Vibration measurement of the KAGRA radiation shield

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Outline

- Purpose of the vibration measurement
- Test of the accelerometer
- Measurement of the KAGRA radiation shield

Purpose

Measurement of the vibration on the radiation shield.



The measurement in Toshiba



The measurement in the #2 cryostat

Displacement Spectra KAGRA cryostat #2 comparison 2013 / 04 / 01 - 50 avg - T(rad.shield)= 8.6K <-> 18.5K



The result of the accelerometer is developed by Luca Naticchioni and Ettore Majorana

It worked at low temperature in the cryostat. The analysis is in progress.

Specification of the accelerometer

1.Noise levels : 10⁻⁹m/rtHz@10Hz

Yokohama-city has this seismic vibration level.

2.Operation at low temperature



In horizontal case, we used a Michelson Interferometer as an accelerometer.

We can use the wavelength to calibrate the accelerometer.

Principle

-The principle to measure the seismic vibration-



The concept figure of the Michelson Interferometer



Cooling part of the accelerometer



Pictures of the accelerometer





oscillator



We used a coil actuator to control the Michelson Interferometer



The result of the cooling test



We measured the seismic vibration at low temperature.

Installation of the accelerometer into the KAGRA radiation shield



Optical fiber port





Inside of the radiation shield

The cryostat

The accelerometer

Installation of the accelerometer into the KAGRA radiation shield



RION We used a commercial accelerometer(RION) to measure the vibration out of the cryostat.

The seismic vibration at Toshiba



These data are measured by RION accelerometer The seismic vibration at Toshiba is larger than that at Kashiwa

Vibration measurement during cooling



We had coincidence measurements with RION. The signals of these two accelerometer are consistent at low frequency.

Modal Analysis of the Cryostat (KEK Shigeaki Koike)



the cryostat and the radiation shield

Vibration measurement during cooling



Vibration measurement above 100K



There are no huge change of the vibration.

Vibration measurements at 100K



There are no huge change of the vibration.

Vibration measurement at 100K



> The origin of this peak is the coolers.

Vibration measurement at 100K



Impulse response measurement -The resonance frequency of the cryocooler unit -



This part is connected with the radiation shield \ during the operation of the cryostat.





We measure the vibration of this part when we hit this cryocooler unit using a hammer.



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We can measure the resonance frequency of the cryocooler unit.



Vibration measurement at ~20K



It seems the noise level goes up. We can only see the peaks. This is because of the change of the alignment.(?) The discussion about this result is in progress.

Impulse response measurements of the cryostat



The discussion about this result is in progress.

Summary

- We measured the vibration of KAGRA radiation shield during the cooling.
- We observed the resonance peaks of the cryostat and the radiation shield.
 - At least the origin of a peak is the cryocooler.
- We should take care these peaks when we design the cryogenic payload.

End



Cooling test of the accelerometer

We had a cooling test before the measurement in Toshiba.



We prepared a vacuum chamber and radiation shield for cooling test.

Measurement at T=250K

