

# 04に向けたKAGRA防振系の改良 II

高橋竜太郎（国立天文台）、KAGRA collaboration

日本物理学会第76回年次大会  
オンライン



# Outline

1. Vibration isolation system in KAGRA
2. Repair plan
3. Upgrade plan
4. Schedule
5. Summary

# Vibration isolation system in KAGRA

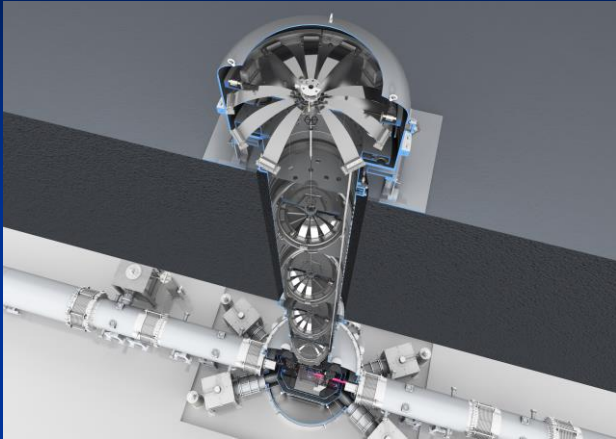
Type-A

Type-A: for cryogenic mirrors

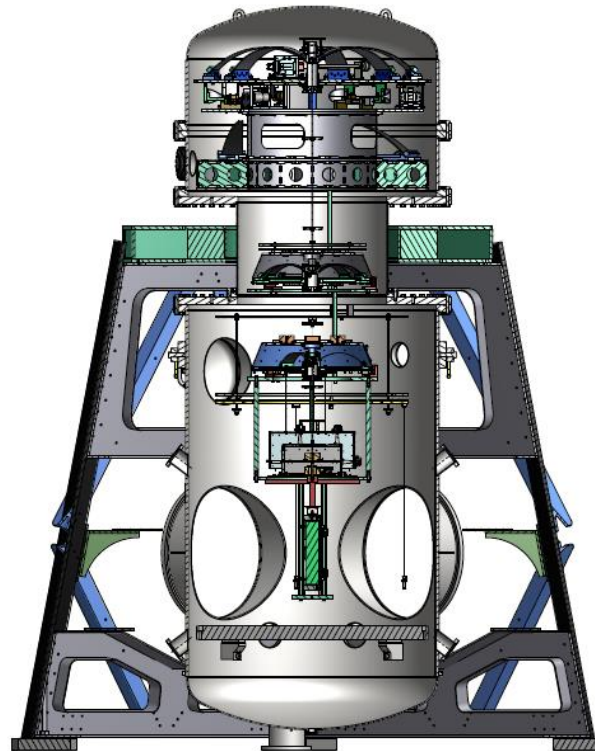
Type-B: for room temperature mirrors

Type-Bp: simpler Type-B

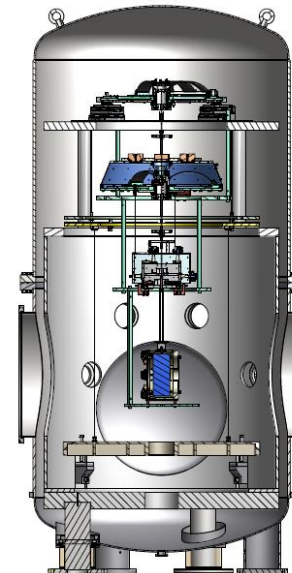
Type-C: for small optics



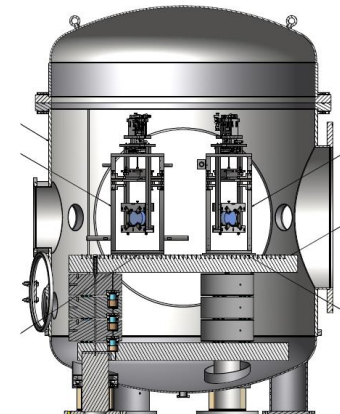
Type-B



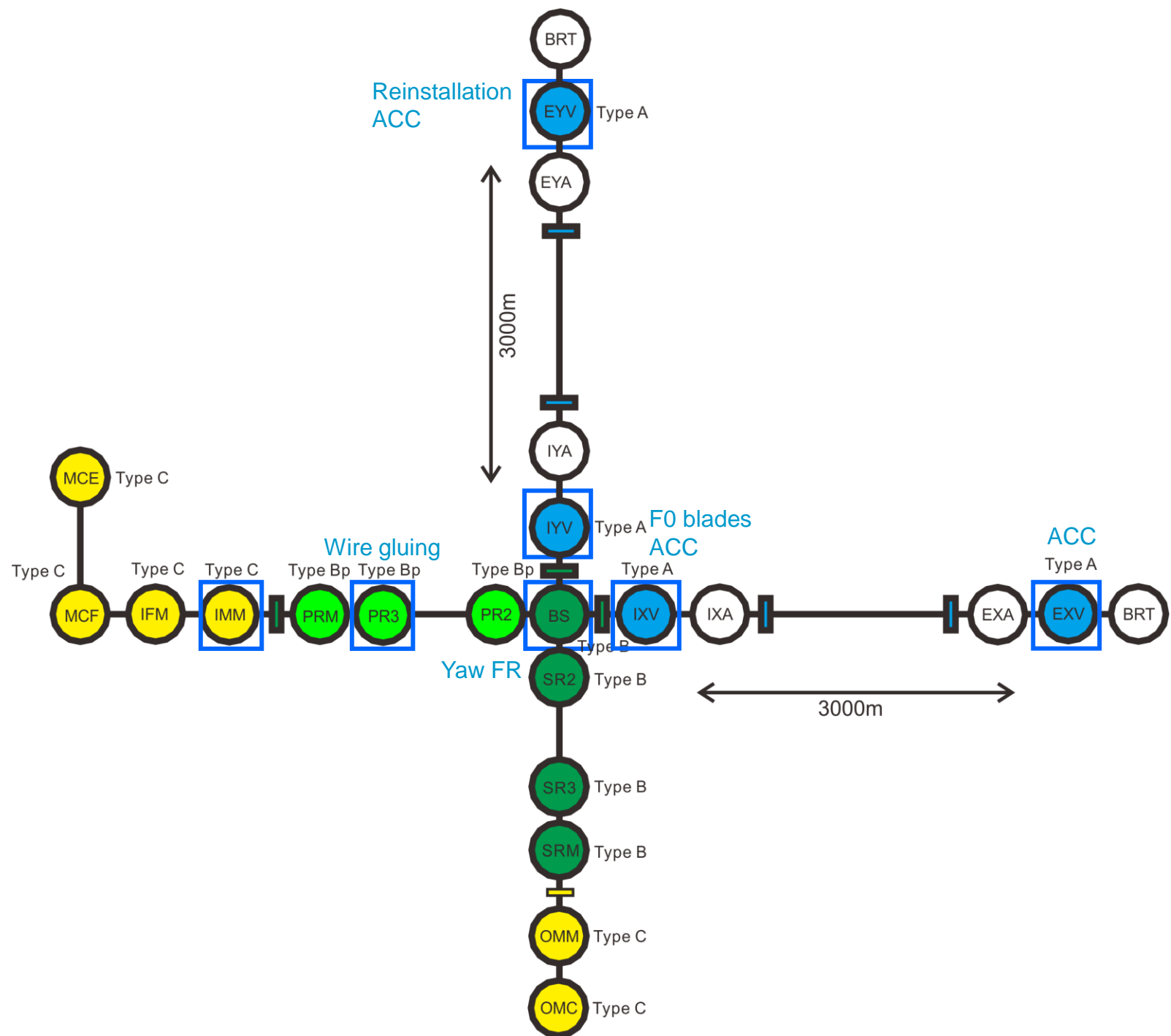
Type-Bp



Type-C



Type-A  
Type-B  
Type-Bp  
Type-C



## 2. Repair plan

### EYV

- The F1-F3 were not working in O3. Replacement of the blades for fishing rod (FR) and **reinstallation** of Type-A tower is on going.

### IXV/IYV

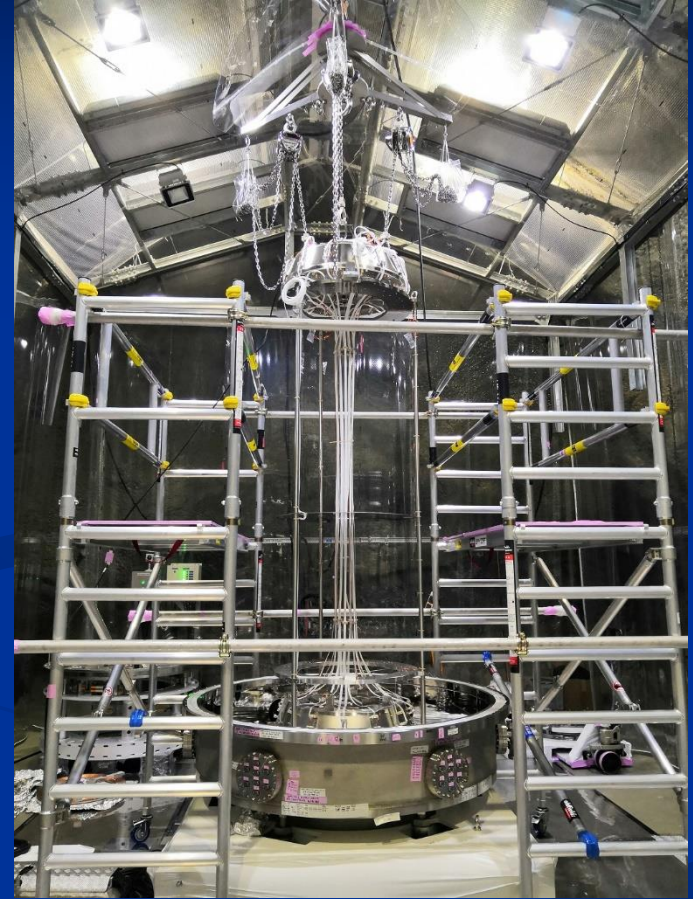
- The F0 overloaded and the keystones were fixed in O3. Replacement of three (of six) GAS blades are on going.

### PR3

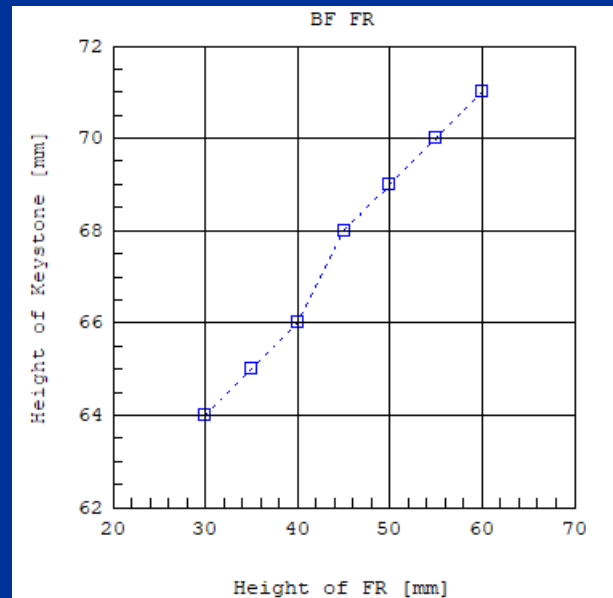
- The suspension wire was glued to avoid the TM jump.

# Reinstallation of Type-A tower in EYV

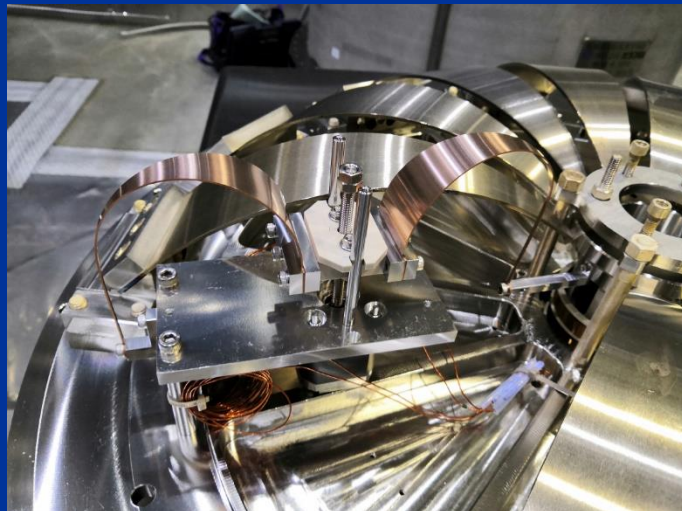
- The FR blades are replaced to expand the adjustable range of keystones.
- Three-step tuning of GAS filter is necessary: without cup, with cup, hung with cup.
- Installation of the F2 stage was finished.



Hung F3 for tuning



Range of FR for BF



Fishing rod mechanism

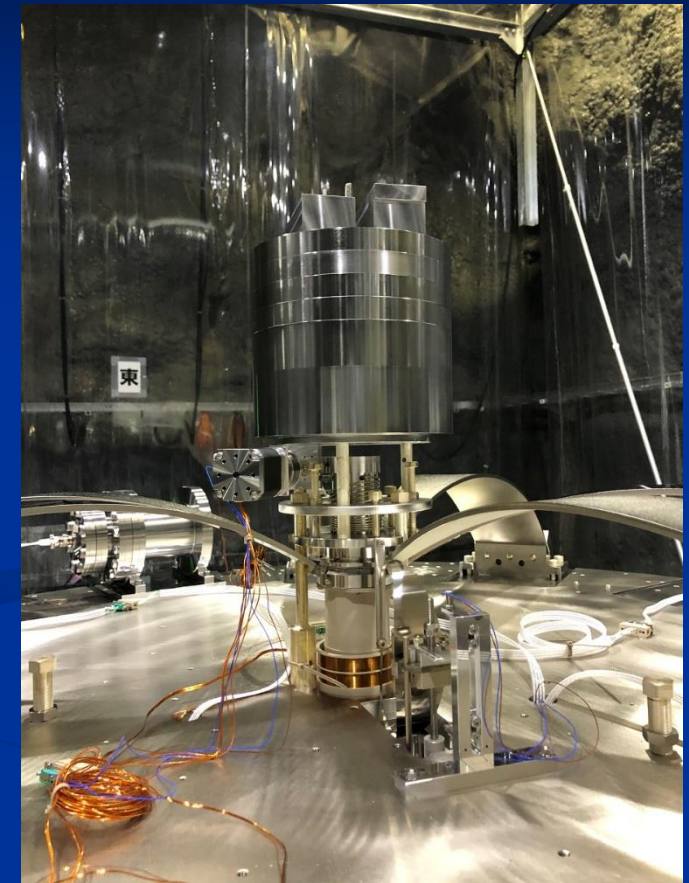
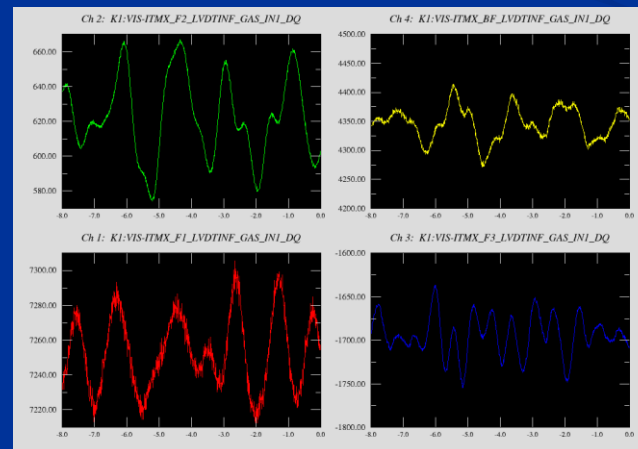


# Replacement of F0 blades in IXV

- Three (of six) blades (for 297kg) were replaced to original three blades (for 347kg) to avoid overload.
- About 50-kg additional load is necessary.
- The cryo-payload has been already connected to the BF. The load for filter chain was tuned.



Blade bending for replacement



Ballast masses on the F0

Free running signals in F1-BF

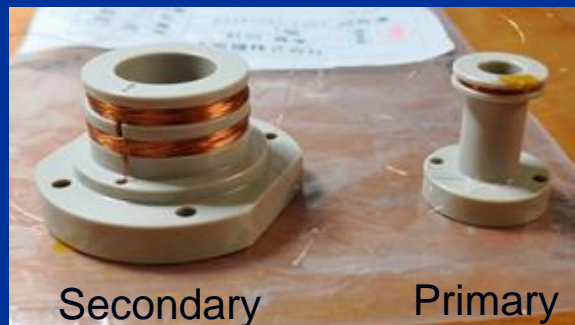
### 3. Upgrade plan

- Improvement of the inertial sensors for IP control in Type-A.
- Installation of the limit switches for FR in Type-A/B.
- Installation of the yaw FR in BS.
- Installation of the thermal control for GAS filters.

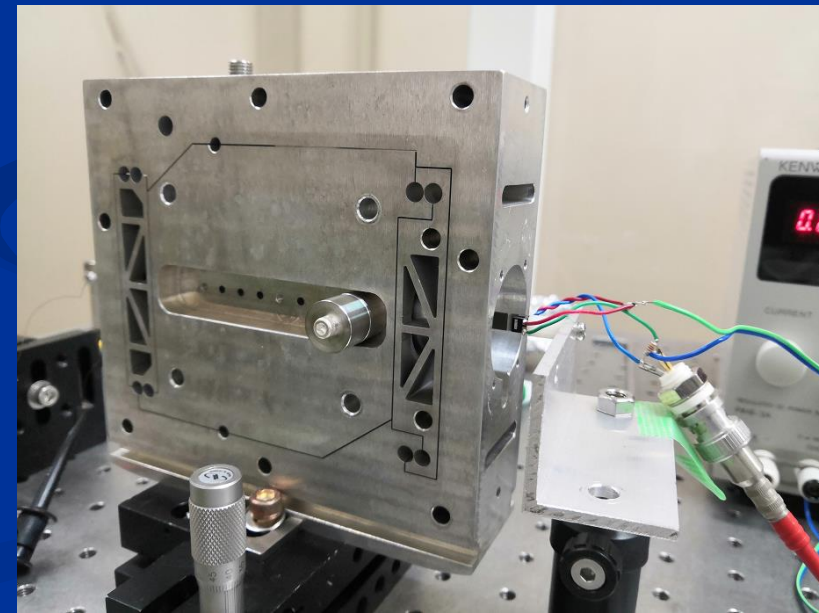


# Improvement of inertial sensors for IP control

- The servo type accelerometers (IXV, IYV) and the commercial geophones (EXV, EYV) were used as inertial sensors in Type-A towers.
- The sensitivity of present inertial sensors were not good enough to control the IPs around 0.1Hz.
- We replace the present inertial sensors to better accelerometers.
  1. Replace the position sensors.
  2. Tune the folded pendulum (FP) from 0.4Hz to 0.2Hz.



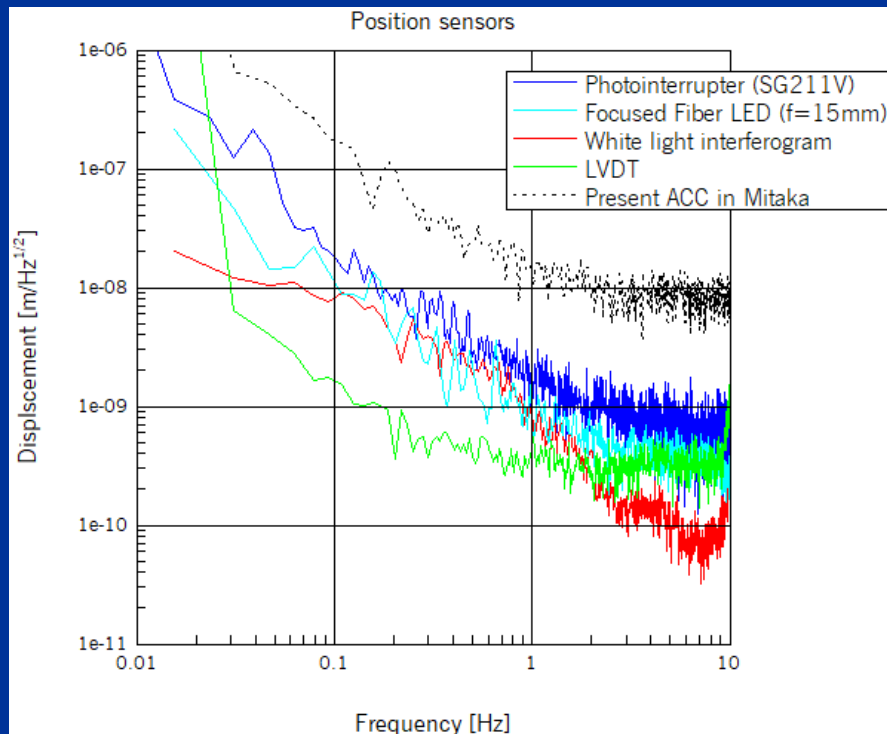
LVDT coils for ACC



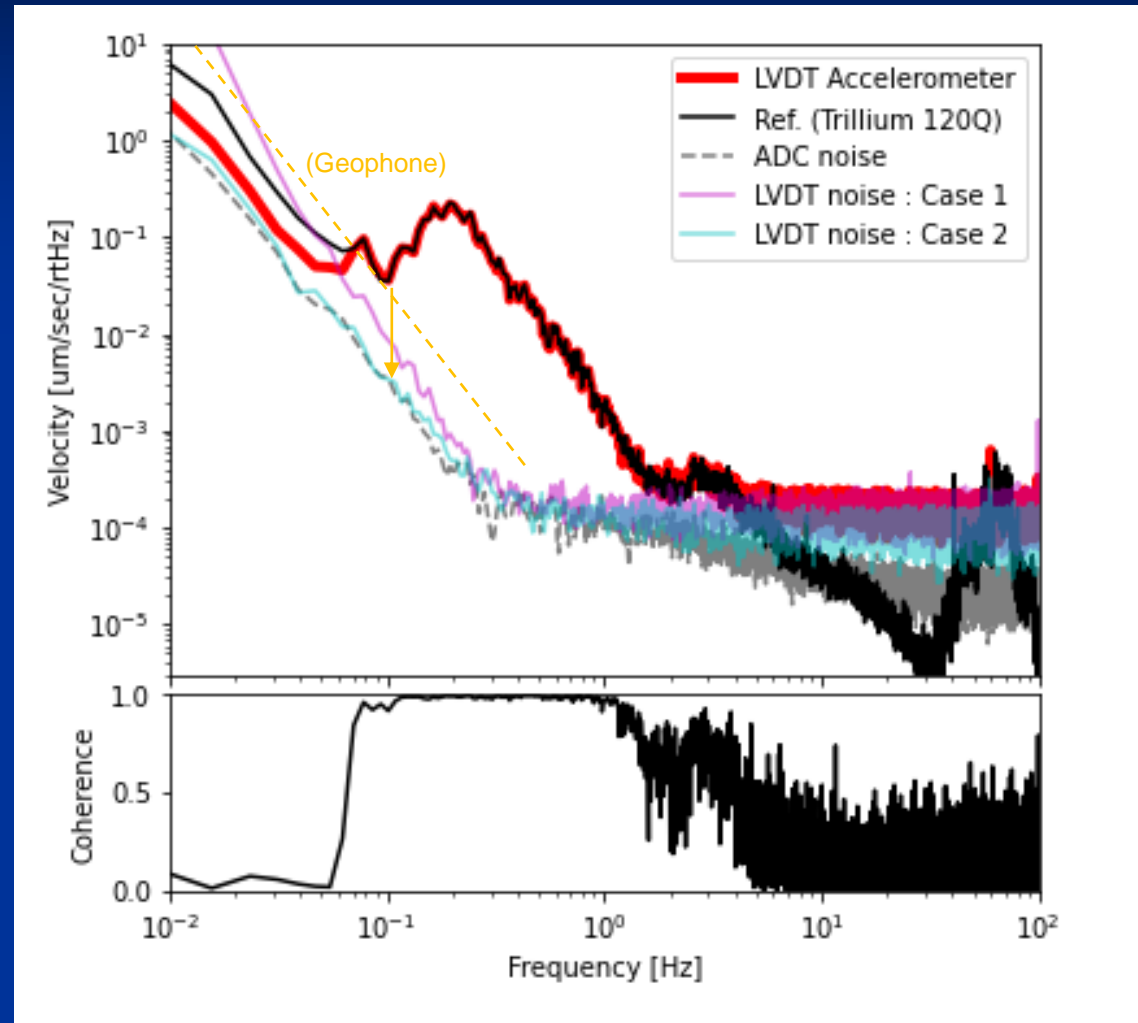
Tuning of FP

# Prototype test at the KAGRA site

- Some kinds of position sensors (photointerrupter, fiber LED, white light interferogram, and LVDT) have been evaluated. The LVDT had the best sensitivity around 0.1Hz.
- Prototype accelerometer with the LVDT was tested at the KAGRA site.



Sensitivities of some kinds of sensors



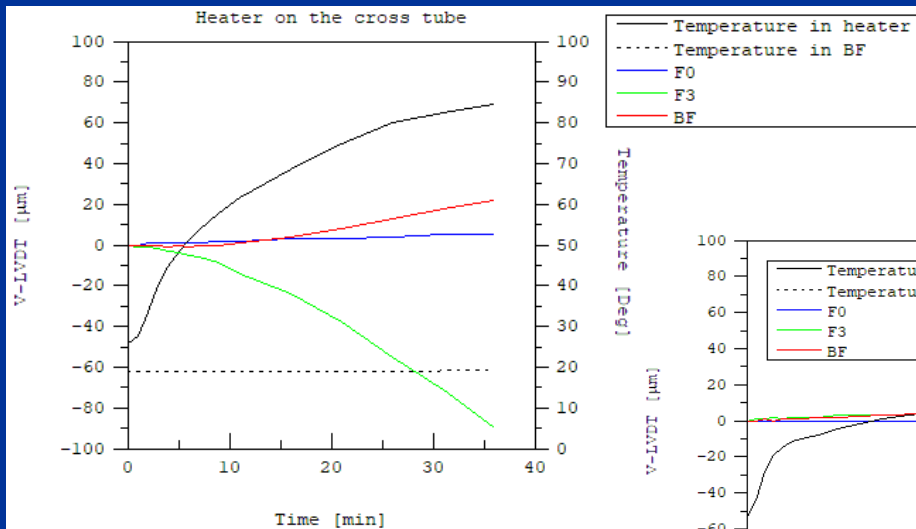
Measured spectra at the KAGRA site

# Test of thermal control for GAS filters

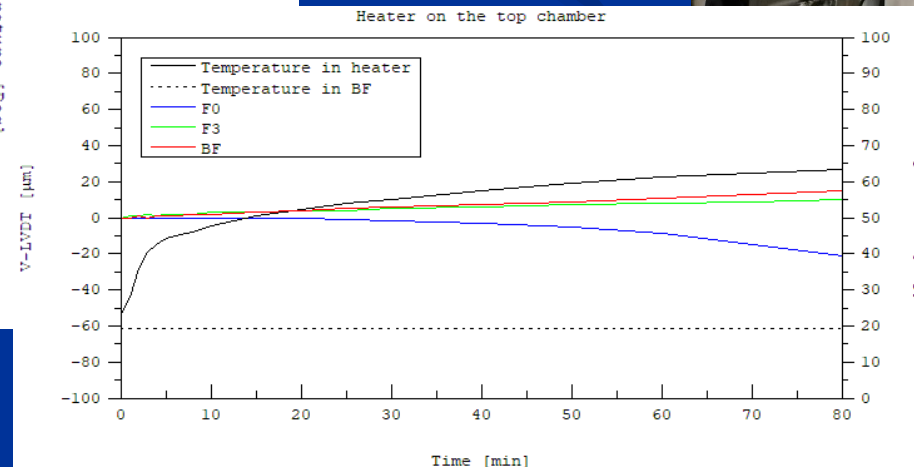
- Drift motion of GAS filters due to the temperature change was larger than our prediction. Temperature should be kept within 0.1 deg.
- Ribbon heaters near not the pre-isolator but the BF were effective.



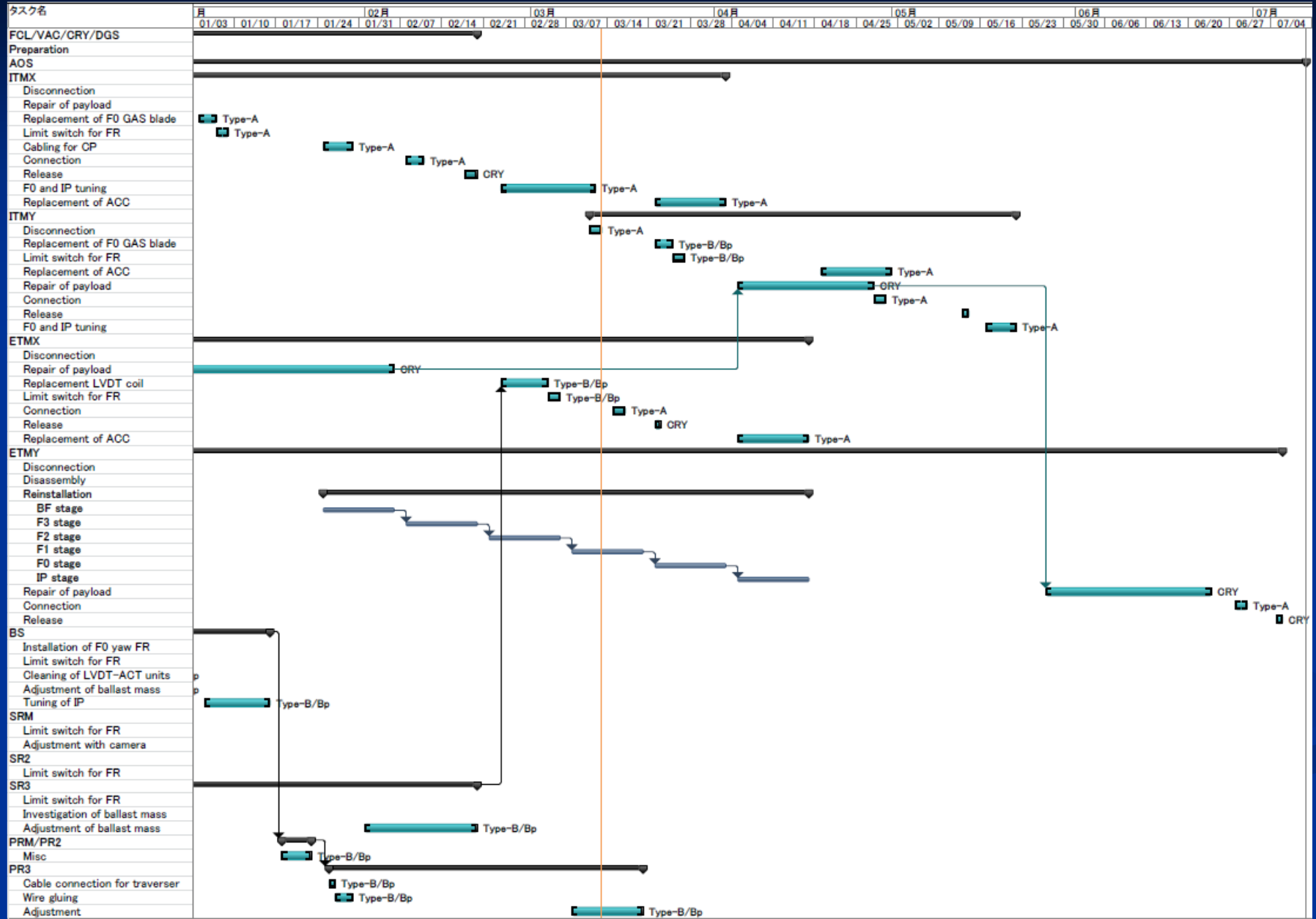
Heaters wrapped on the cross tube



LVDT responses by heating



# Schedule



# Summary

- Reinstallation of the Type-A tower is on going in EYV. Installation of the F2 stage was finished.
- GAS blades for the F0 were replaced and the load for filter chain was tuned in IXV.
- The accelerometer prototype with LVDT was demonstrated in IXV and showed good performance.
- The ribbon heaters wrapped on the chamber were tested in EXV.