Our work in 2017
1-2

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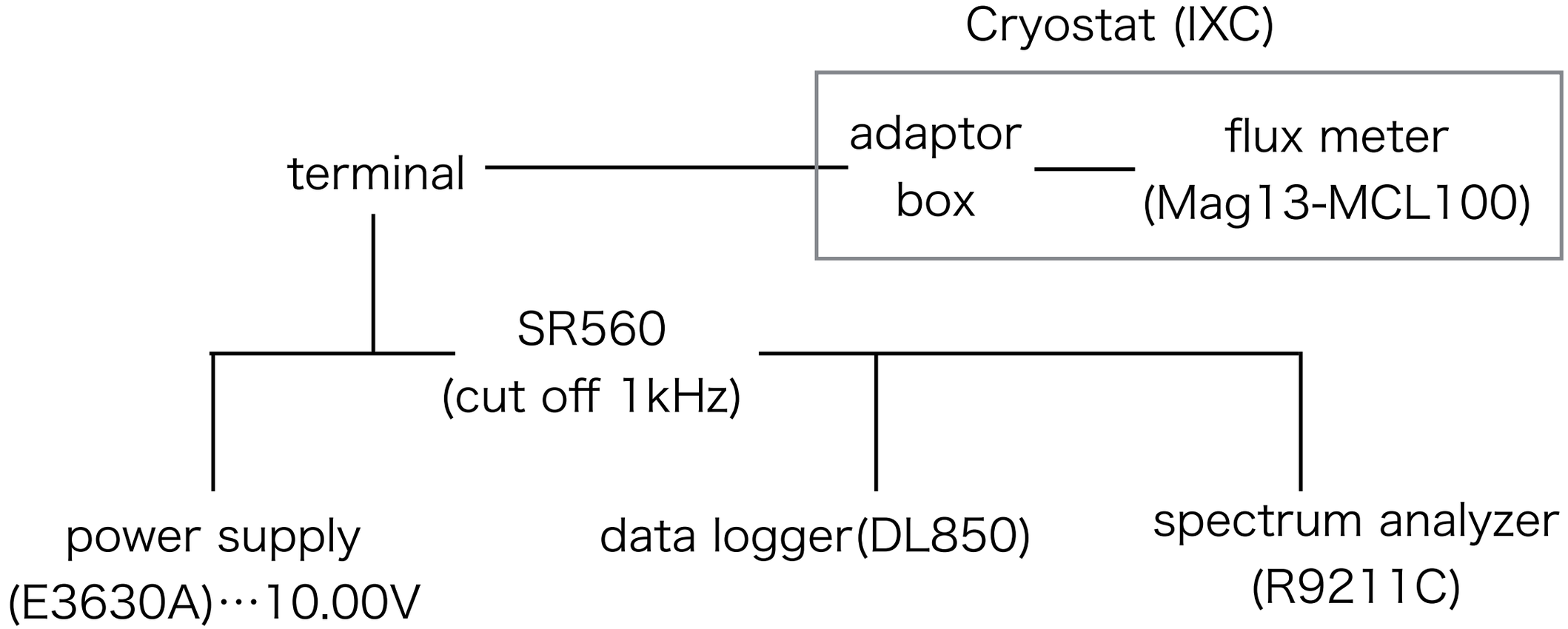
Purpose

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

- We measured the fluctuation of the magnetic field in IXC last December.

Setup in Kamioka



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

long-time measurement

- We measured the fluctuation during midnight from 12/18(Sun) to 12/19(Mon) in order to check whether the fluctuation changes during midnight or not.

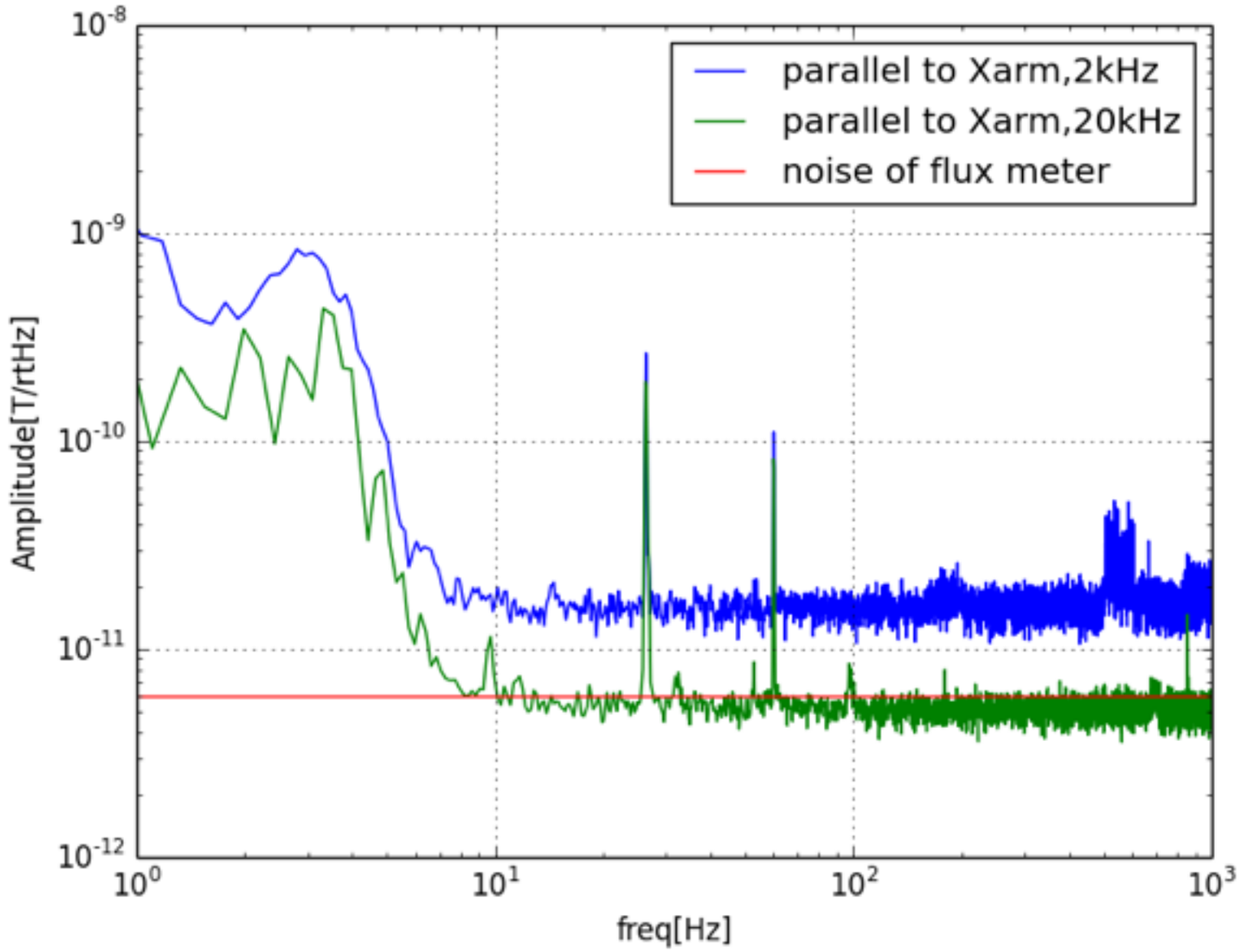
- If the sampling rate is larger than 2kHz, the data becomes so heavy that DL850 can’t save 20-hours data.

- We set the sampling rate to be 2kHz.

long-time measurement

- Before long-time measurement, we did short measurements with 2kHz sampling rate and 20kHz sampling rate.

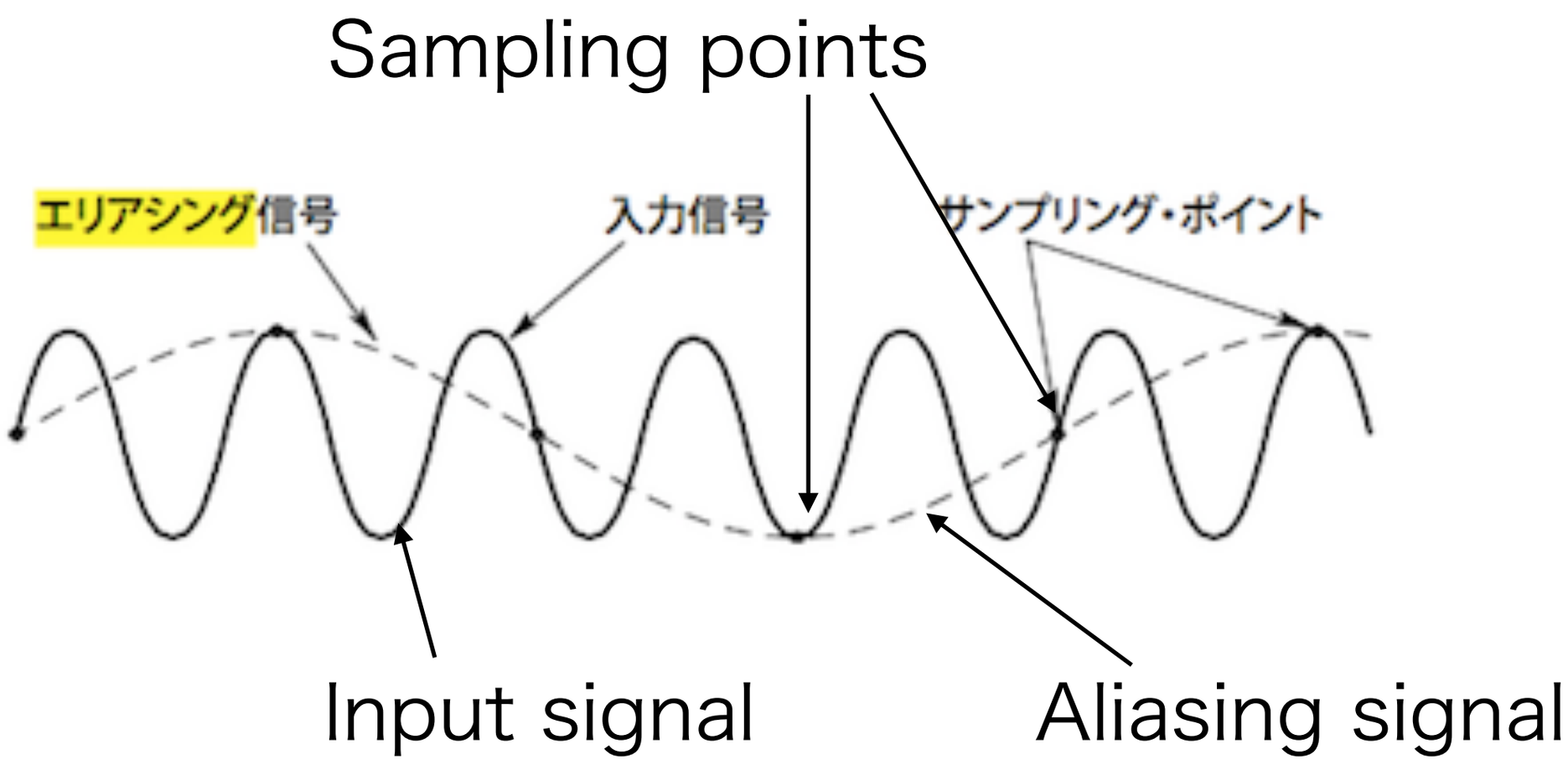
2kHz and 20kHz measurement



“Aliasing” happened (I will explain on the next page).

Aliasing

If the sampling rate is low, the frequency of the signal becomes smaller than that of the real signal.



long-time measurement

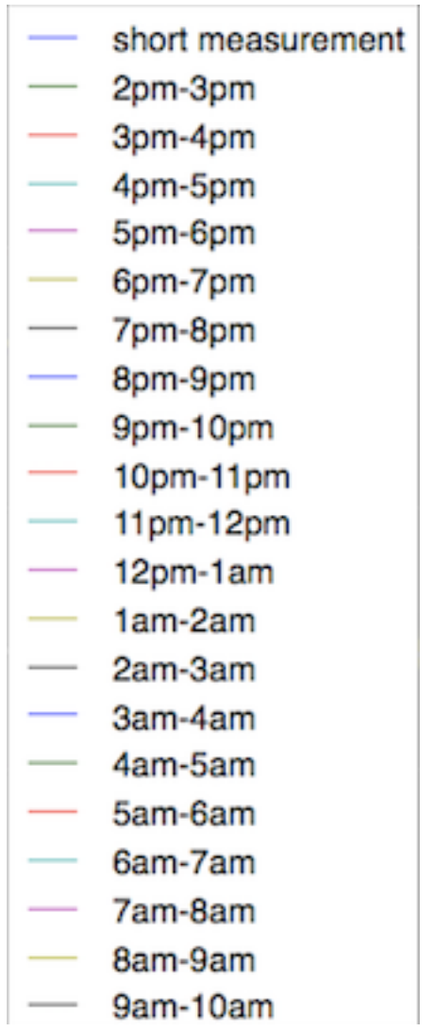
- If there is a large change of the fluctuation during midnight, we can catch it even in lower accuracy.

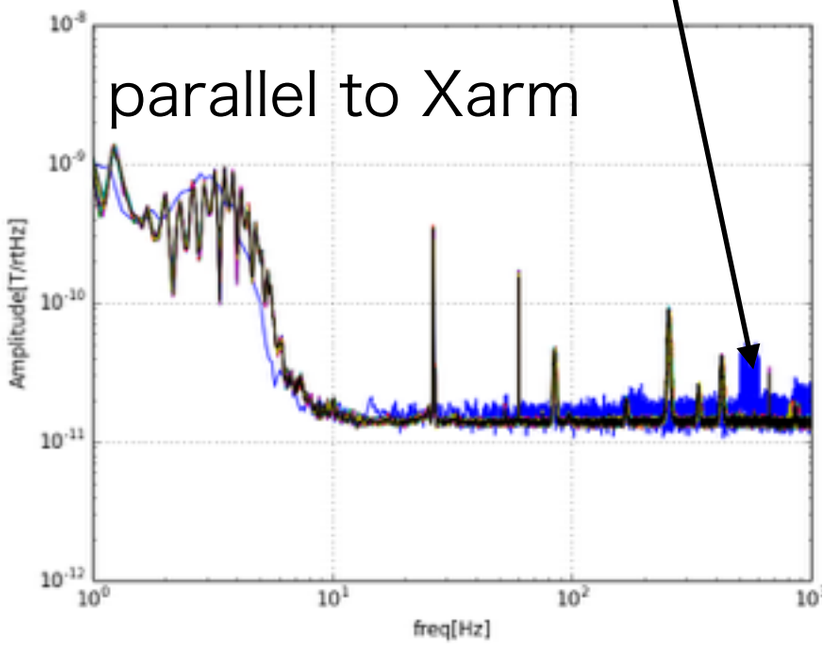
- Anyway, we tried a long-time measurement with 2kHz sampling rate.

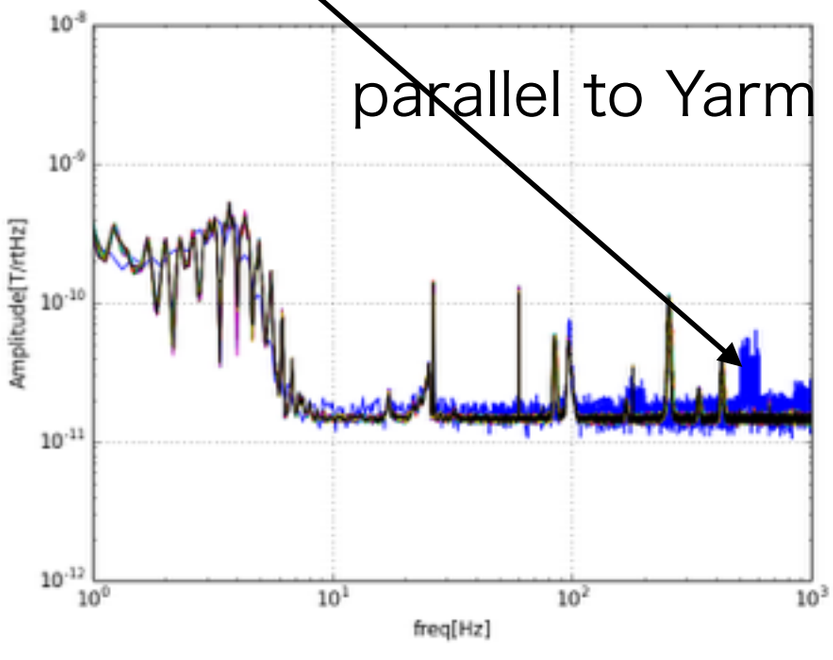
long-time measurement

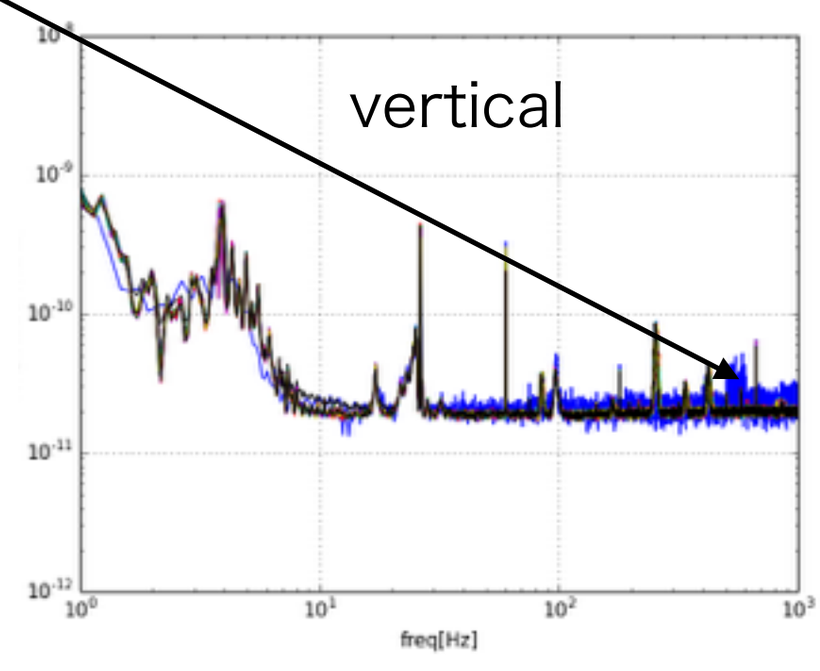
I devided the 20 hours into 20 pieces (Each piece is 1 hour).
Then I made the spectrum of each piece.

blue line…short measurement (2kHz, 2minutes)









We find no large change of the fluctuation during midnight.

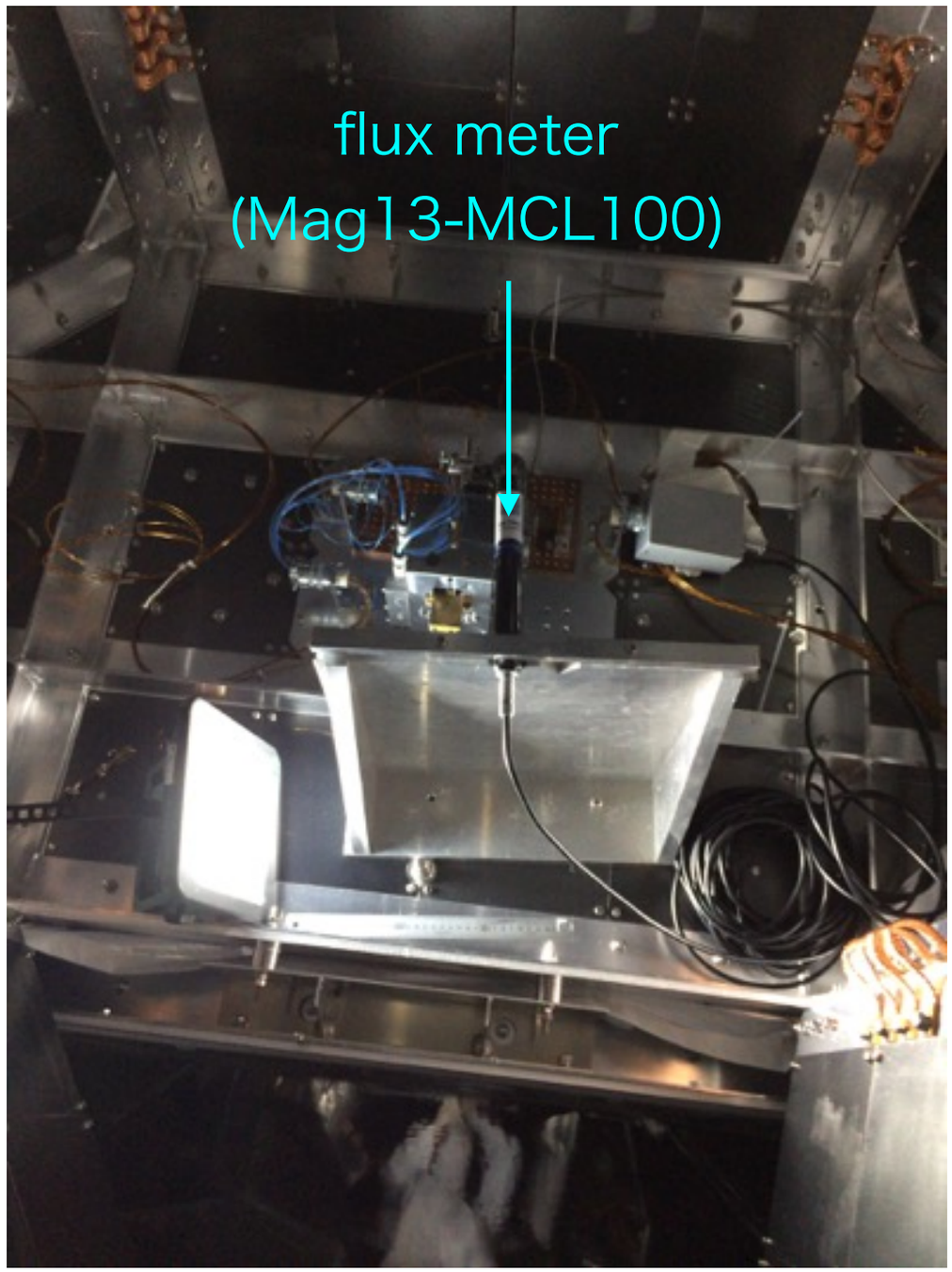
Future work

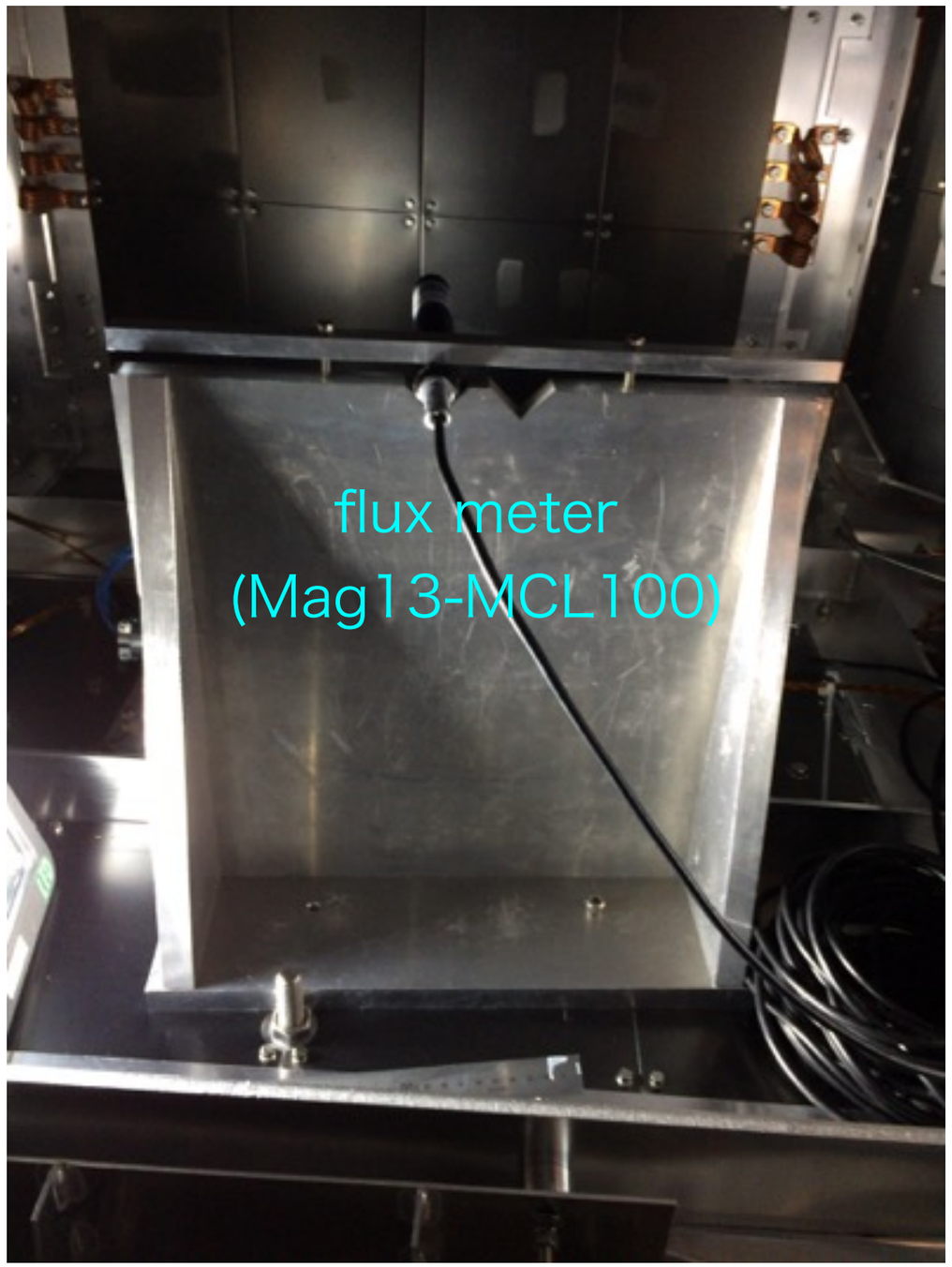
- I will calculate the requirement of the fluctuation of magnetic field.

- I will measure the fluctuation of other cryostats.

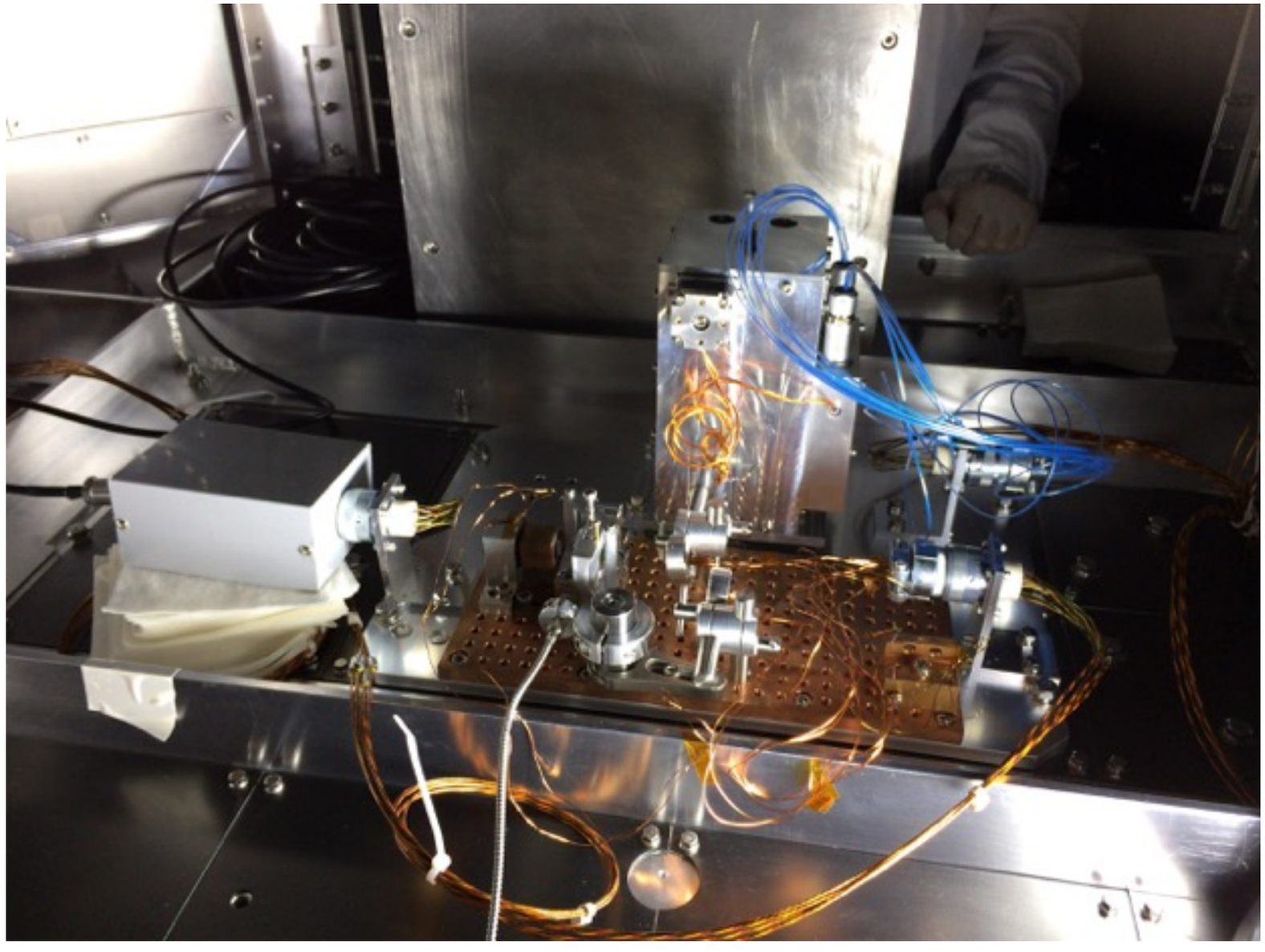
Setup in Kamioka

Inside



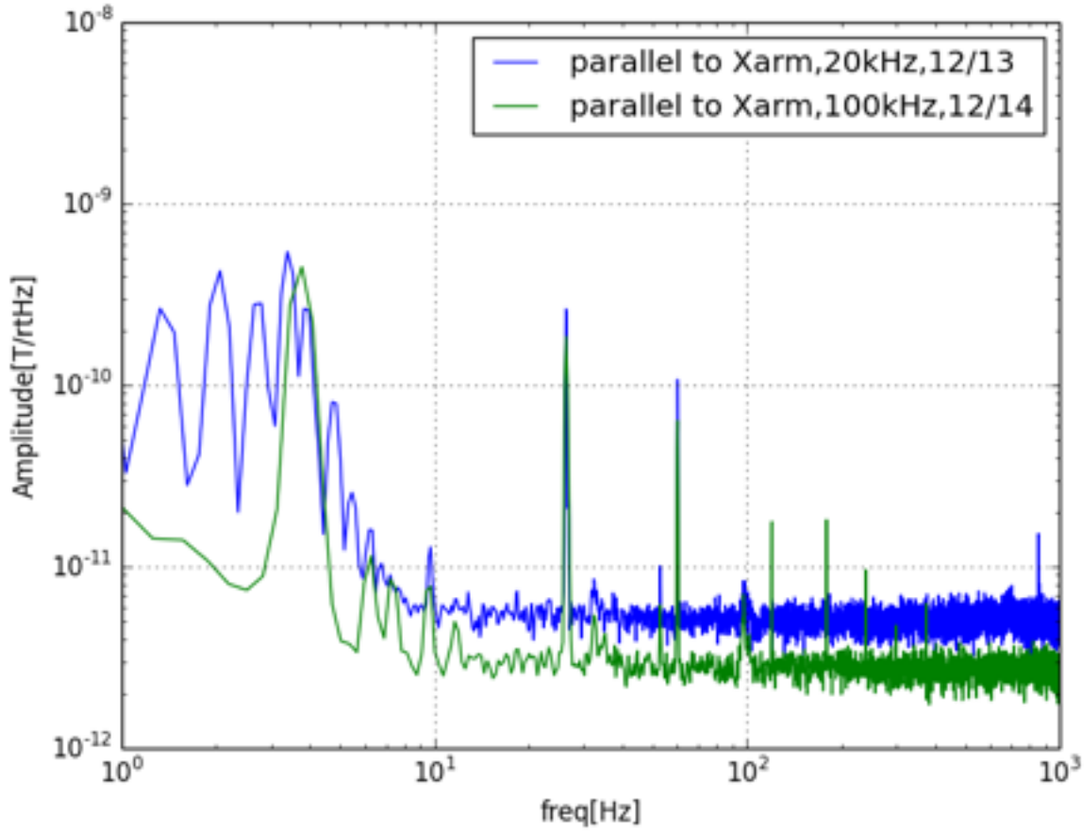


加速度計



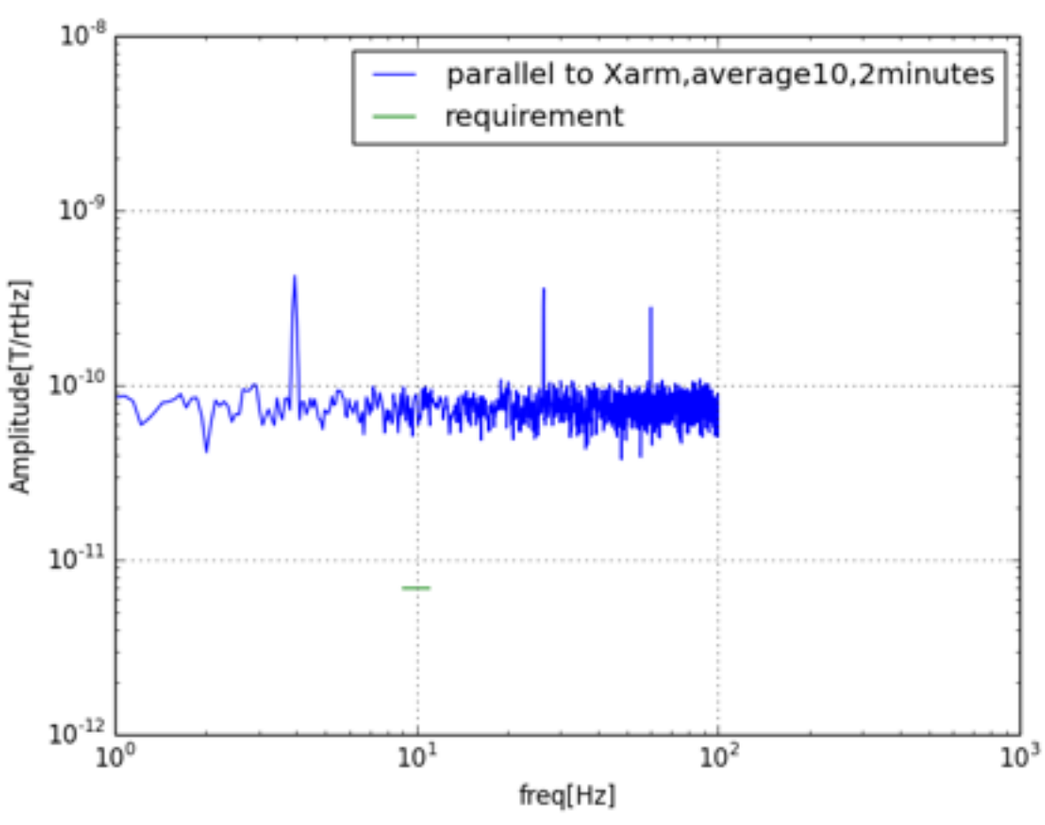
Inside the cryostat

100kHz
parallel to Xarm
average 60
1minute



noise floor…3pT/rtHz

200Hz
parallel to Xarm
average 10
2minutes



noise floor…70pT/rtHz

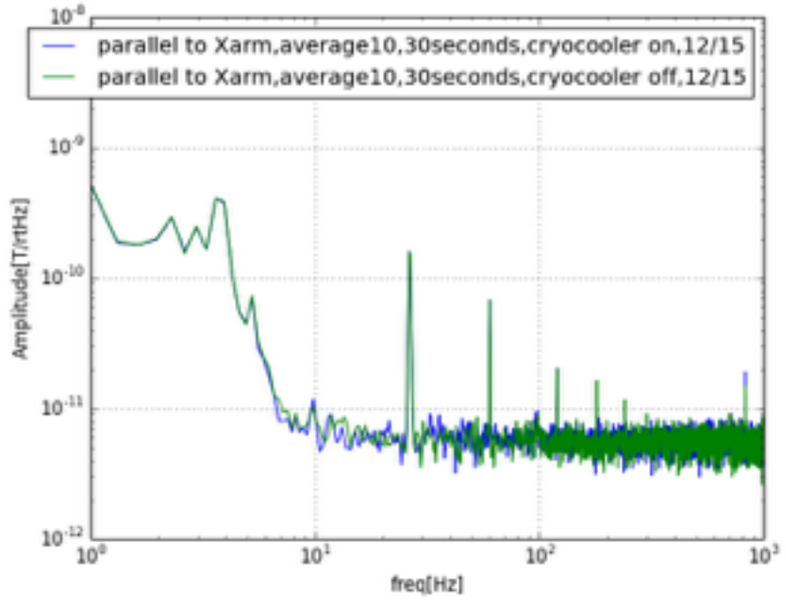
Cryocooler

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.

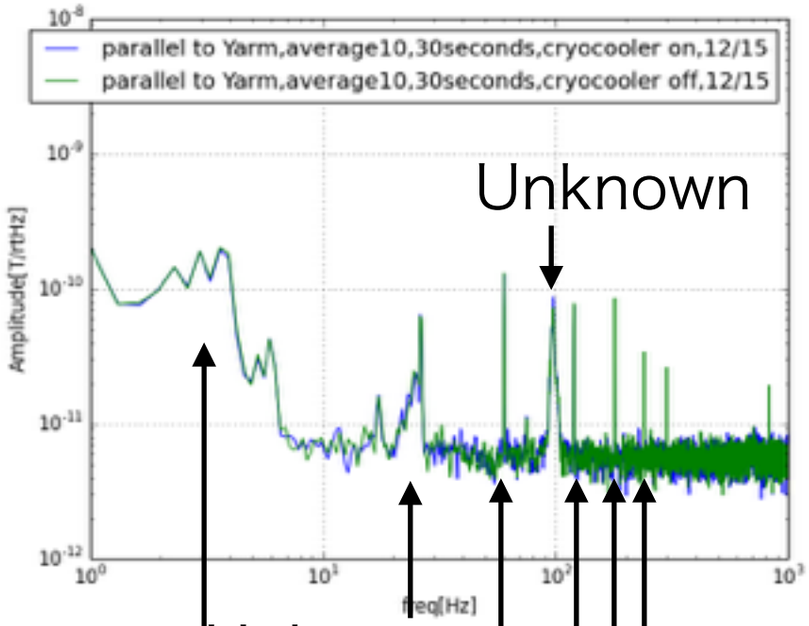
parallel to Xarm



Unknown

Utility frequency

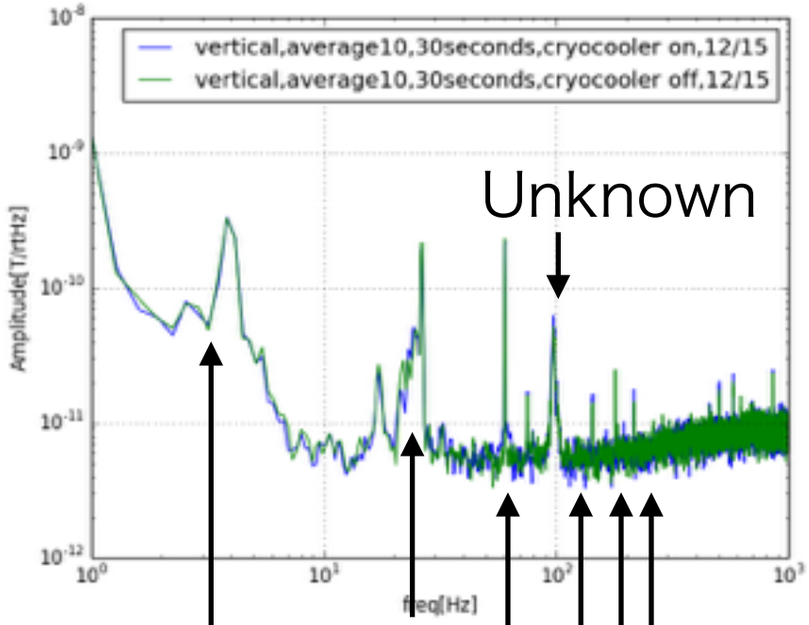
parallel to Yarm



Unknown

Utility frequency

vertical



Unknown

Utility frequency

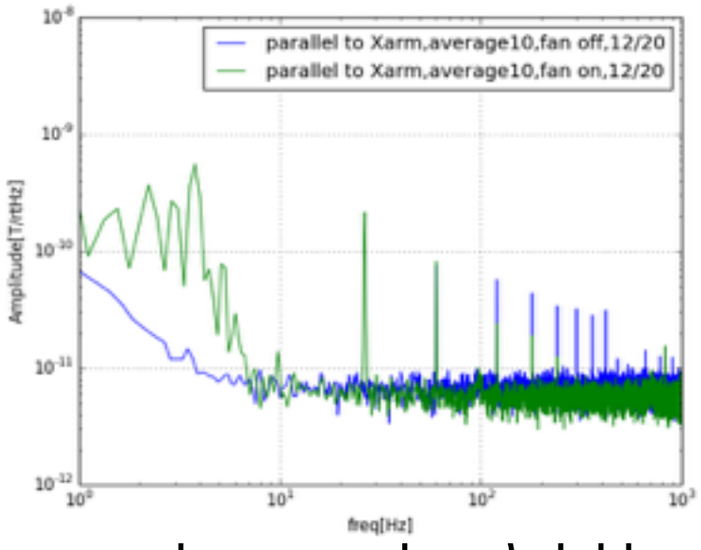
This fluctuation seems to be due to the movement of the fan (I will explain later).

The fan

First we measured the fluctuation while the fan was on.

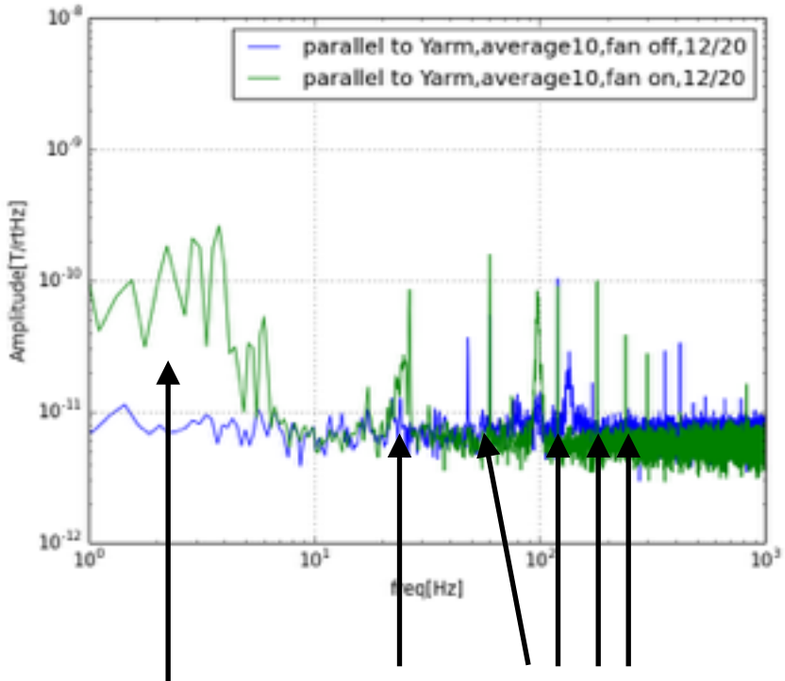
30 minutes later we stopped the fan and measured the fluctuation again.

parallel to Xarm



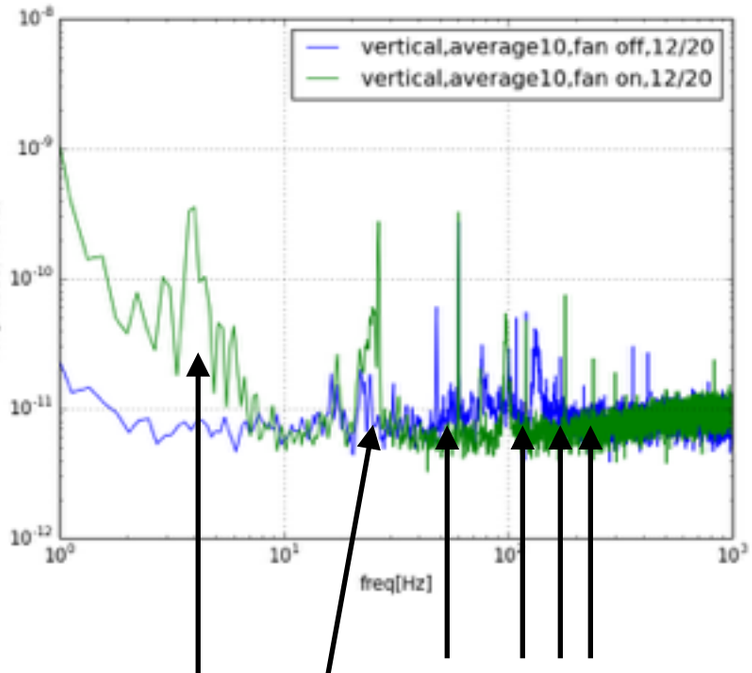
Unknown Utility frequency

parallel to Yarm



Unknown Utility frequency

vertical

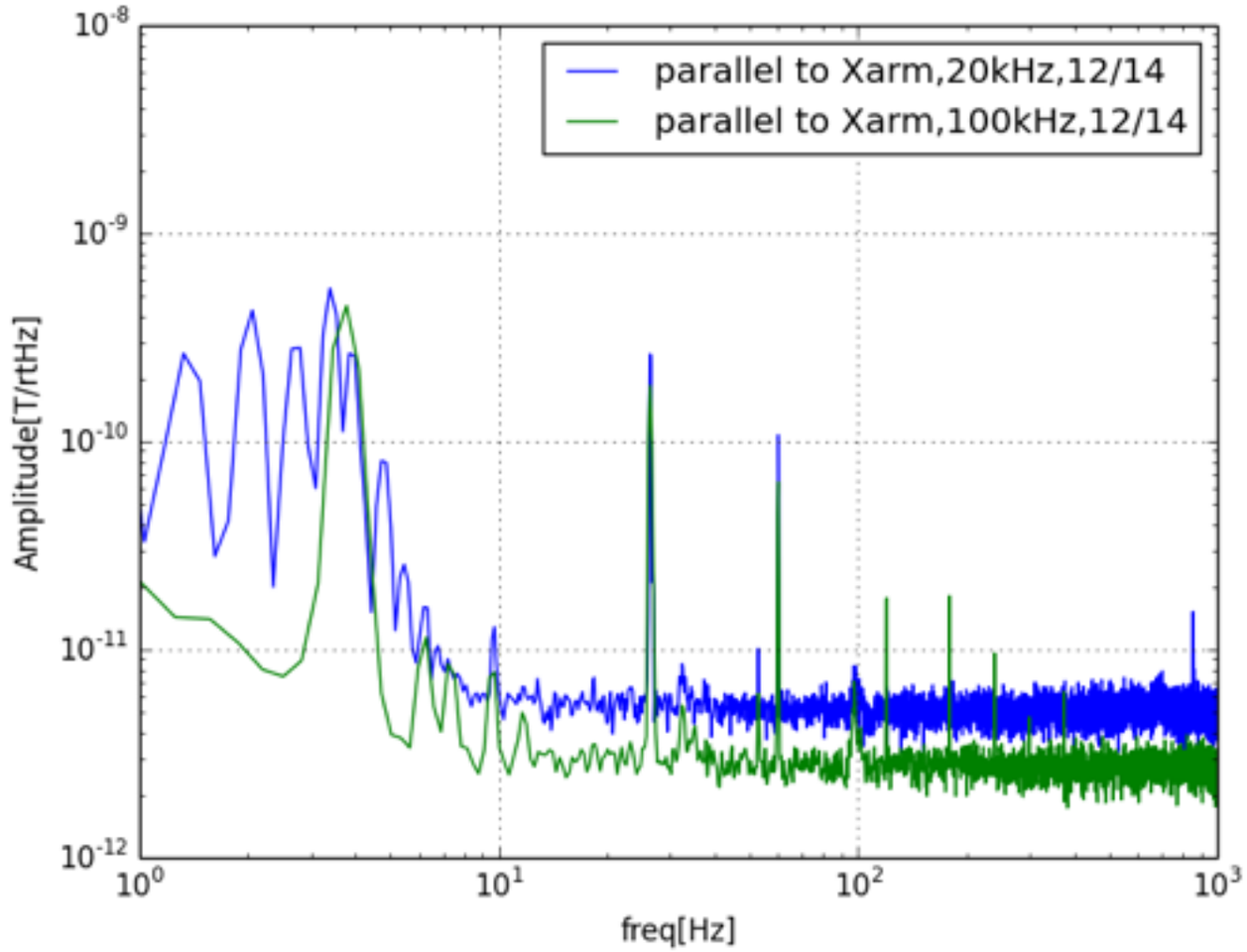


Unknown

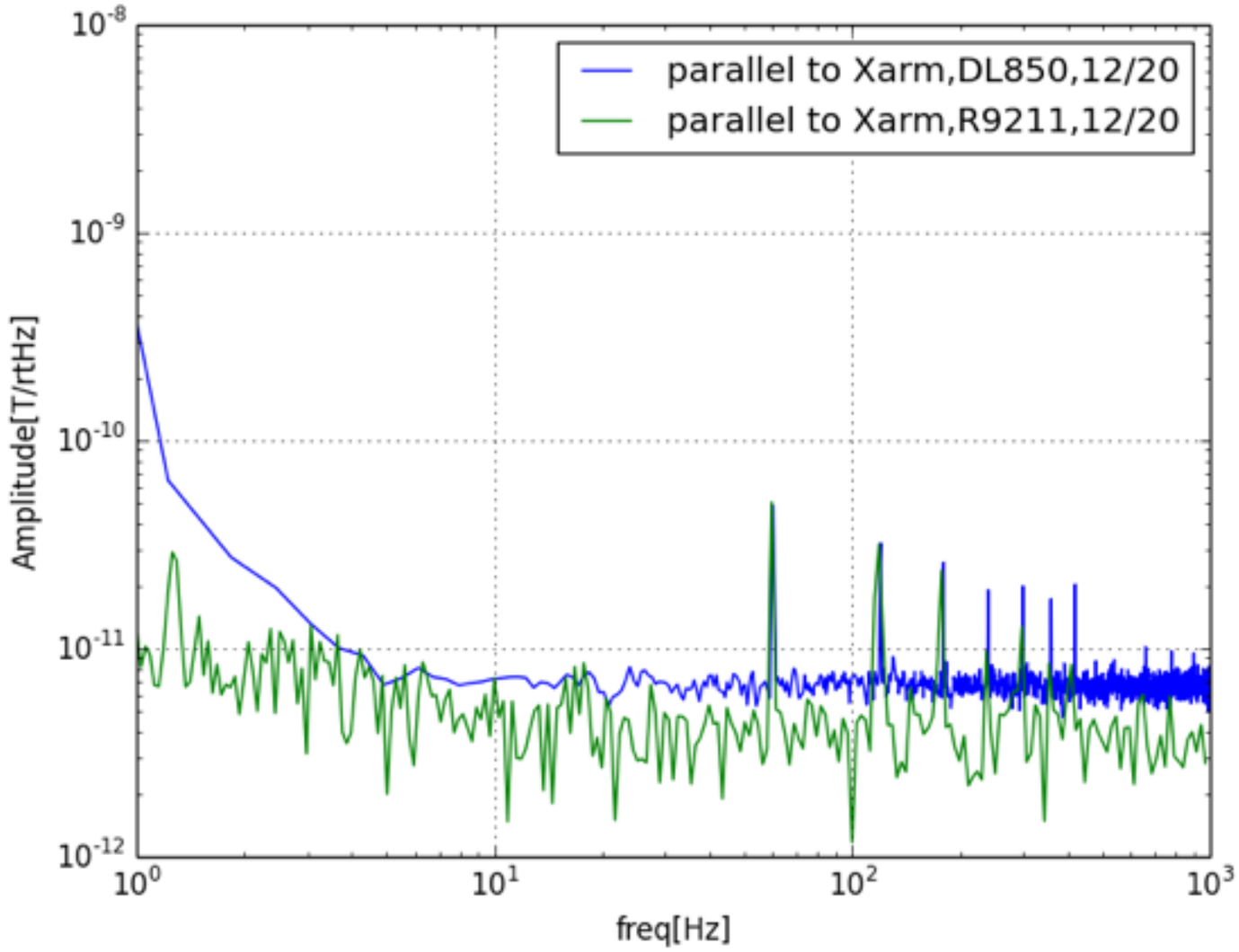
Utility frequency

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

aliasing


parallel to Xarm,20kHz,12/14
parallel to Xarm,100kHz,12/14
Amplitude[T/rtHz]
freq[Hz]
10^-8
10^-9
10^-10
10^-11
10^-12
10^0
10^1
10^2
10^3

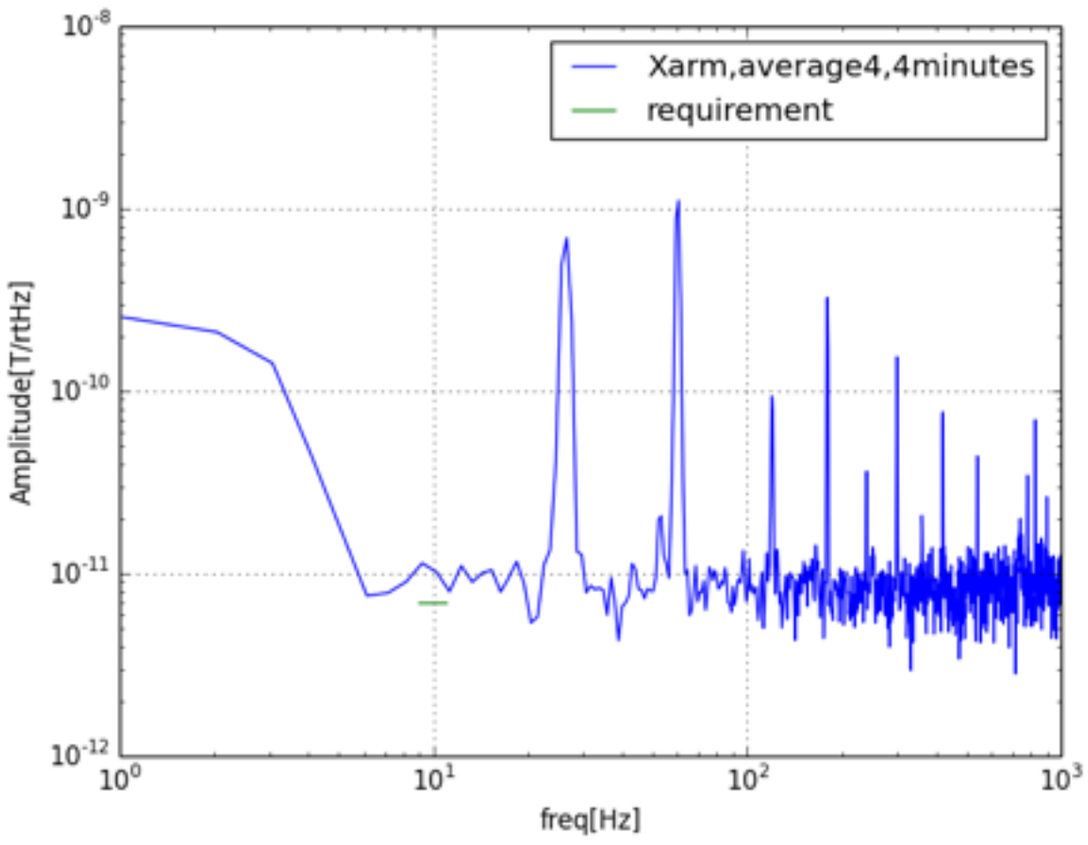
aliasing


parallel to Xarm,DL850,12/20
parallel to Xarm,R9211,12/20
Amplitude[T/rtHz]
freq[Hz]
10^-8
10^-9
10^-10
10^-11
10^-12
10^0
10^1
10^2
10^3

Two modes (Outside)

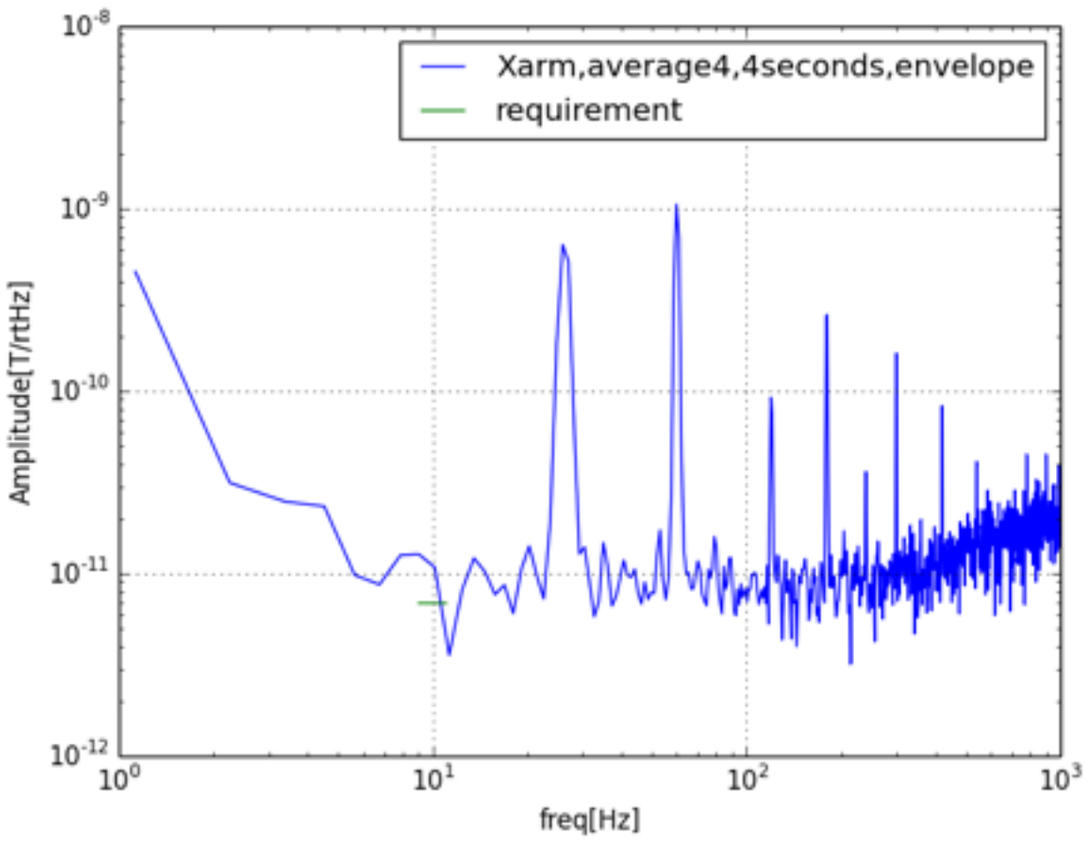
sampling rate 20kHz

normal mode

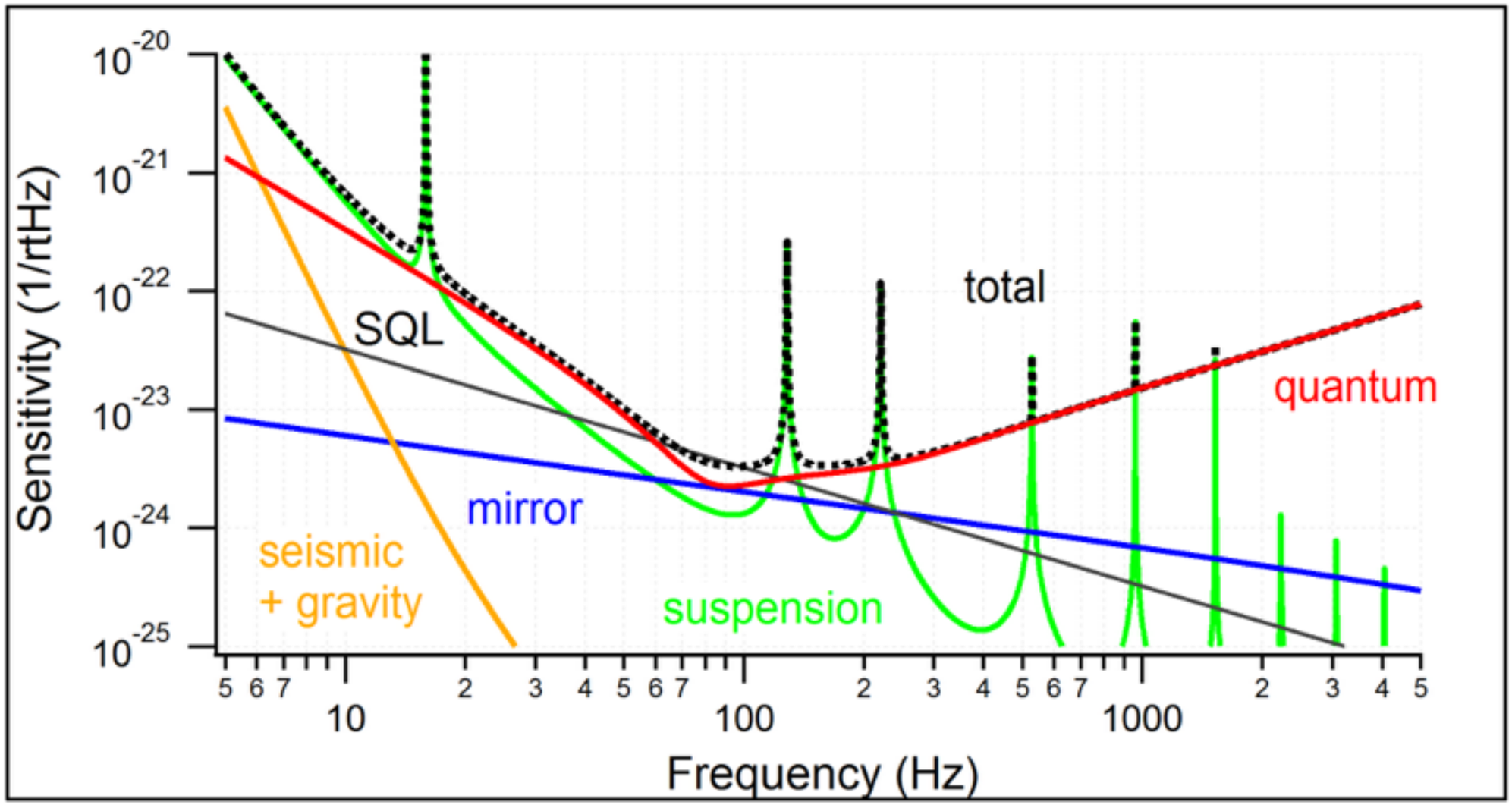


sampling rate 20kHz

envelope mode



感度曲線



出典…KAGRA HP

Plan for JPS meeting

- -Jan. 2017 Calculate the noise due to the magnetic field
- Feb. 2017 Measure the magnetic field of other cryostats.
- Mar. 2017 Make the presentation

梶田先生ミーティング回答

- Schumann共振は1pT/rtHzのとき2e-20(m/rtHz)すなわち6.7e-24(/rtHz)なのでそもそも他のノイズに埋もれて見えない。