Our work in 2016

12-1

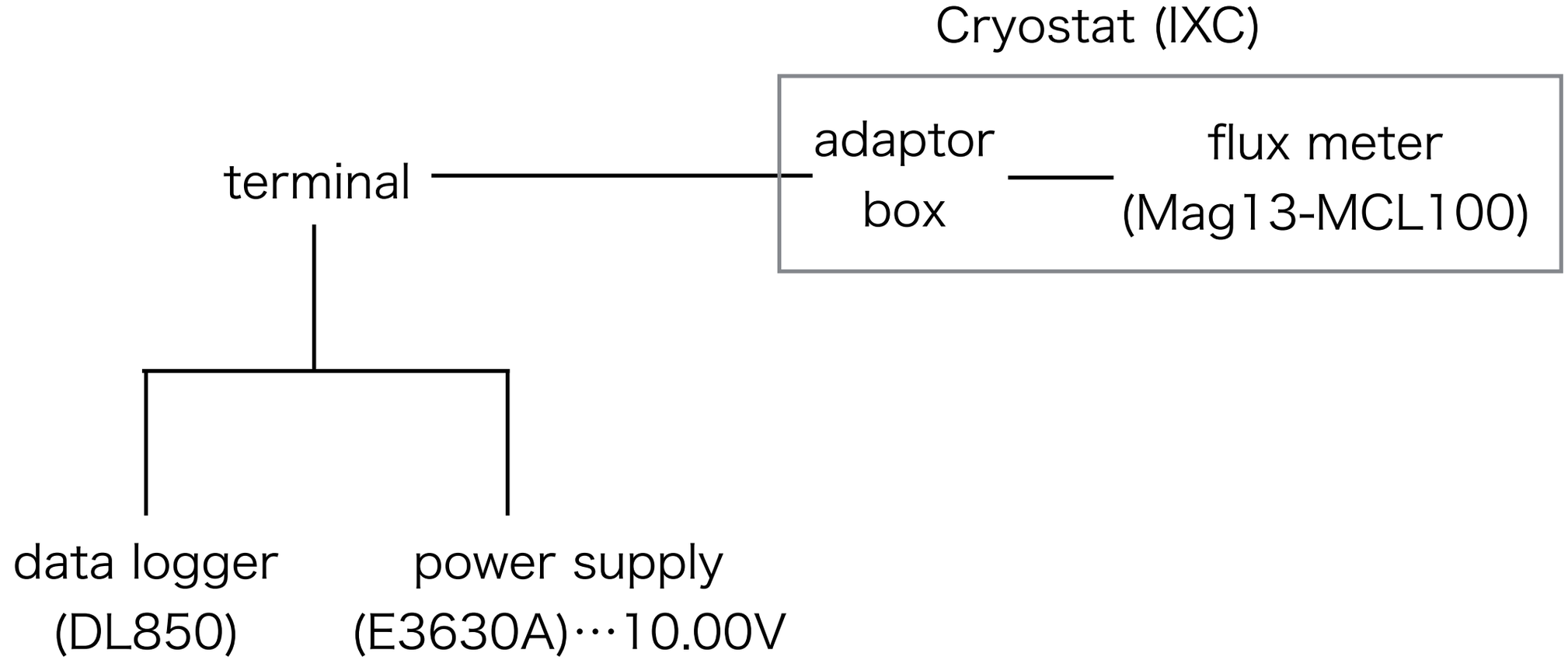
Hiroki Tanaka

Purpose

- In KAGRA, the requirement of the fluctuation of magnetic field in the cryostats is less than 7pT/rtHz@1Hz(http://gwwiki.icrr.u-tokyo.ac.jp/JGWwiki/KAGRA/subgroup/ifo/MIF/Minutes20160125).

- We measured the fluctuation of the magnetic field in X-front cryostat (IXC) on 12/12-12/20.

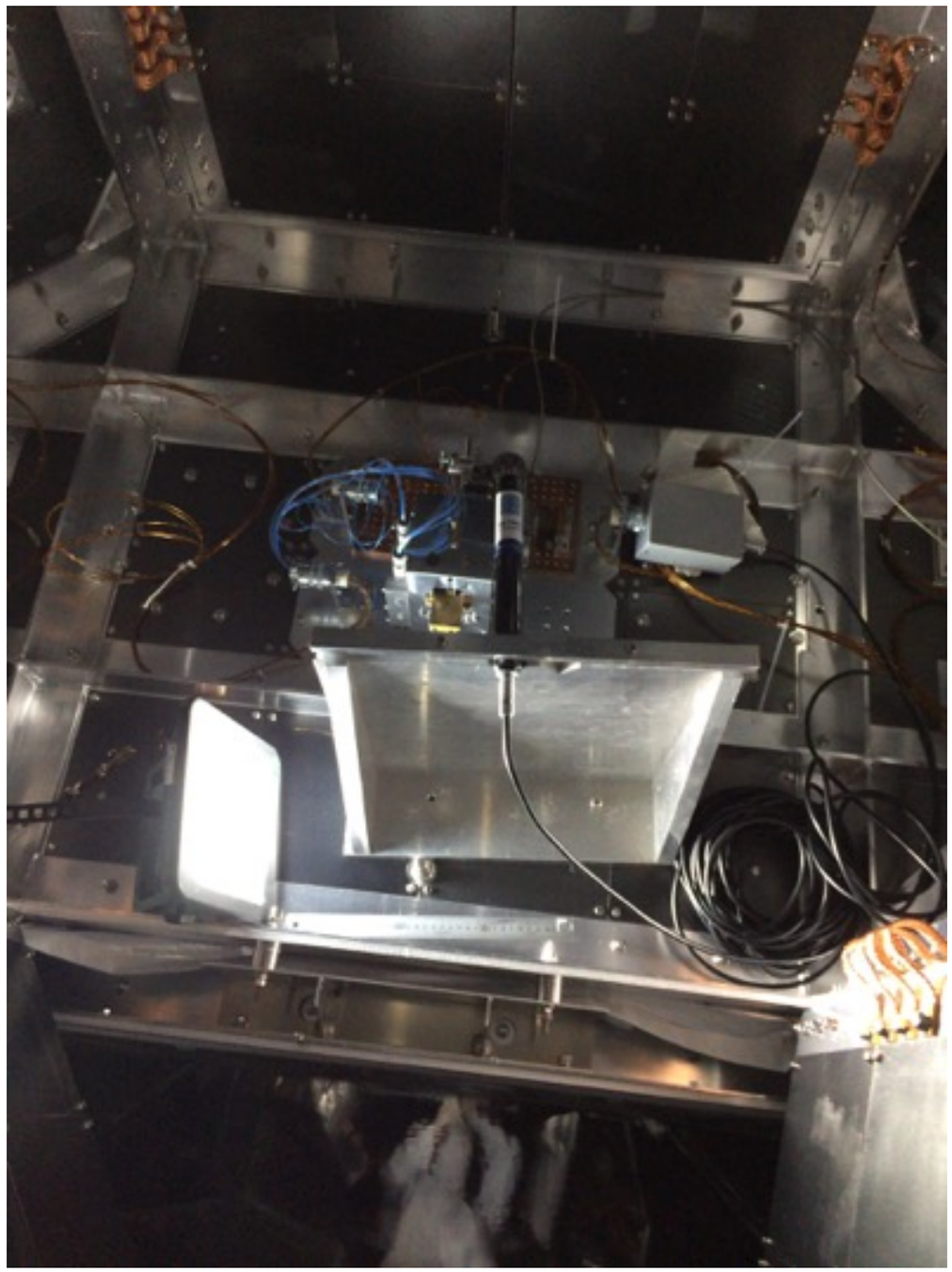
Setup in Kamioka

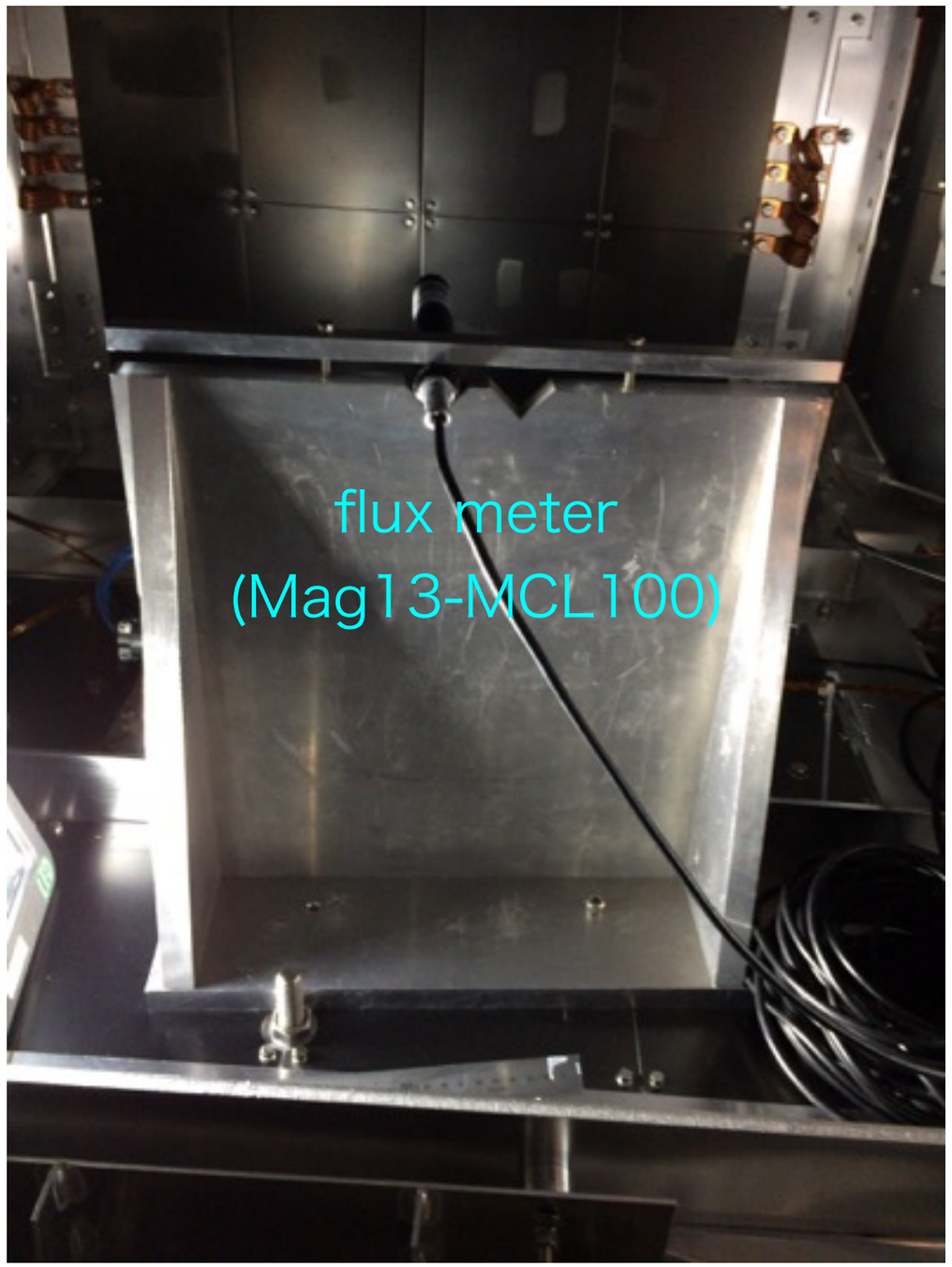


When we use Mag13-MCL100, we can measure all components (xyz).

Setup in Kamioka

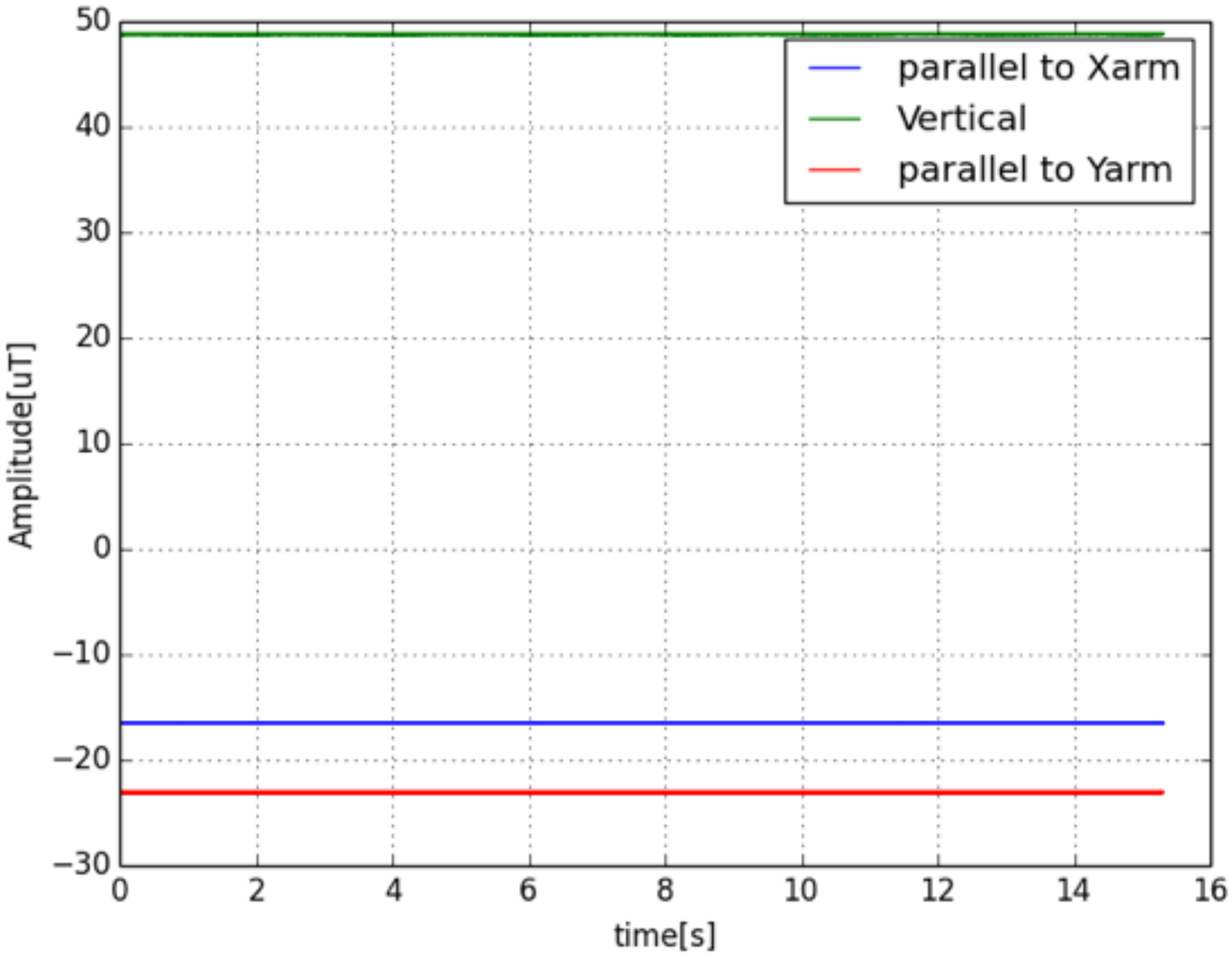
Inside





DC component

All components were comparable to the Earth's magnetic field.

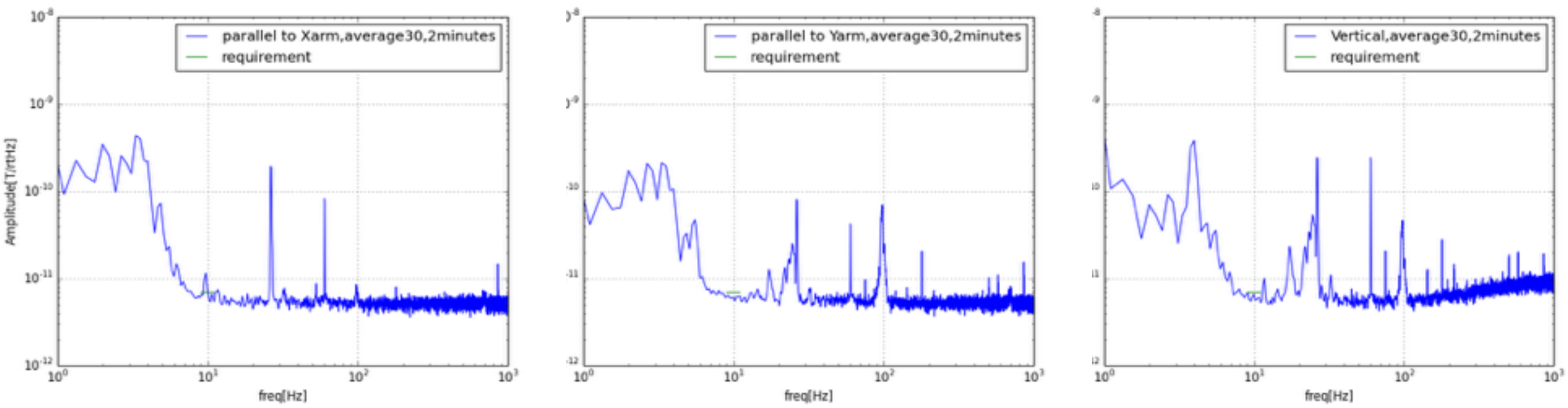


Inside the cryostat

We used AC coupling.

Sampling rate 20kHz、2minutes、average 30

parallel to Xarm　parallel to Yarm　Vertical

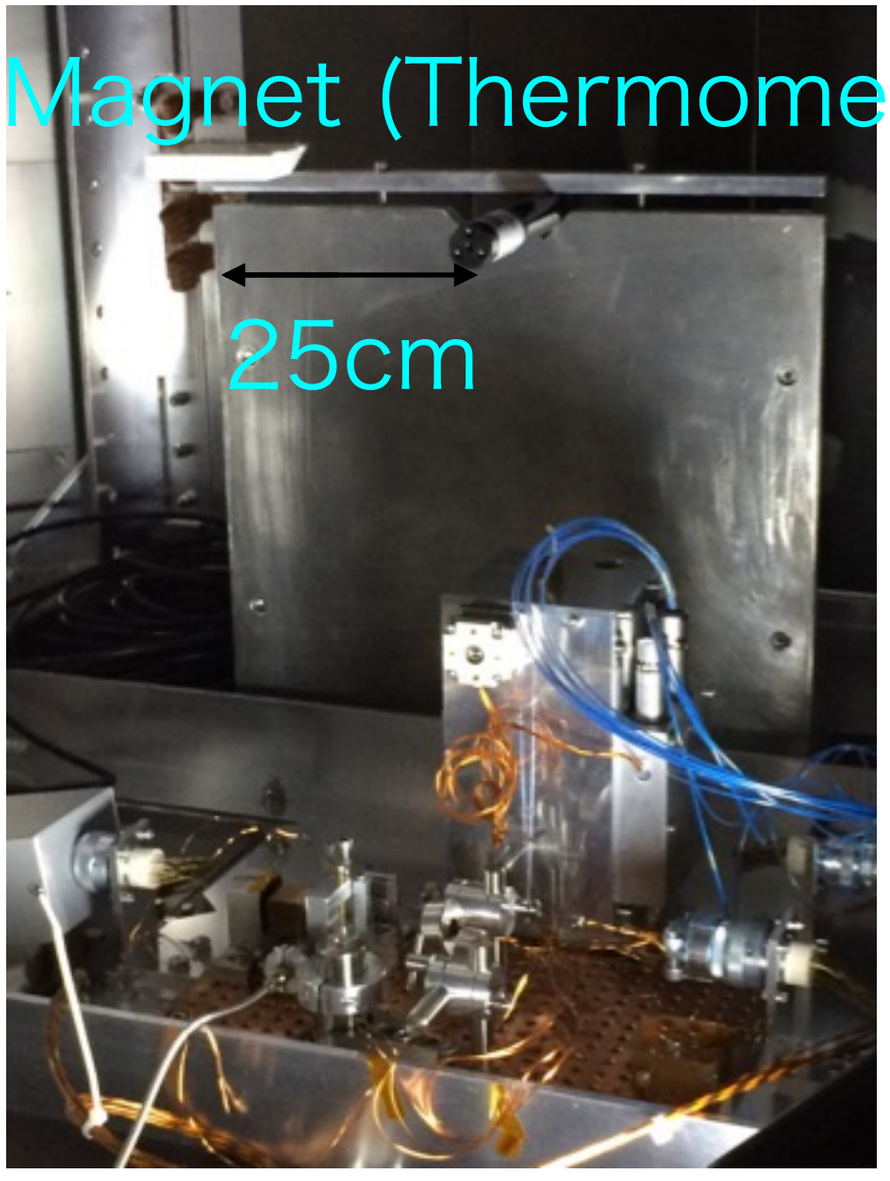


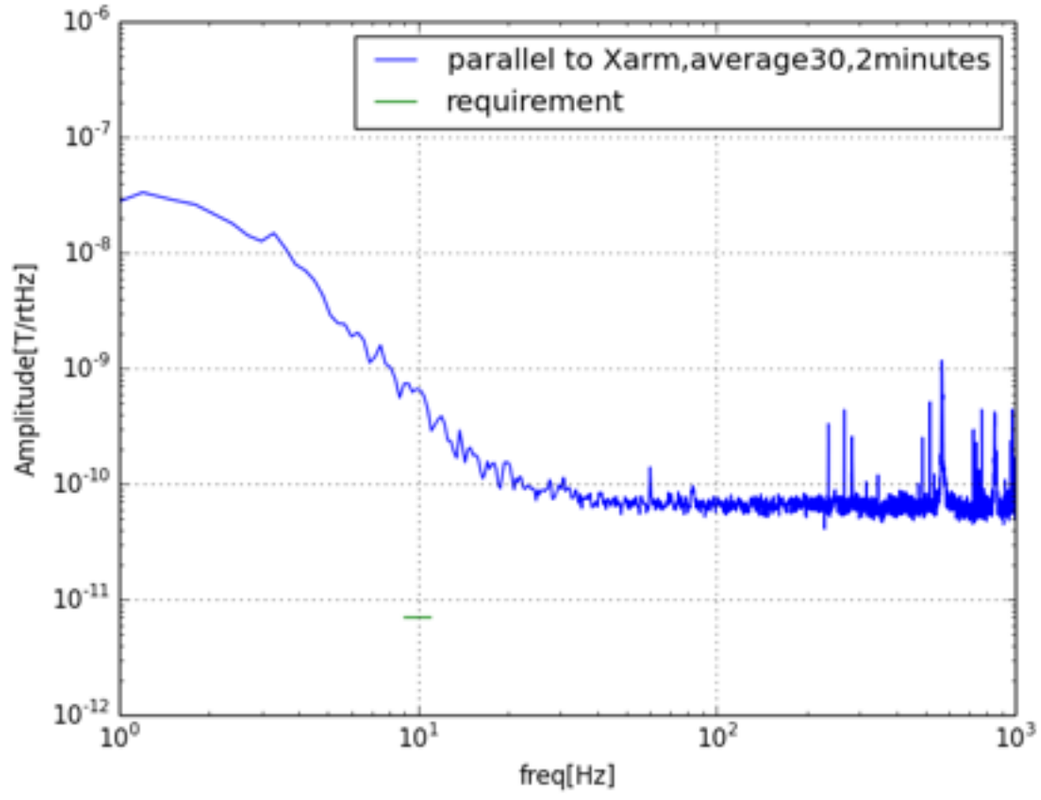
The noise floor was about 5pT/rtHz.

I am still analyzing these results.

Magnet measurement

2kHz、2 minutes、parallel to Xarm、average30



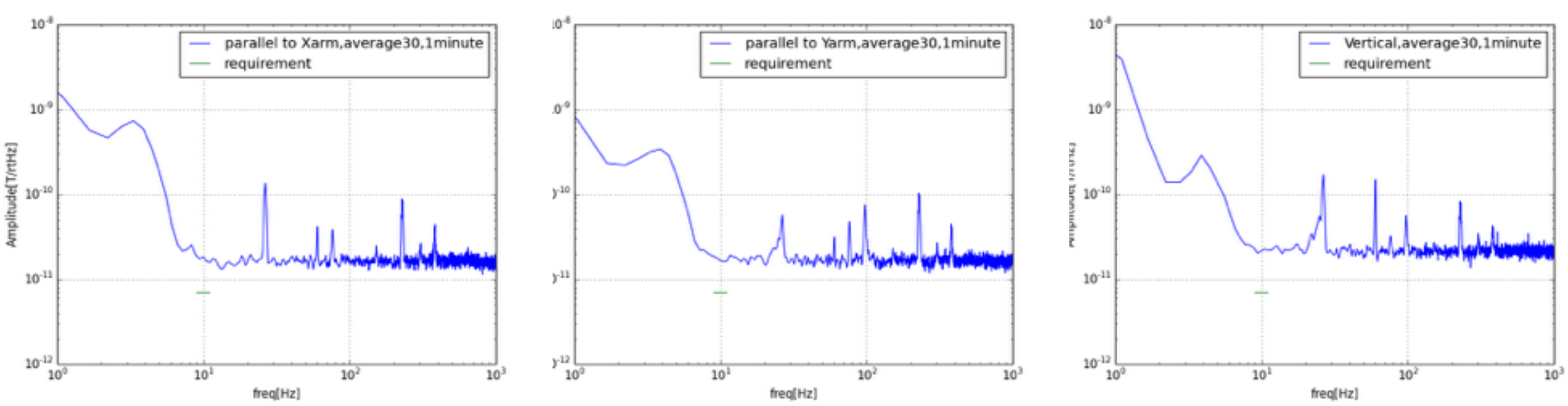


The fluctuation became much larger.

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.

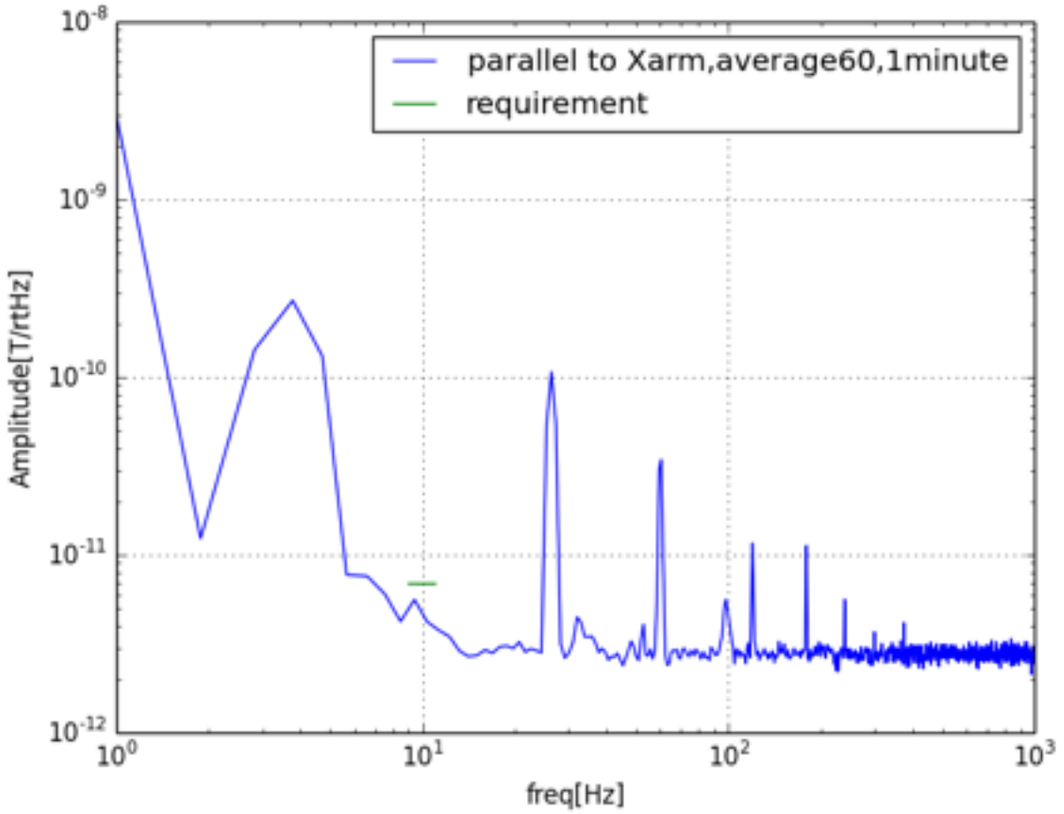
Sampling rate

- 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.

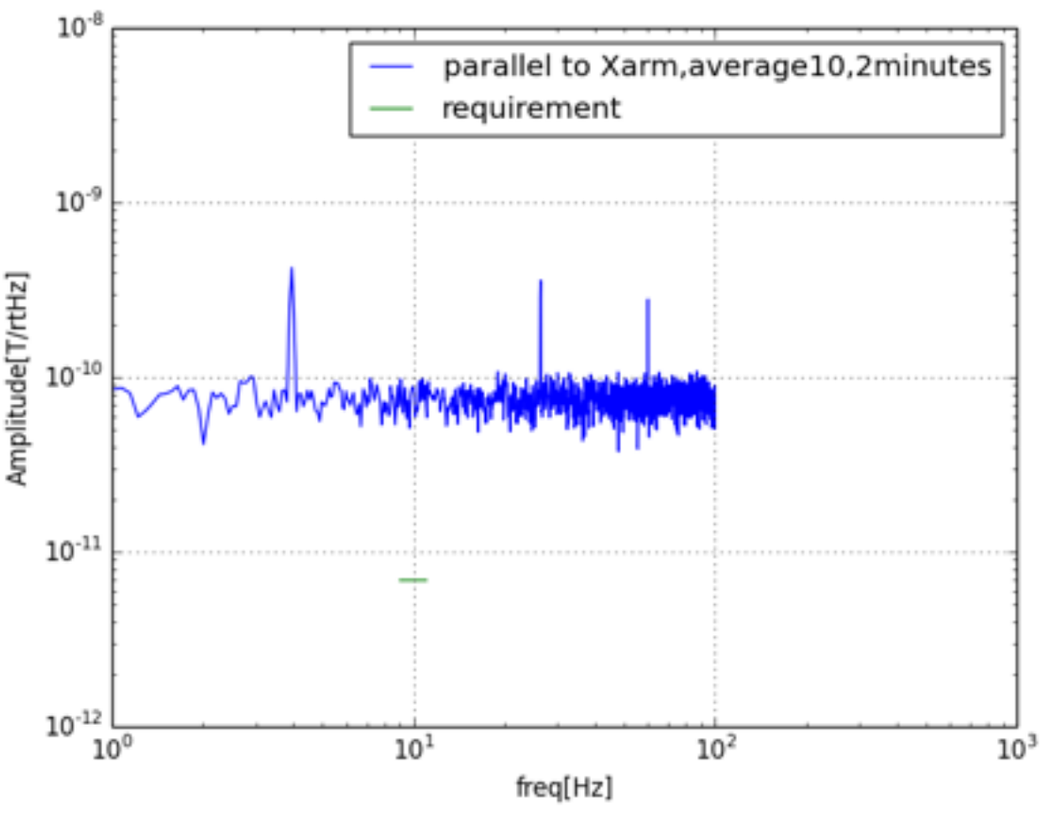
Inside the cryostat

100kHz
parallel to Xarm
average 60
1minute



noise floor…3pT/rtHz

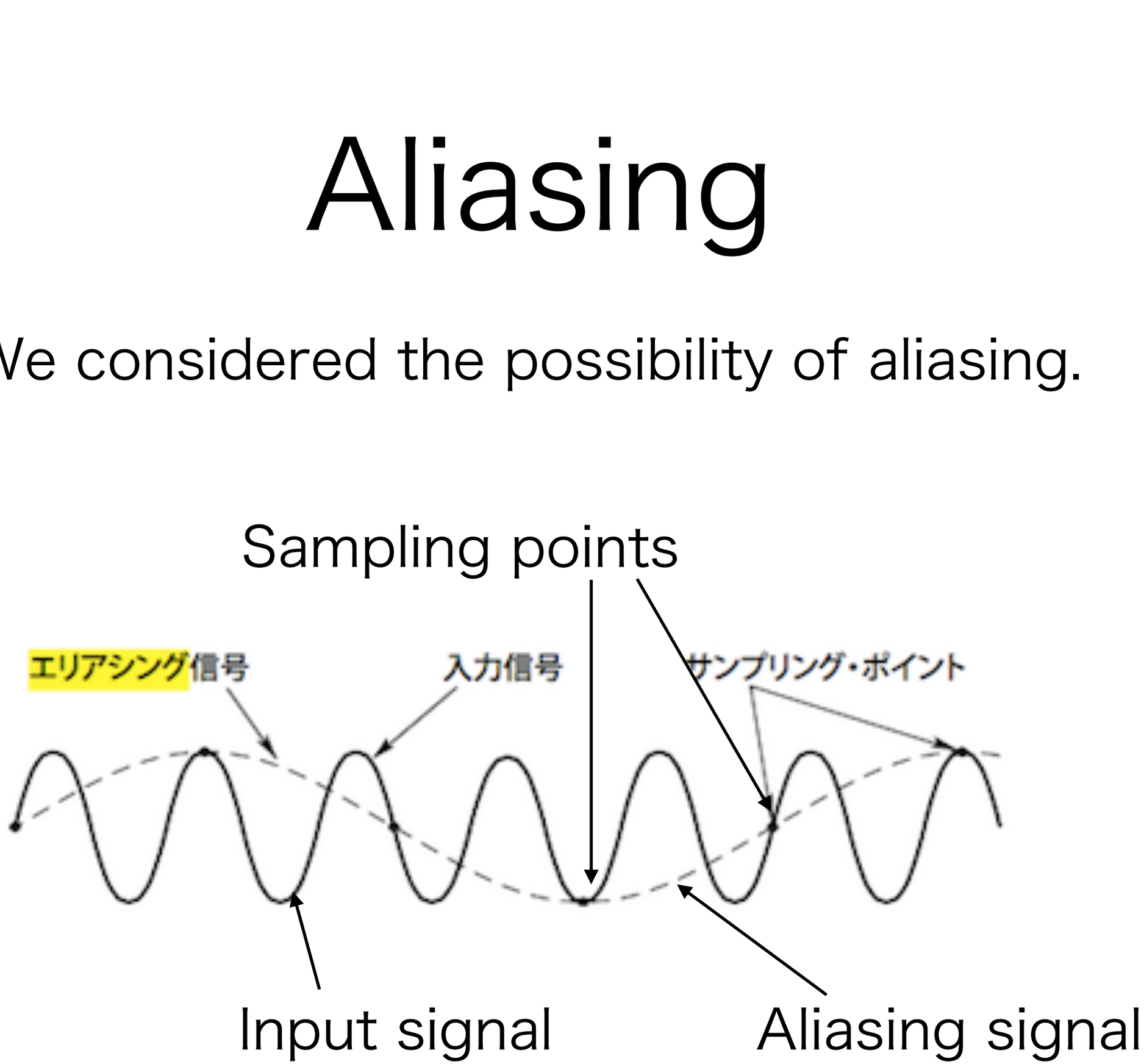
200Hz
parallel to Xarm
average 10
2minutes



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.

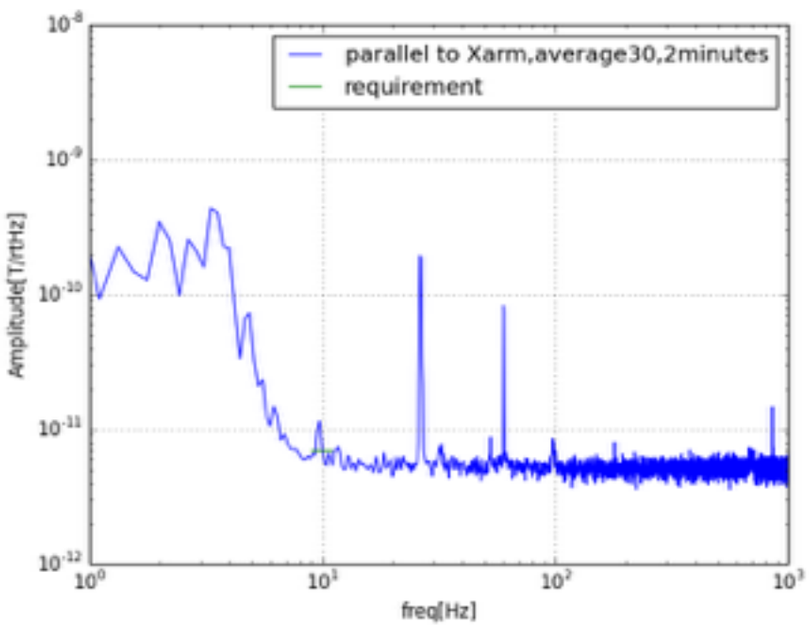
(1){x_1, x_{11}, x_{21},…}

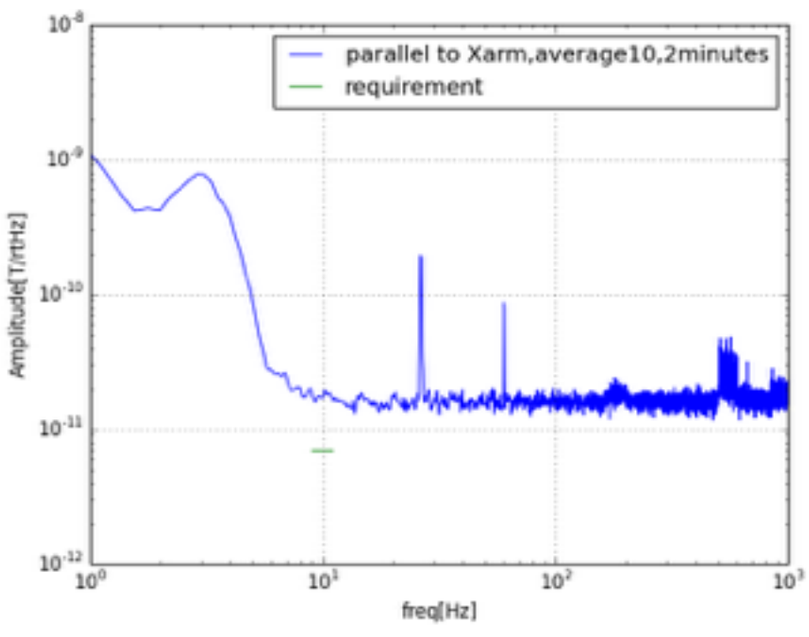
(2){(x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8+x_9+x_{10})/10,…}

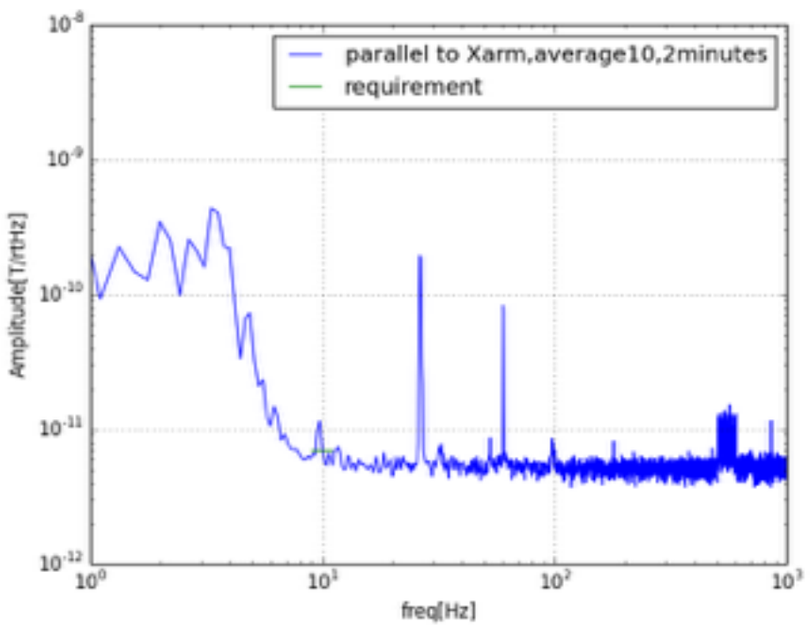
If the aliasing occurs, the noise floor of (2) is smaller than that of (1) because the high-frequency component disappears only in (2).

Checking aliasing in Kashiwa

Raw data (1) (2)





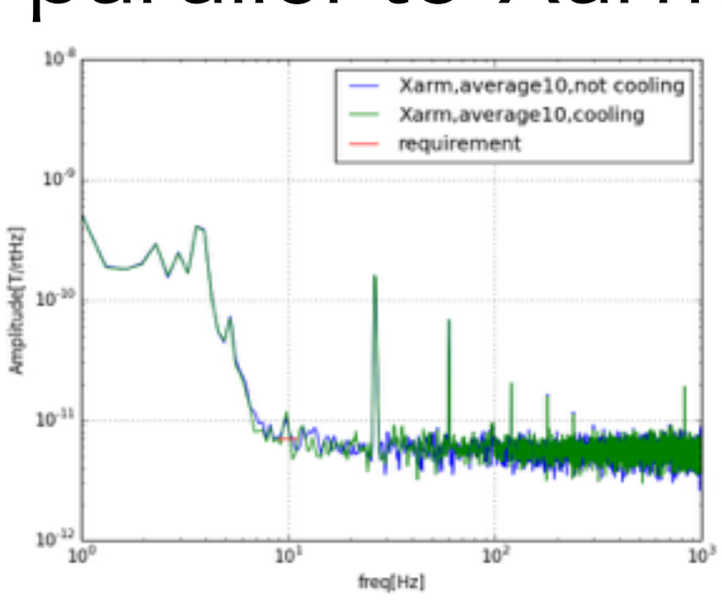


Cryo-cooler

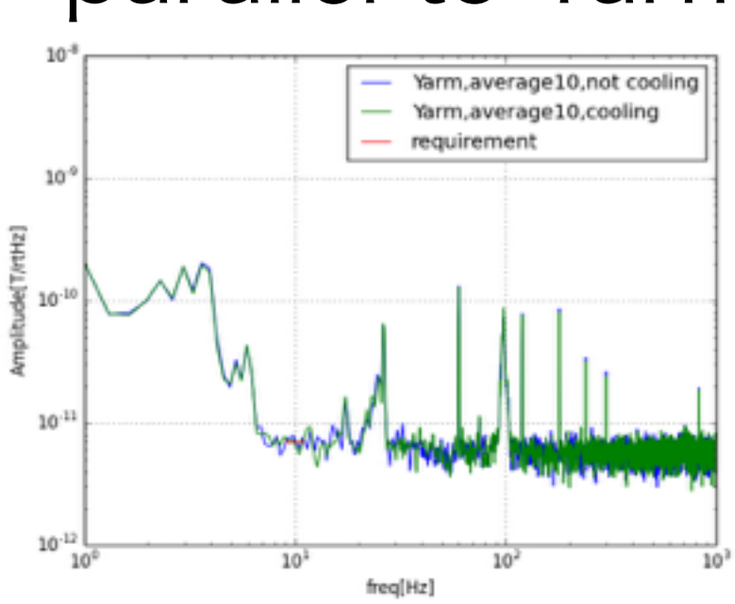
Sampling 20kHz
Measurement time 30 seconds
average 10

We moved the cryocoolers near IXC and checked whether the fluctuation of magnetic field changes or not.

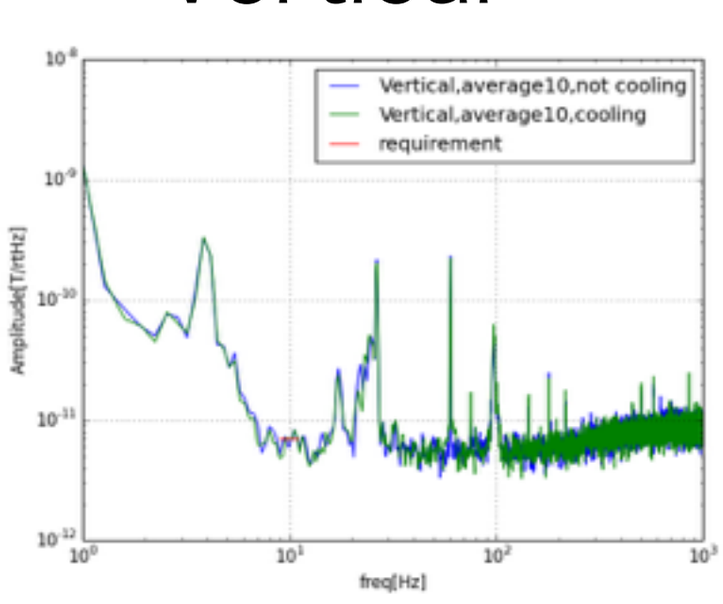
parallel to Xarm



parallel to Yarm



Vertical

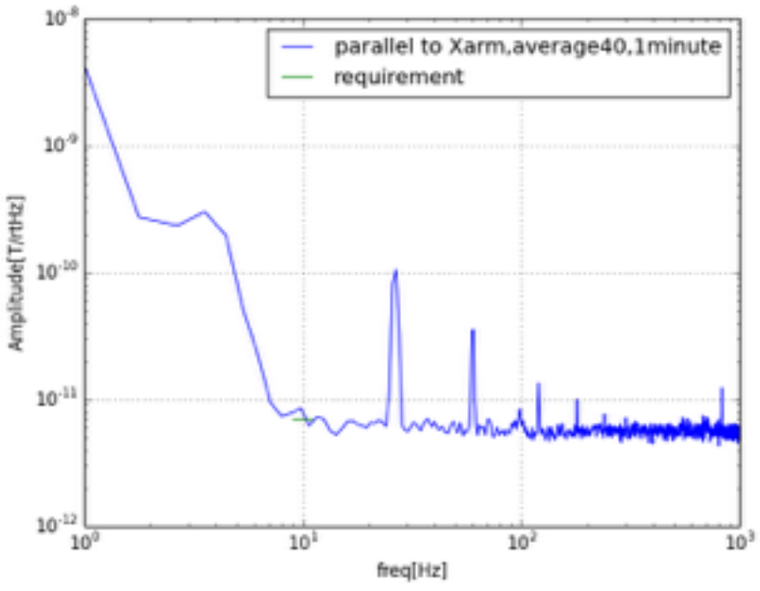


The fluctuation of magnetic field didn't change so much while the cryocoolers were moving.

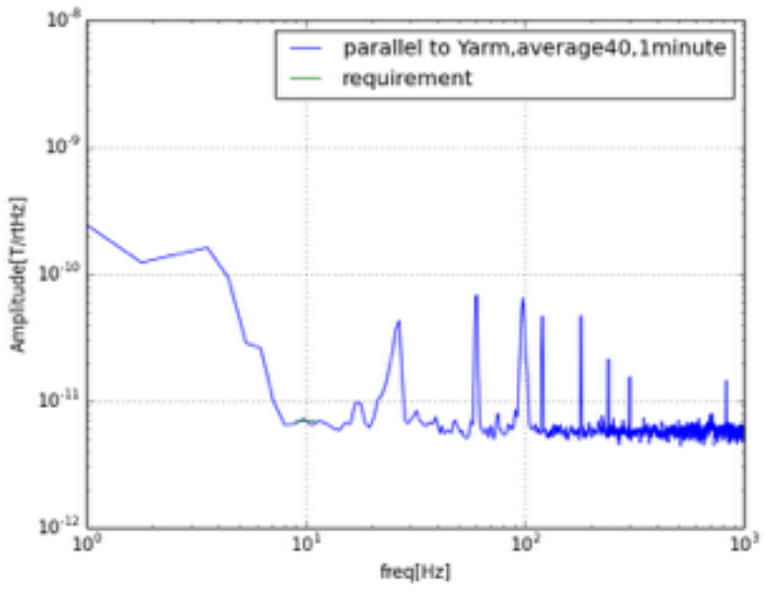
Before stopping the fan

20kHz、average 40、measurement 1minute

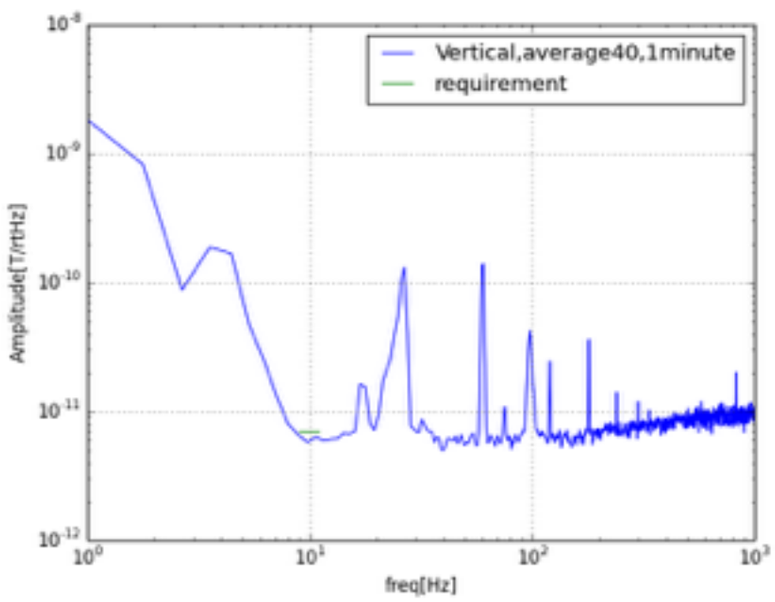
parallel to Xarm



parallel to Yarm

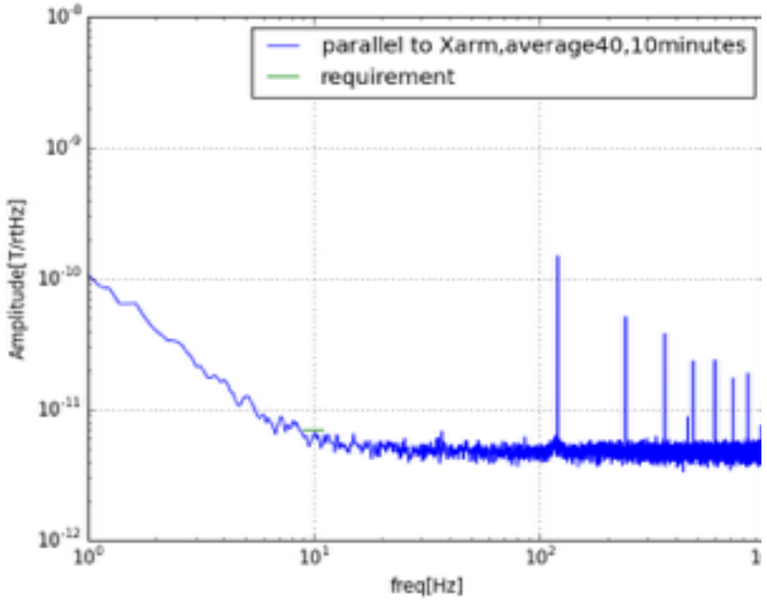


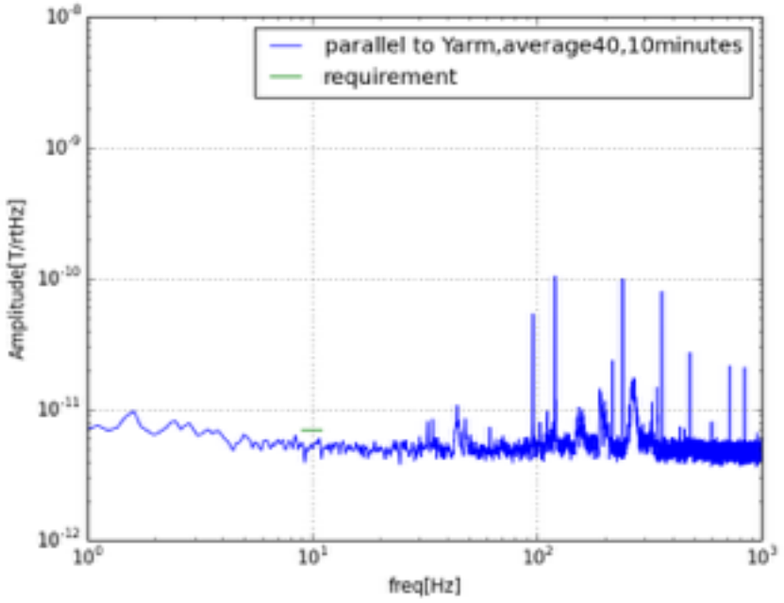
Vertical

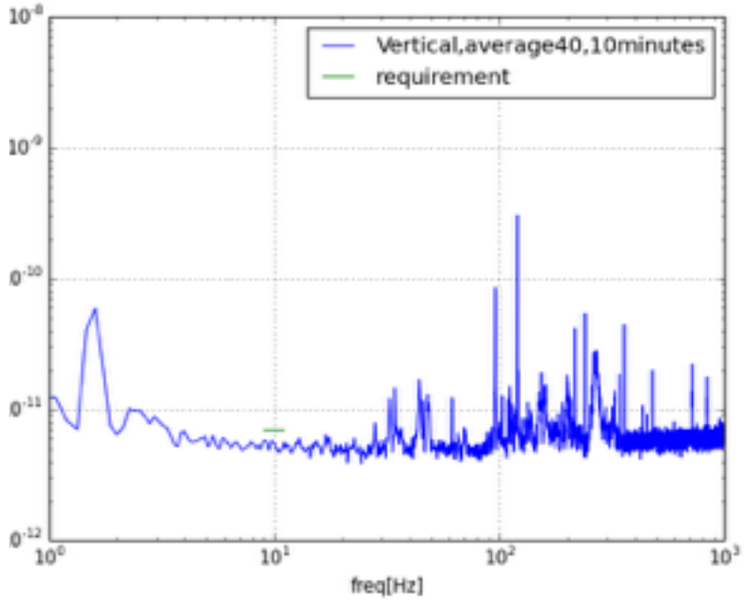


After stopping the fan

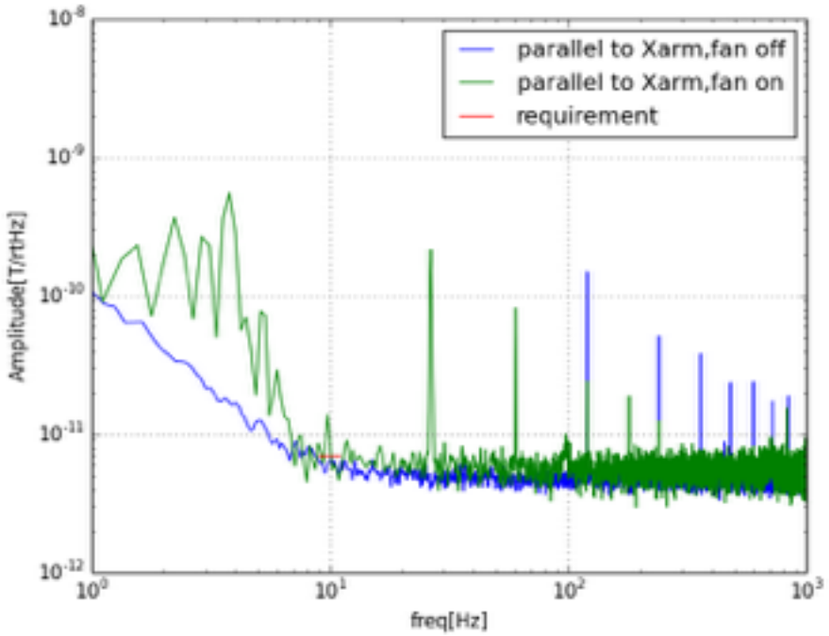
Sampling 20kHz
Measurement time 10 minutes
average 40

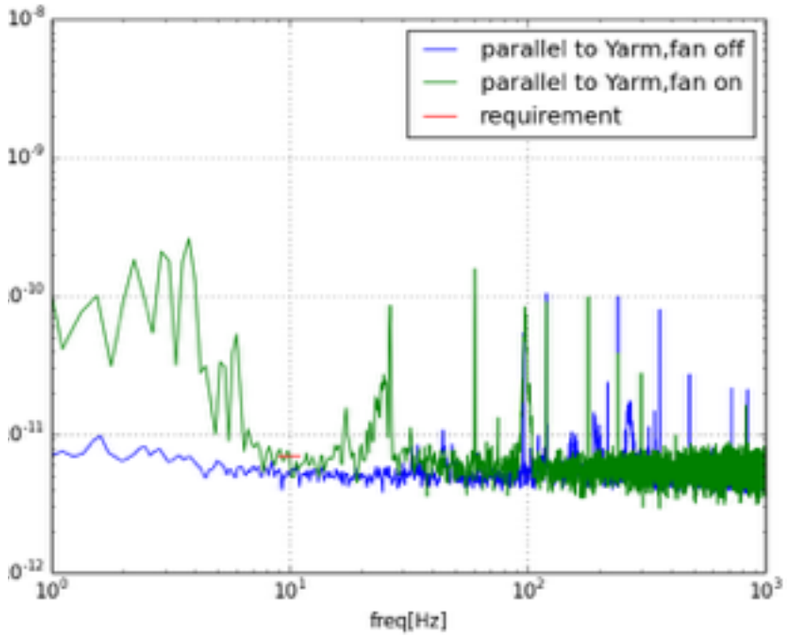


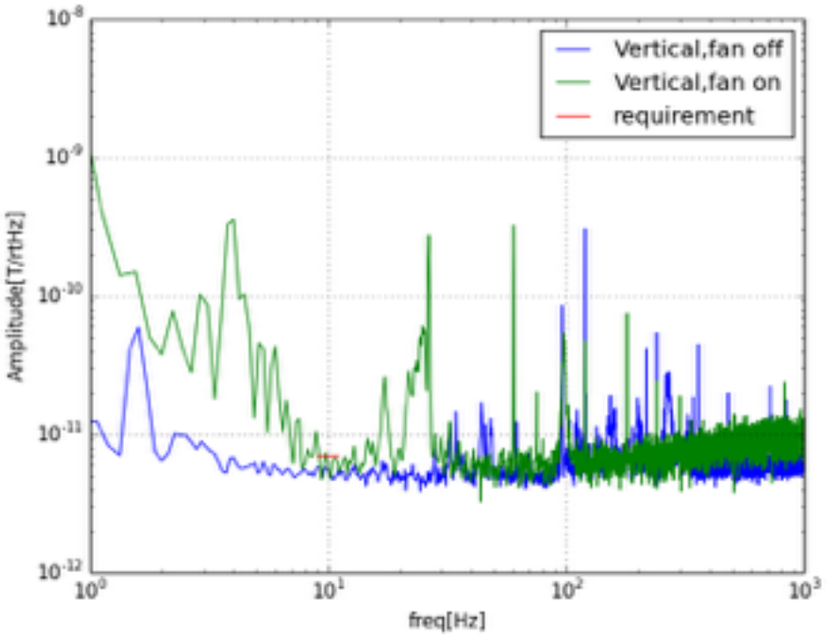




The fan



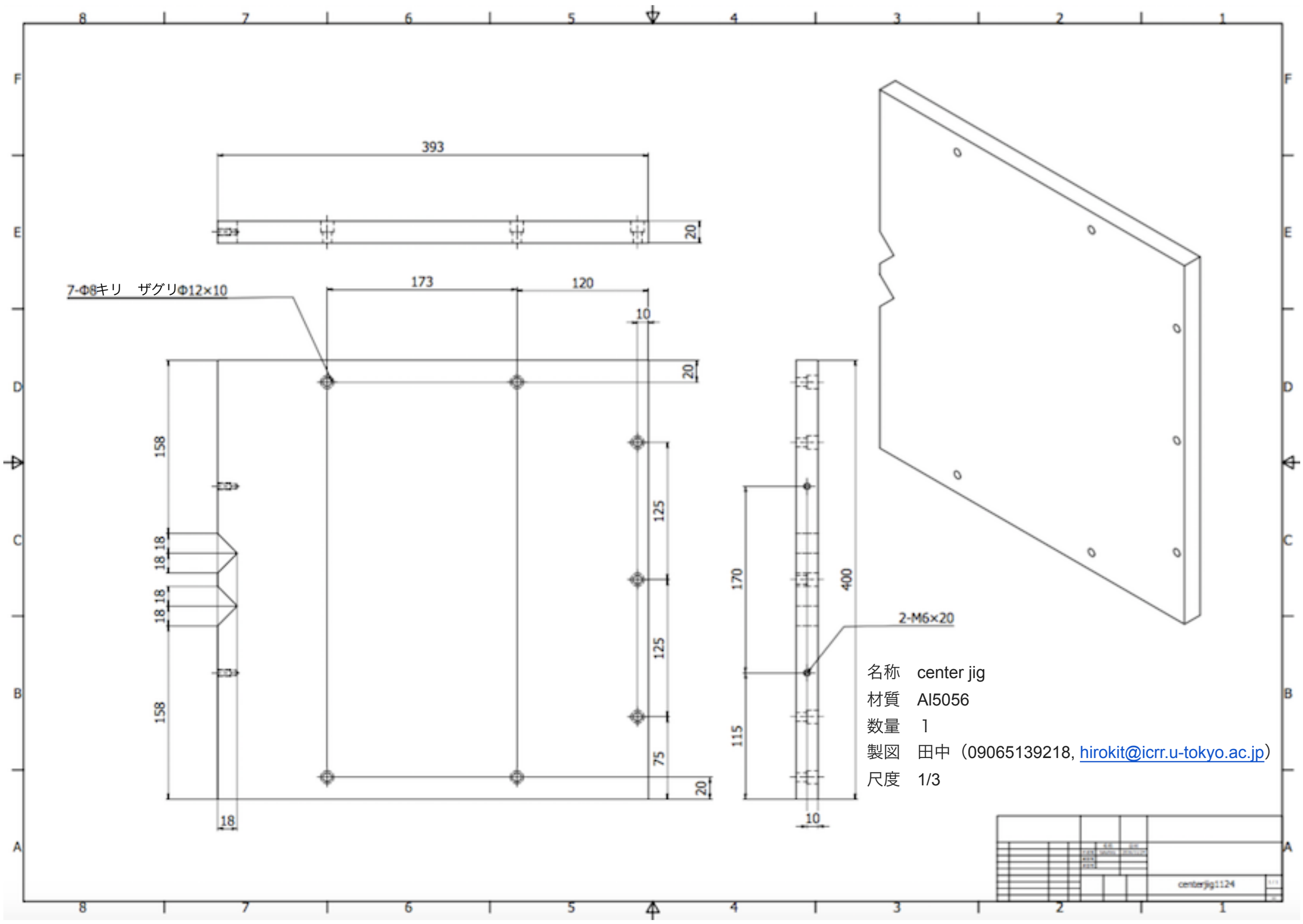


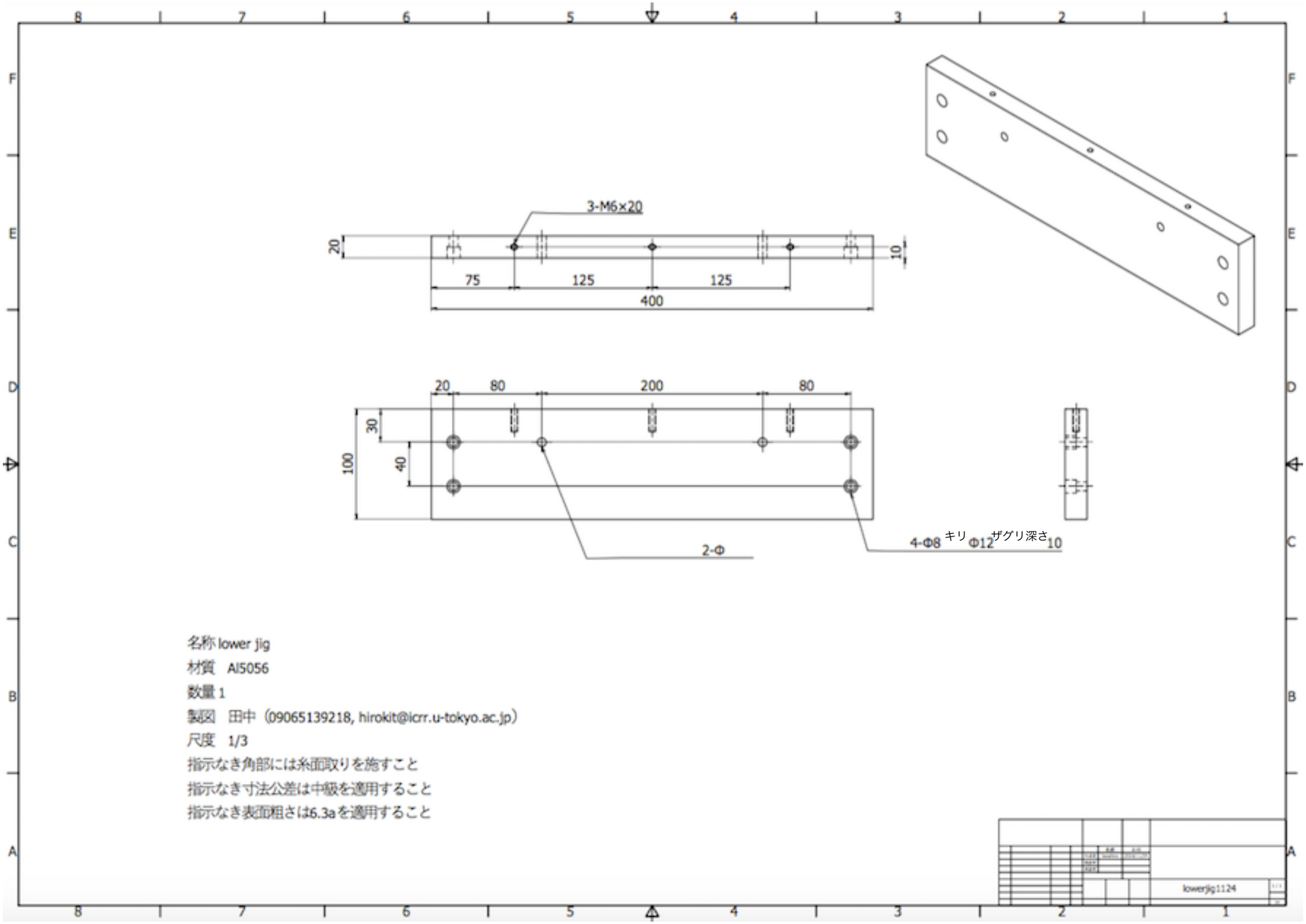


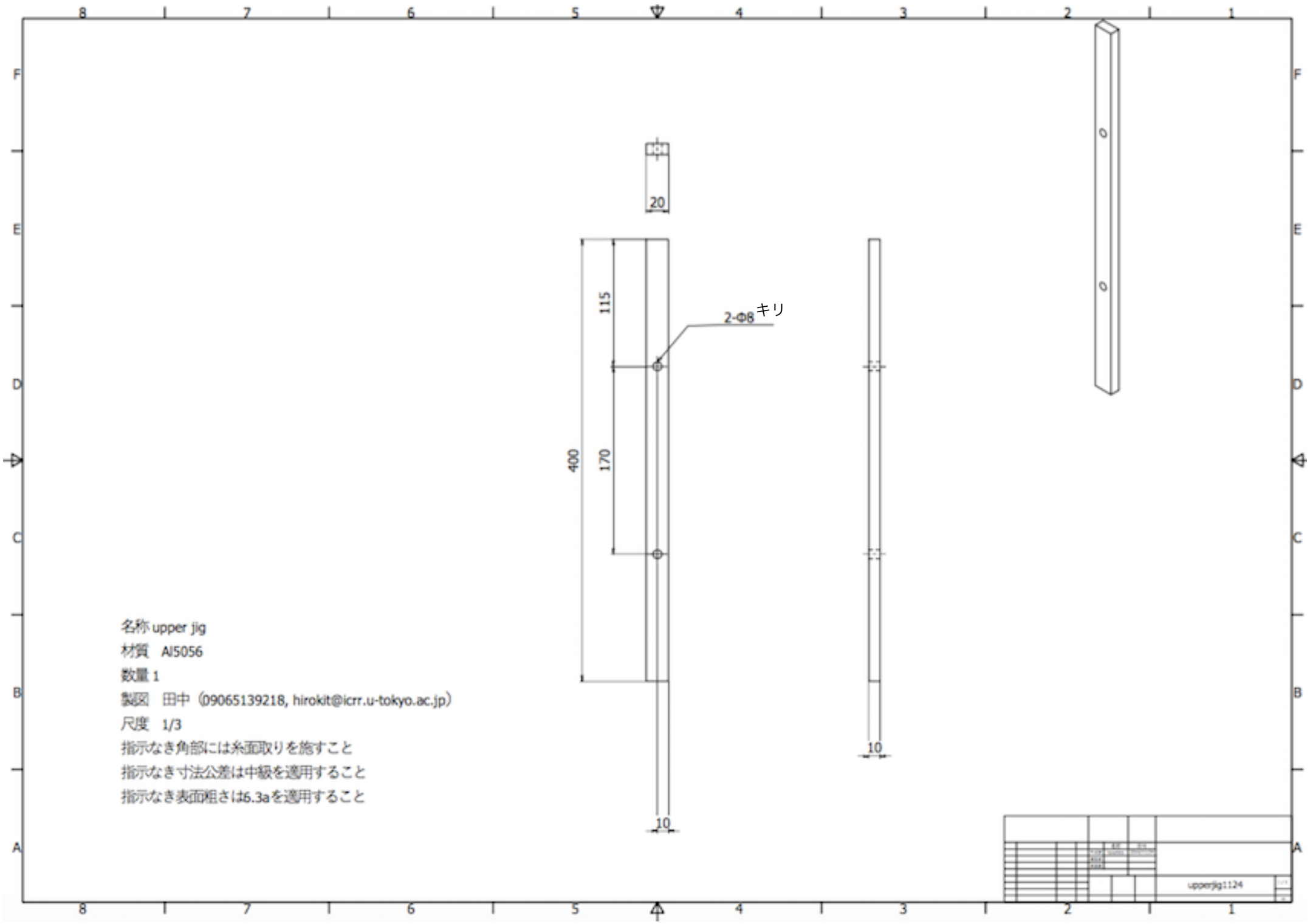
In low-frequency area, the noise became much smaller when we turned off the fan.

Future work

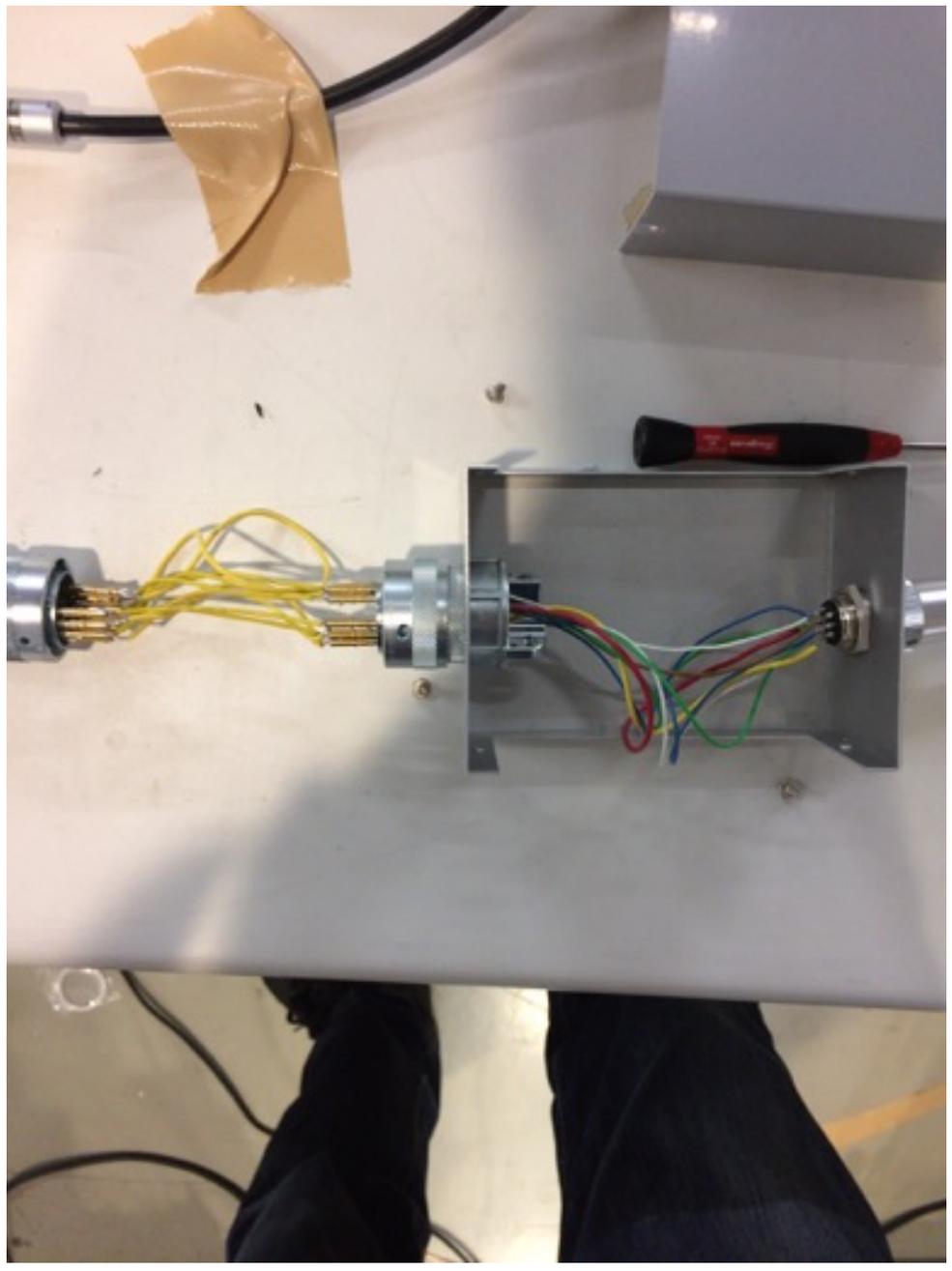
- I will continue the analysis.
- I will calculate the KAGRA noise due to the environmental magnetic field from the results of this test.


393
20
7-Φ8キリ　ザグリΦ12×10
173
120
10
20
158
18
18
18
18
158
125
125
75
20
18
170
400
115
10
2-M6×20
名称　center jig
材質　Al5056
数量　1
製図　田中（09065139218, hirokit@icrr.u-tokyo.ac.jp）
尺度　1/3
centerjig1124

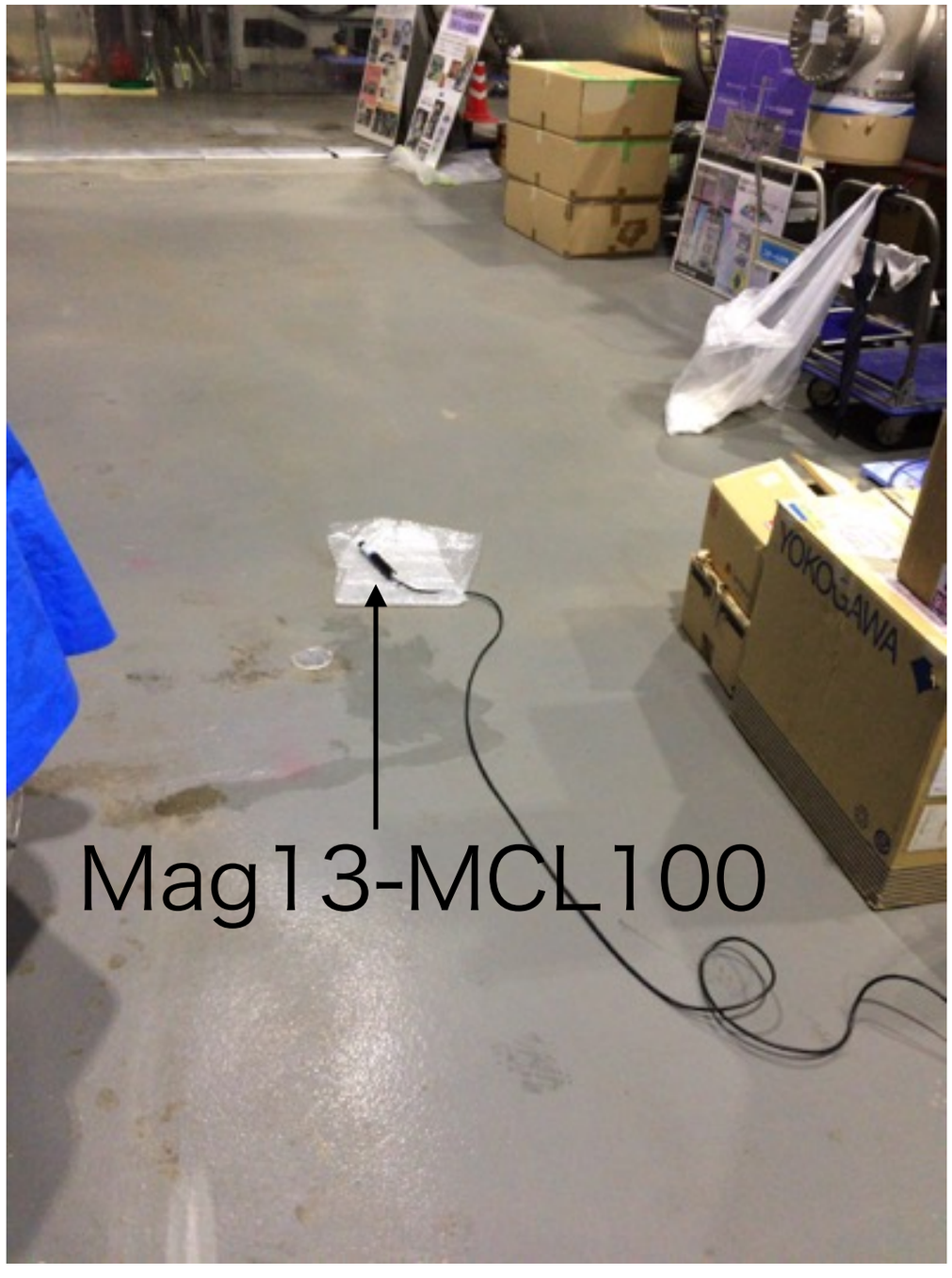

3-M6×20
20
10
75
125
125
400
20
80
200
80
30
40
100
2-Φ
4-Φ8 キリ Φ12 ザグリ深さ10
名称 lower jig
材質 Al5056
数量 1
製図 田中（09065139218, hirokit@icrr.u-tokyo.ac.jp）
尺度 1/3
指示なき角部には糸面取りを施すこと
指示なき寸法公差は中級を適用すること
指示なき表面粗さは6.3aを適用すること
lowerjig1124


20
115
2-Φ8キリ
400
170
10
10
名称 upper jig
材質 Al5056
数量 1
製図 田中（09065139218, hirokit@icrr.u-tokyo.ac.jp）
尺度 1/3
指示なき角部には糸面取りを施すこと
指示なき寸法公差は中級を適用すること
指示なき表面粗さは6.3aを適用すること
upperjig1124

box



Outside the cryostat



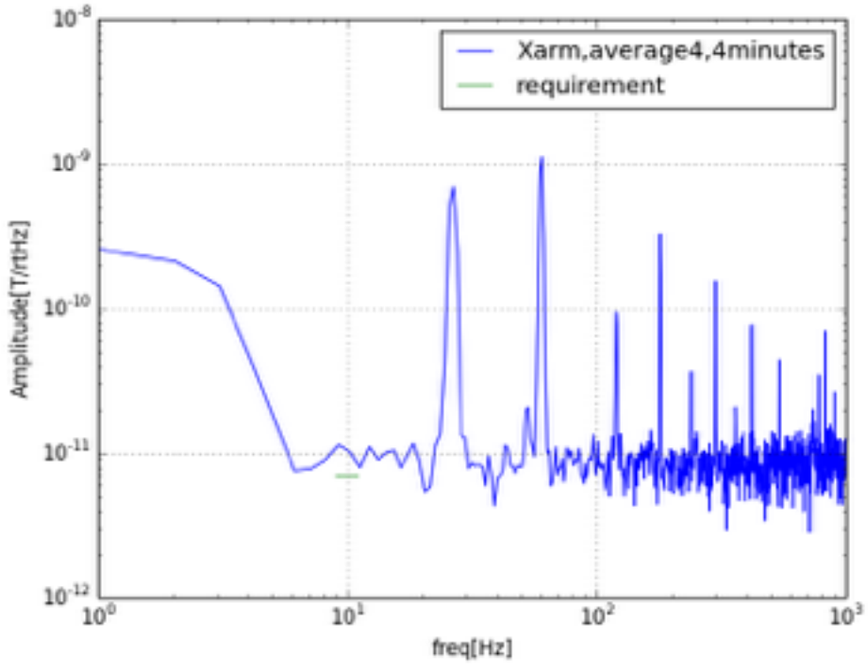
Outside the cryostat

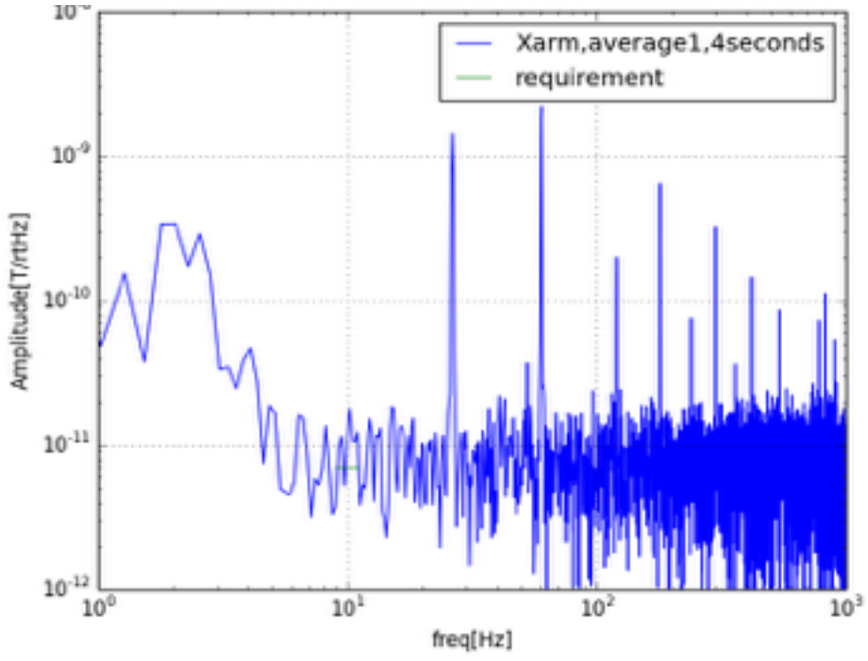
sampling rate 20kHz

Xarm axis

Average 4

Measurement time 4s



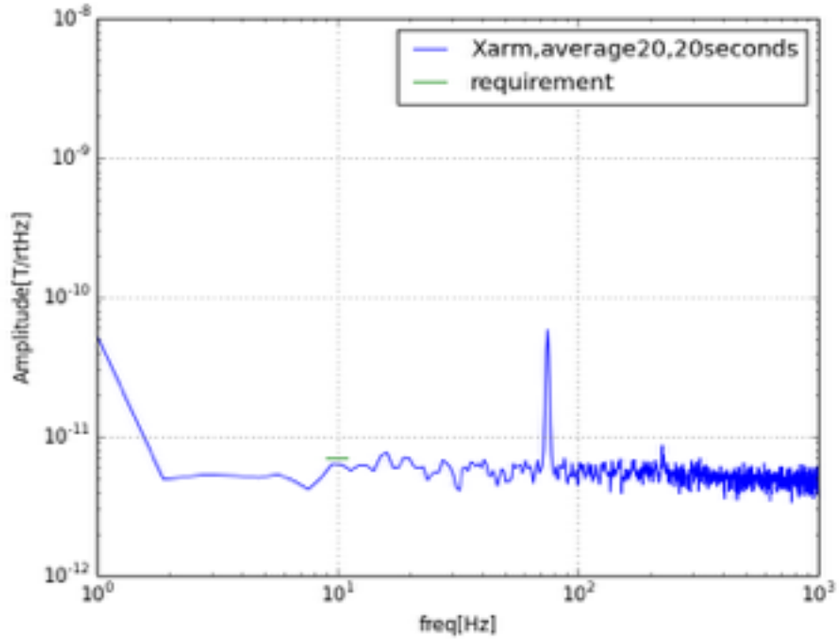


sampling rate 2kHz

Xarm axis

Average 20

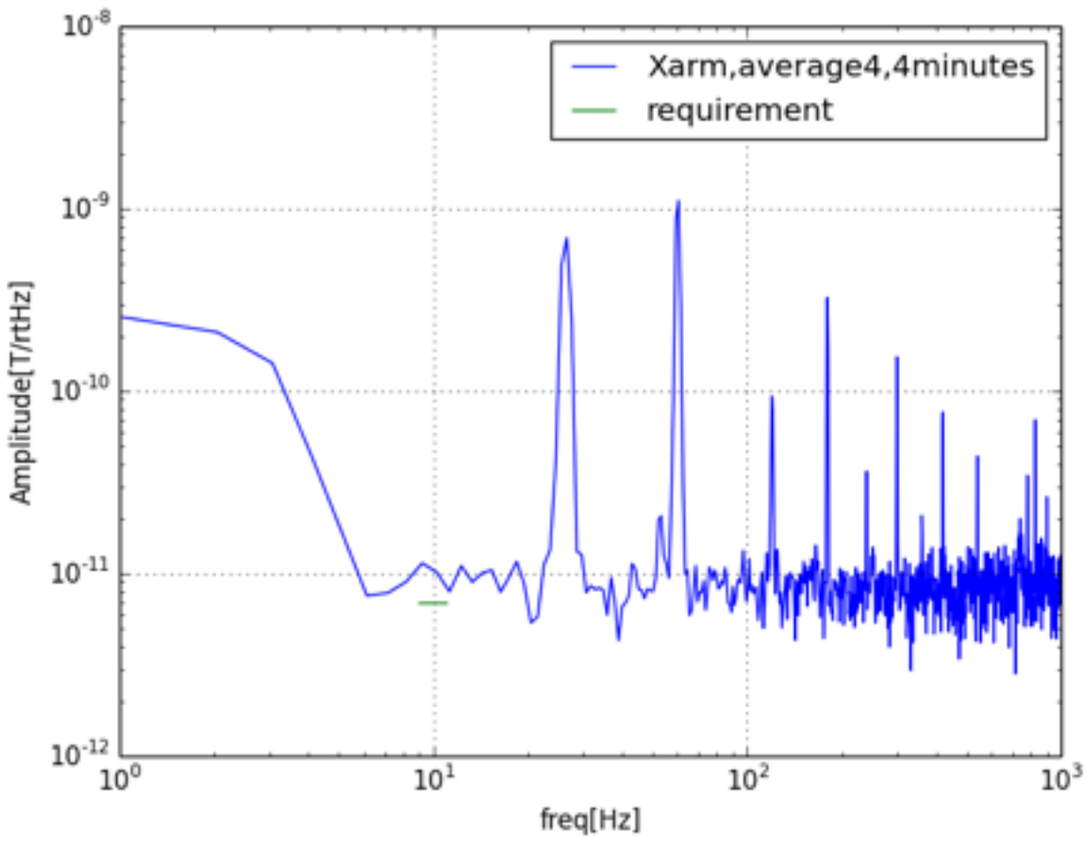
Measurement time 20s



Two modes (Outside)

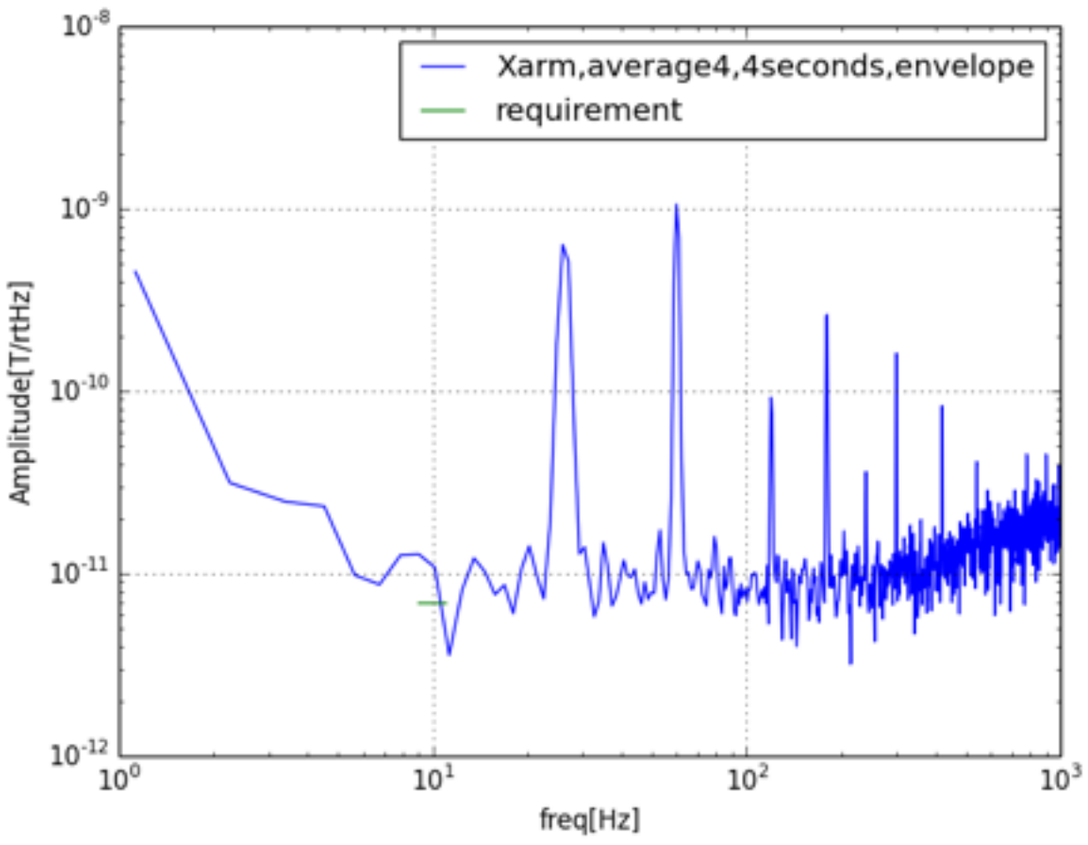
sampling rate 20kHz
Xarm
Average 4
Measurement time 4seconds

normal mode

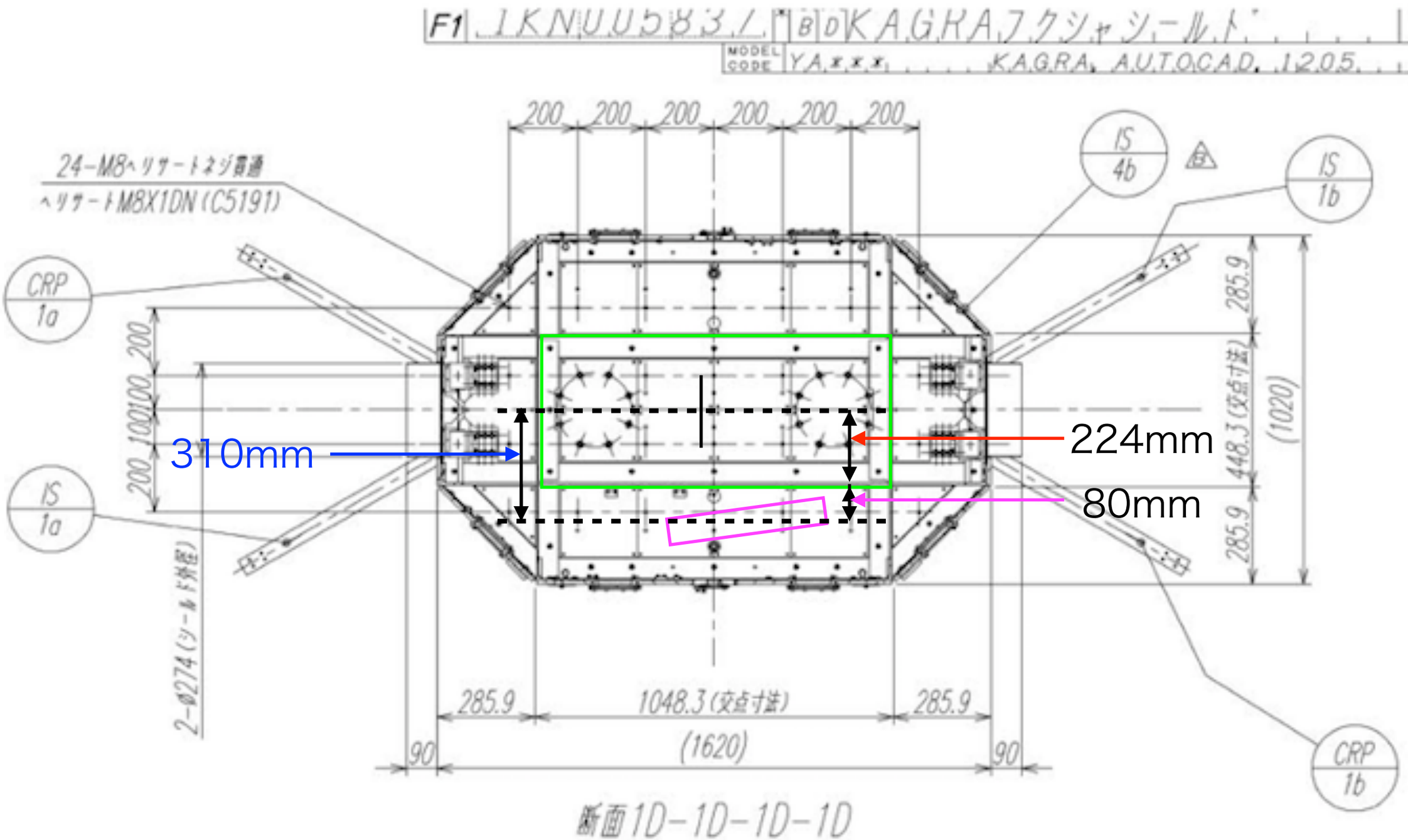


sampling rate 20kHz
Xarm
Average 4
Measurement time 4seconds

envelope mode

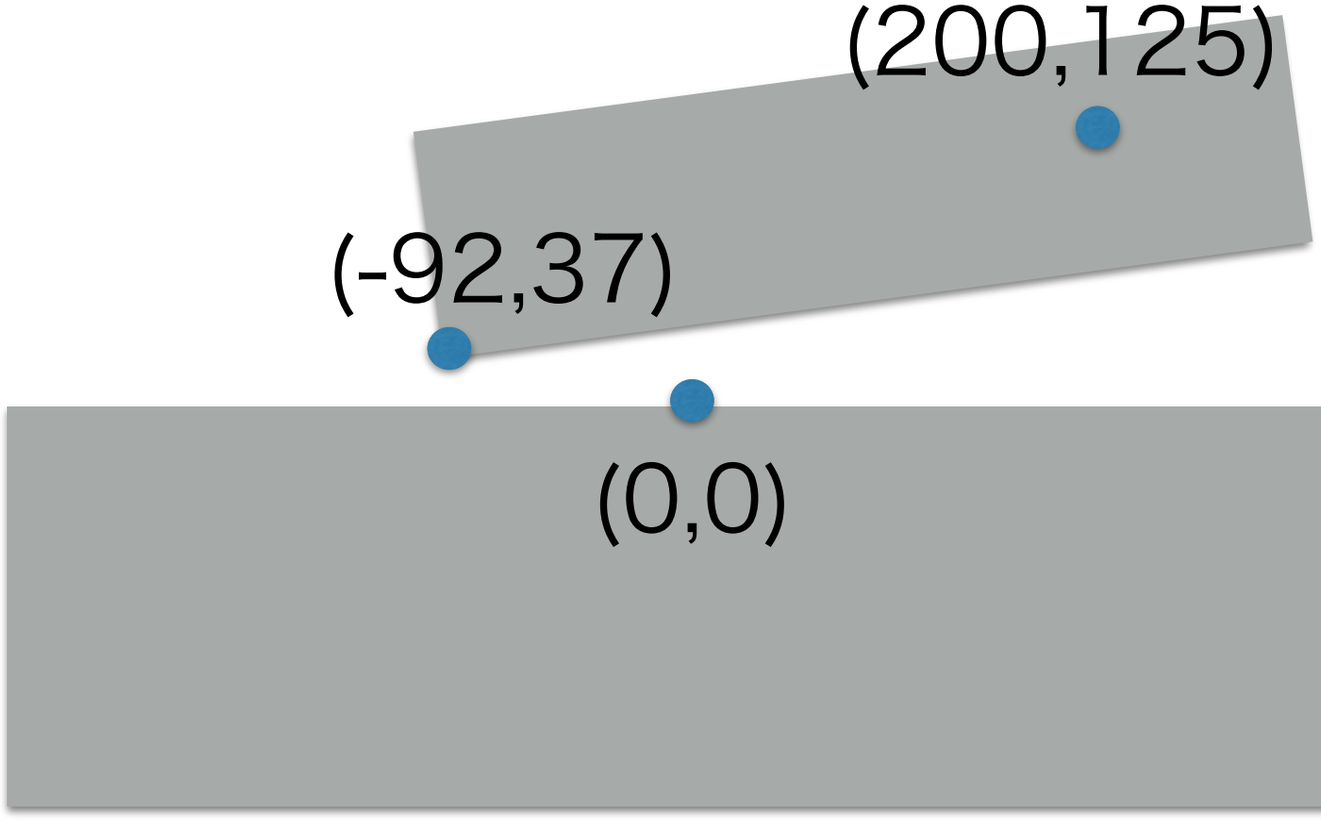


Position of the jig



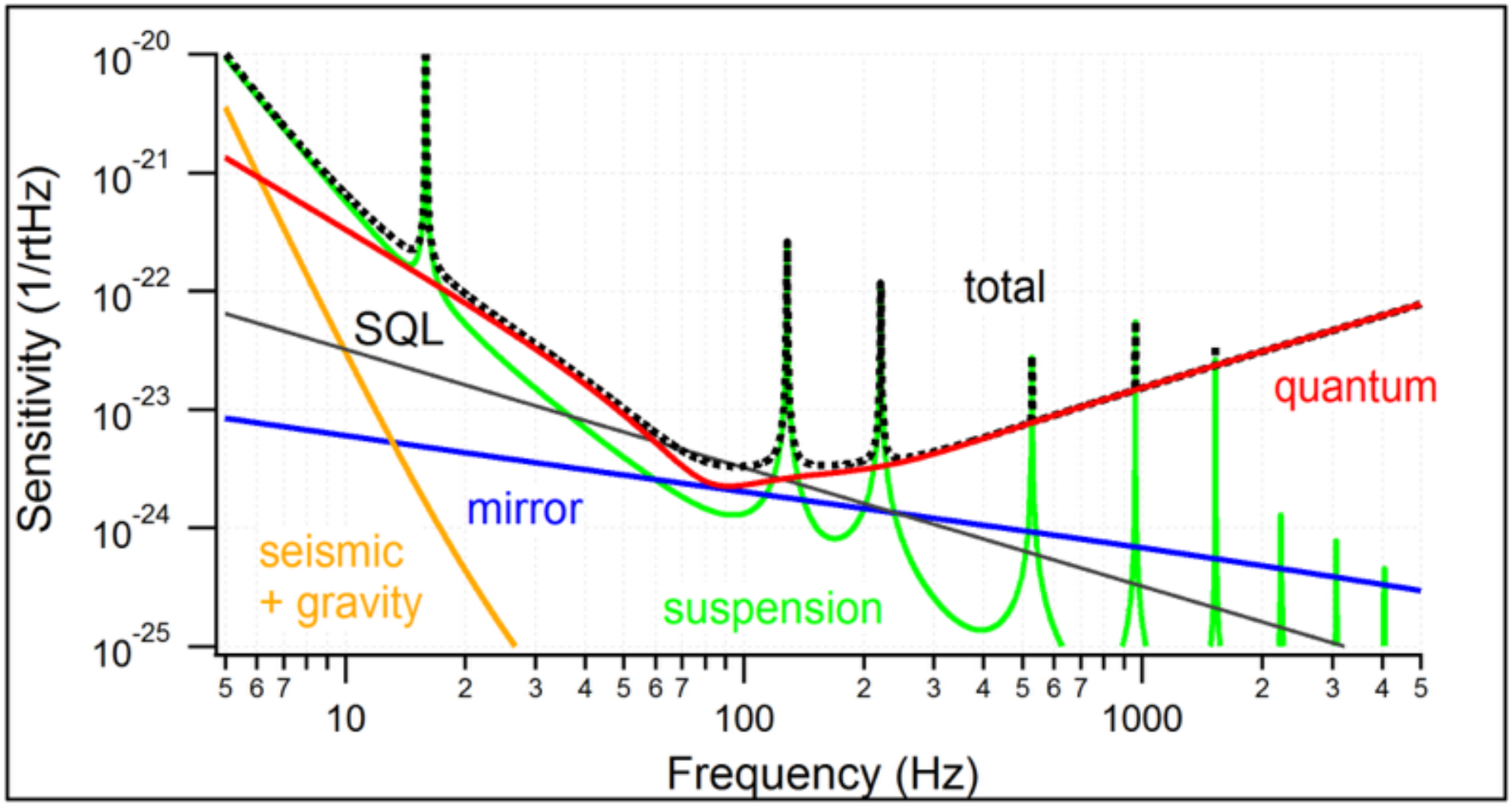
磁束計の傾き

本来(-100,55)と(200,120)



θ ～19/308=0.062(rad)=3.5°

感度曲線



出典…KAGRA HP

エリアシングか確認

- noise floorが100kHzまで4pT/rtHzで、そこから減るとする。

- Samplingが10kHzとすると、（見かけの）10Hzの信号は10Hz、10Hz+10kHz、10Hz+20kHz、…10Hz+90kHzの和なので
(4^2×10)^1/2=4×10^1/2pT/rtHz

- Samplingが1kHzとすると、見かけの10Hzの信号は4×100^1/2pT/rtHz

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