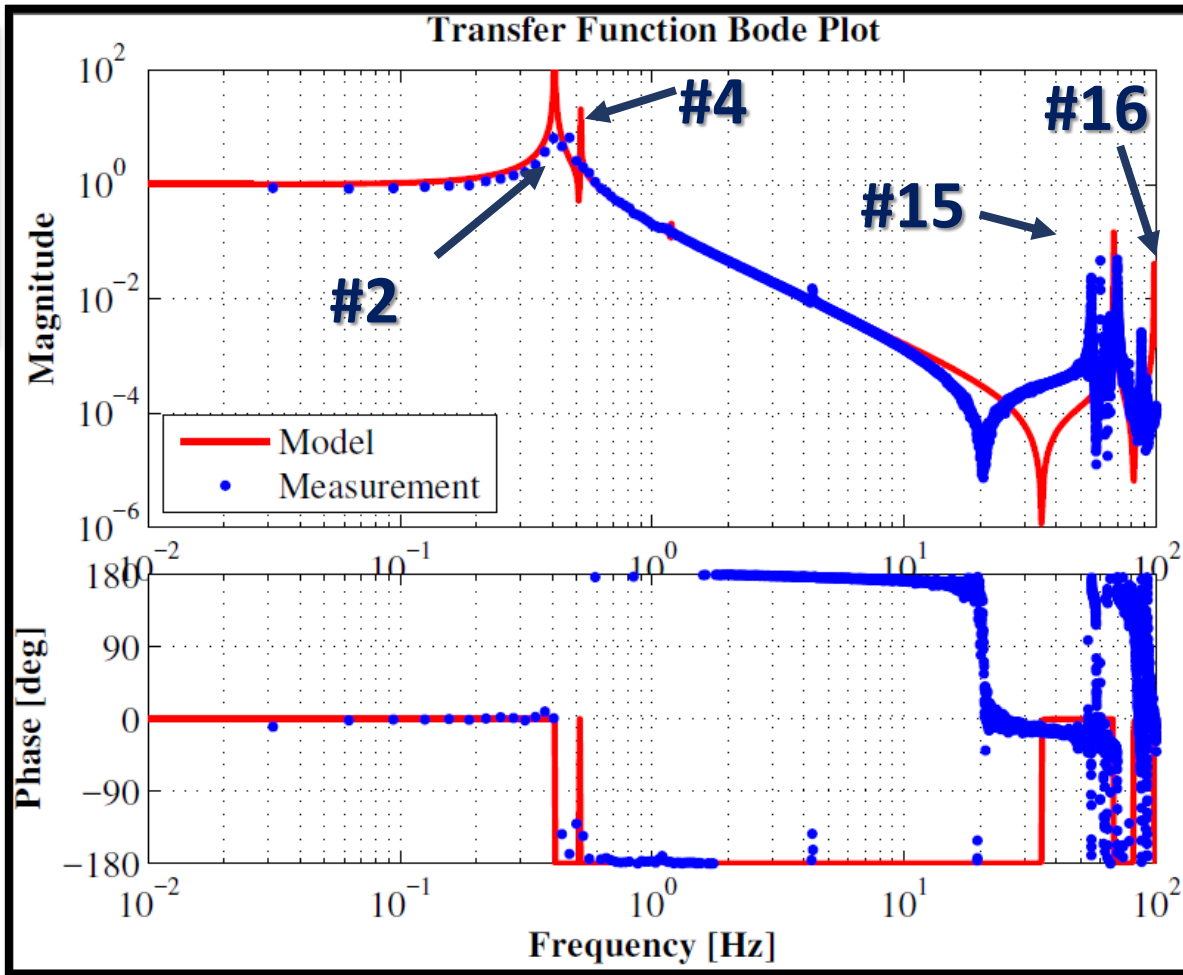
**#14 : VRM**

**#18 : VIR**

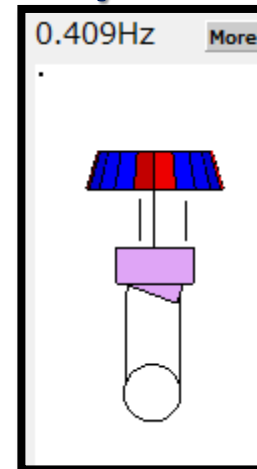


# Force Transfer Function TypeBp with IP

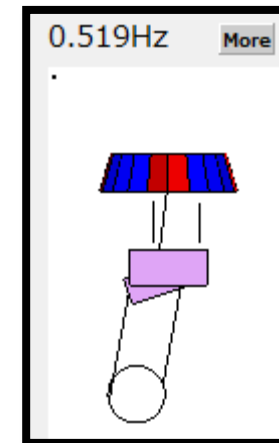
**OSEM\_RIM / actRIM**



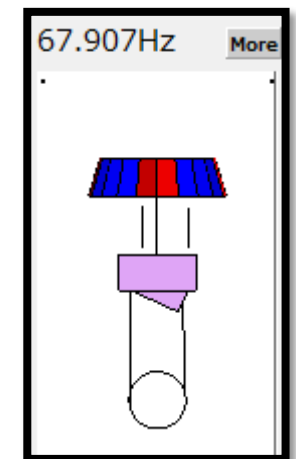
#2 : RIM /RRM



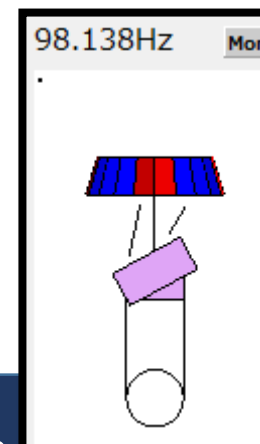
#4 : RIM /RRM



#15 : RIM



#16 : RIR

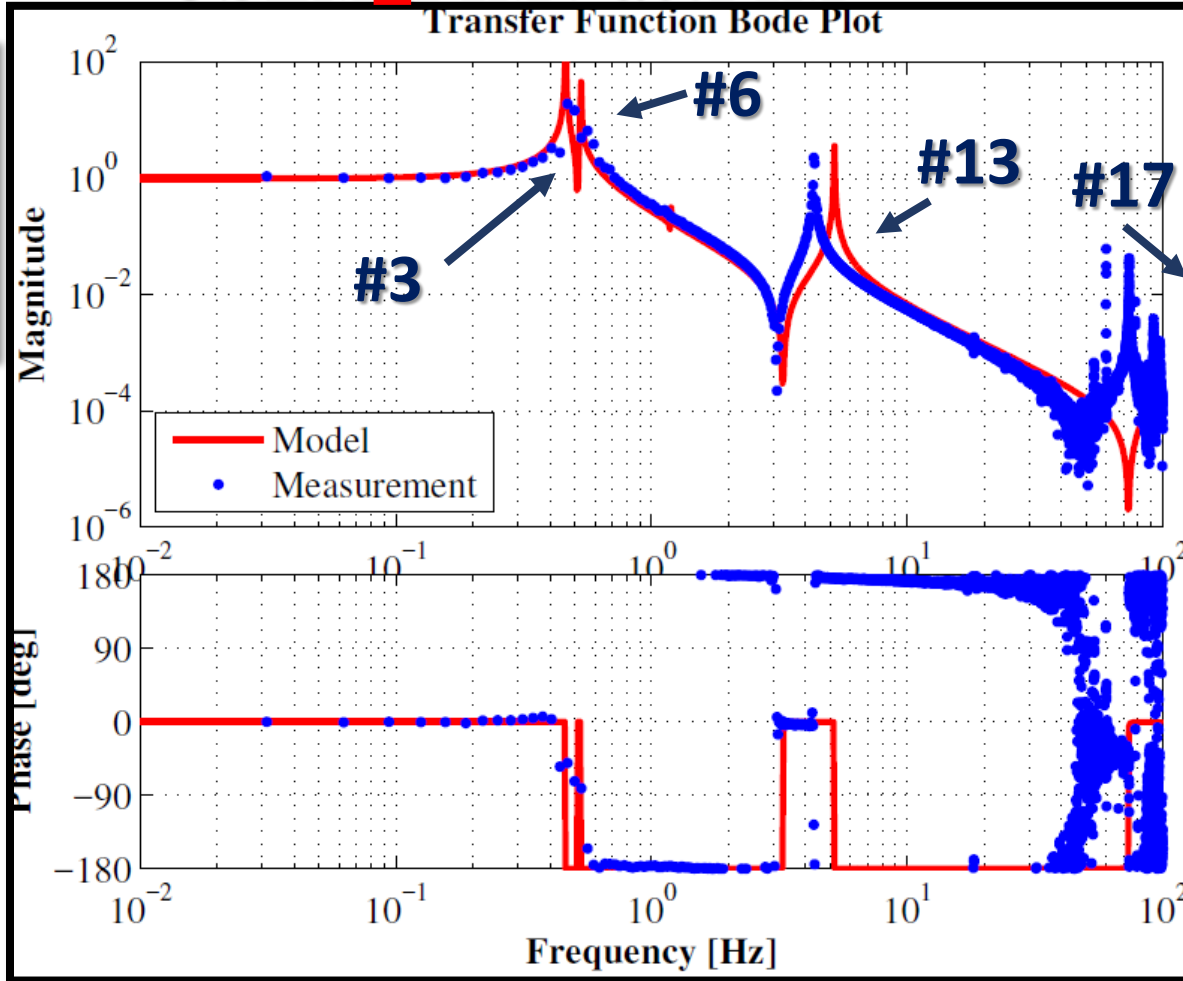


# Force Transfer Function

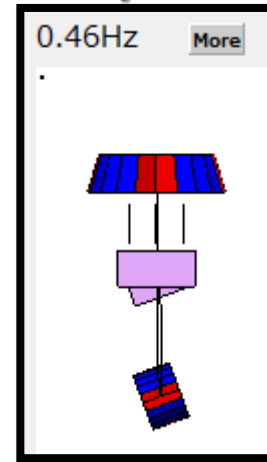
# TypeBpp for iKAGRA (real configuration)

**OSEM\_PIM / actPIM**

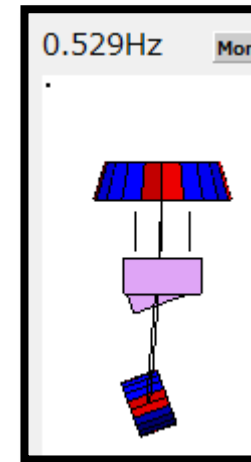
Transfer Function Bode Plot



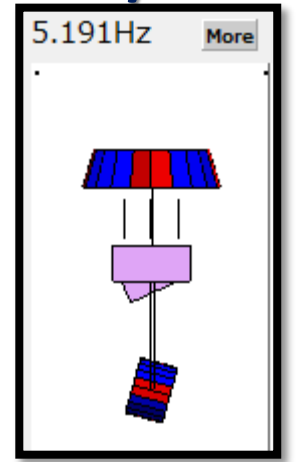
#3 : PIM  
/PRM



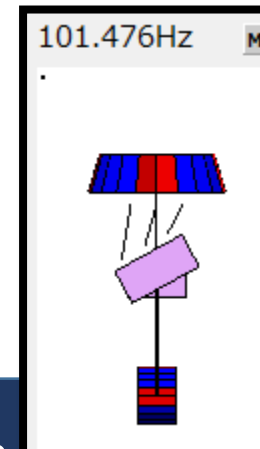
#6 : PIM  
/PRM



#13 : PIM  
/PRM



#17 : PIR



PR SAS Model for real iKAGRA PR3

# Force Transfer Function

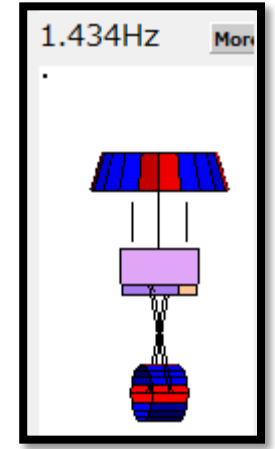
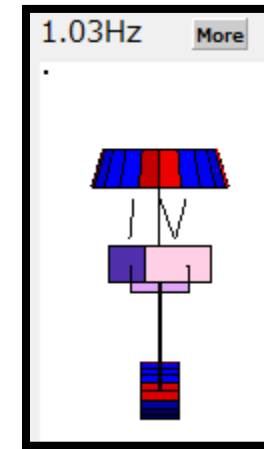
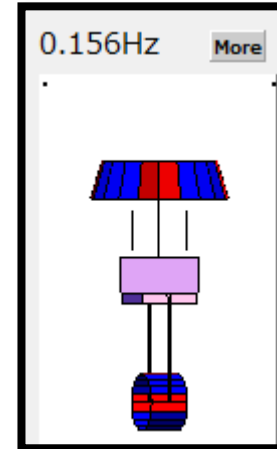
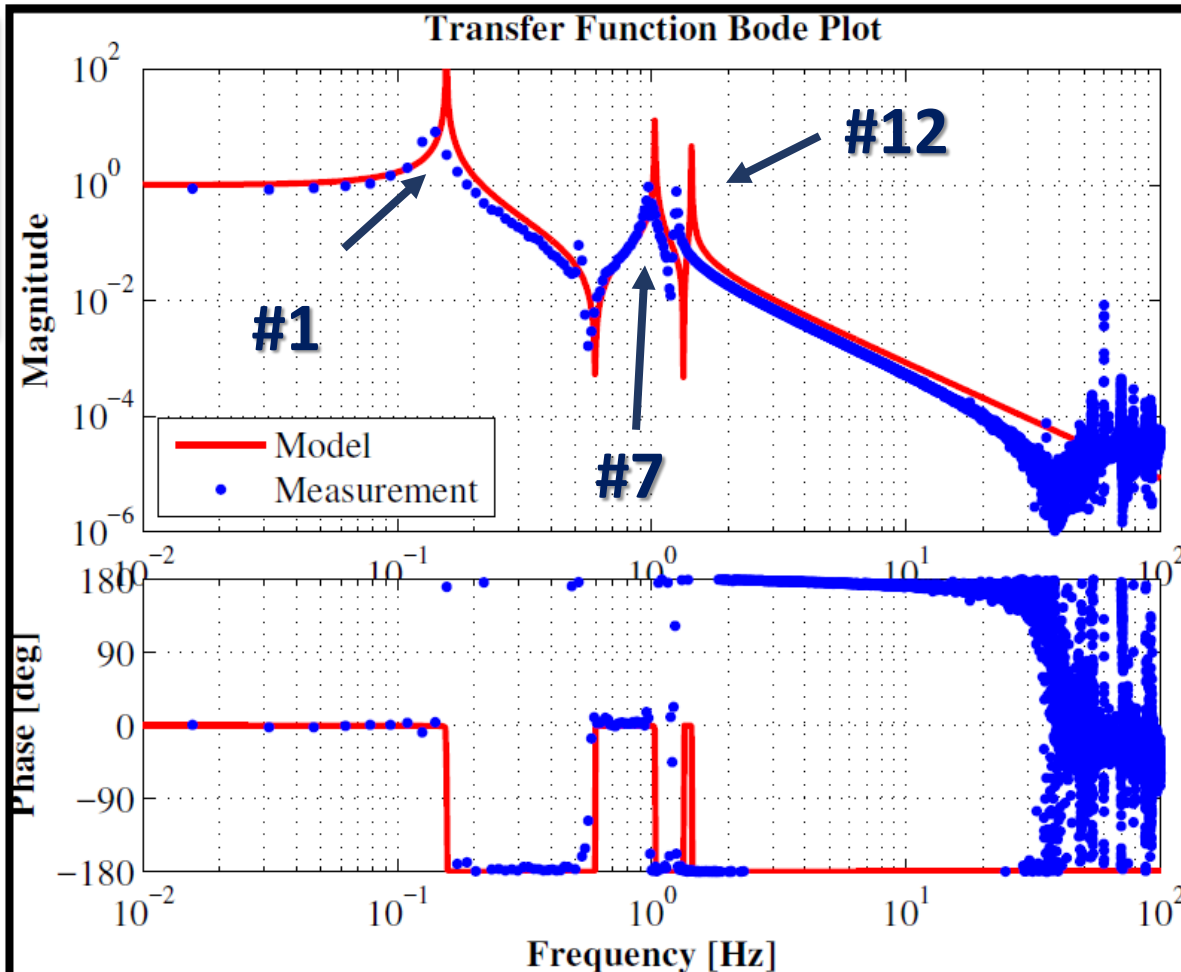
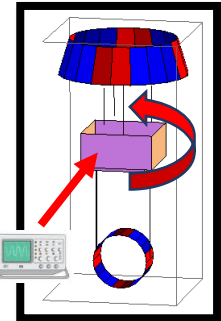
# TypeBpp for iKAGRA (real configuration)

**OSEM\_YIM / actYIM**

#1 : Whole chain

#7 : YIR

#12 : YIM /YIR

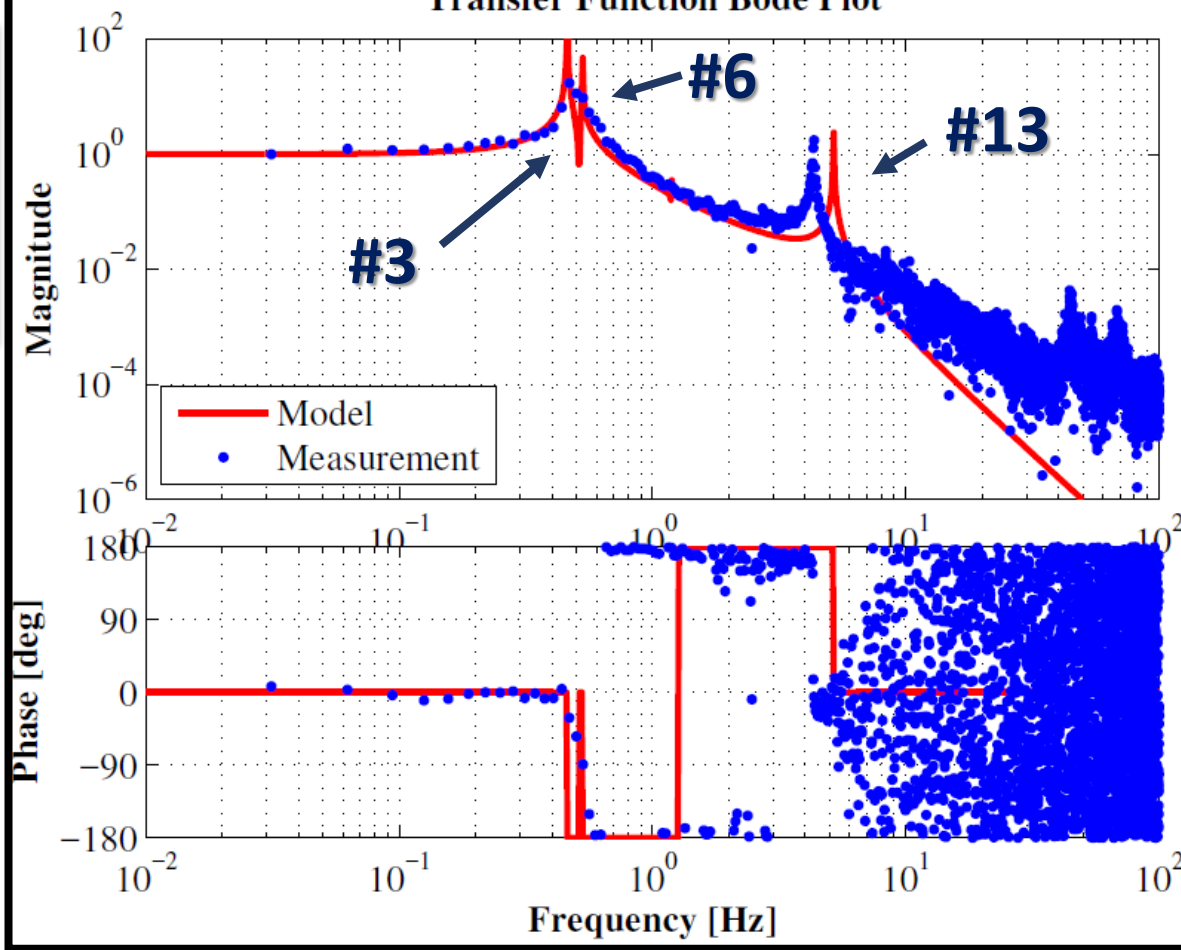


# Force Transfer Function

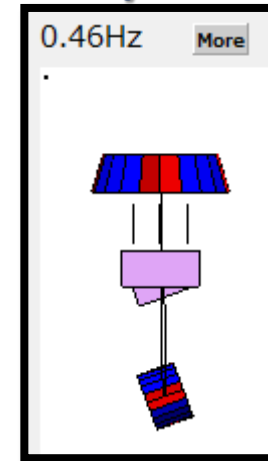
# TypeBpp for iKAGRA (real configuration)

Oplev PTM / actPIM

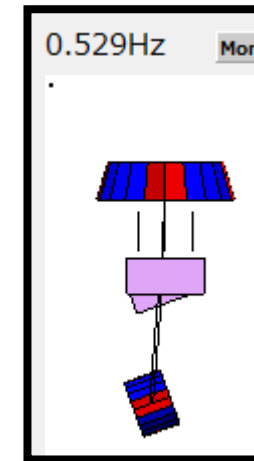
Transfer Function Bode Plot



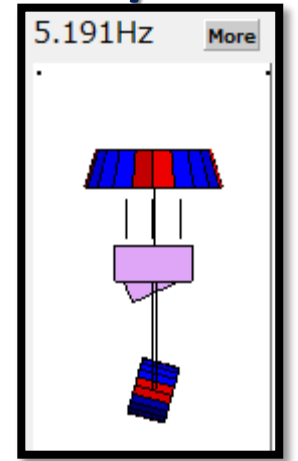
#3 : PIM  
/PRM



#6 : PIM  
/PRM



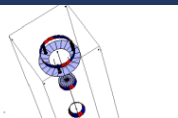
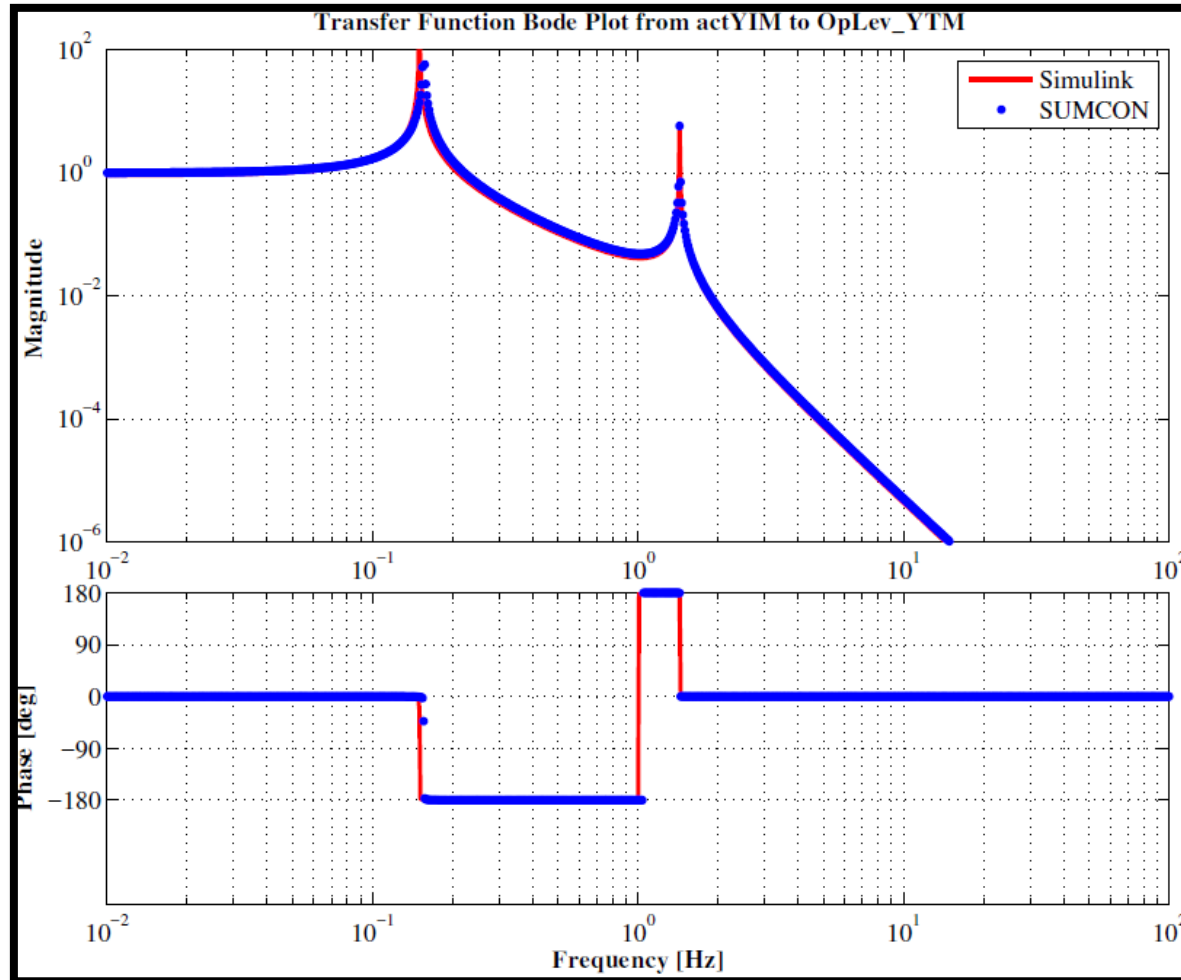
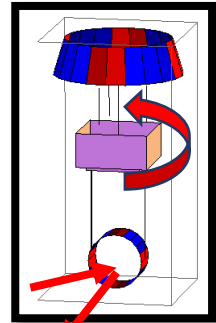
#13 : PIM  
/PRM



# Force Transfer Function

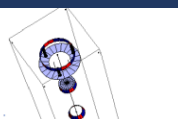
# TypeBpp for iKAGRA (real configuration)

## OpLev\_YTM / actYIM





## ③ Installation test vs. SUMCON : TypeBpp\_iKAGRA

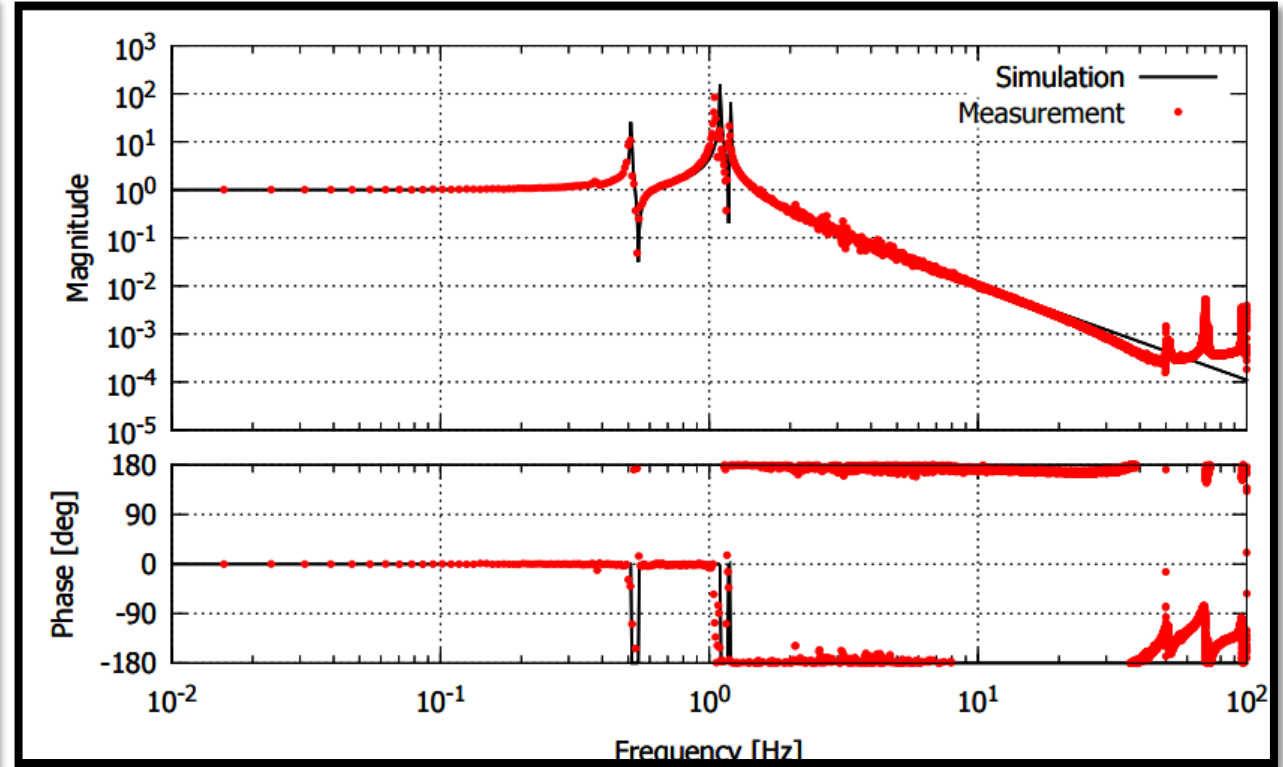
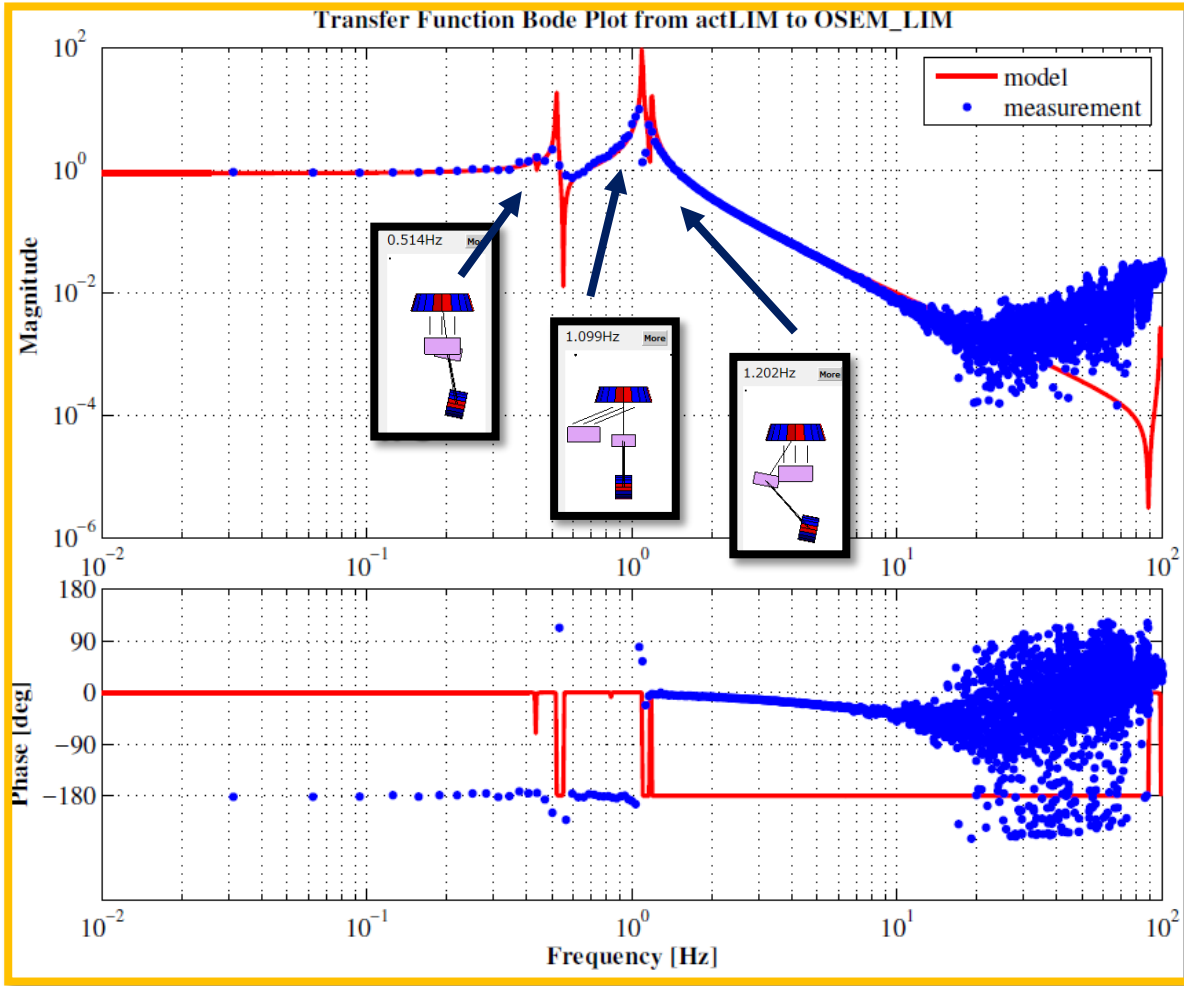




# Investigation of TypeBpp Frequency response

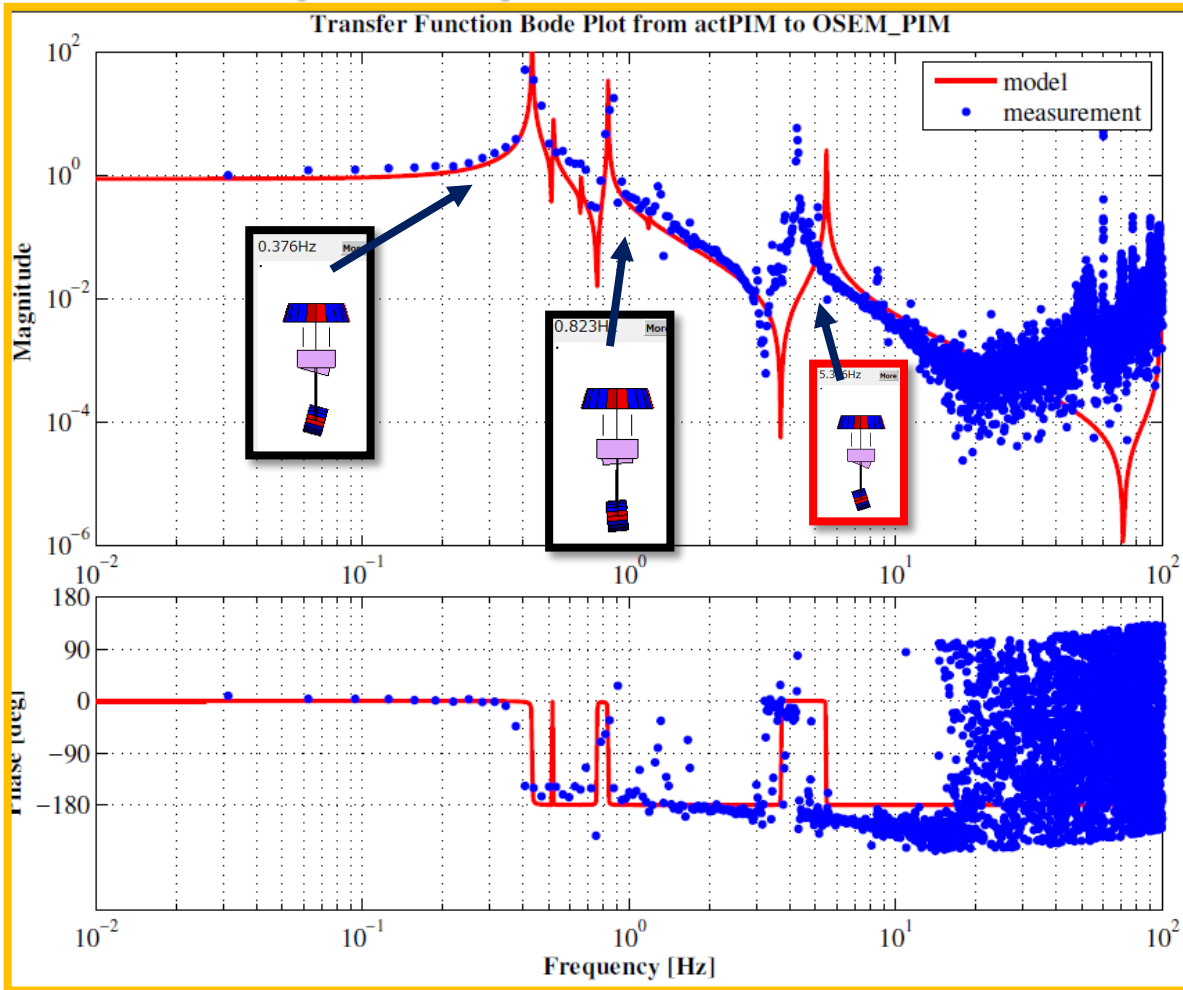
## LIM (OSEM) TF

## REF : LIM (OSEM) TF of 20 m SAS

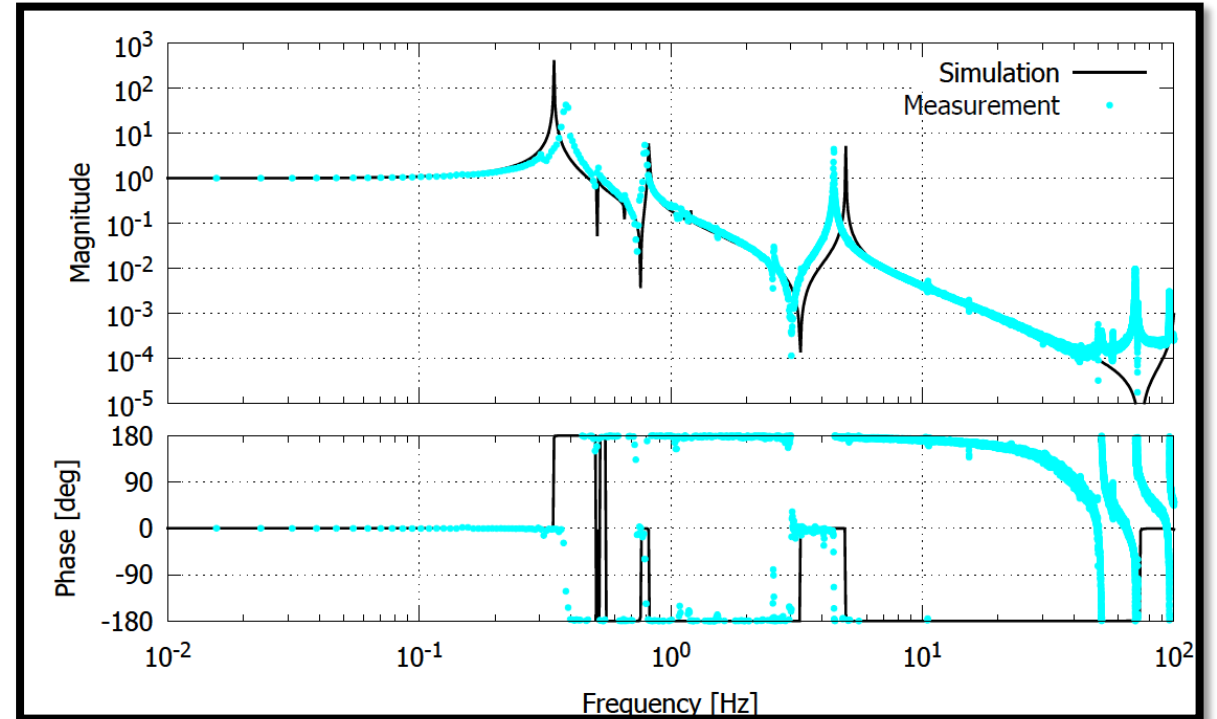


# Investigation of TypeBpp Frequency response

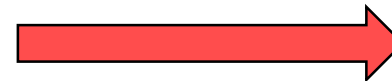
## PIM (OSEM) TF



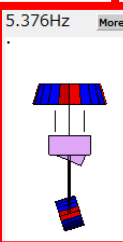
## REF : PIM (OSEM) TF of 20 m SAS



Resonance frequency is lower than its prediction by around 1 Hz.



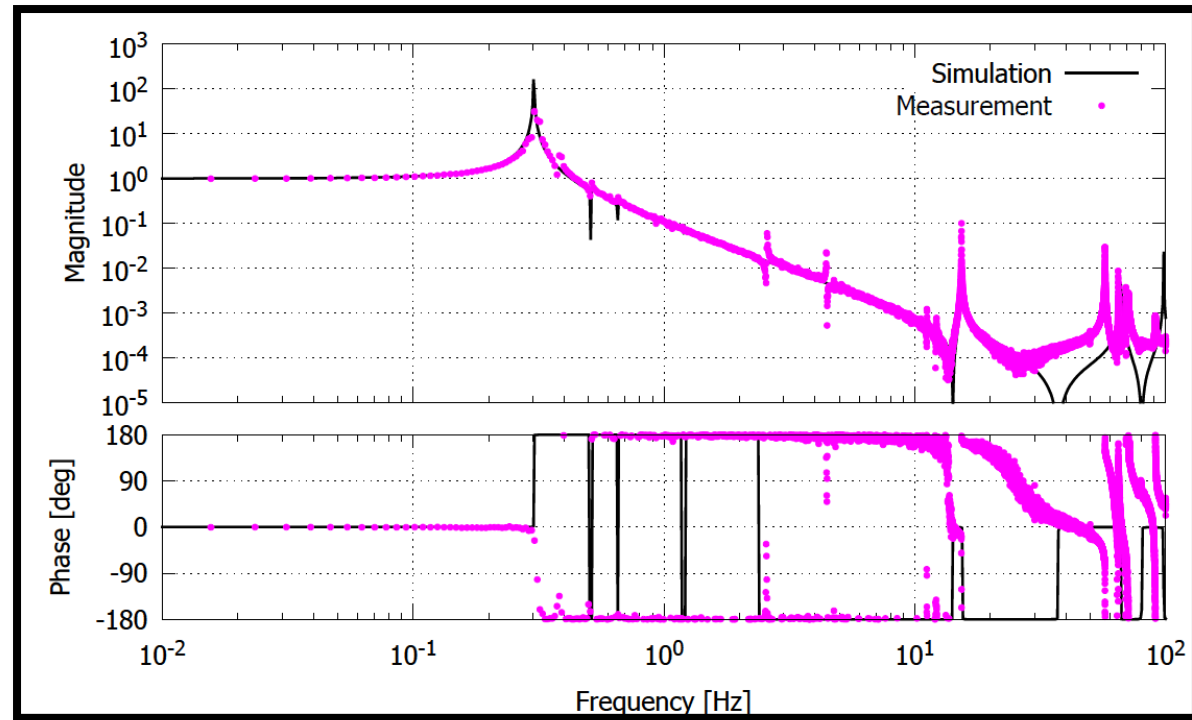
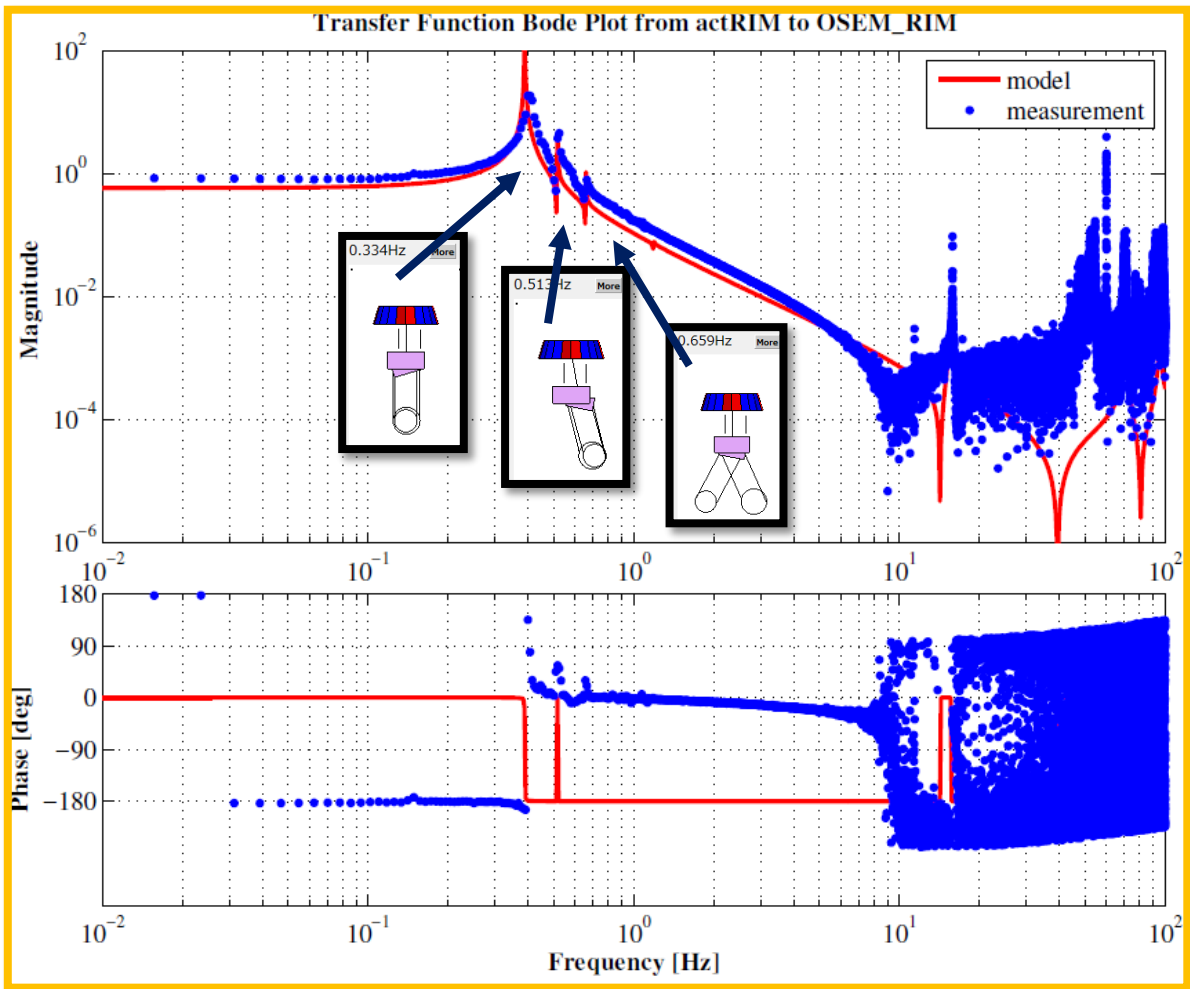
To be investigated.



# Investigation of TypeBpp Frequency response

## RIM (OSEM) TF

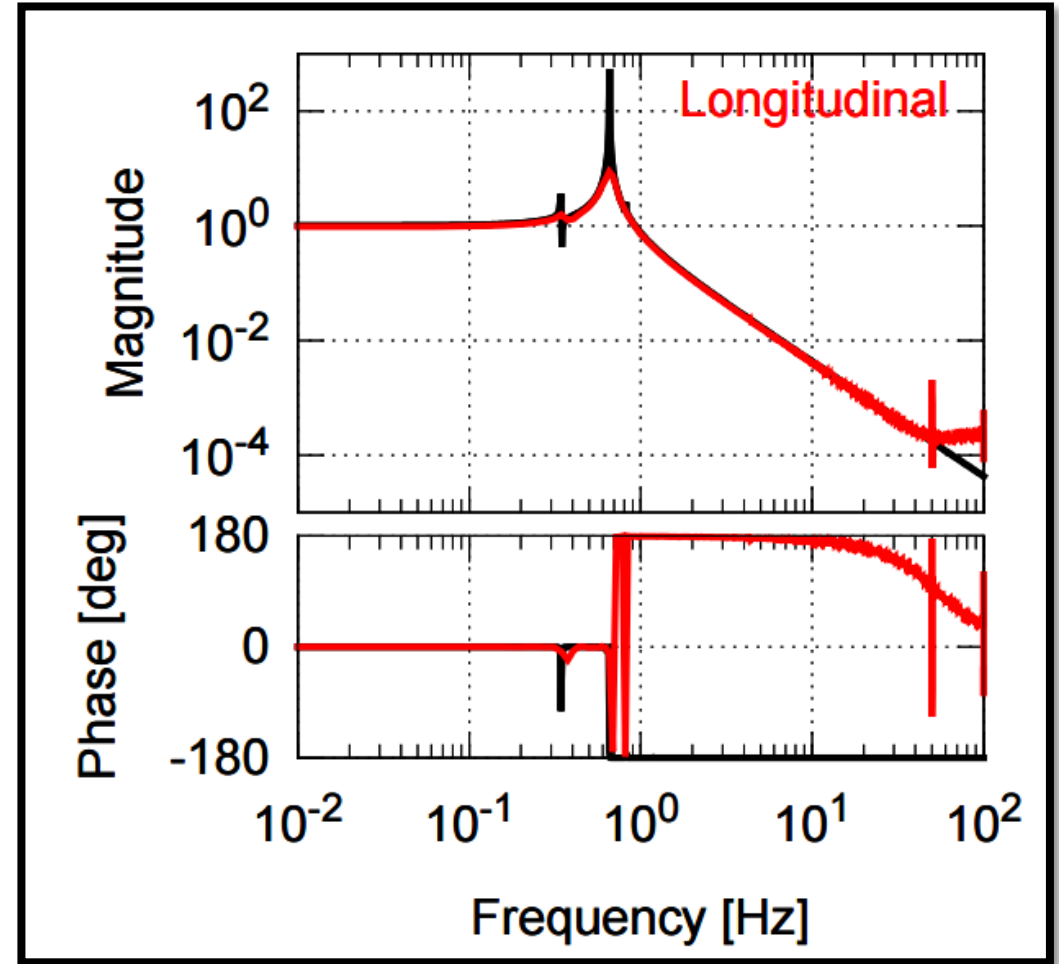
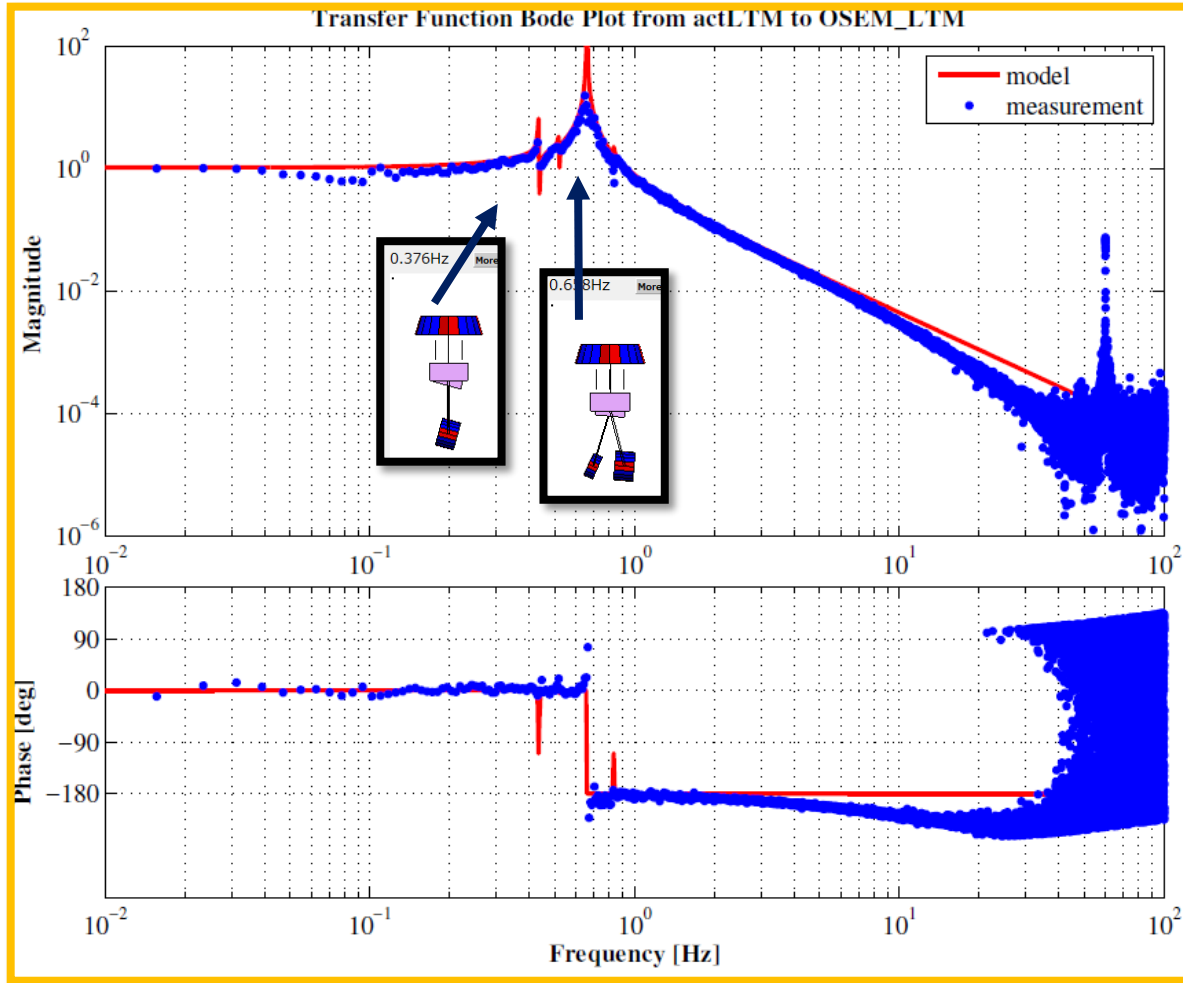
## REF : RIM (OSEM) TF of 20 m SAS



# Investigation of TypeBpp Frequency response

## LTM (OSEM) TF

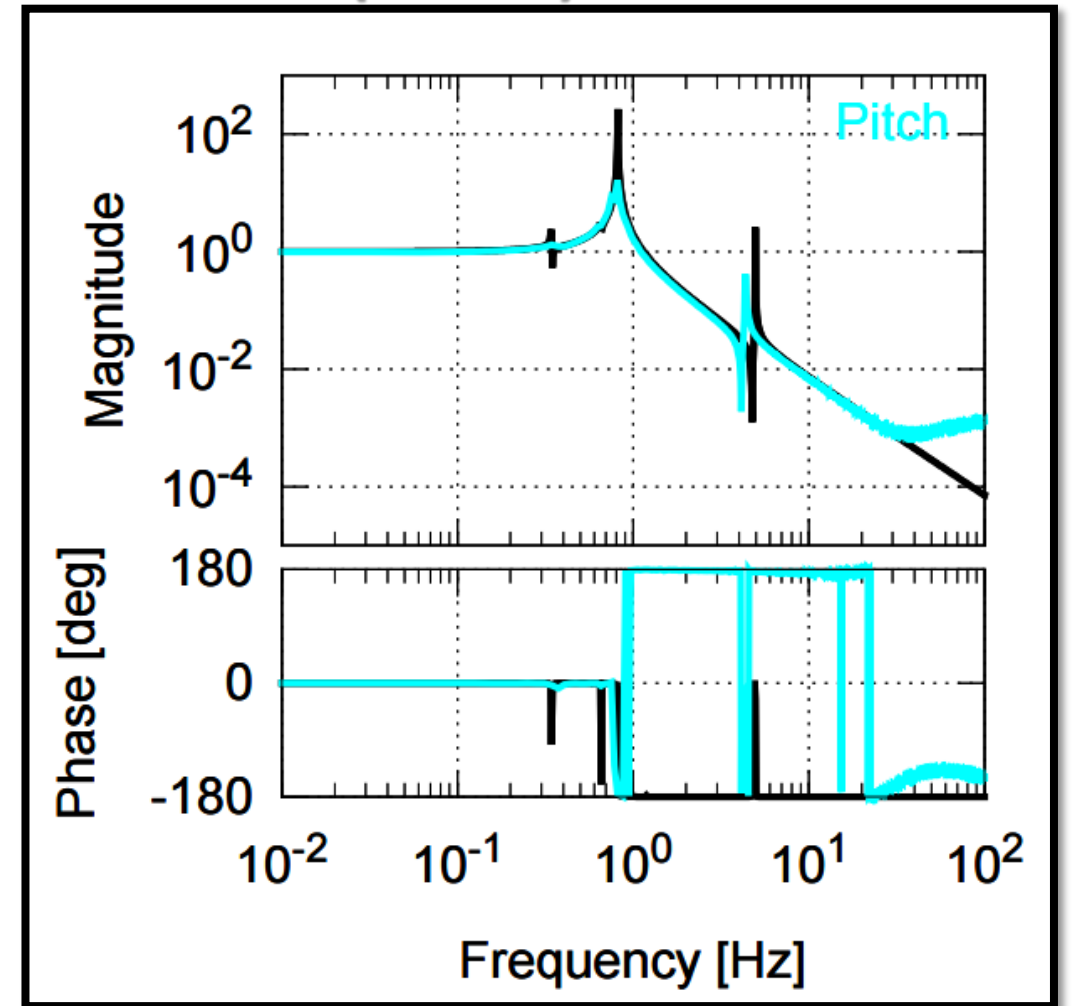
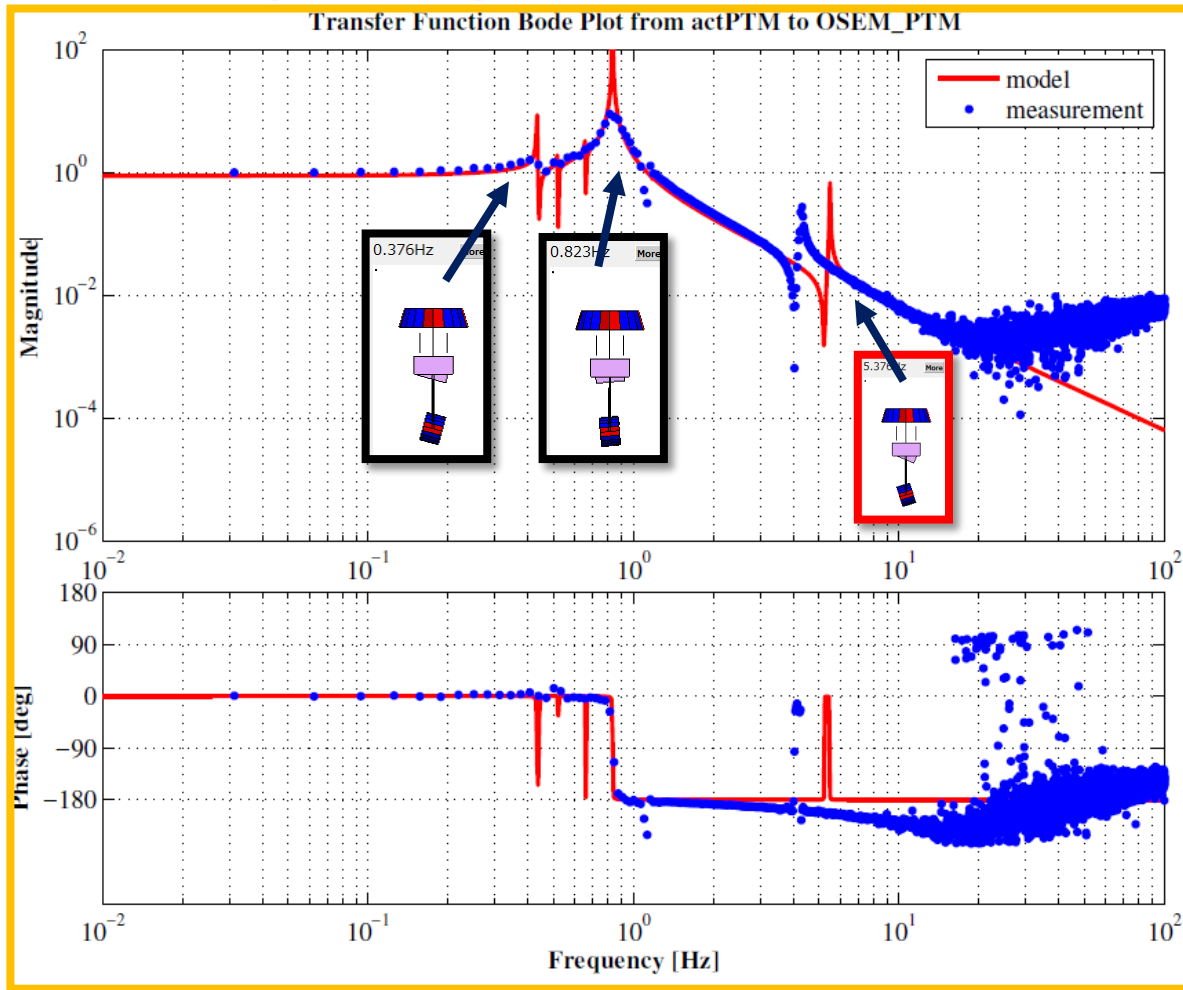
REF : LTM (OSEM) TF of 20 m SAS



# Investigation of TypeBpp Frequency response

## PTM (OSEM) TF

REF : PTM (OSEM) TF in 20 m SAS

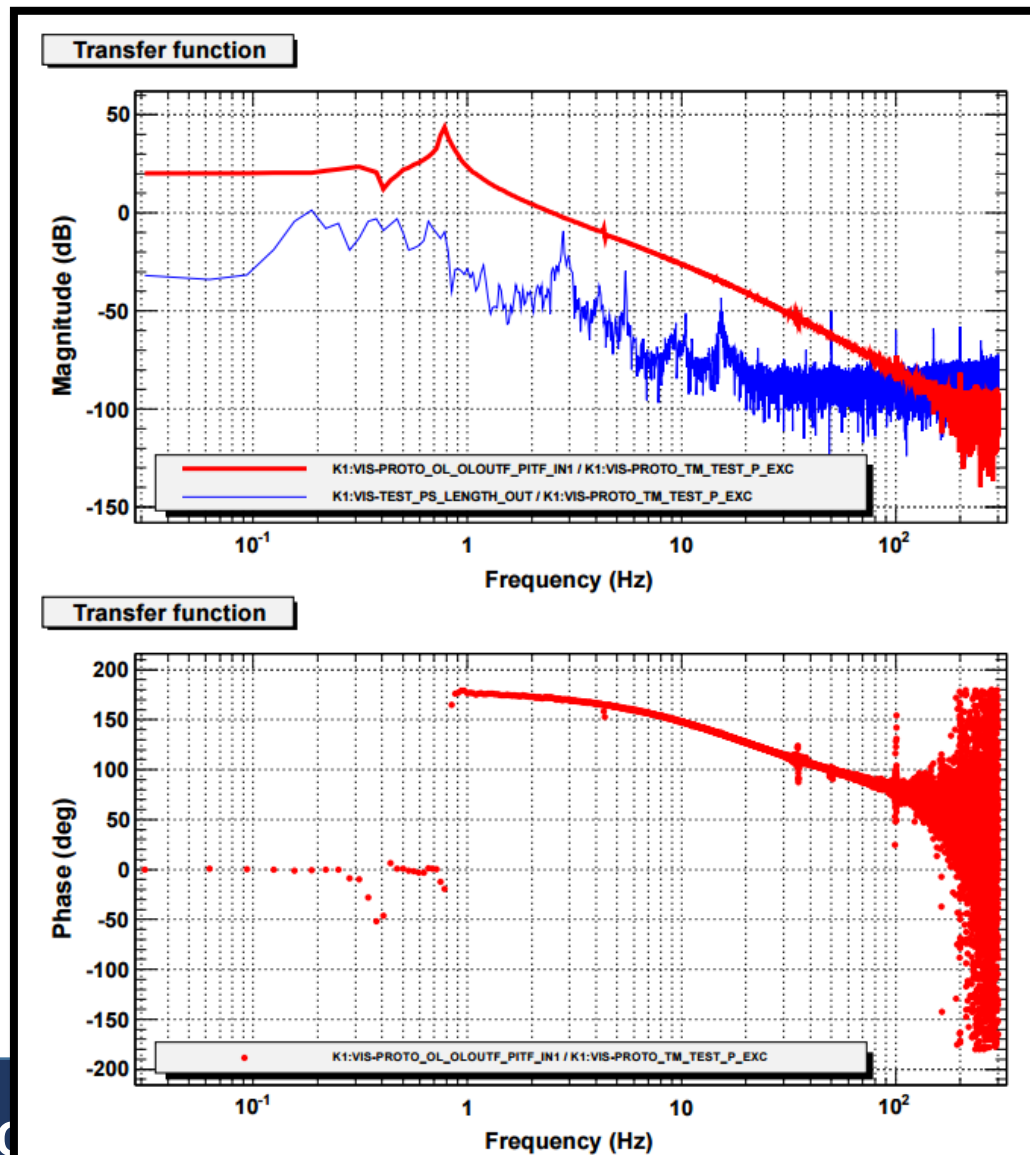
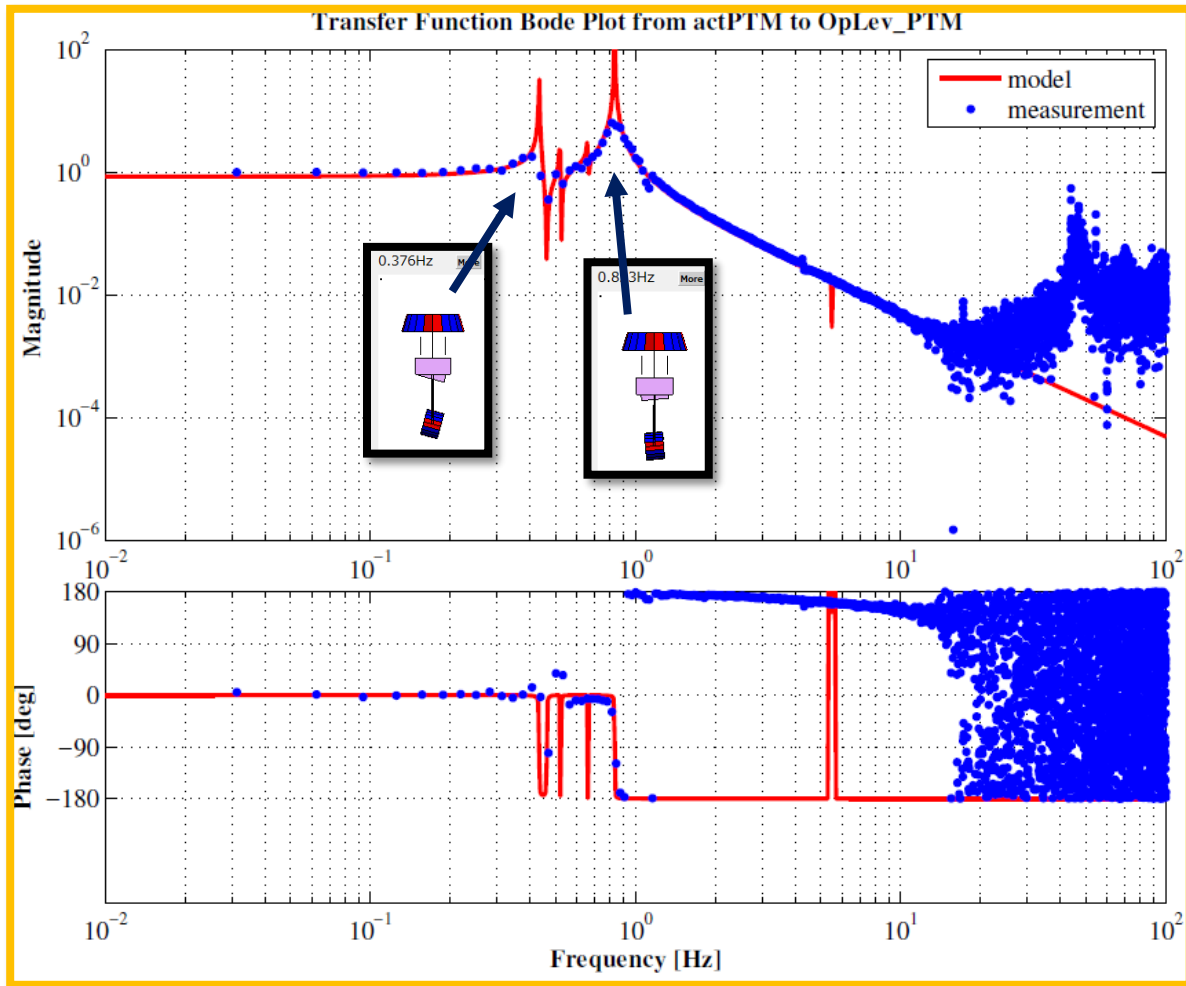




# Investigation of TypeBpp Frequency response

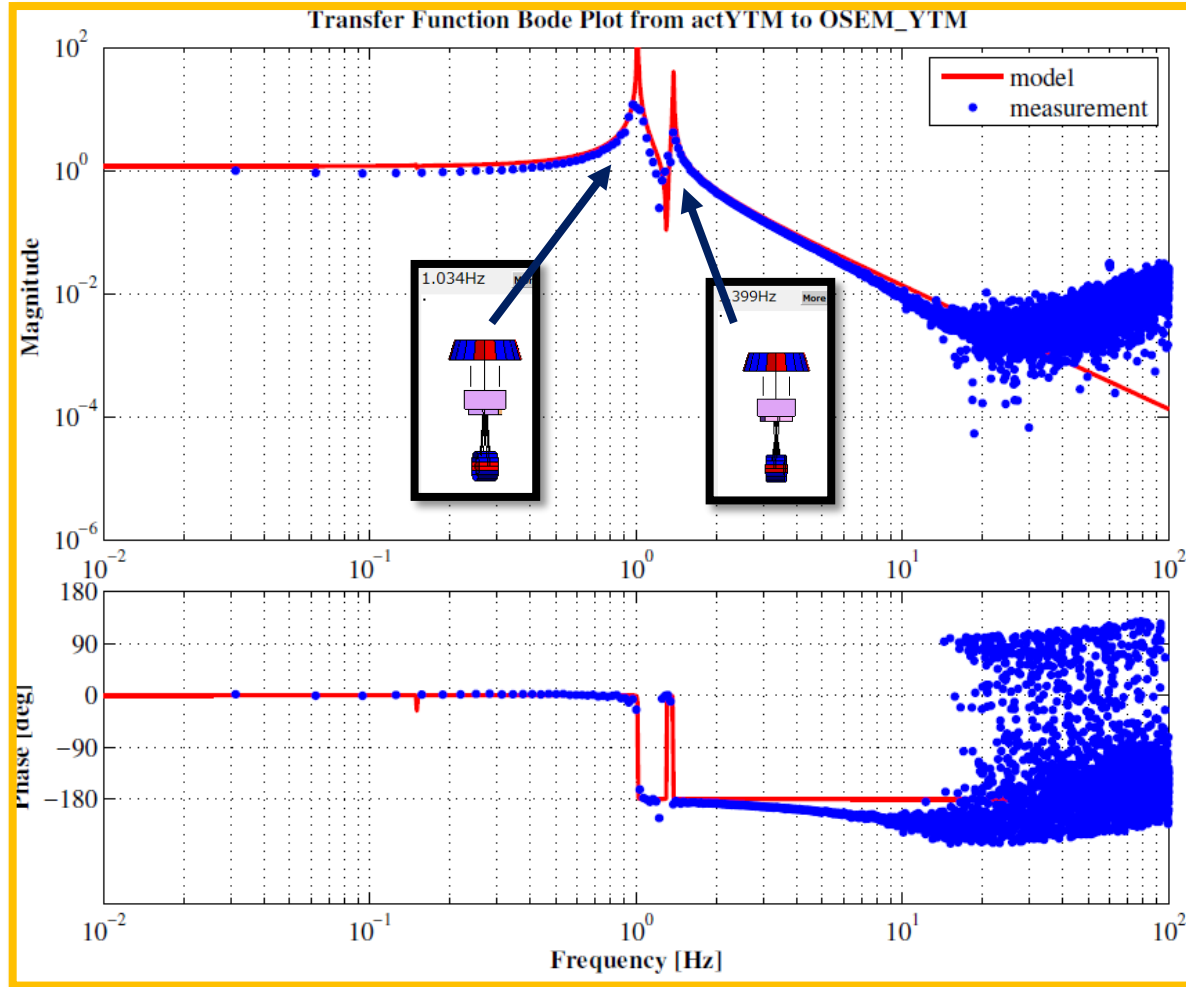
## PTM (Oplev) TF

REF : PTM (Oplev) TF of Type B1

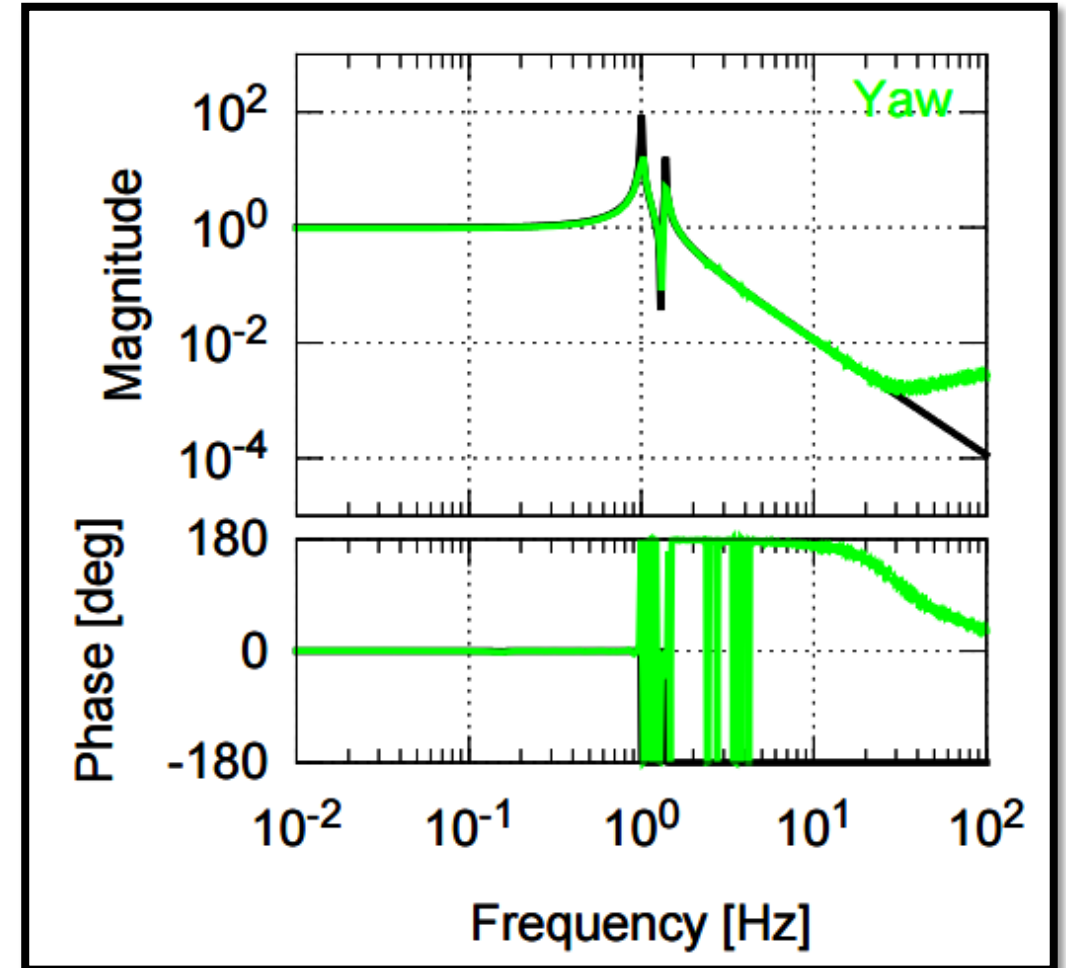


# Investigation of TypeBpp Frequency response

## YTM (OSEM) TF

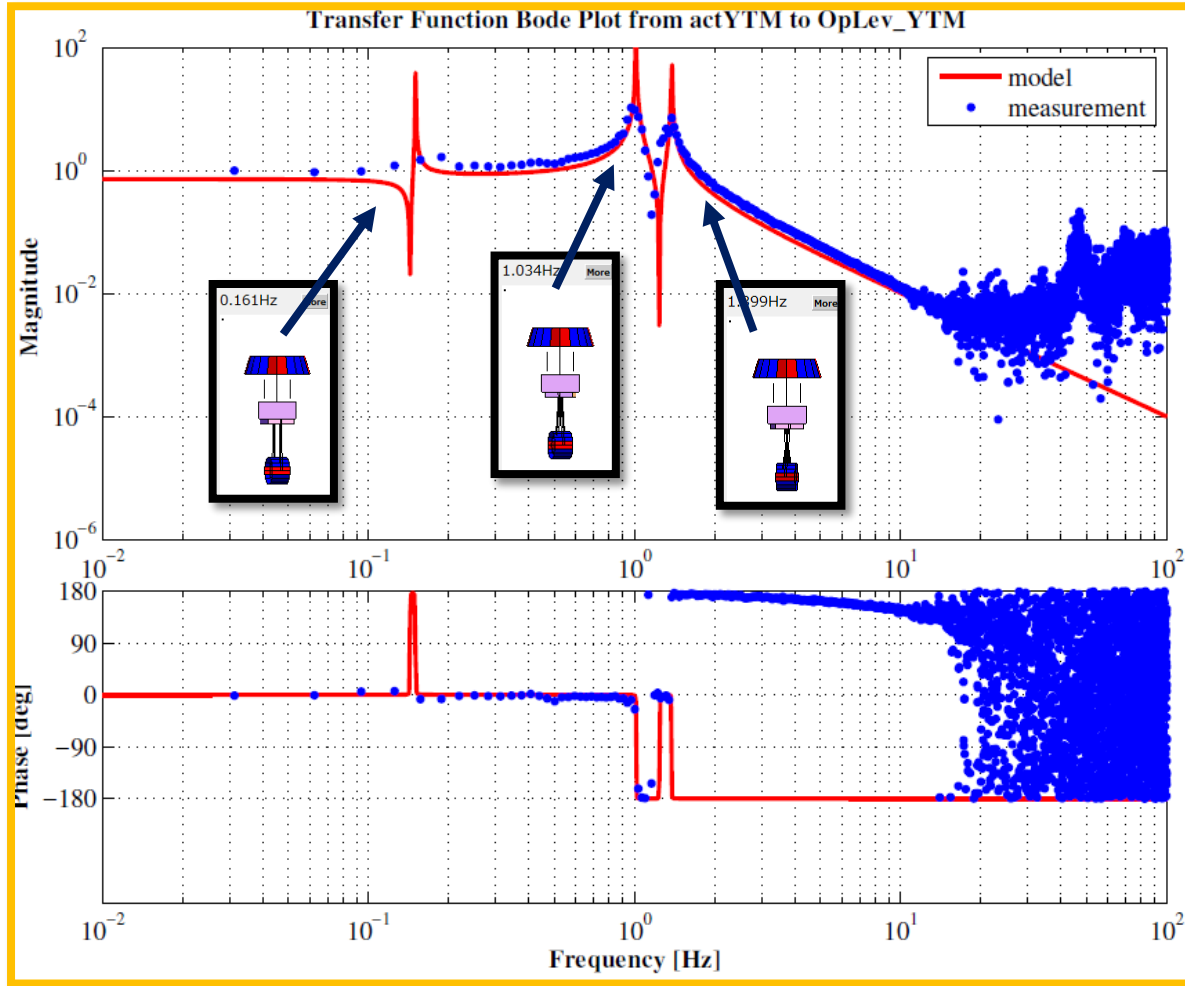


## REF : LTM (OSEM) TF of 20 m SAS

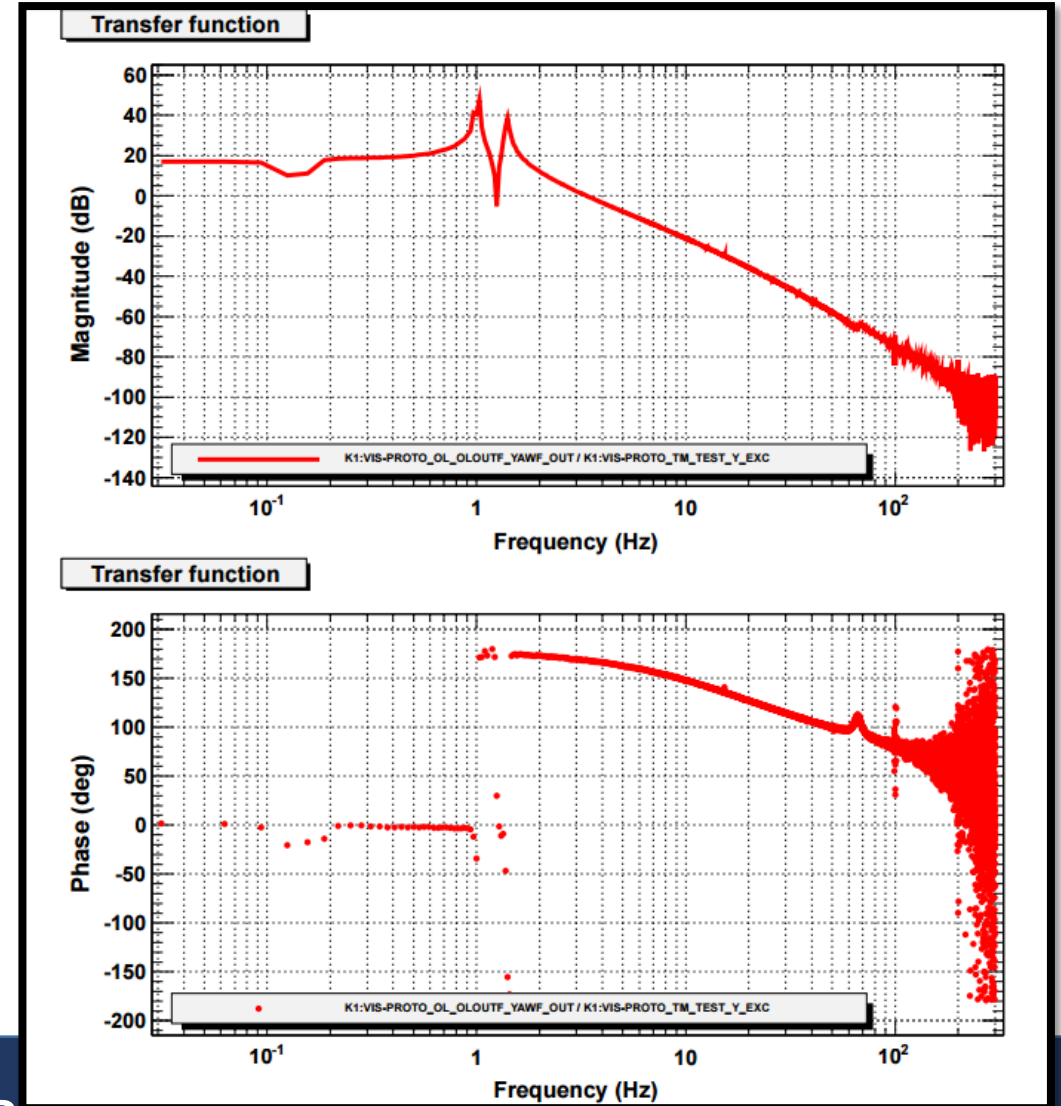


# Investigation of TypeBpp Frequency response

## YTM (Oplev) TF



## REF : YTM (Oplev) TF of Type B1





# Spectra

with No 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.

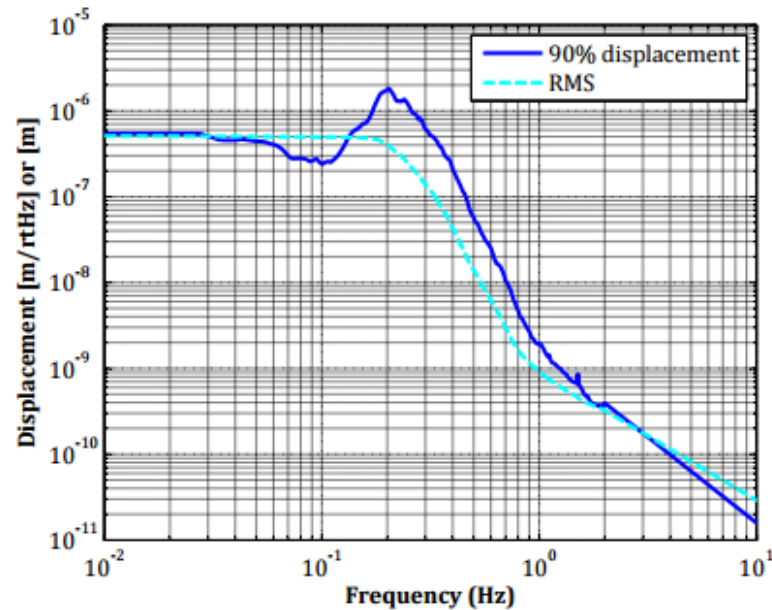


Figure 1: The high-level seismic displacement in Kamioka.

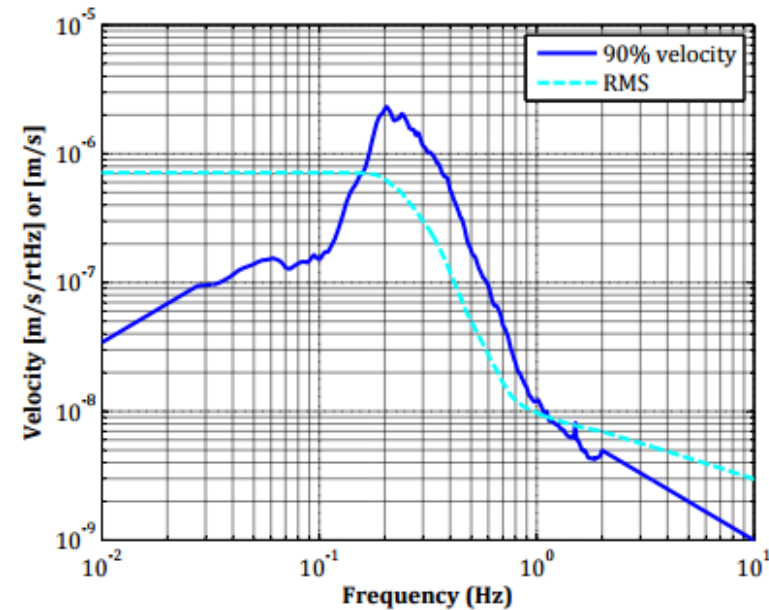
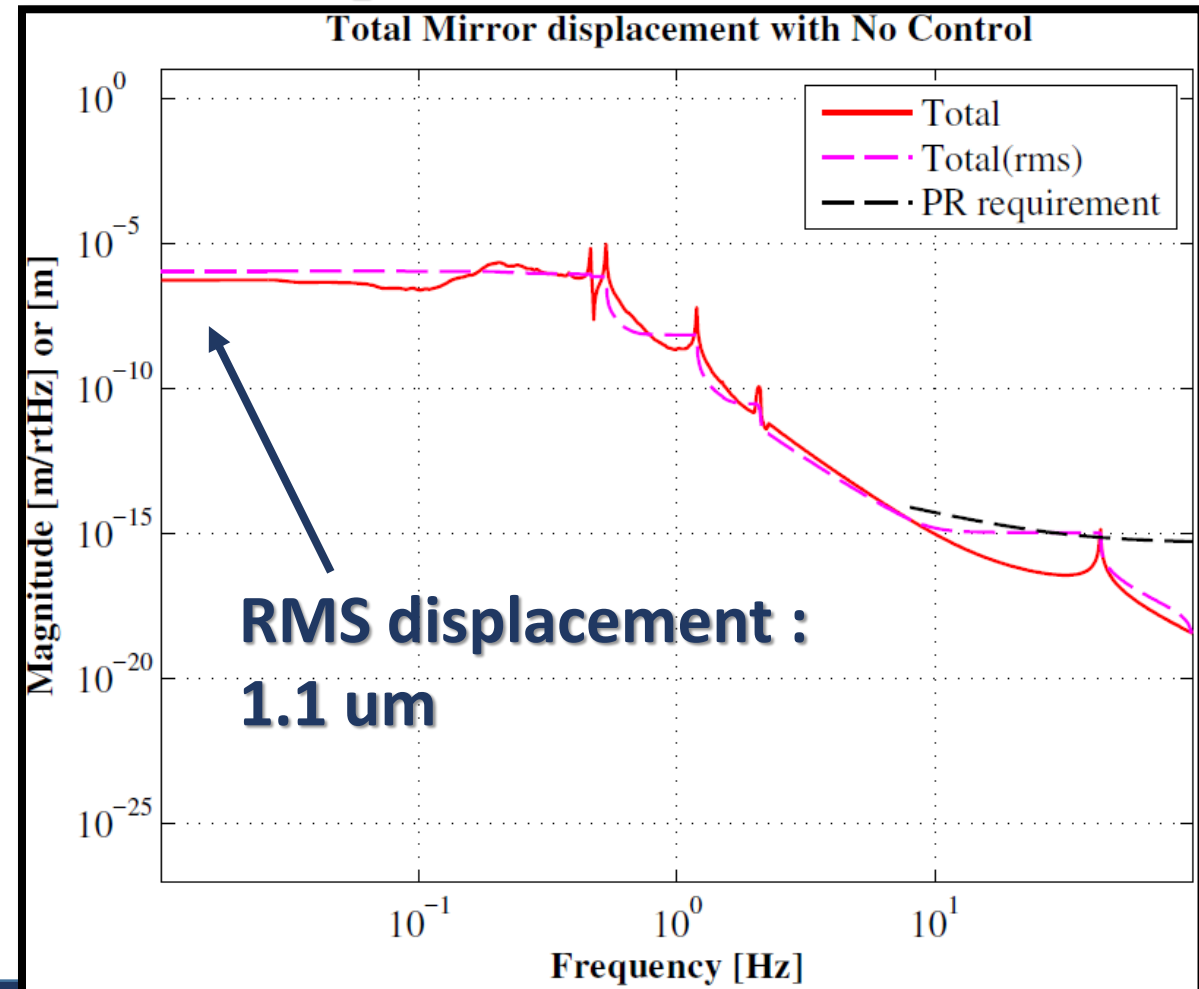
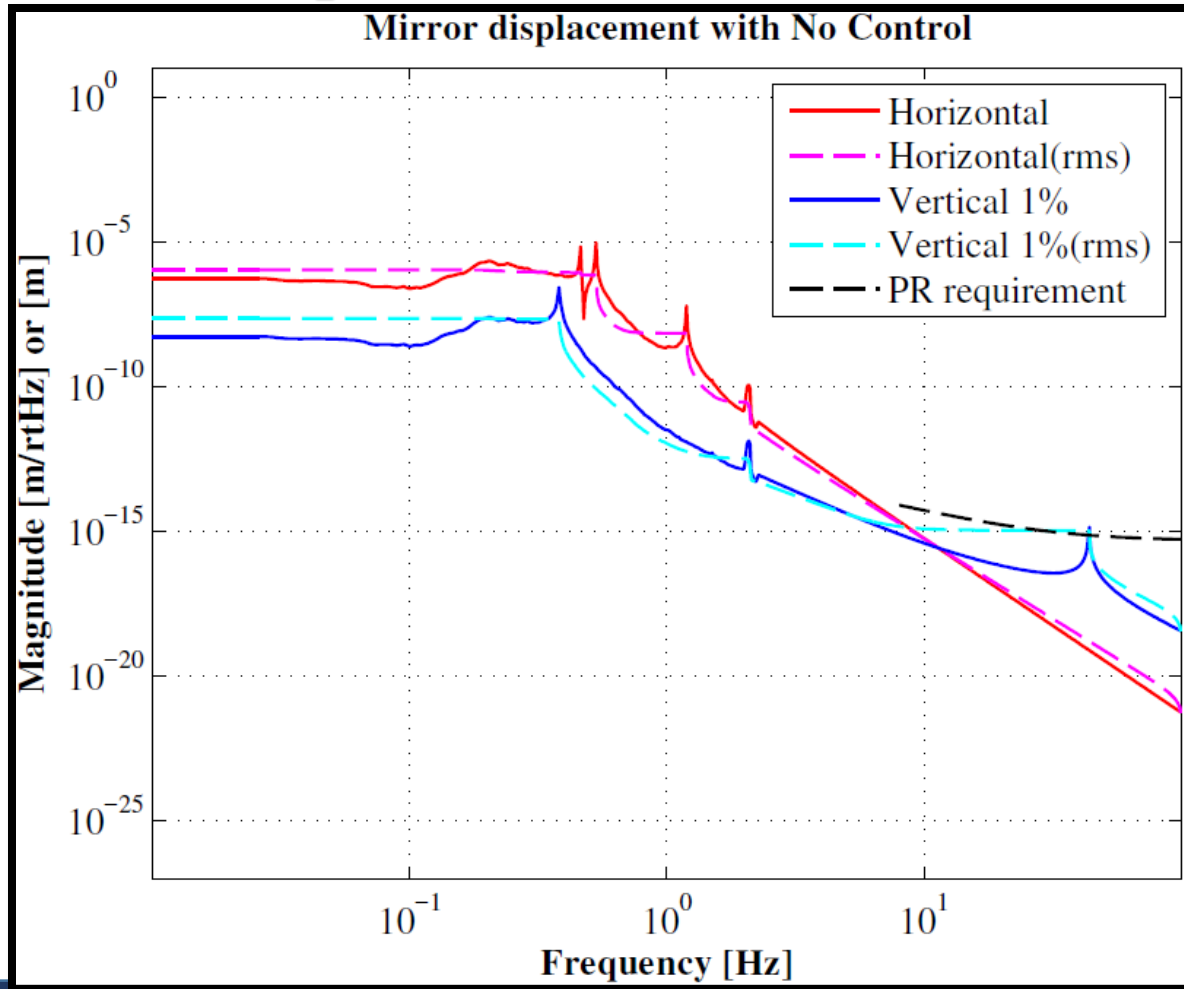


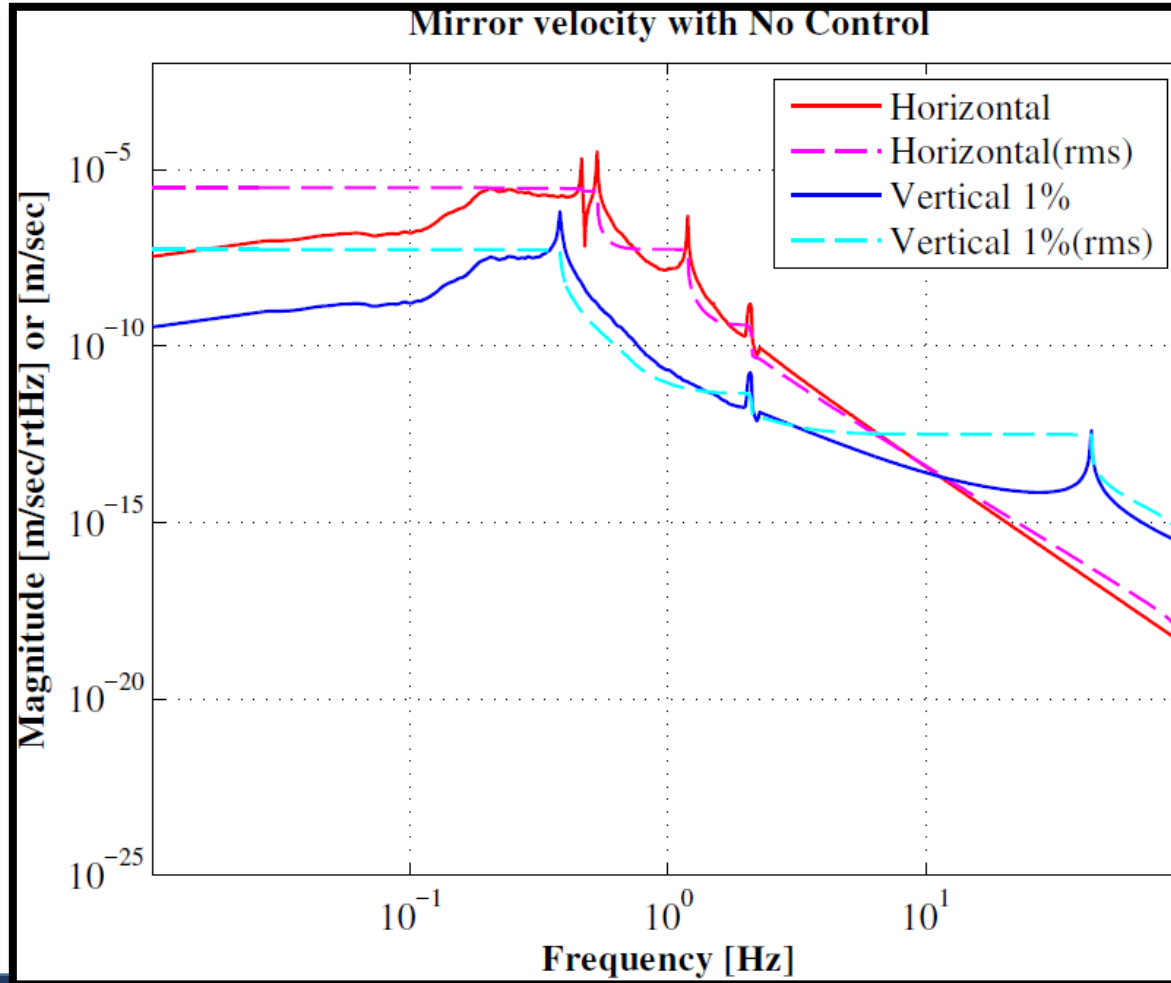
Figure 2: The high-level seismic velocity in Kamioka.

TM displacement : H and V 1%

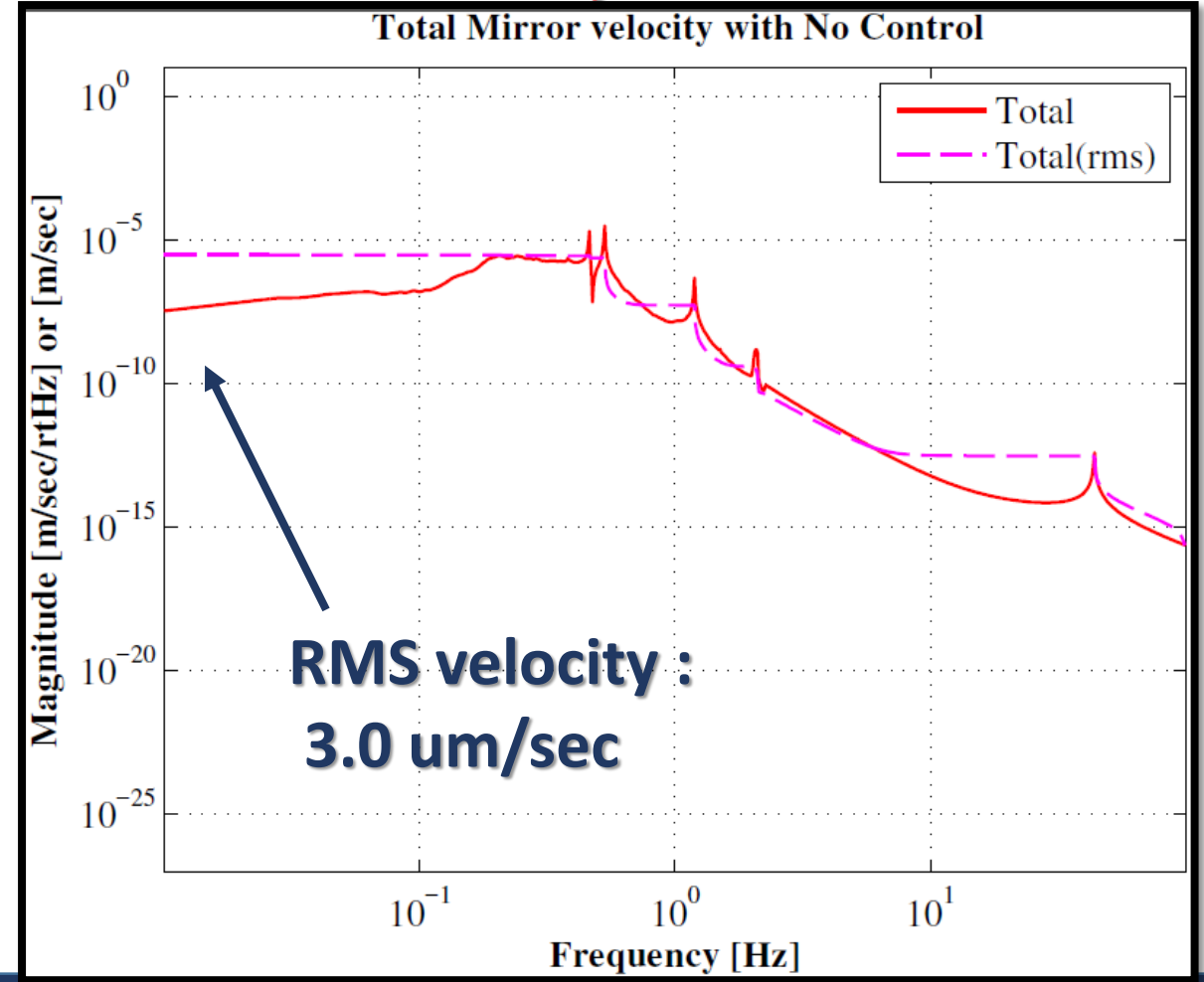
TM displacement : H + V 1%



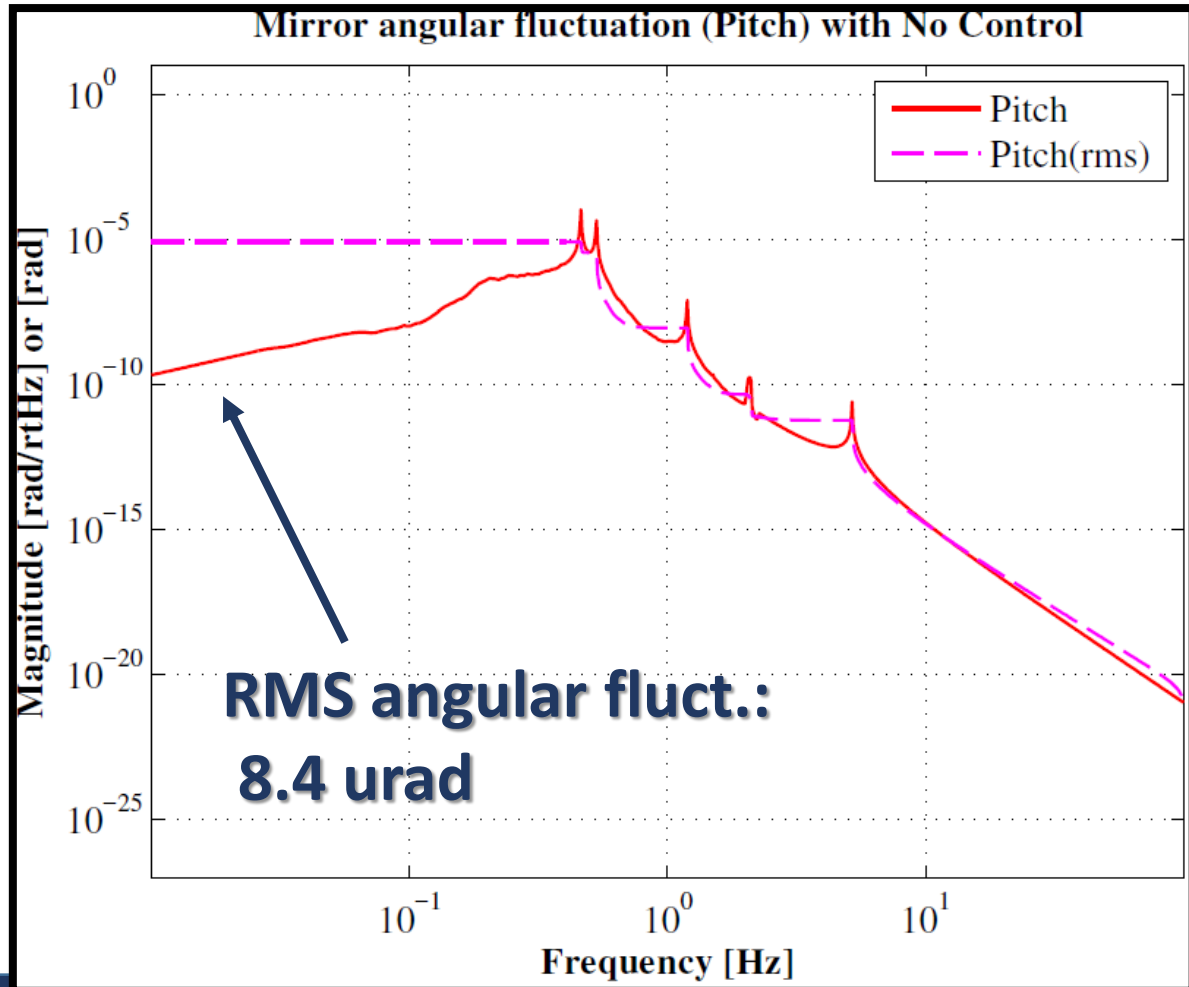
TM velocity : H and V 1%



TM velocity : H + V 1%



TM Angular fluctuation : LGND >> Pitch



# Control Simulation

## Calculated by Simulink tool

