Our work in 2017

1-1

Hiroki Tanaka

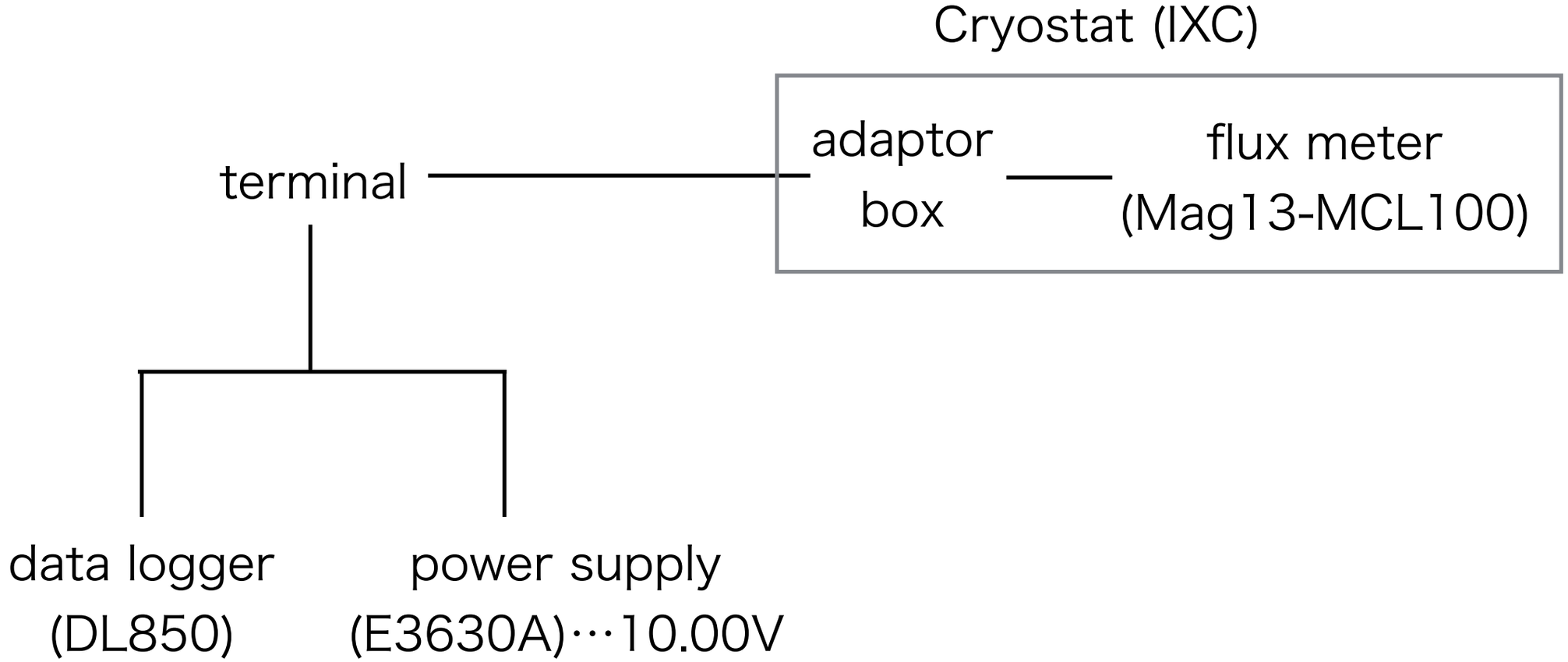
Measurement of the fluctuation of the magnetic field in IXC (1)

Purpose

- In KAGRA, the requirement of the fluctuation of magnetic field in the ITM and ETM is less than 7pT/rtHz@10Hz.

- We measured the fluctuation of the magnetic field in IXC on 12/12-12/20.

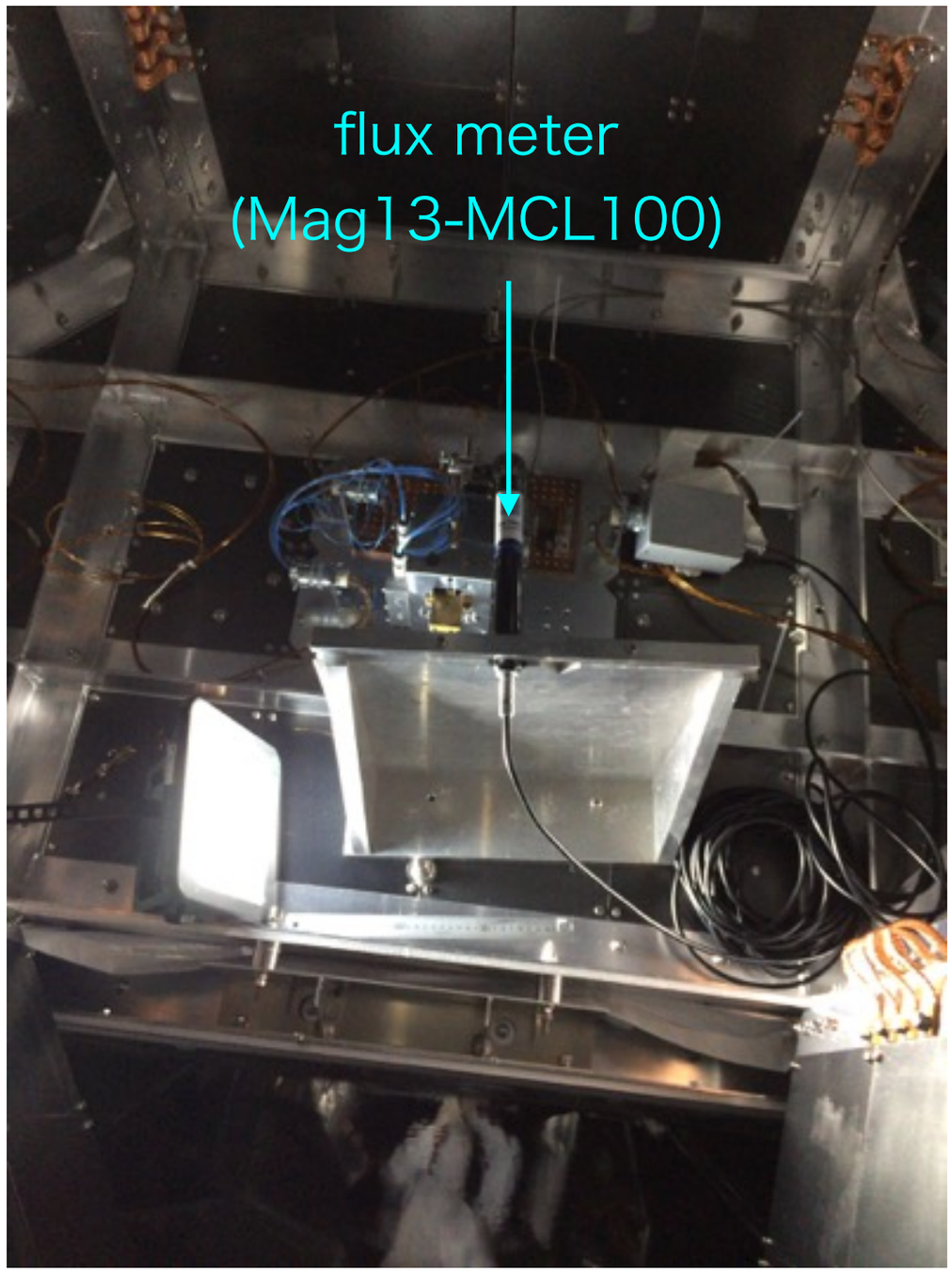
Setup in Kamioka

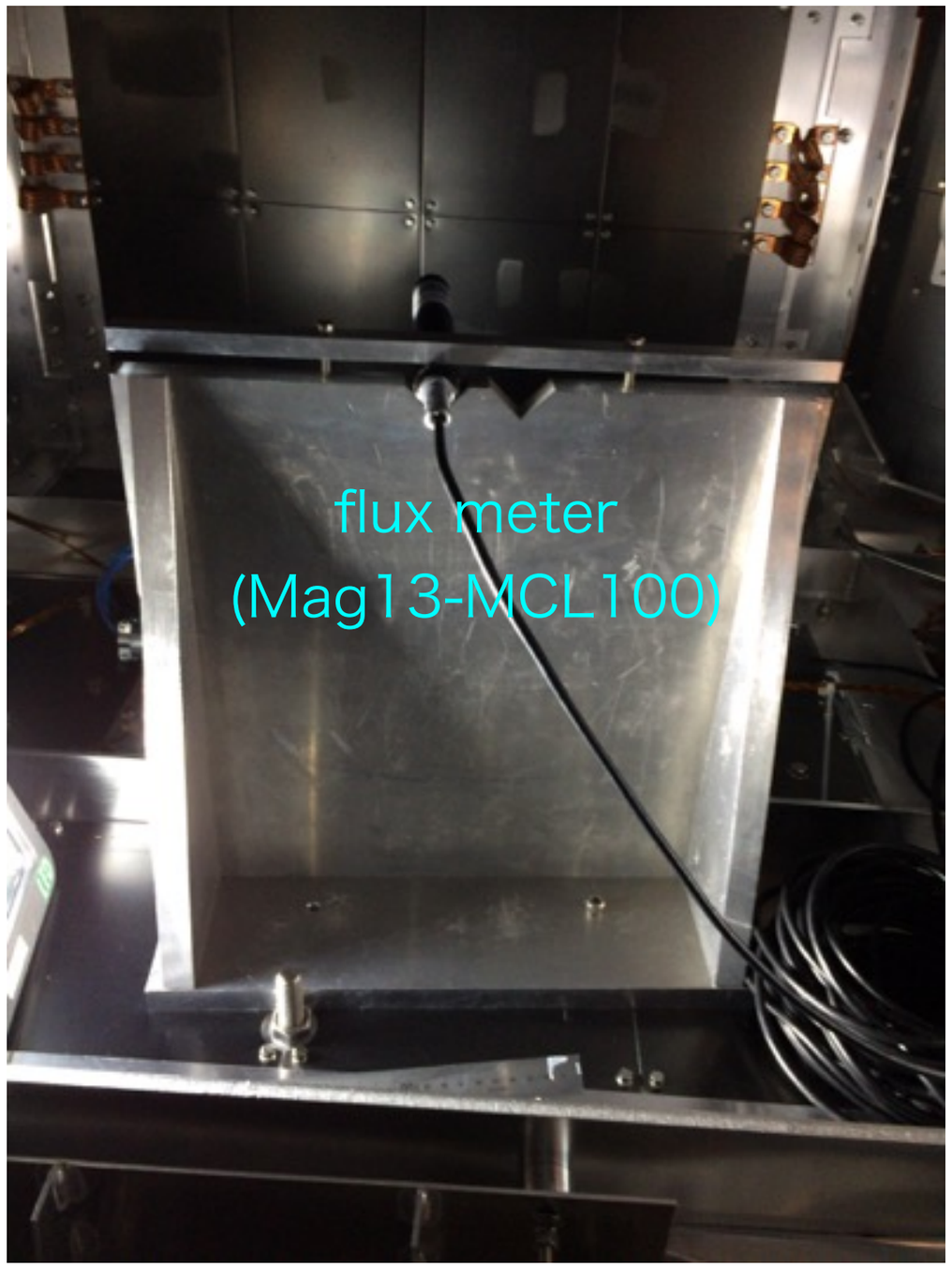


When we use Mag13-MCL100, we can measure all components (xyz).
Noise level of Mag13-MCL100 is 6pT/rtHz@10Hz (written on the manual).

Setup in Kamioka

Inside

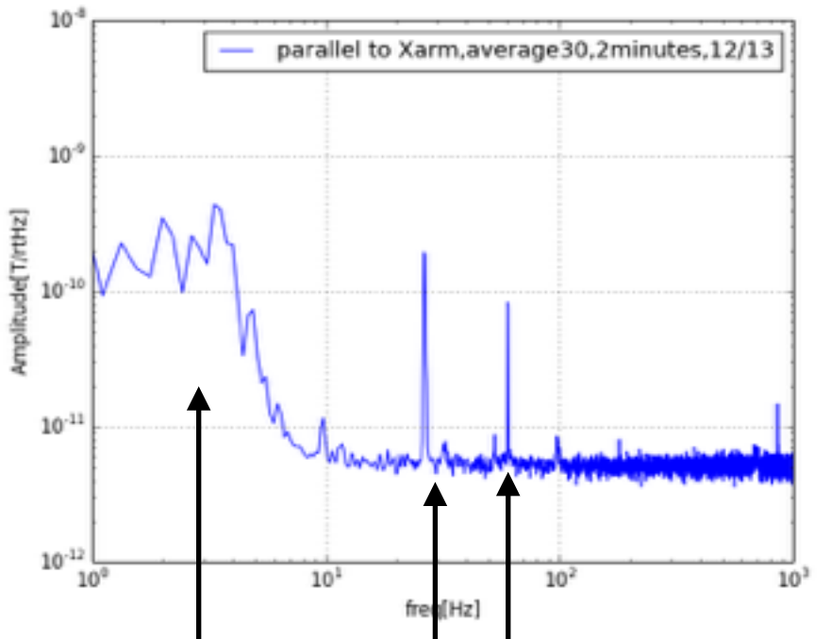




Inside the cryostat

Sampling rate 20kHz

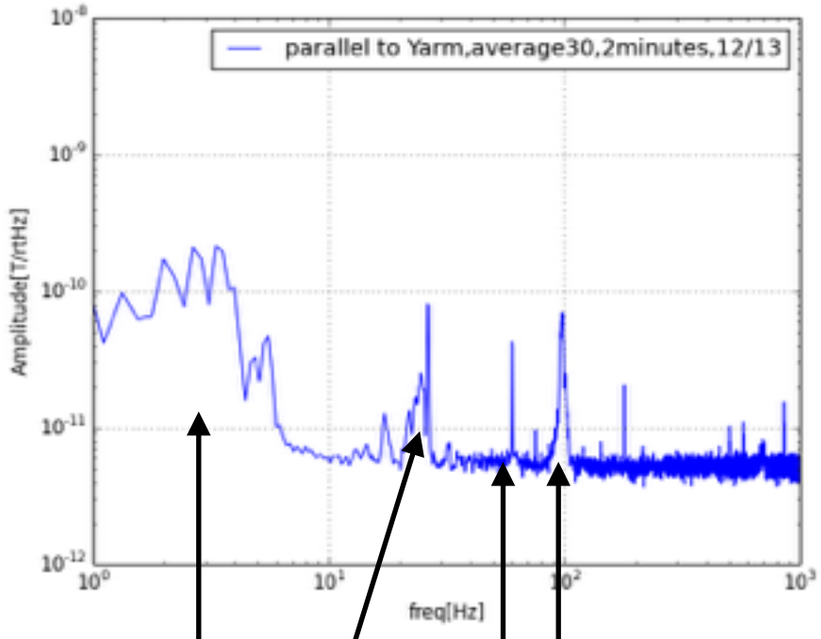
parallel to Xarm



60Hz (Utility frequency)

25Hz (Unknown)

parallel to Yarm

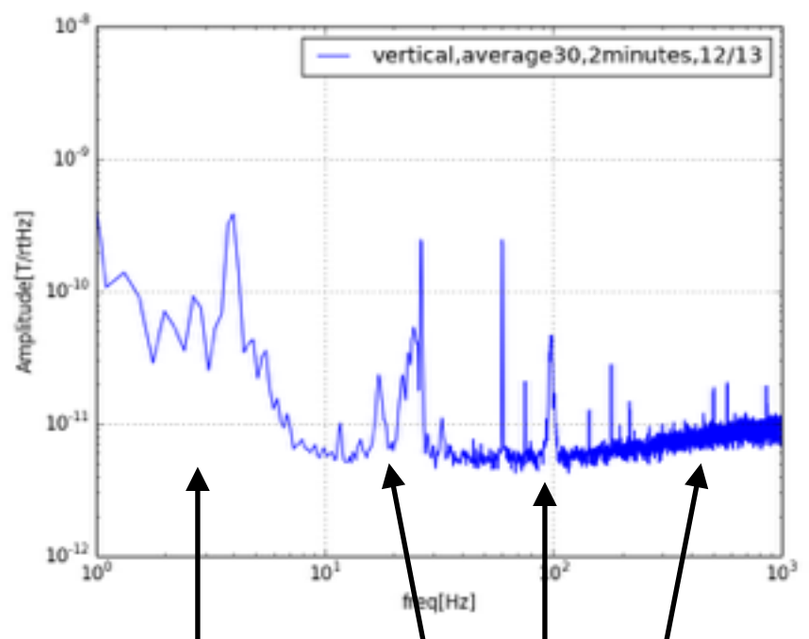


25Hz (Unknown)

100Hz (Unknown)

60Hz (Utility frequency)

vertical



Unknown

This fluctuation seems to be due to the operation of the fan (I will explain later).

The noise floor was about 5pT/rtHz.

Cryocooler

We operated the cryocoolers and checked whether the fluctuation of magnetic field would change or not.

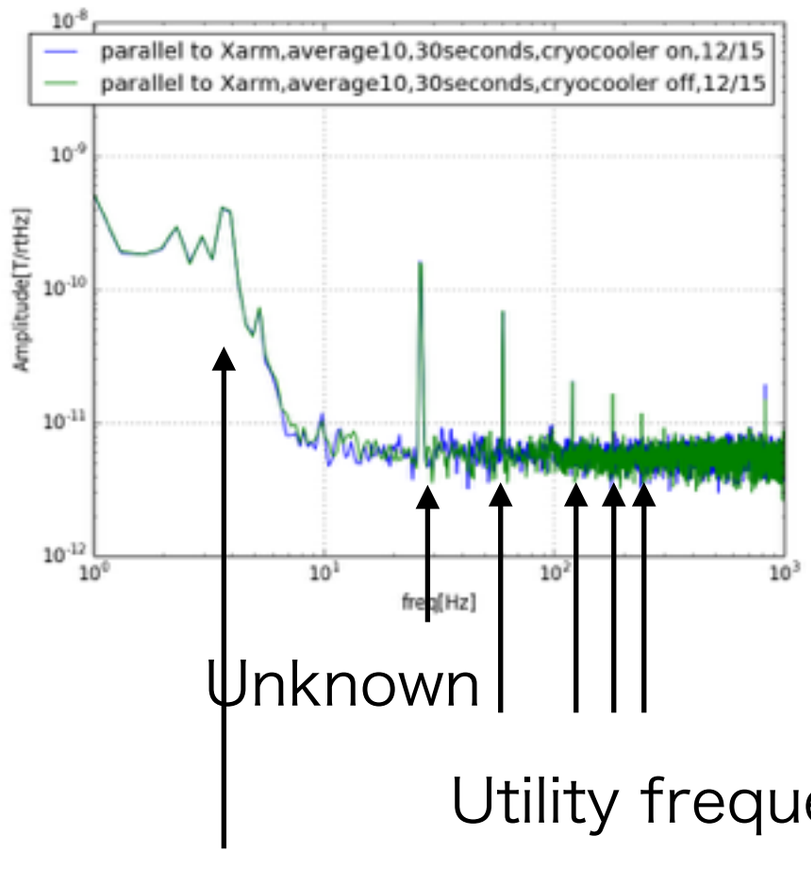
Cryocooler

First we measured the fluctuation while the cryocooler was off.
5 minutes later, we operated the cryocoolers near IXC and measured the fluctuation again.

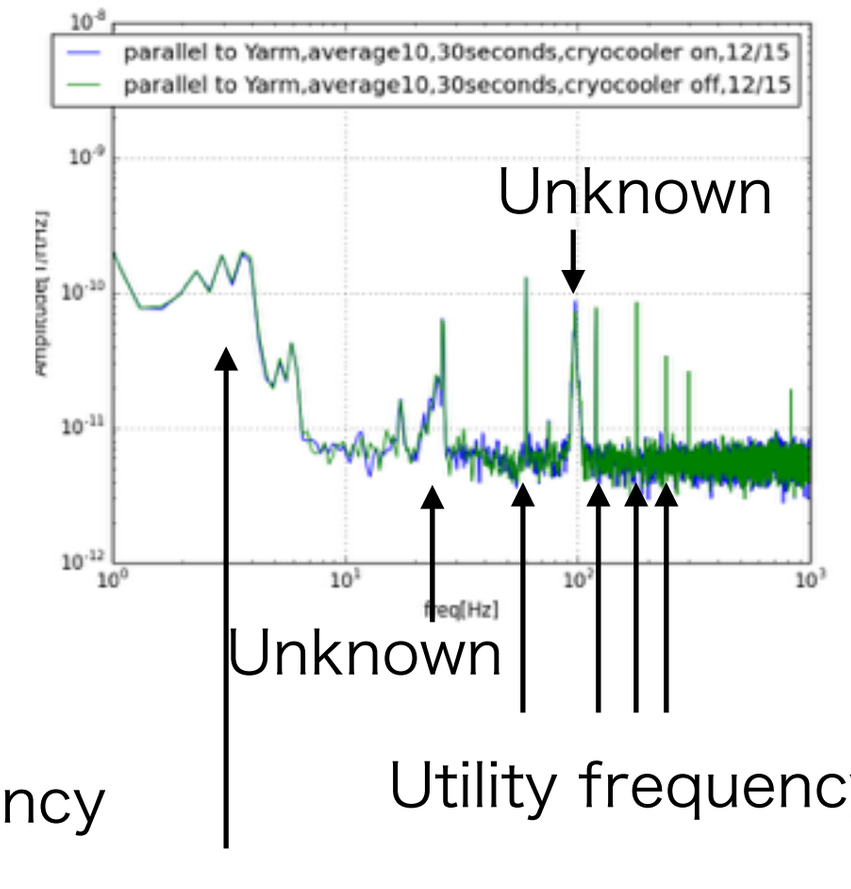
Sampling 20kHz

The fluctuation didn't change so much while the cryocoolers were operating.

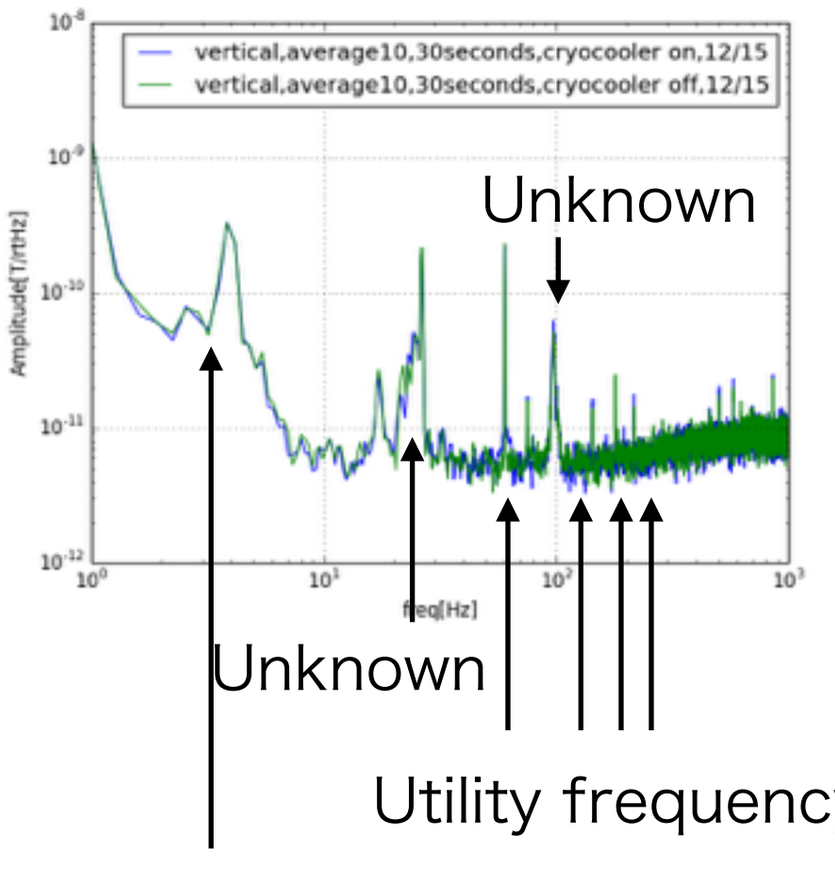
parallel to Xarm



parallel to Yarm



vertical



This fluctuation seems to be due to the movement of the fan (I will explain later).

Fan

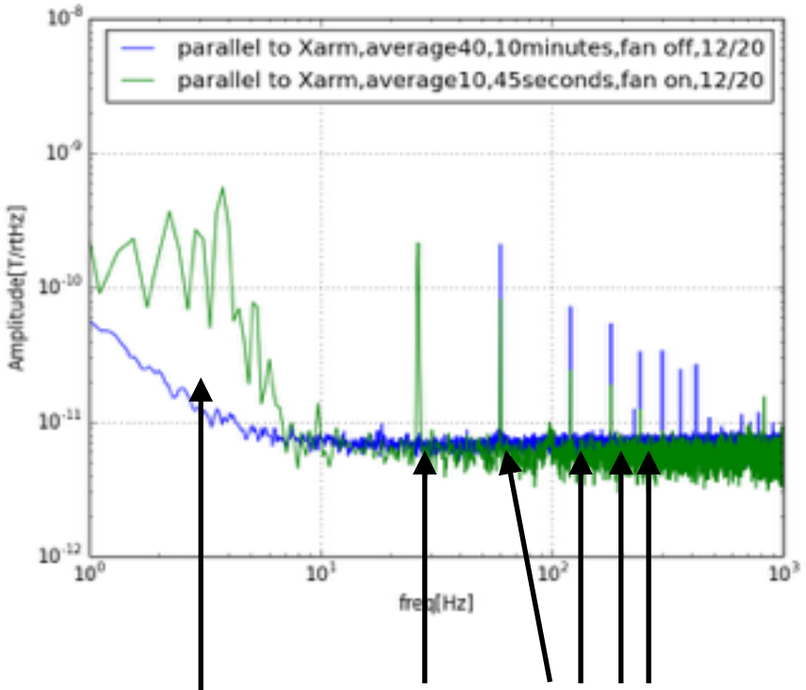
We stopped the fan and checked whether the fluctuation of magnetic field would change or not.

The fan

First we measured the fluctuation while the fan was on.

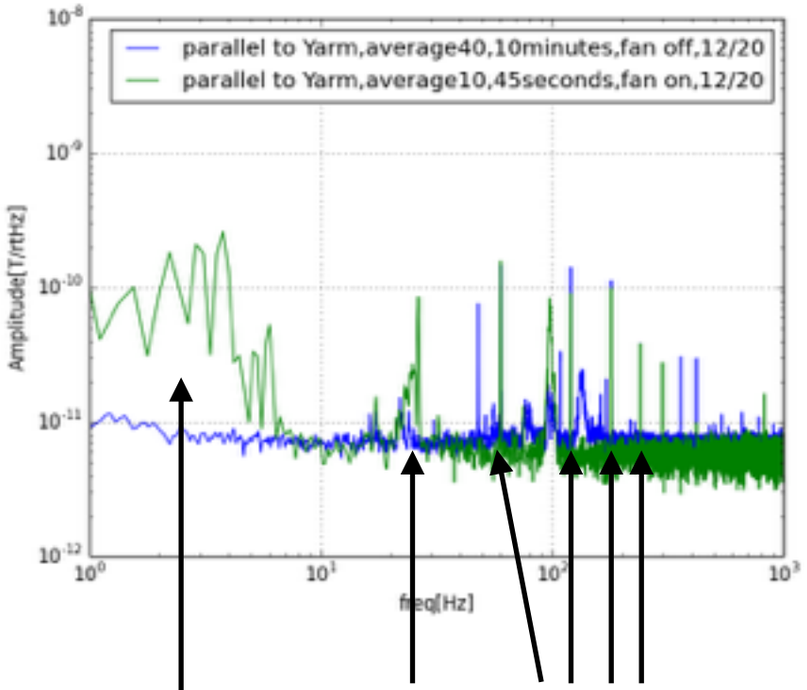
30 minutes later we stopped the fan and measured the fluctuation again.

parallel to Xarm



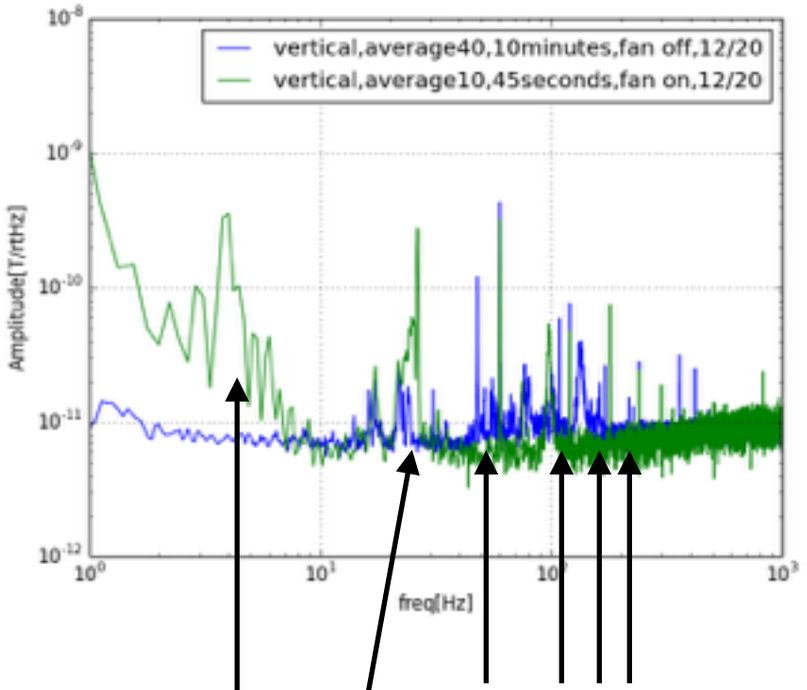
Unknown Utility frequency

parallel to Yarm



Unknown Utility frequency

vertical



Utility frequency

Unknown

In low-frequency area, the noise became much smaller when we turned off the fan.

long-time measurement

- We measured the fluctuation during midnight from 12/18 to 12/19.

- I will explain it in the next meeting.

KAGRA Requirement

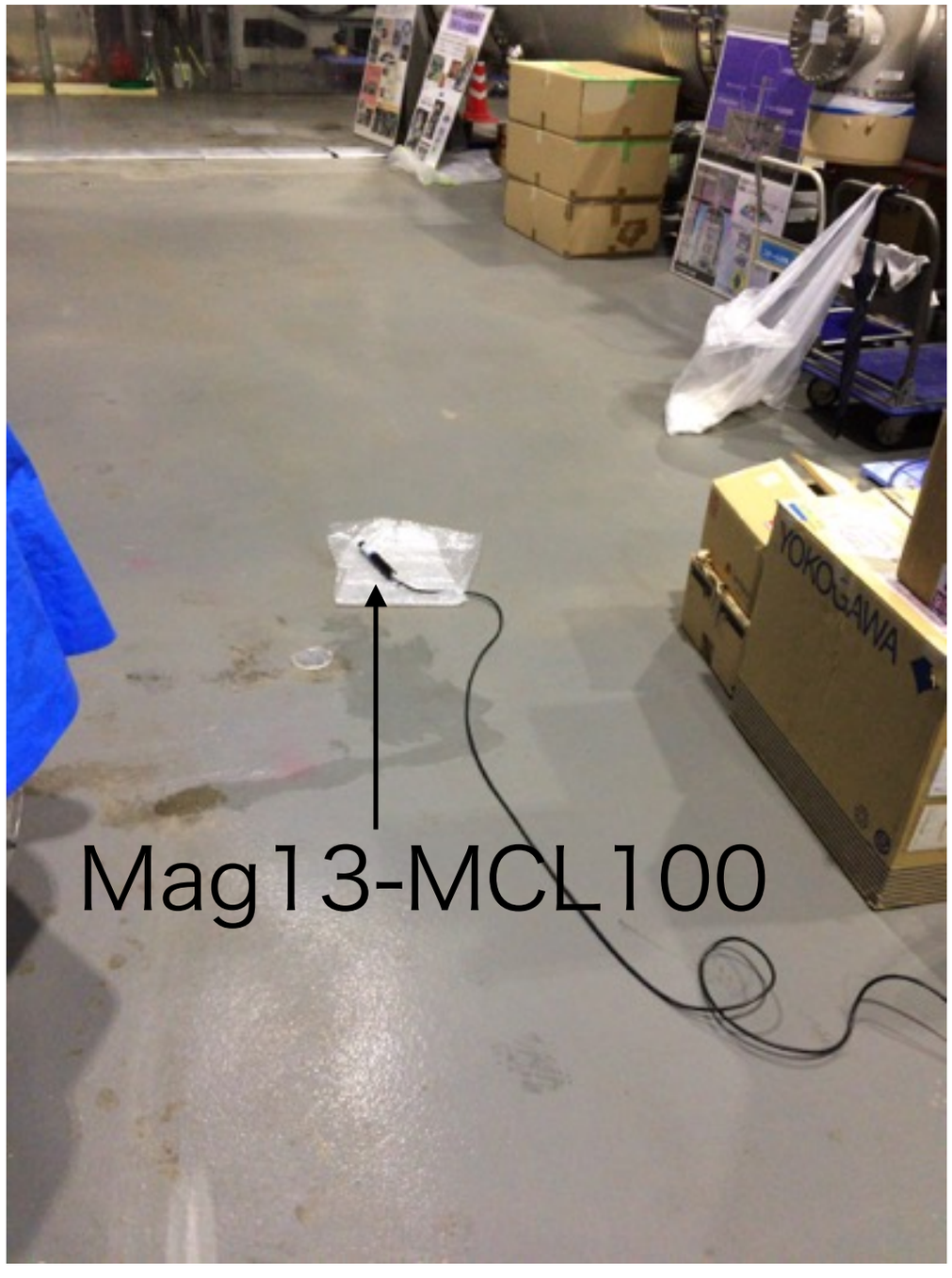
- I heard the KAGRA requirement for ITM and ETM is 7pT/rtHz@10Hz, but this mentions only at 10Hz.

- I am calculating the requirement more exactly (I will show the result in the next meeting).

Future work

- I will continue the analysis.
- I will explain the rest part of this measurement in the next meeting.

Outside the cryostat



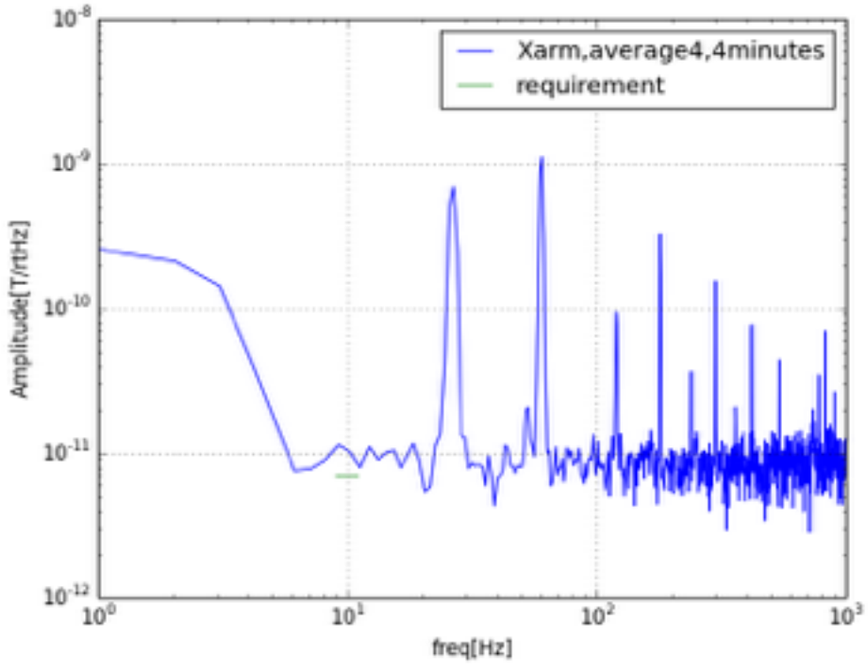
Outside the cryostat

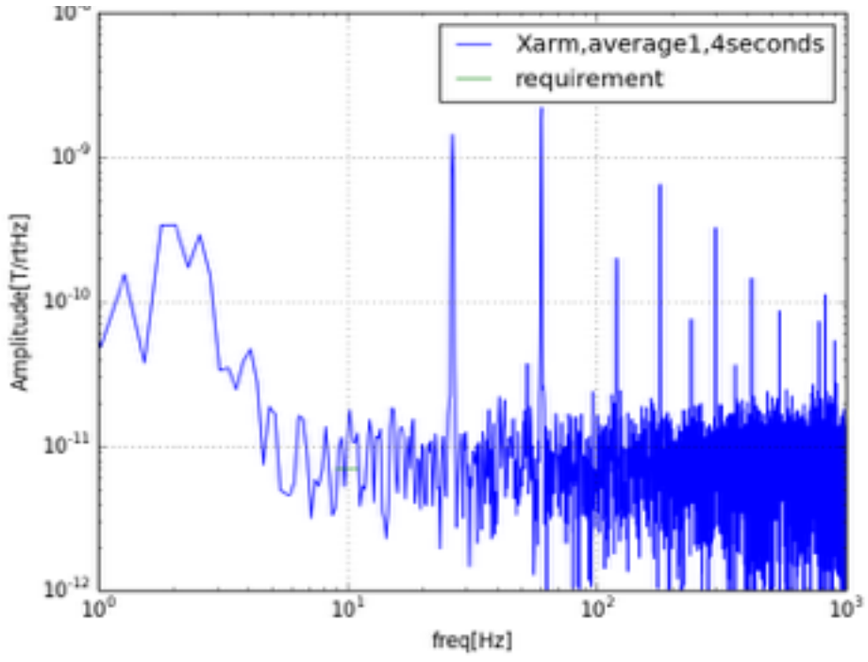
sampling rate 20kHz

Xarm axis

Average 4

Measurement time 4s



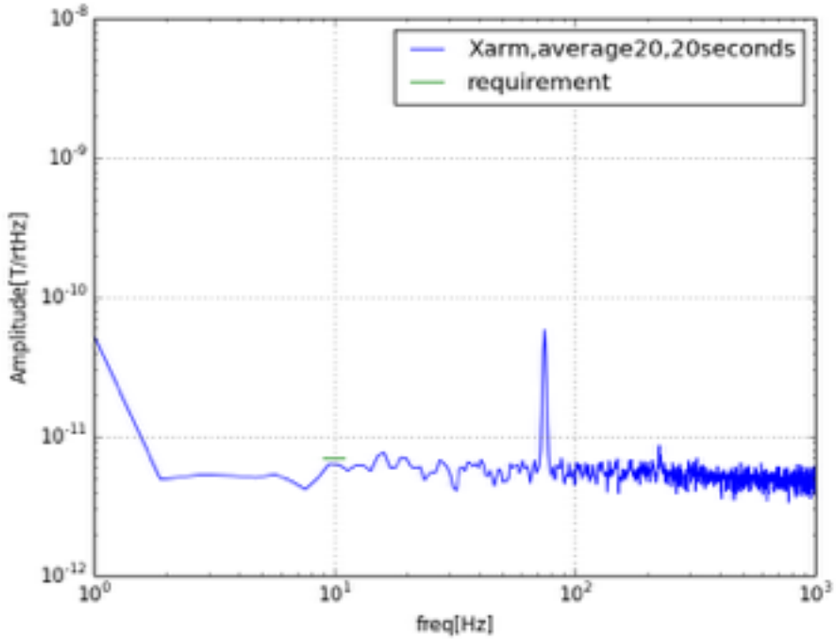


sampling rate 2kHz

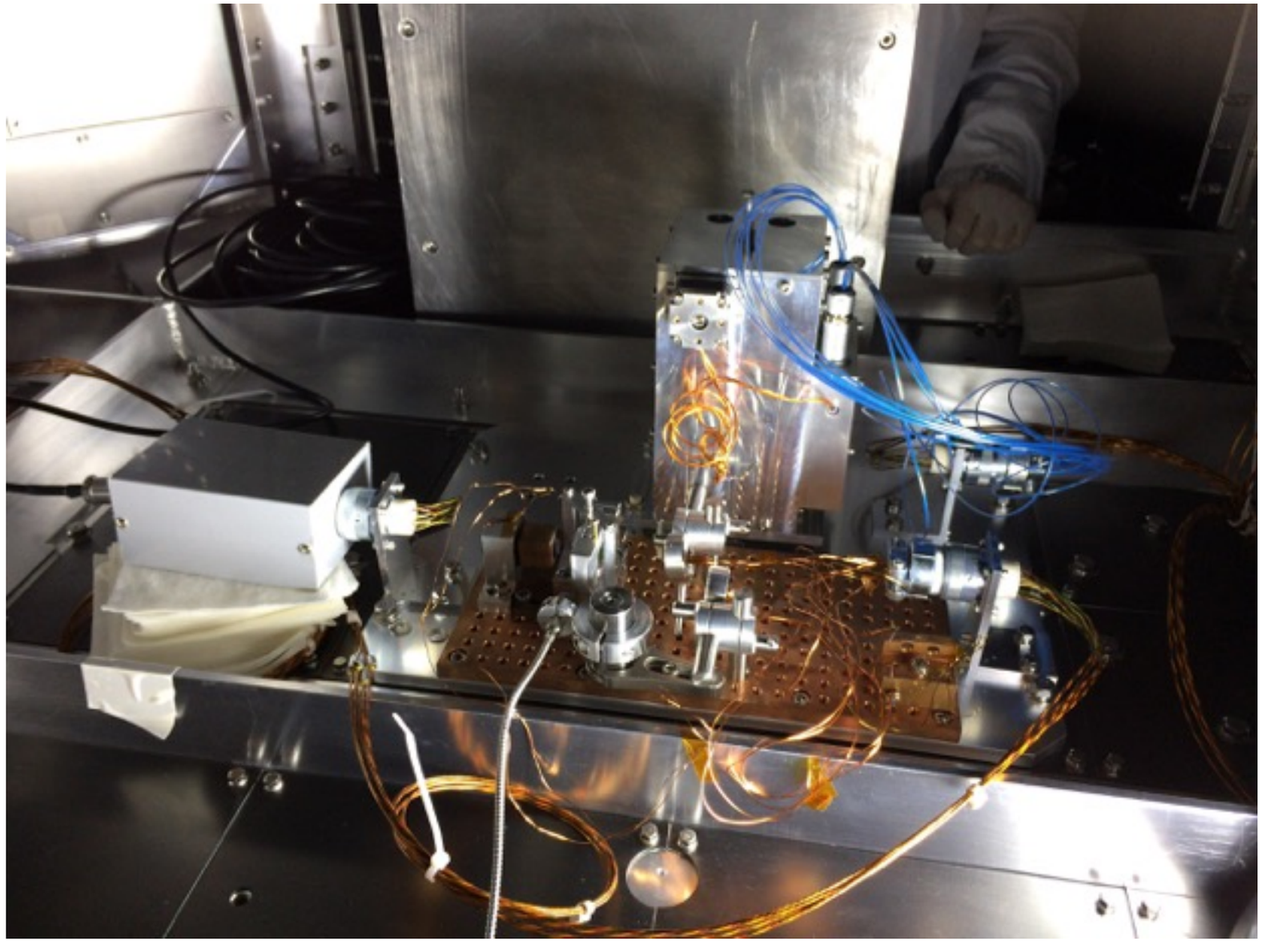
Xarm axis

Average 20

Measurement time 20s



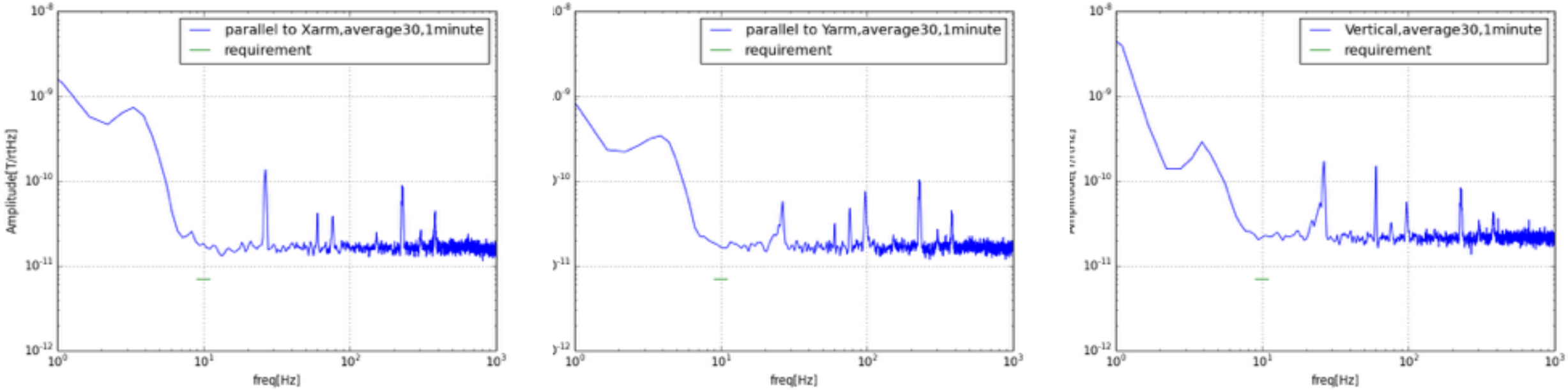
加速度計



Inside the cryostat

We changed the sampling rate from 20kHz to 2kHz.
Sampling rate 2kHz、1minute、average 30

parallel to Xarm　parallel to Yarm　Vertical



The noise floor was about 15pT/rtHz.

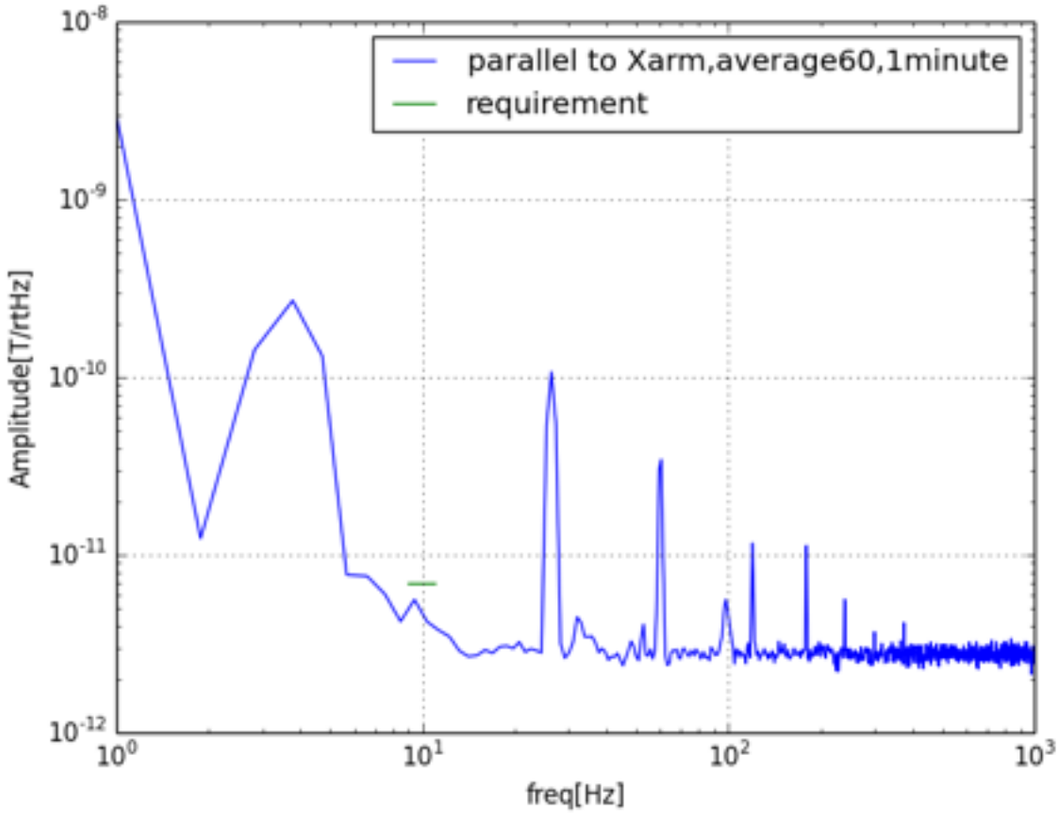
Sampling rate

- We noticed that the noise floor changed depending on the sampling rate.

- We set the sampling rate as 100kHz and 200Hz and did the measurement.

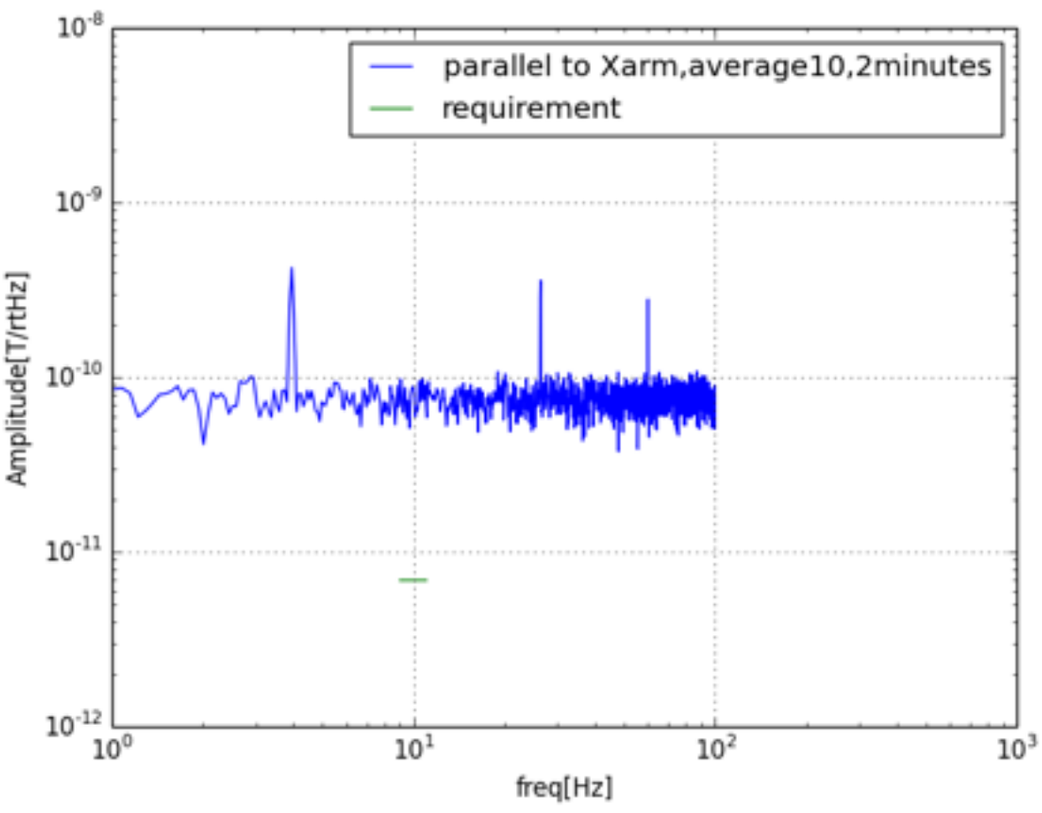
Inside the cryostat

100kHz
parallel to Xarm
average 60
1minute



noise floor…3pT/rtHz

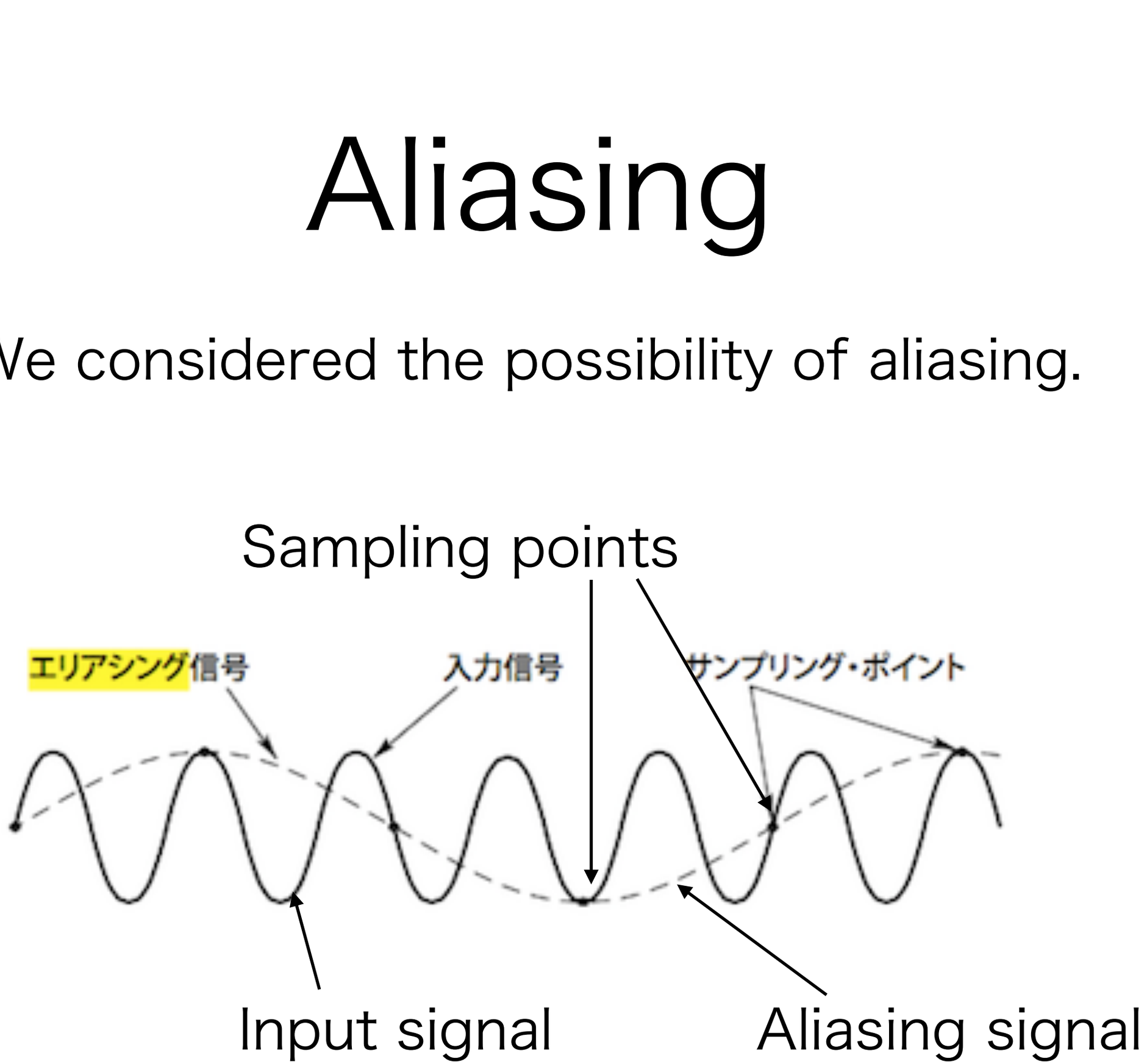
200Hz
parallel to Xarm
average 10
2minutes



noise floor…70pT/rtHz

Aliasing

- We considered the possibility of aliasing.



Checking aliasing in Kashiwa

Sampling rate 20kHz

Raw data…{x_1, x_2, x_3,…}

We can make two datas which have 2kHz sampling rate.

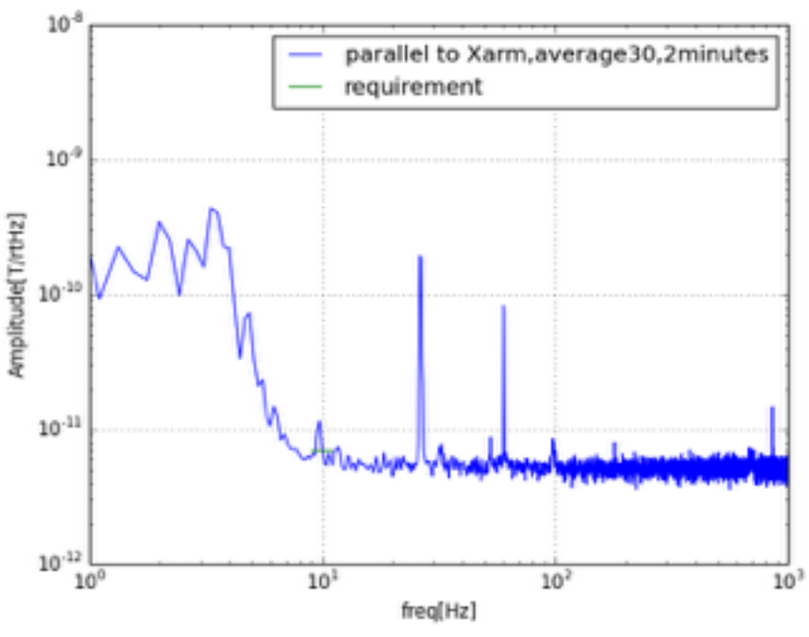
(1){x_1, x_{11}, x_{21},…}

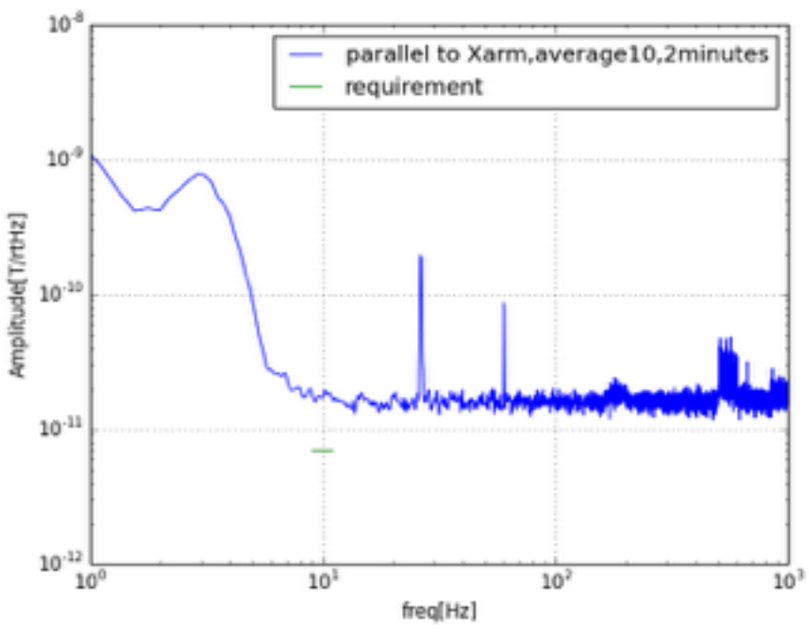
(2){(x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8+x_9+x_{10})/10,…}

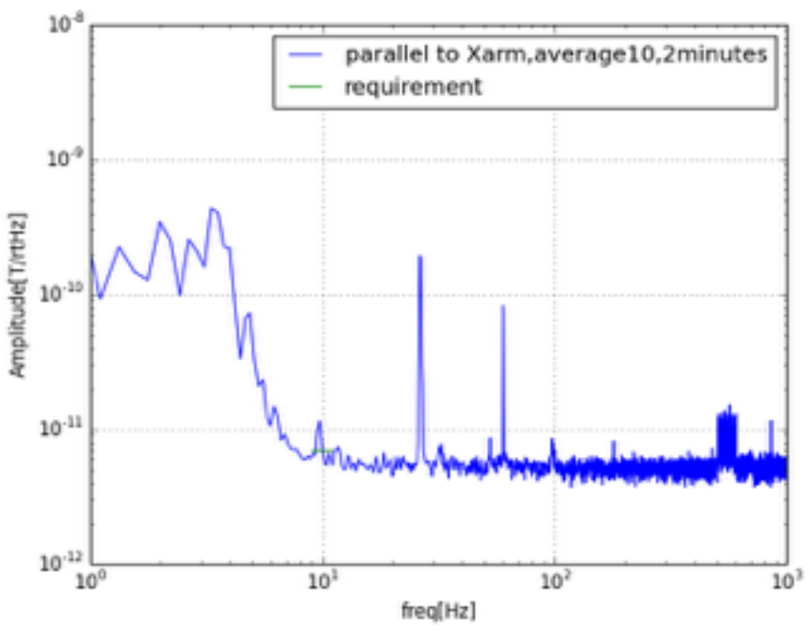
If the aliasing occurs, the noise floor of (2) is smaller than that of (1) because the high-frequency component disappears only in (2).

Checking aliasing in Kashiwa

Raw data (1) (2)



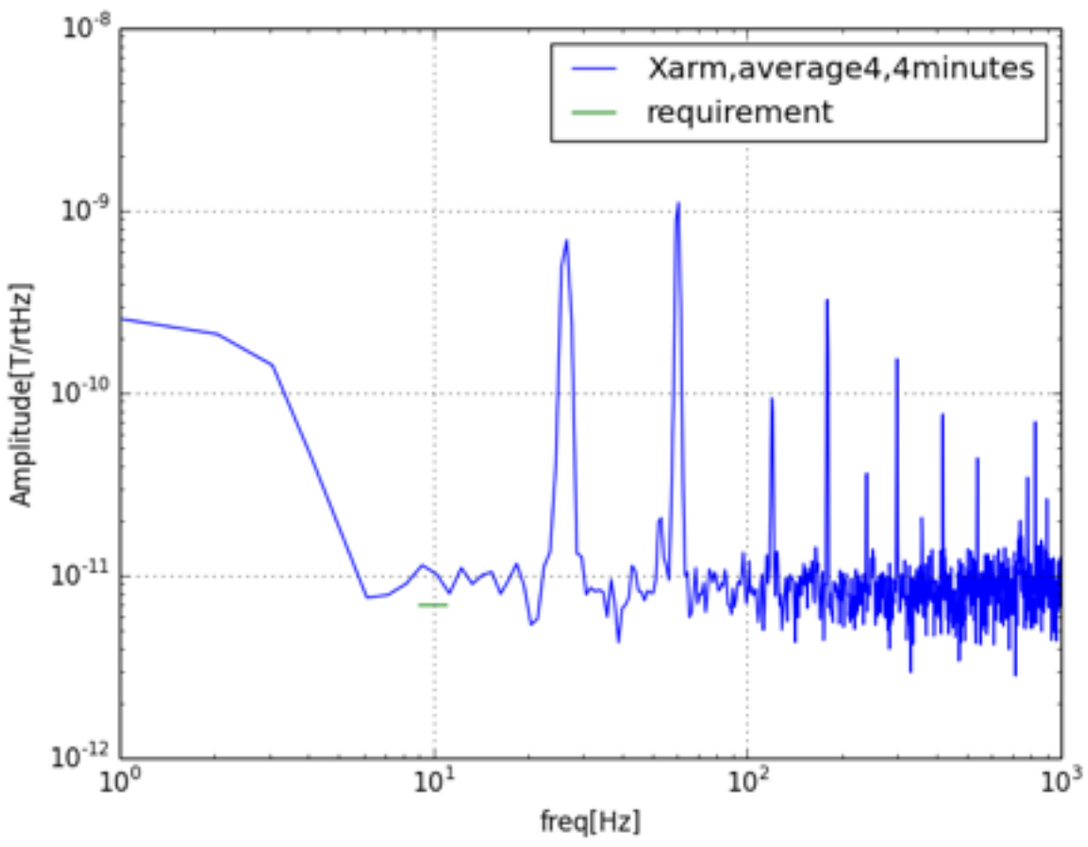




Two modes (Outside)

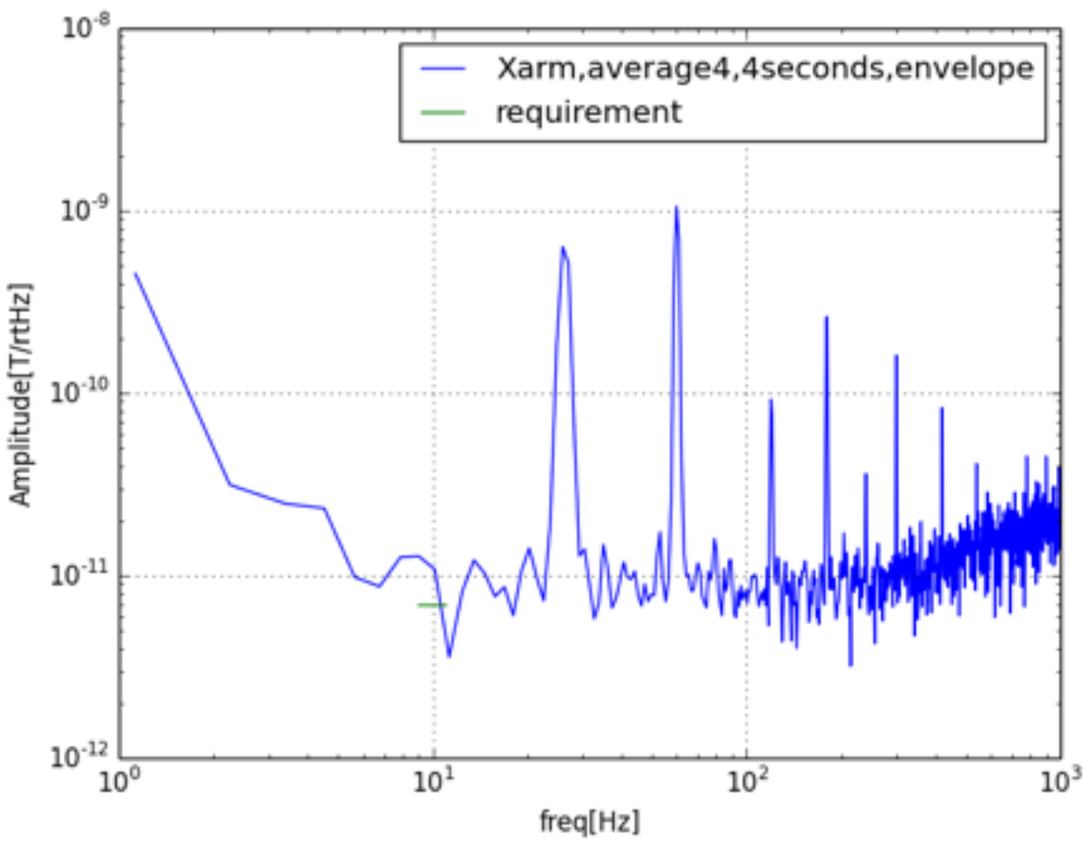
sampling rate 20kHz
Xarm
Average 4
Measurement time 4seconds

normal mode



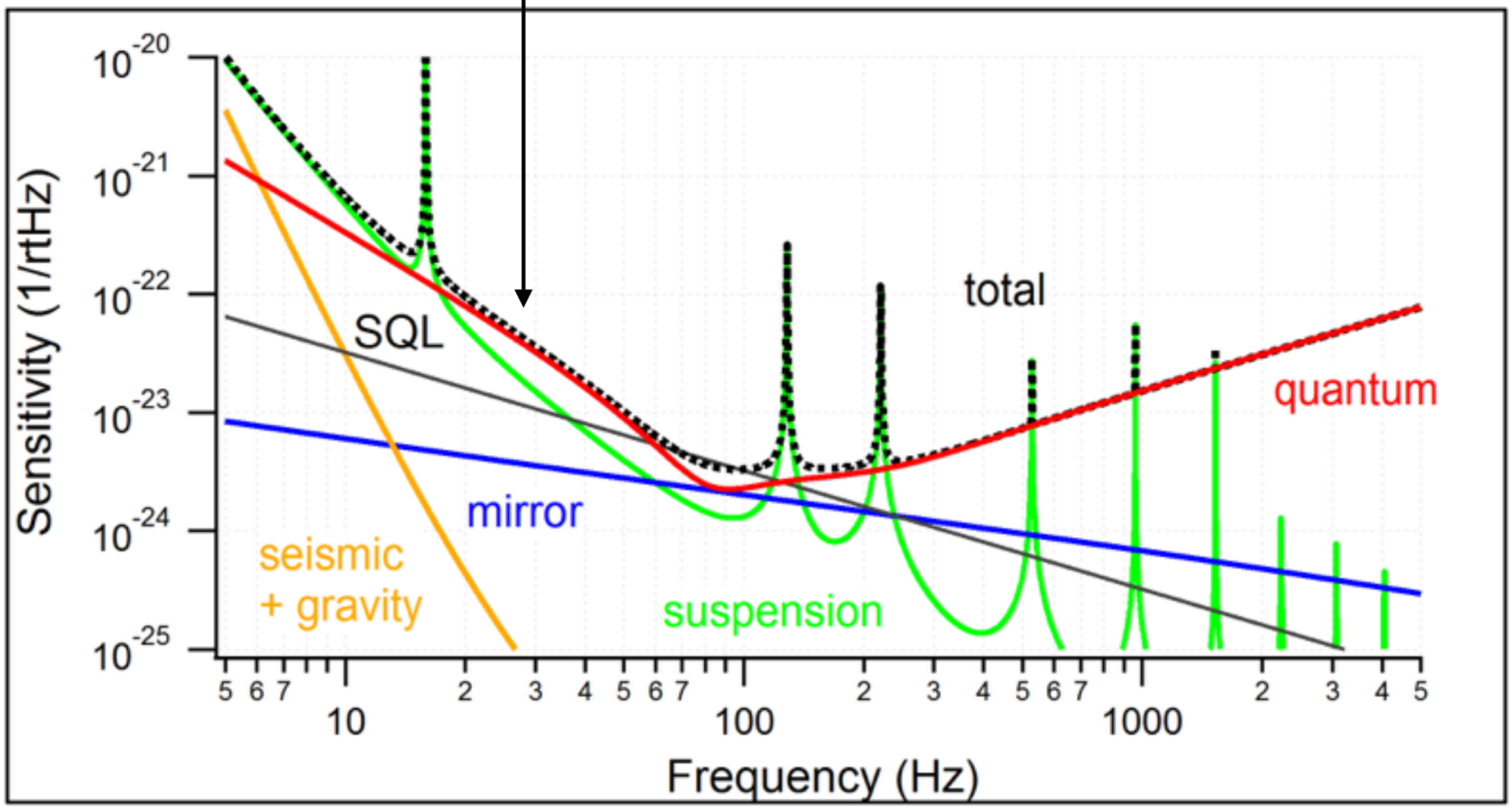
sampling rate 20kHz
Xarm
Average 4
Measurement time 4seconds

envelope mode



感度曲線

logh=-2.64logf-18.515→h=3.055×10^-19f^-2.64



出典…KAGRA HP

JPS （Backup plan)

- 12/10-12/30 Make the program in digital system to get the data automatically

- Jan. 2017 Measure the magnetic field on each part （each end, center)

- Feb. Calculate the noise due to the magnetic field

- Mar. Make the presentation

Plan for JPS meeting

- 12/10-12/30 Calculate the noise due to the magnetic field
- -Jan. 2017 Make the program in digital system to get the data automatically
- 2/1-2/10? Measure the magnetic field outside IXC
- 2/10?-2/28 Compare the magnetic field between inside and outside.
- Mar. Make the presentation