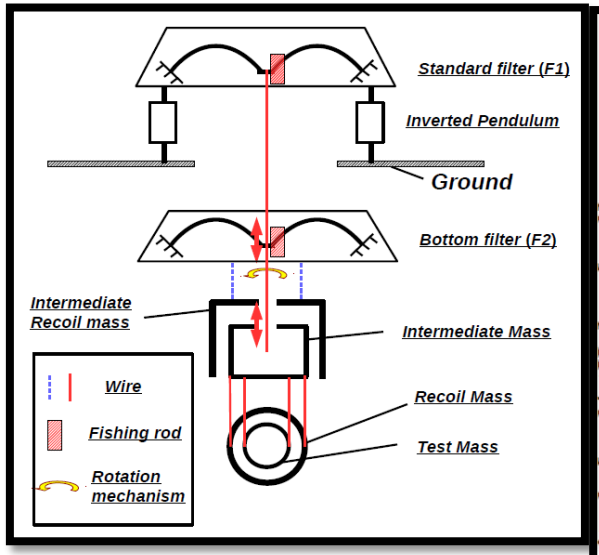
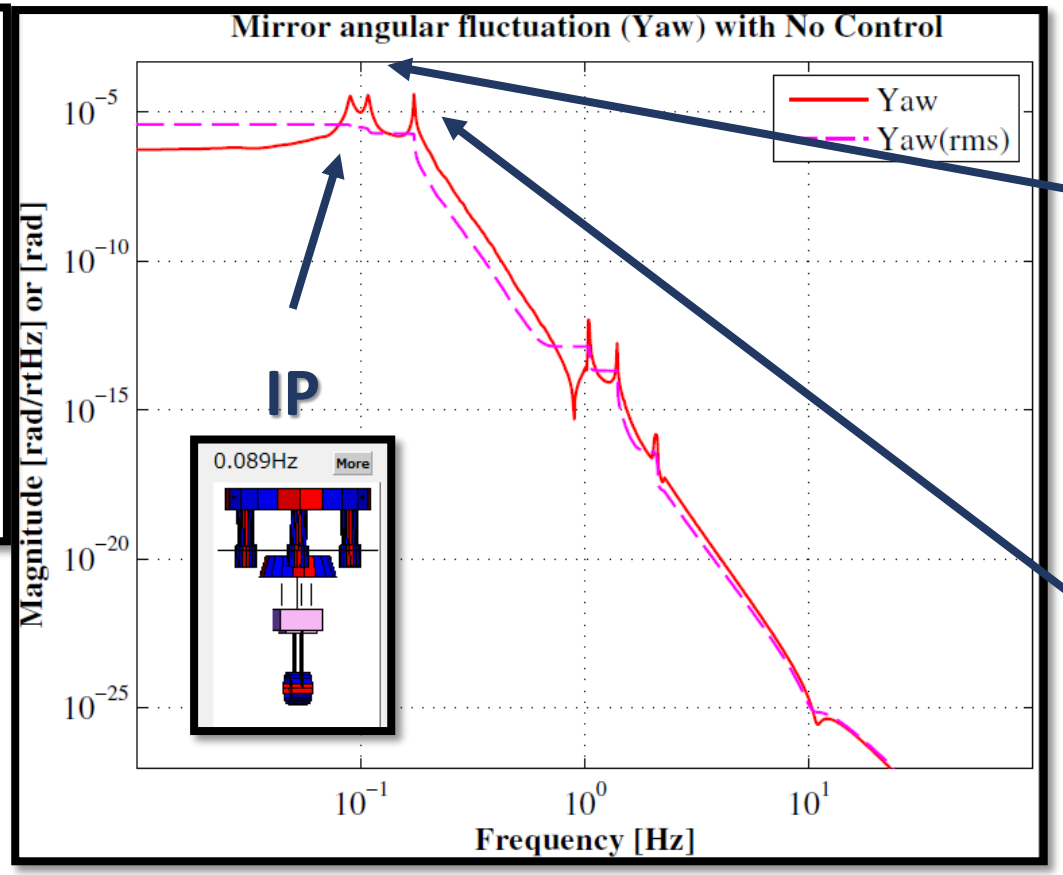
❖ IP Yaw frequency requirement

IPL,T frequency < ~ 0.80 Hz?

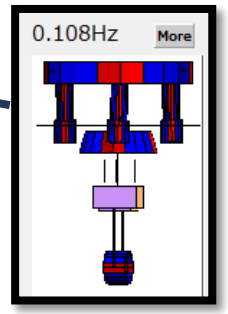
IPyaw frequency < payload frequency (~ 0.15 Hz?)

1) IP Yaw frequency mainly depends on its top, bottom flexure shape.

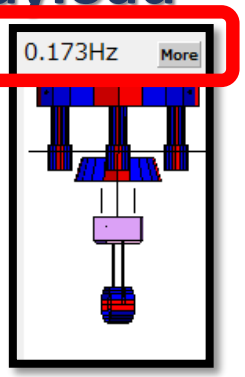




Whole chain

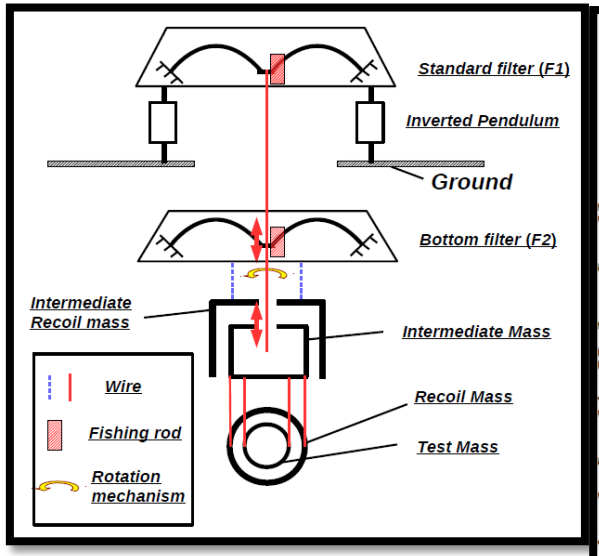


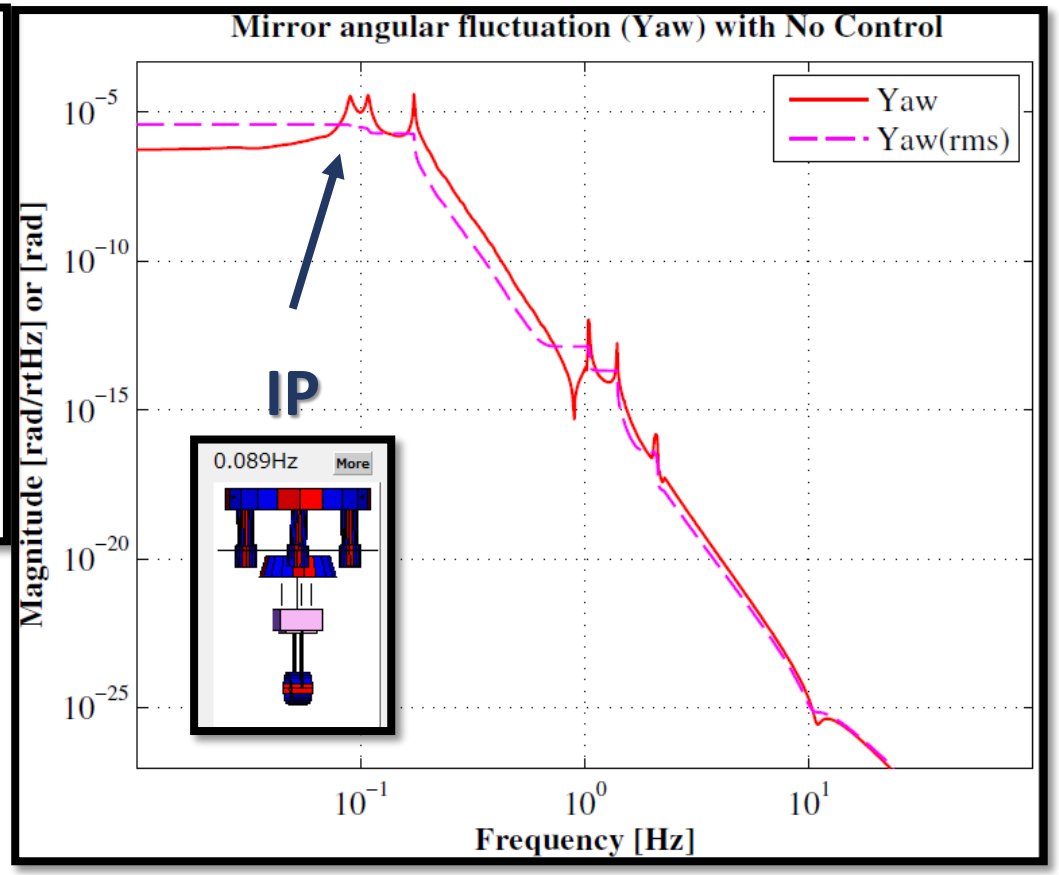
Payload



❖ IP Yaw frequency requirement

NOTE : IP Yaw frequency by SUMCON is different from the formula I told the other day.





IP Yaw frequency by SUMCON

$$\neq \overset{\text{回転}}{k_{\text{eff}}} = \left(\frac{k_\theta}{L^2} - \frac{Mg}{L}\right) r^2 + 3k_t$$

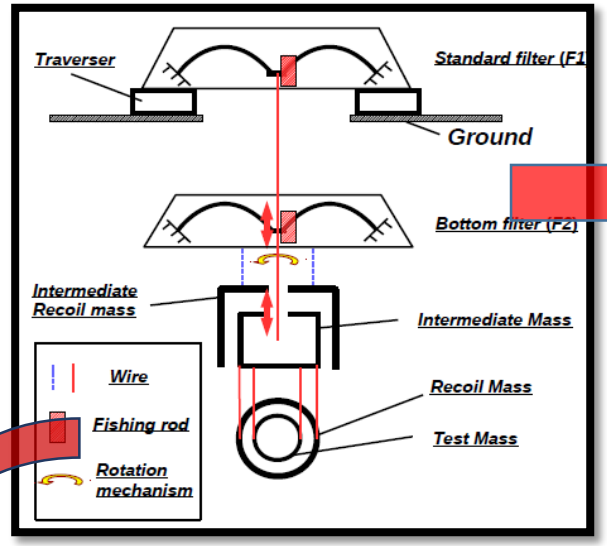
formula I told the other day.

(To be confirmed)

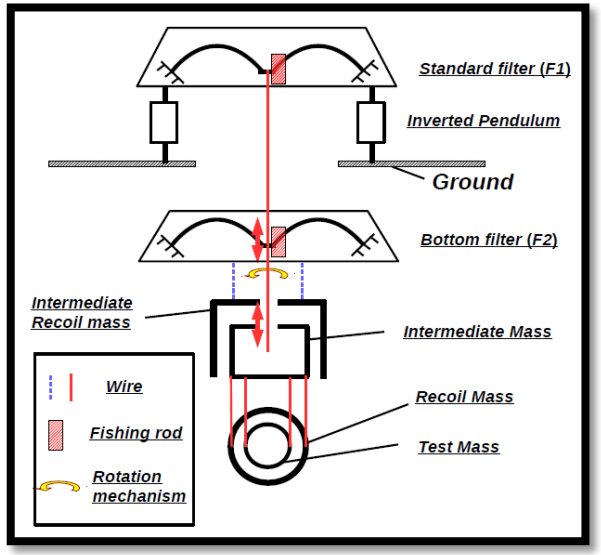
❖ Magnetic damper is needed?

~~Bp + IP needs MD.~~

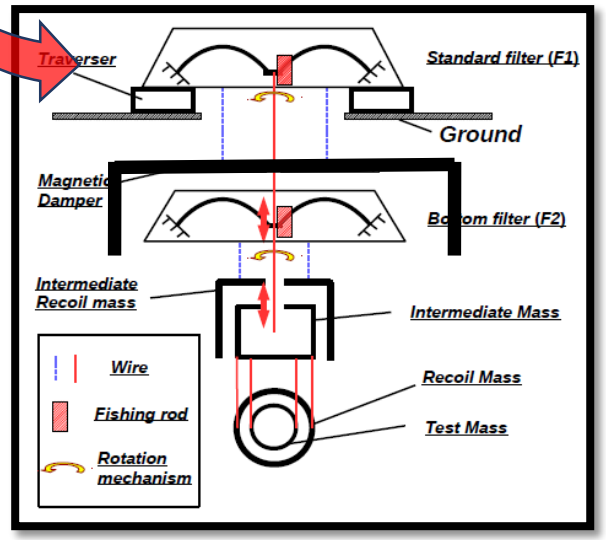
Bp + GAS-OSEM needs No MD.



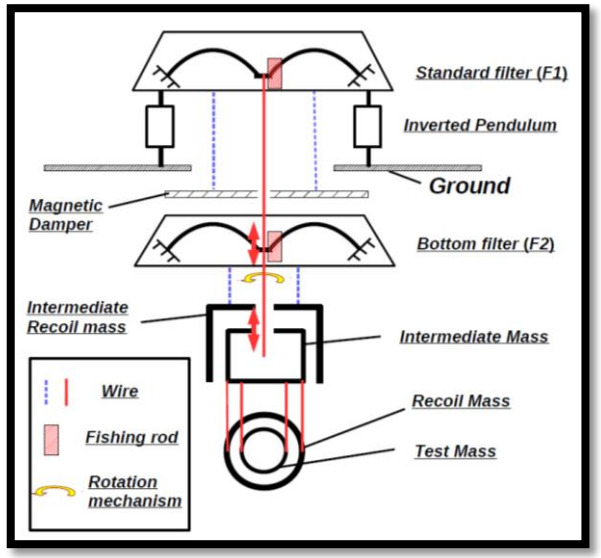
+ IP



+ GAS-RM



+ MD



❖ **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.

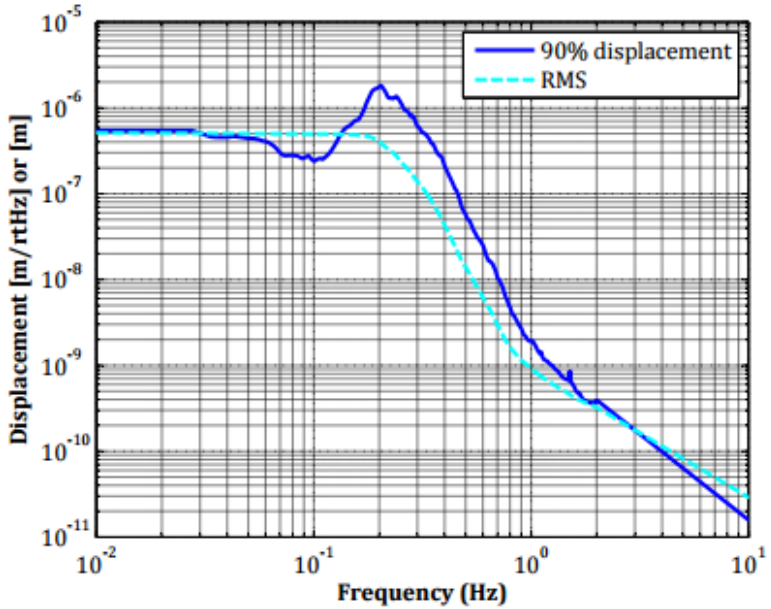


Figure 1: The high-level seismic displacement in Kamioka.

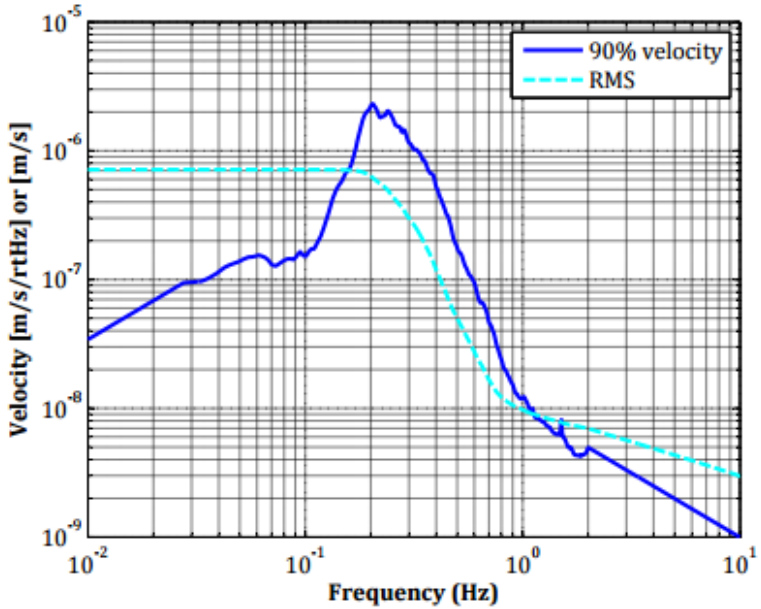
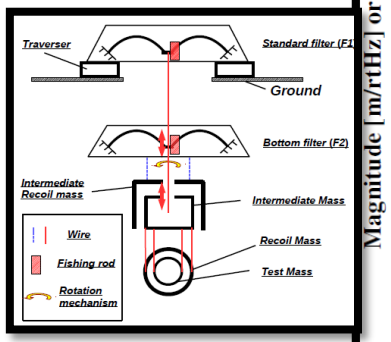
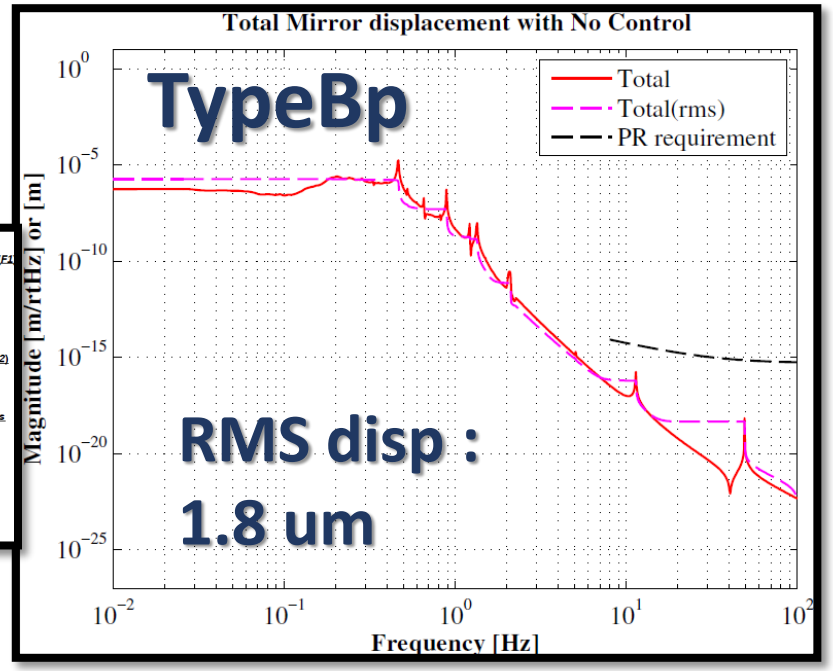
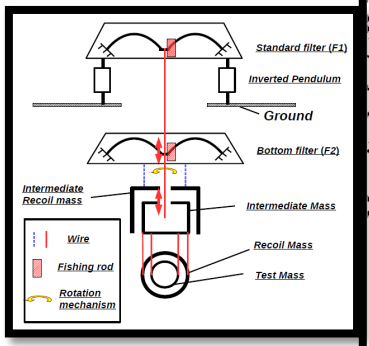


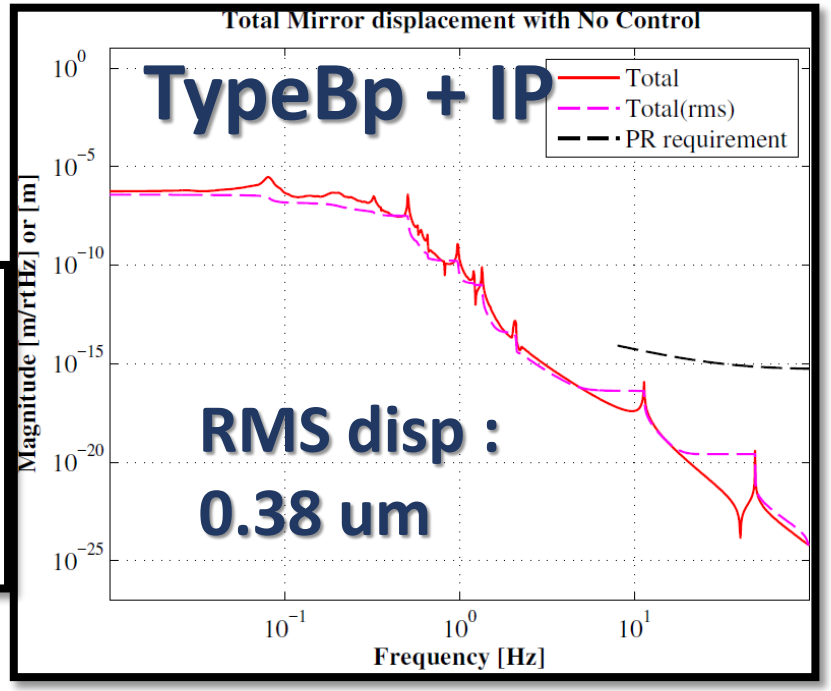
Figure 2: The high-level seismic velocity in Kamioka.

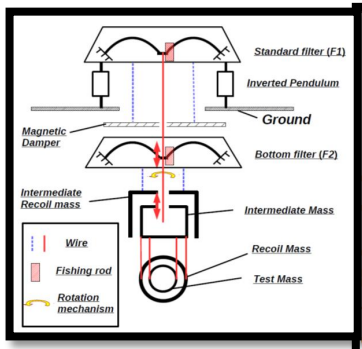
TM displacement without control

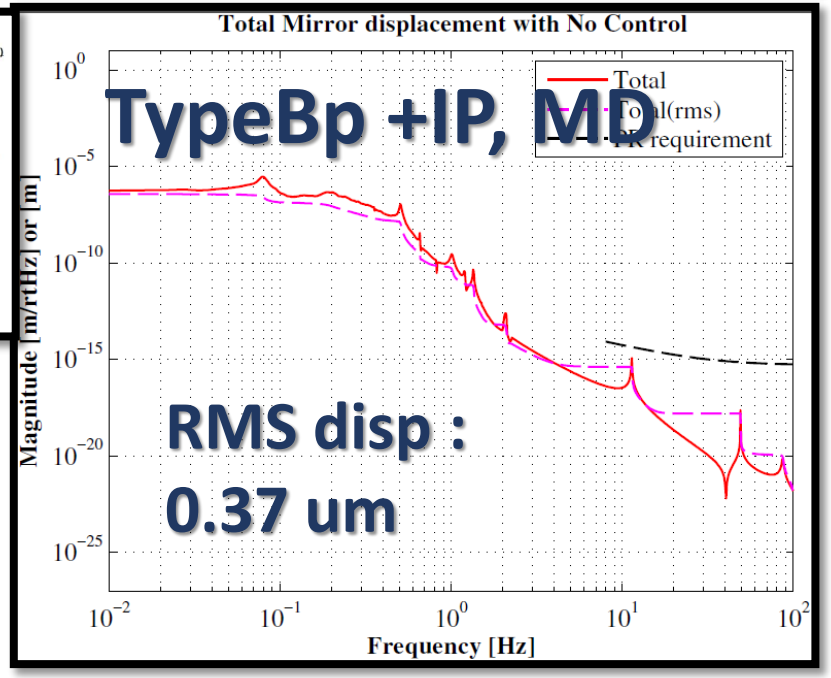






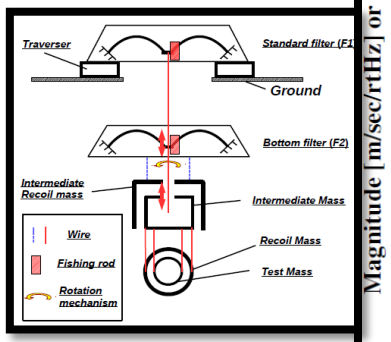


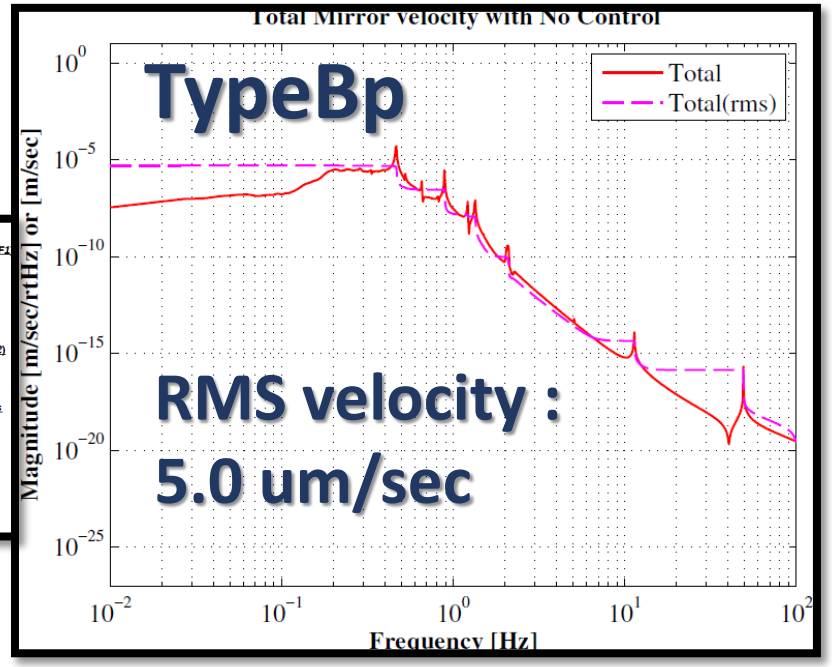


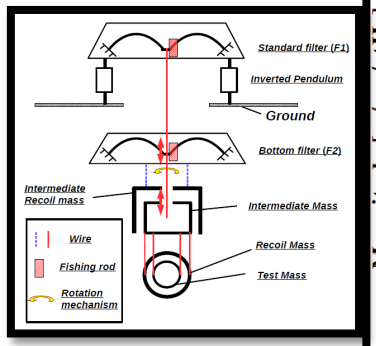


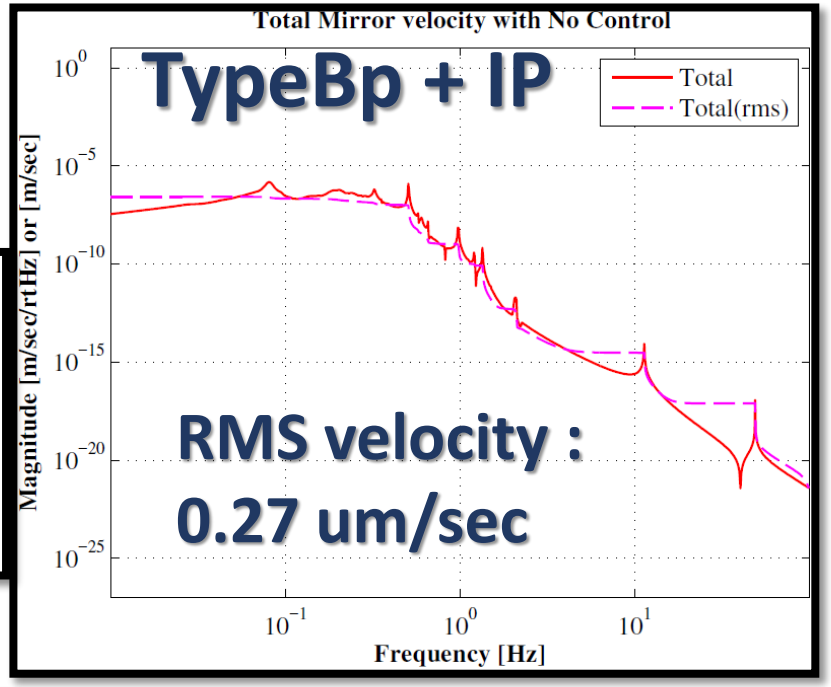
MD doesn't bother the TM displacement

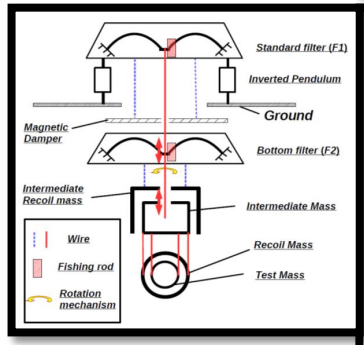
TM velocity without control

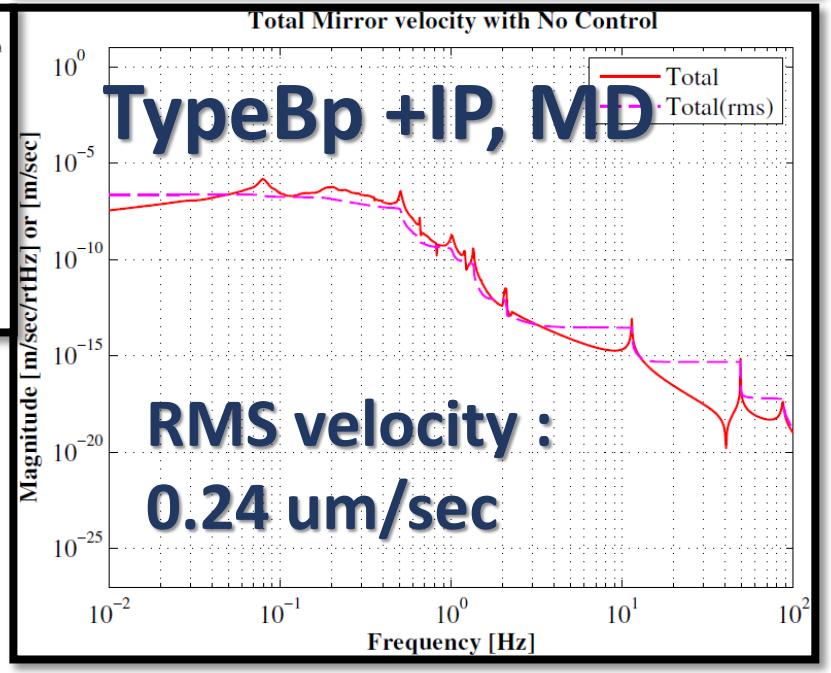






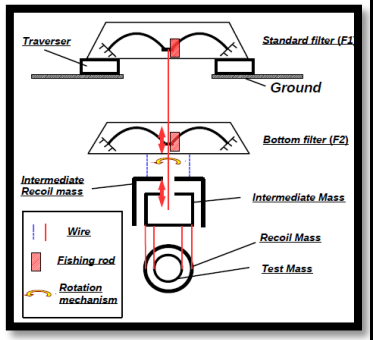


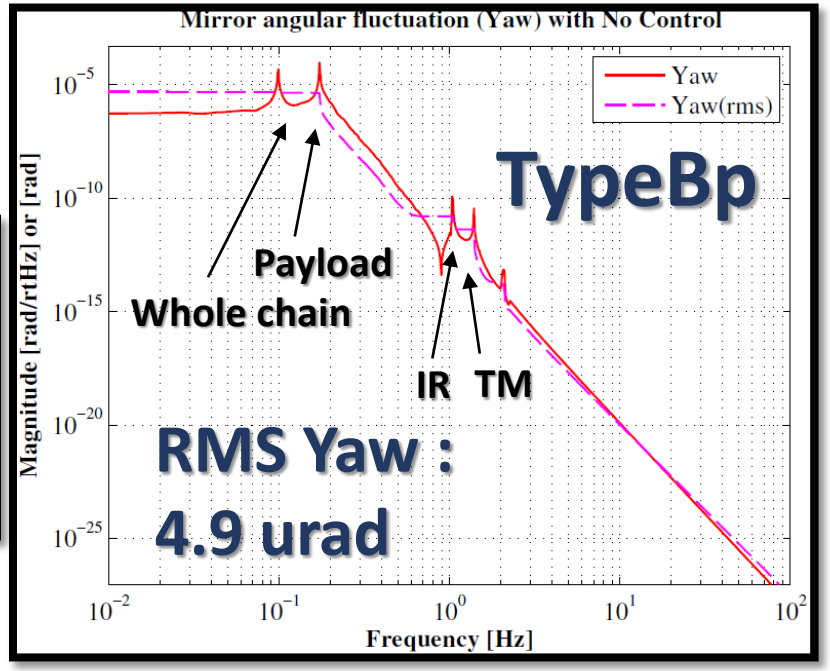


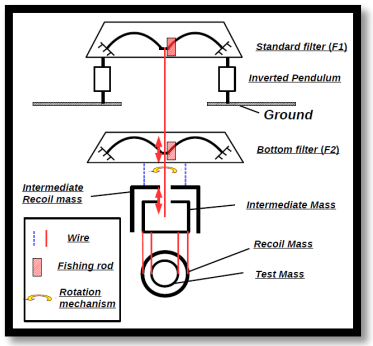


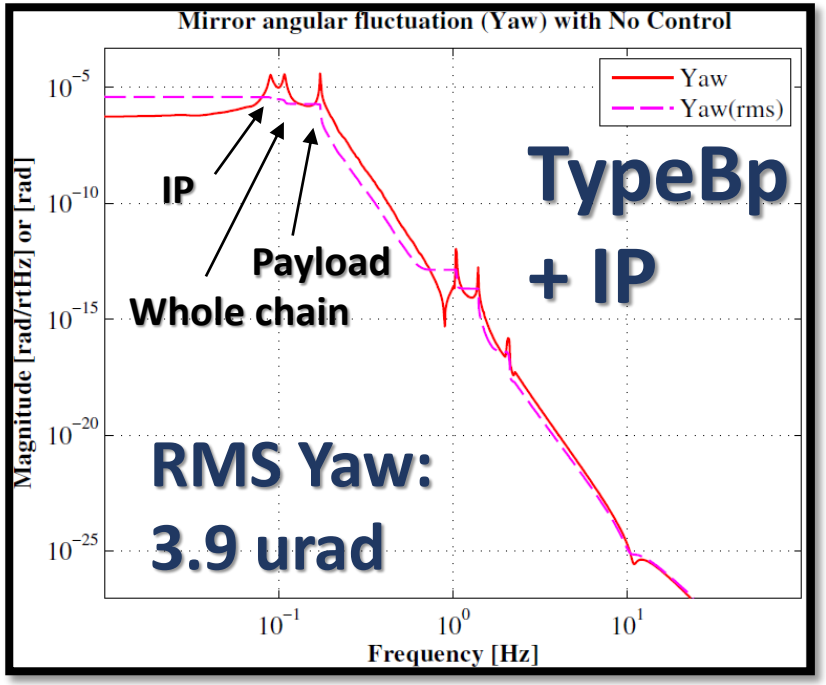
MD doesn't bother the TM velocity.

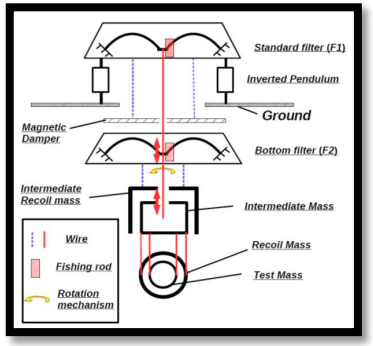
GND->TM Yaw motion without control

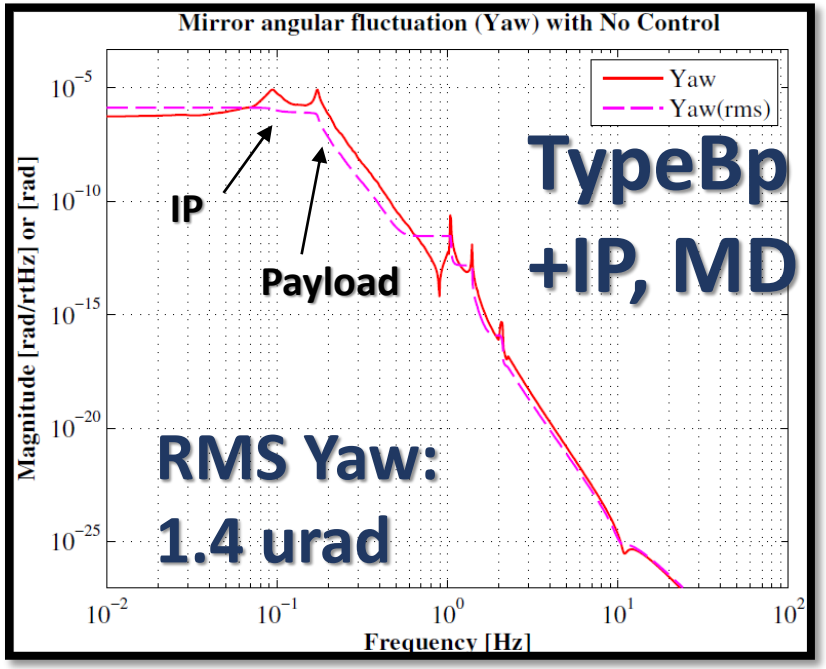




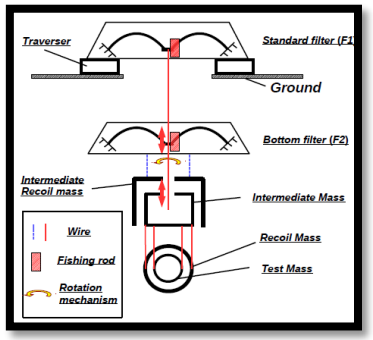


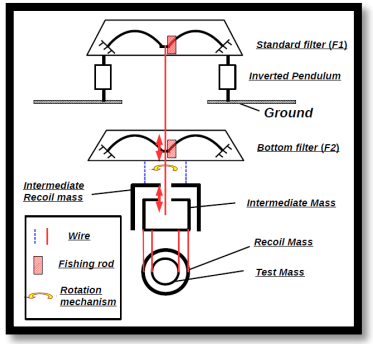


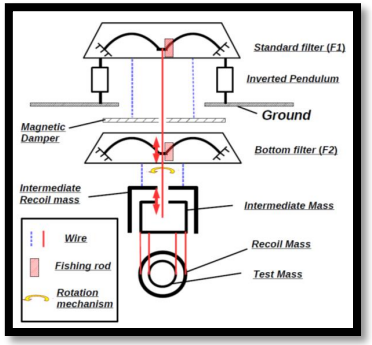


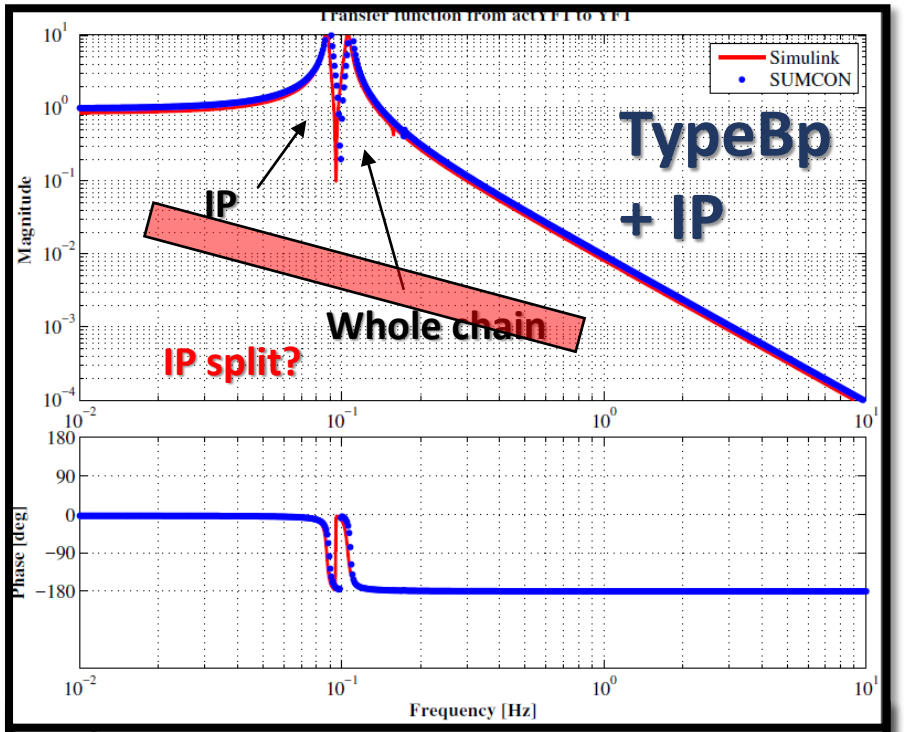


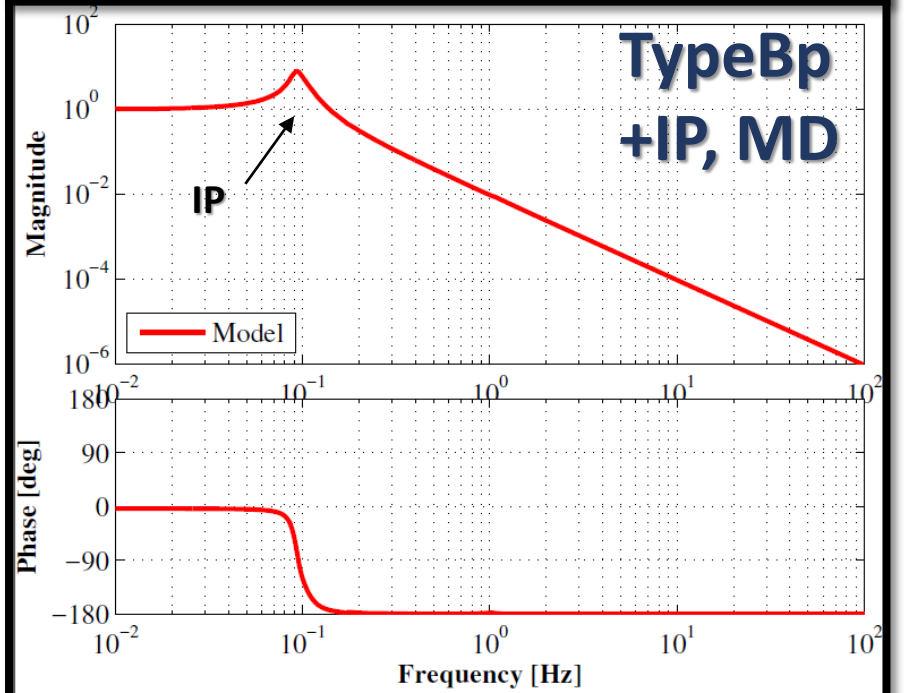
F1 -> F1 Yaw Transfer function without control











In principle,
We can damp all the Yaw motion
with using IP, IR/IM OSEMs.
>> there is no need to use MD for Bp+IP for damping

❖ Magnetic damper is needed?

1) After the SAS calms down, IP or GAS-OSEM can damp the Yaw resonances.
2) However,,

Torsion Mode Damping

From Tseki M thesis

6.1 Overview

In order to attenuate the vertical seismic motions of the mirrors, cascades of GAS filters are employed on the vibration isolation systems of LCGT. Each GAS filter is suspended by a single wire, to achieve seismic attenuation in the three rotational DoFs. Due to the softness of the wire in its torsional movement and the large moment of inertia of the filter around the vertical axis, the yaw modes of the attenuation chain have quite low (in the order of 10 mHz) resonant frequencies, and therefore the yaw motions of the filters are isolated well.

However, since these modes have long decay time due to their high quality factors ($\gtrsim 100$), the filters will keep oscillating once these modes are excited. It was observes that the oscillation amplitude of the mirror rotation angle grows easily to levels of milli-radians by the actions of earthquakes or the accidentally wrong controlling forces. This large mirror motion utterly exceeds the range of the mirror actuators and thus disturbs the interferometer operation for a long time. In TAMA-SAS, which also utilizes single-wire suspensions, it took several hours to resume the interferometer lock, without any damping mechanism for the torsion modes. During this time we cannot run the observation of gravitational waves, and thus the duty time of the detector decreases. The damping mechanism for the torsion modes is indispensable for the continuous observation of gravitational waves.

アクチュエータのレンジを超えていなければOK.

If so,
We should have
Magnetic damper
in Bp + IP

But, we have to make another modification to implement MD.

❖ Conclusion

IP Yaw frequency requirement

* IP L,T frequency < 80 mHz
* IP Y frequency < 150 mHz

(Note : The formula is different from the one that I told the other day.
To be confirmed.)

MD for Bp + IP

* If the resonance frequency of the whole chain yaw motion can be set same to the one IP yaw motion -> MD is not needed.
* If else, MD is needed.

Resonance frequency Tuning
vs.
magnetic damper modification