

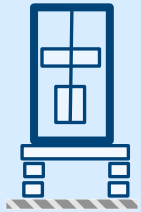
Mode Cleaner suspension installation

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S. Kawamura^C, T. Uchiyama^C, Y. Aso^A, and E. Hirose^C
A: NAOJ, B: Niigata Univ., C: ICRR

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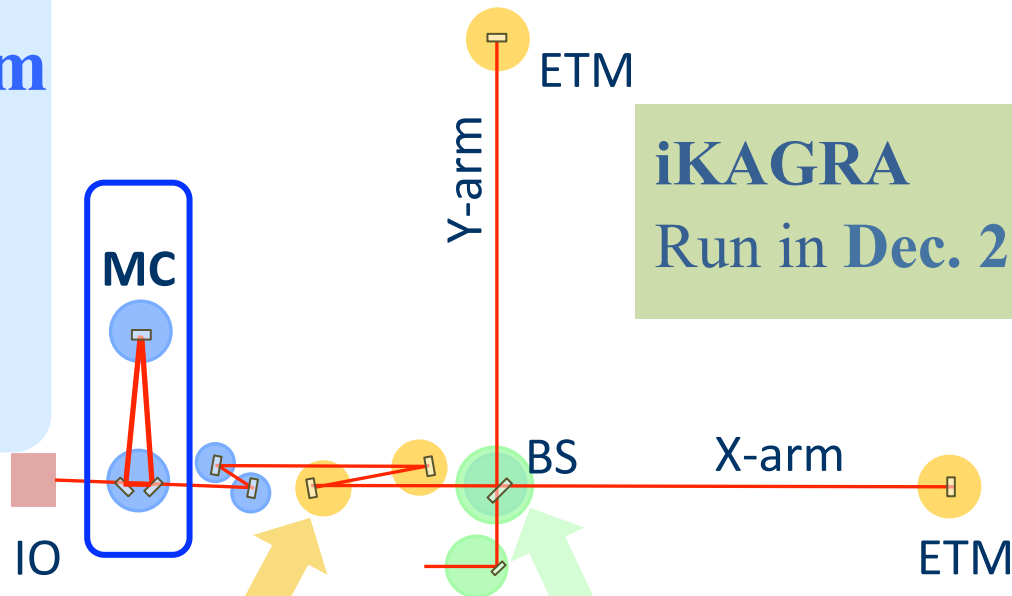
- **Introduction:**
 - Mode Cleaner (MC)
 - Mode Cleaner Suspension
- **What we have done after the last f2f**
 1. Magnet and wire breaker glued to mirror
 2. Bread board re-installation and position measurement
 3. Transfer function re-measurement
- **Schedule**
- **Summary**

Introduction



Type-C system

- Mode cleaner
Silica, 0.5kg,
290K
- Stack+Payload



iKAGRA

Run in **Dec. 2015** ~1 month

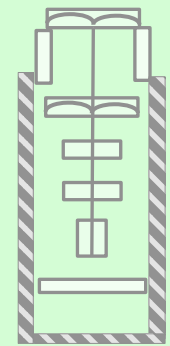
Type-Bp payload;

Test mass and
core optics.
Table + GASF +
Type-B payload.

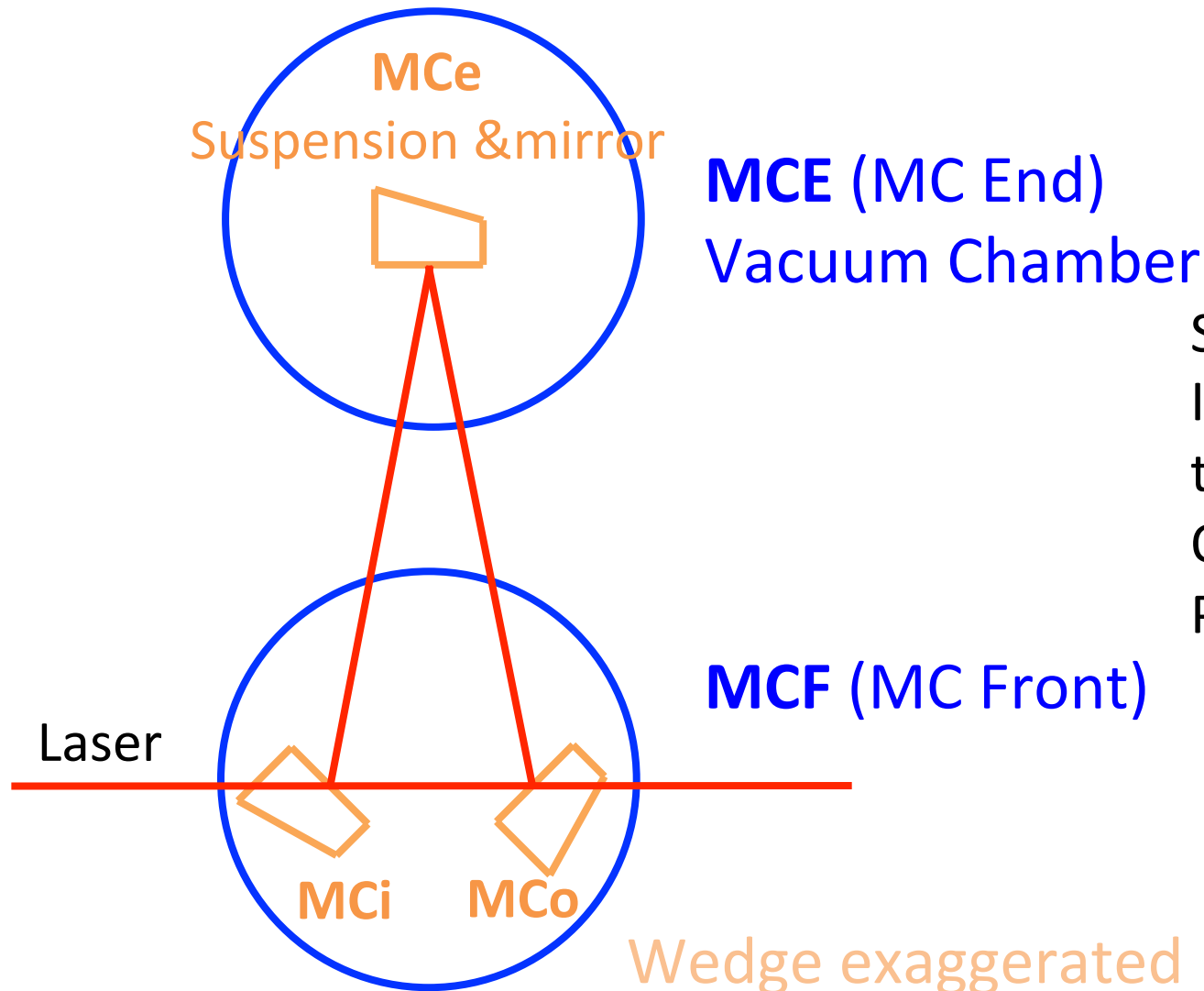


Type-B payload;

Beam splitter
IP + GASF + payload



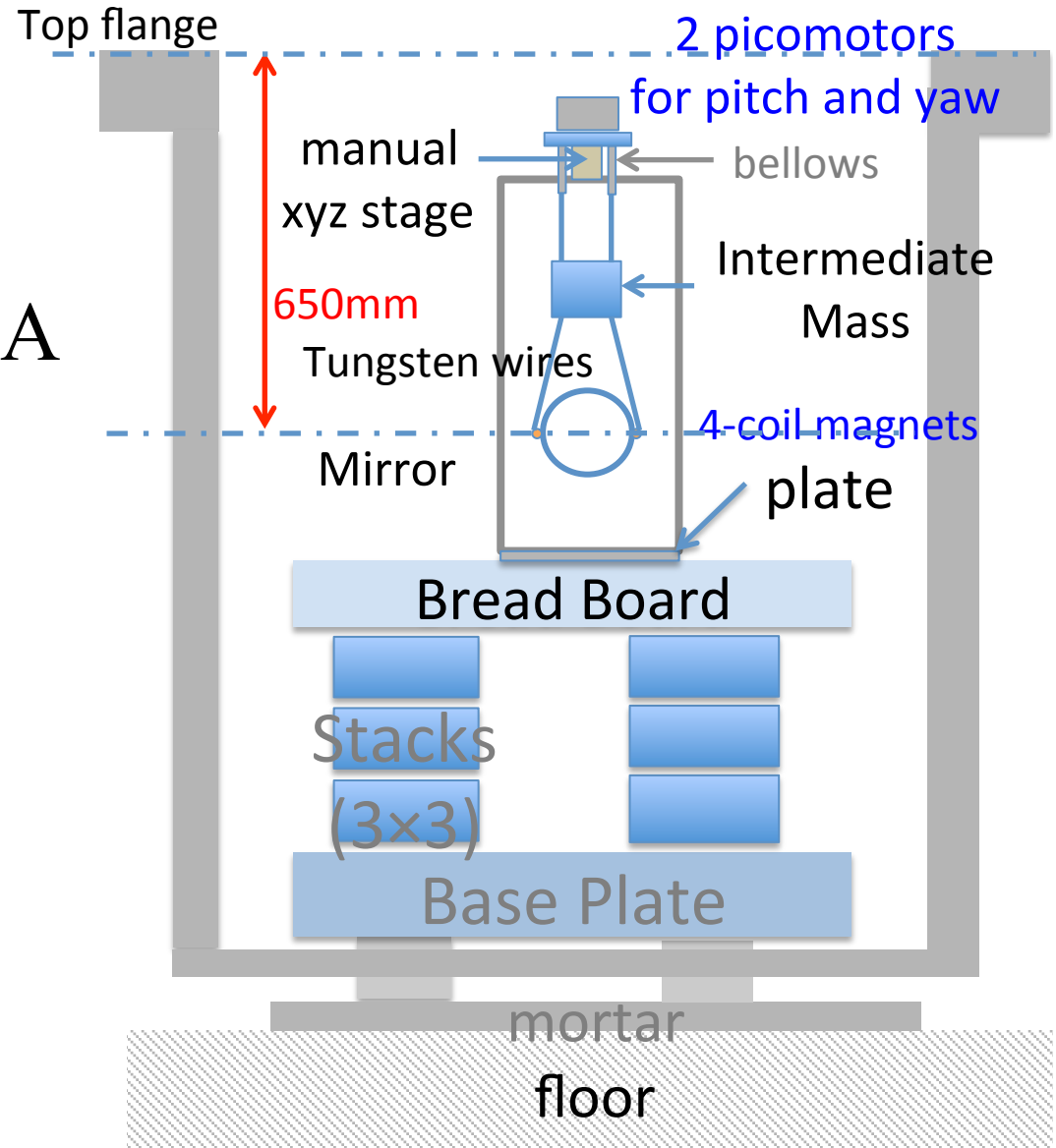
Abbreviations: Mode Cleaner (MC)



Sometimes written as
IMC (Input MC)
to distinguish it from
OMC (Output MC) or
PMC (Pre MC)

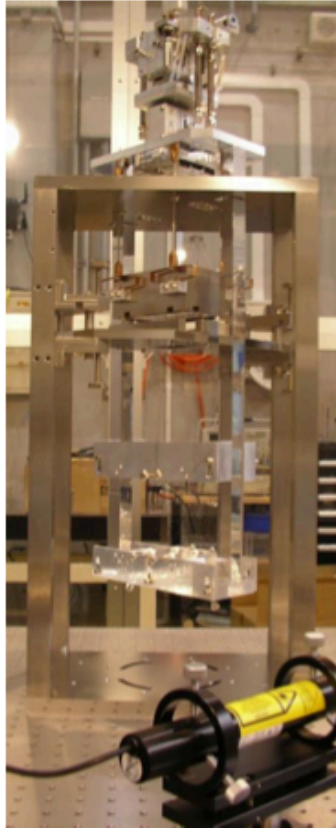
Mode Cleaner Suspension

- MC_x (x=i, e, o) is a double pendulum once used for TAMA
- Design changes
 - Frames
 - Wire Breakers (stand-off)



photograph

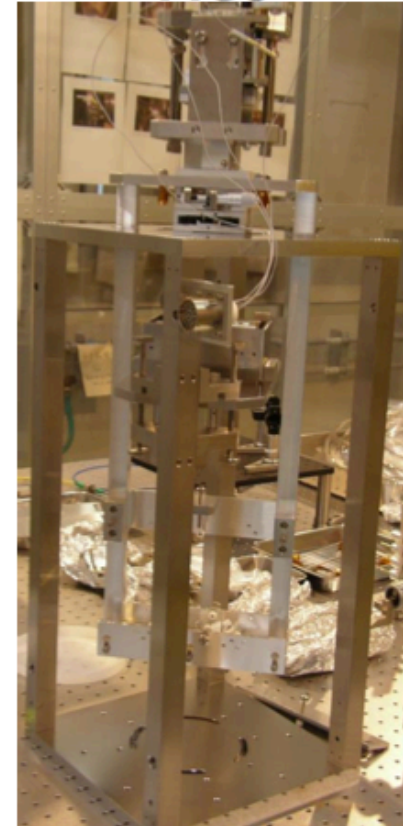
MCI



MCE



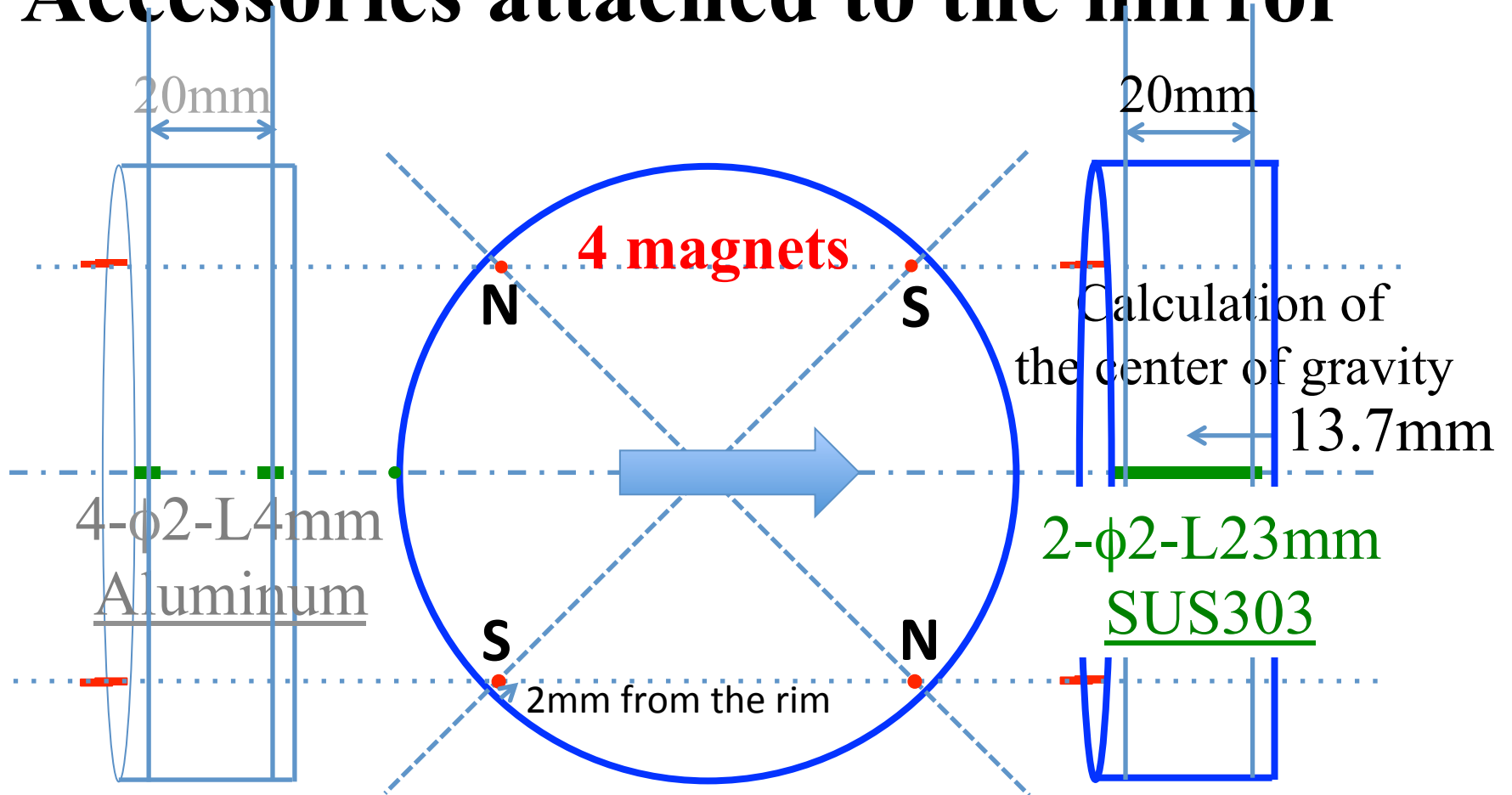
MCo



Contents

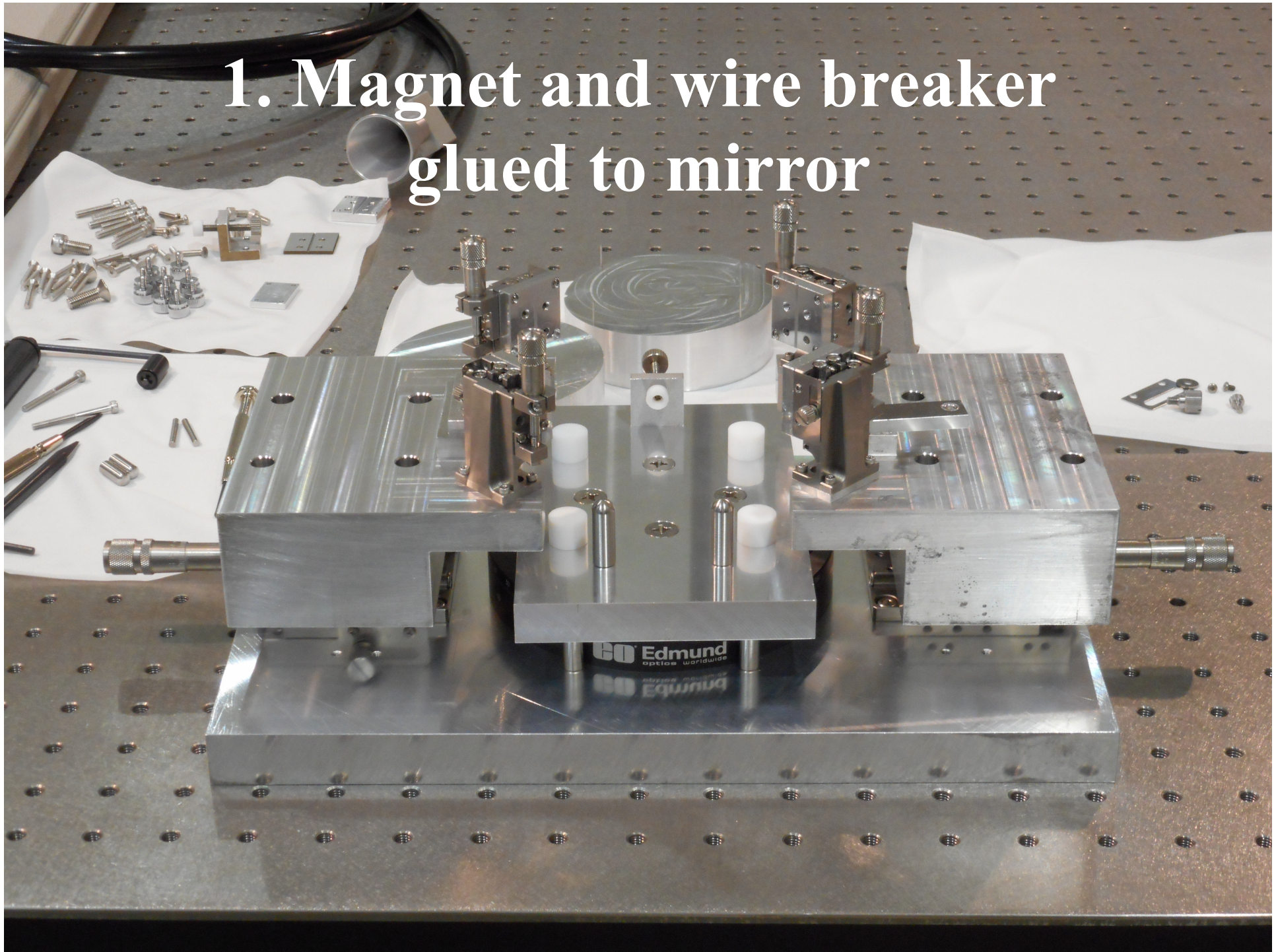
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Accessories attached to the mirror

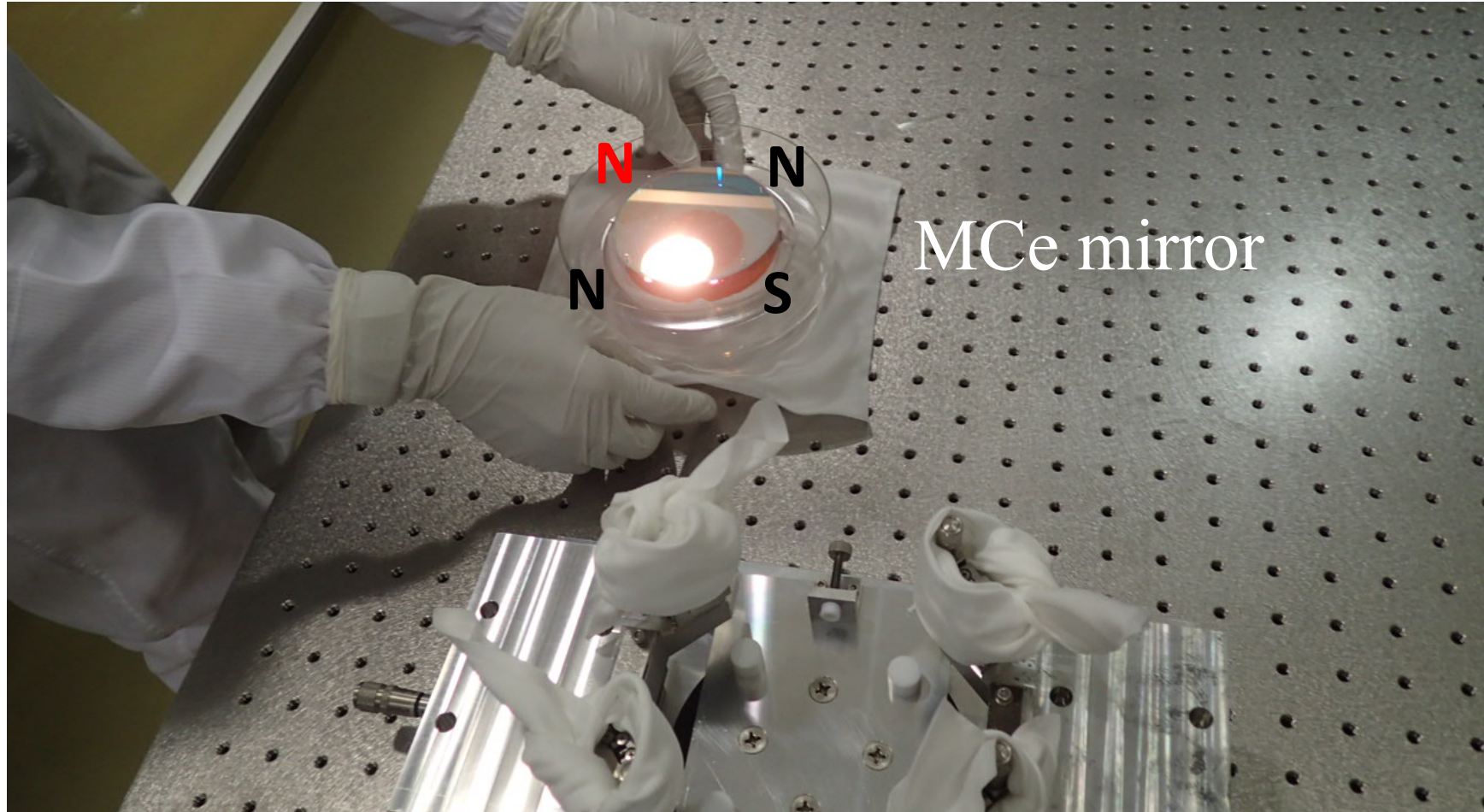


- **4 Nd magnets** with $\phi 1\text{mm}$ and $L 5\text{mm}$
- **2 wire breakers (standoff)** $\phi 2\text{mm}$ and $L 23\text{mm}$

1. Magnet and wire breaker glued to mirror



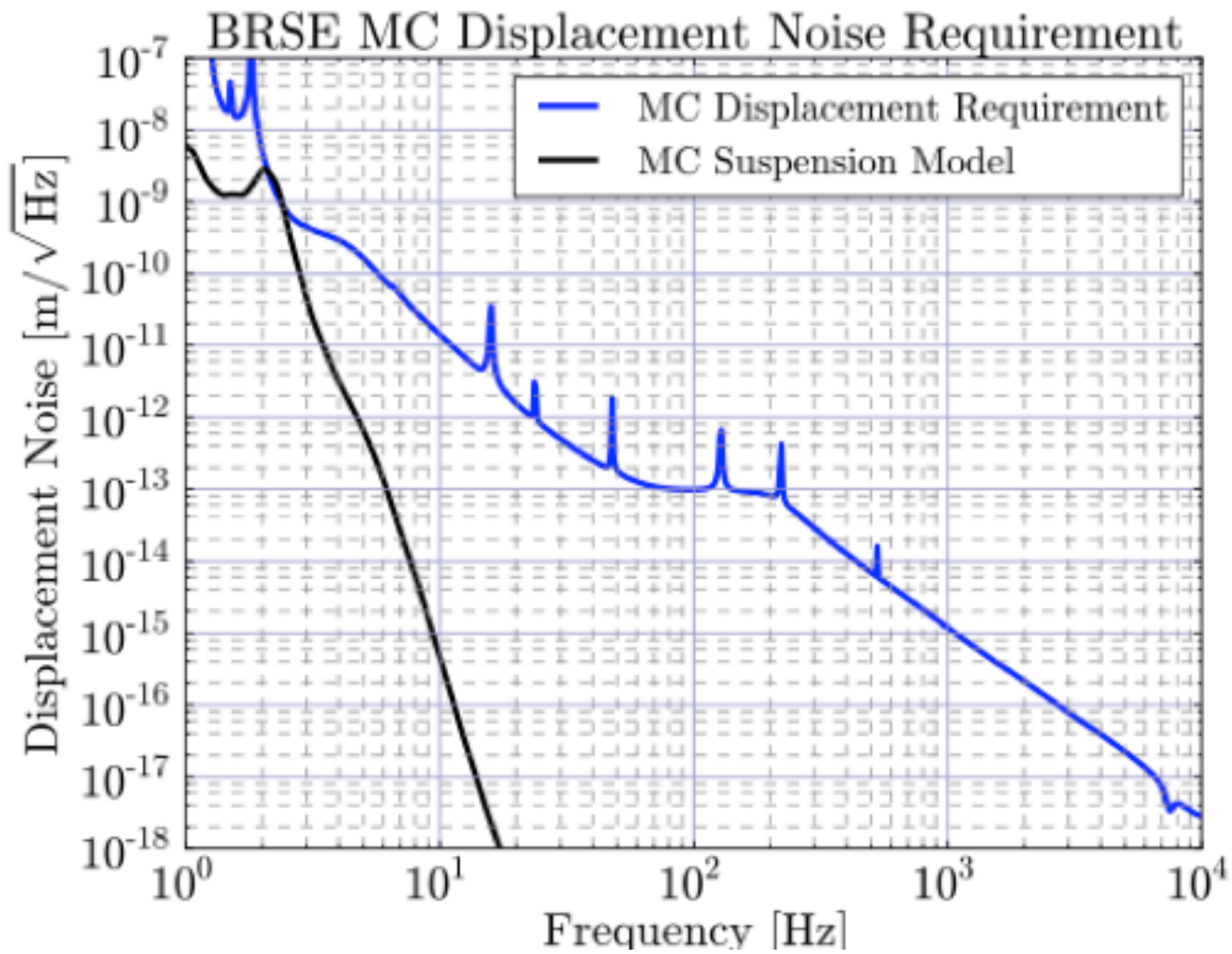
Glued a magnet in the wrong direction



We used magnetometer for MCI and MCo but didn't for MCE

After we found the mistake...

- **Evaluation of magnetic field (Michimura-san)**
 - **NNNS is Permissible** in terms of displacement noise
 $5e-15\text{m/rHz}$ (NSNS) \rightarrow $3e-13\text{m/rHz}$ (NNNS)
 $< 1e-11\text{m/rHz @10Hz}$ requirement for
- **Adhesive removal test (Hirose-san)**
(Two Liquid Mixture Type Epoxy Resin Adhesive)
 - Adhesive can be removed by heating
 - Re-glueing test is necessary
 - There still remains the fear of damaging AR coating
- **Decision** about to repair/or not to repair the polarity will be made at the next IOO meeting (Aug 31th)



2. Breadboard **re**-installation

- MCE Breadboards were installed before March 2015

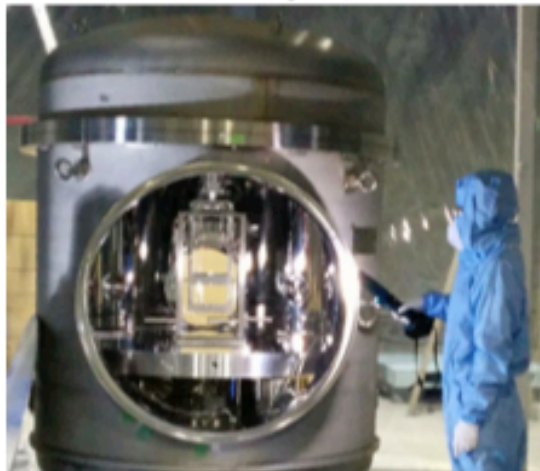
Status of IMC install

- Vacuum chamber MCE

Baseplate, stack, and bread board have been installed by VIS.

Suspension MCE has been put on the optical table.

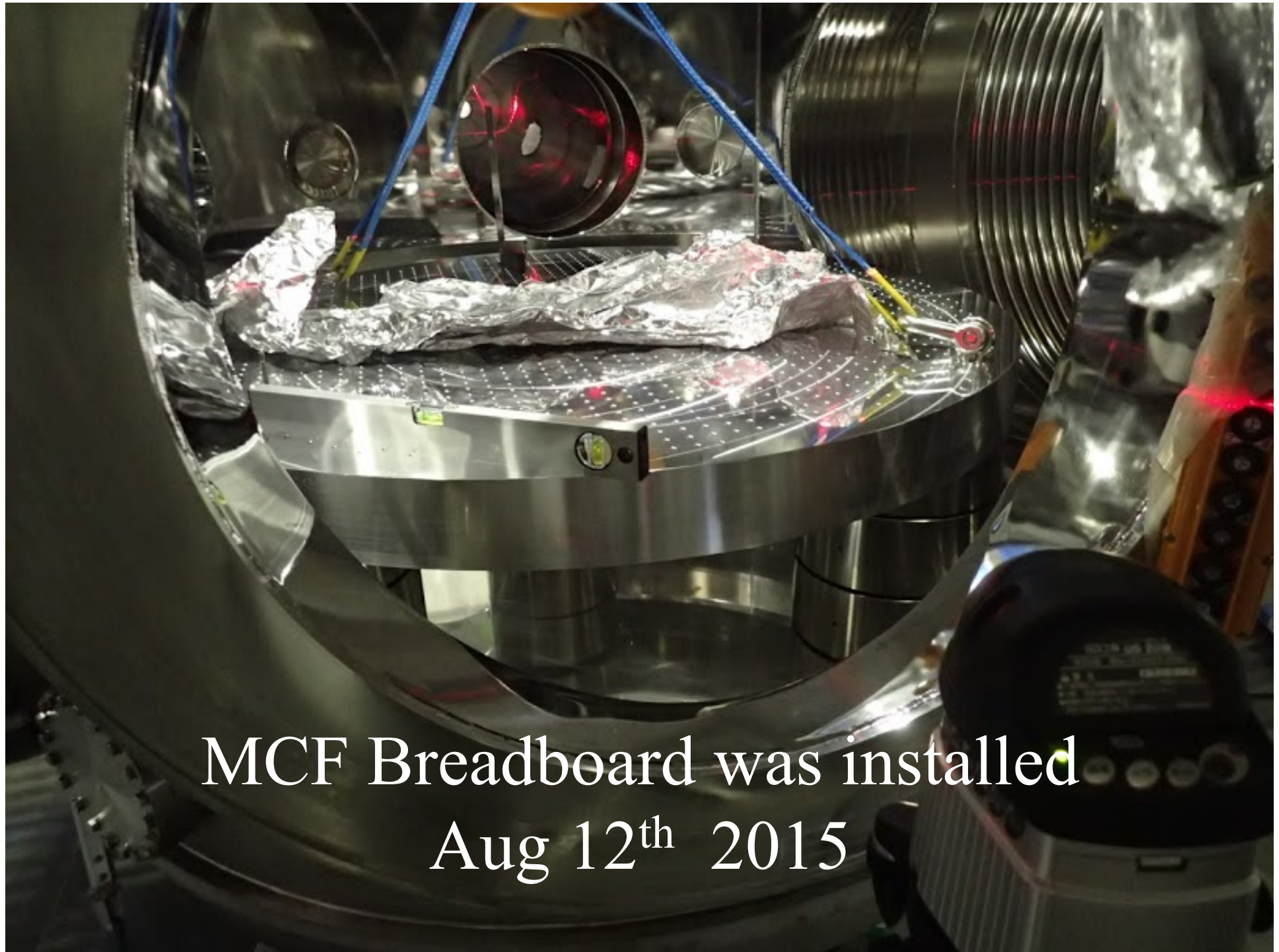
Position adjustment of suspension will be done from now.



Presentation by
Saito-san
Feb 6th 2015
F2f meeting
@Hongo

However, MCF Bread Board was partly blackened

- When the MCF breadboard was installed perhaps in Feb, we found it partly blackened
- Both MCE and MCF board were sent back to Hitz (日立造船) for cleansing in Mar
- Reinstallation
 - MCE: installation in May and leveling in Jun
 - MCF Aug 12th



MCF Breadboard was installed
Aug 12th 2015

Detailed reports on leveling and position/orientation measurement are found at klog

<http://klog.icrr.u-tokyo.ac.jp/osl/>

KAGRA Logbook 3.4

Sections... Tasks... username ***** > LOG-IN

Home Search Help

Quick search > 🔍

Displaying reports 1-20 of 24. Go to page 1 End

[Comment to MCF bread board leveling \(Click here to view original report: 20\)](#)

Detailed work report on the MCF bread board position and orientation measurements

Ohishi, Uchiyama, Aso on 2015/8/15

After leveling the bread board, we measured the position and the orientation of the MCF bread board.

First, we put a straightedge across the top flange of the chamber. Then we hung a plummet from it as shown in the picture. By setting the tip of the plummet on the edge of the bread board, we can measure the distance between the bread board edge and the inner and outer edge of the top flange.

The straightedge was aligned with the scratch marks on the flange's outer wall. There are four marks with 90 degrees separation. They are aligned with the optical axis.

We also measured the rotation of the bread board around the center. When the straightedge is aligned with the scratch marks, the screw holes on the bread board should also be aligned with the straightedge if there is no rotation. In reality, they are not aligned. By reading the deviation of the hole positions from the straightedge line using the plummet, we can get the information of the bread board rotation.


Actual numbers are reported in the parent report (<http://klog.icrr.u-tokyo.ac.jp/osl/?r=20>).

Images attached to this comment



Lessons Learned ?

- Galling of Stainless screw

VIS (MCF)
yoichi.aso - 07:36, Saturday 15 August 2015 (24) 
Comment to MCF bread board leveling (Click here to view original report: [20](#))

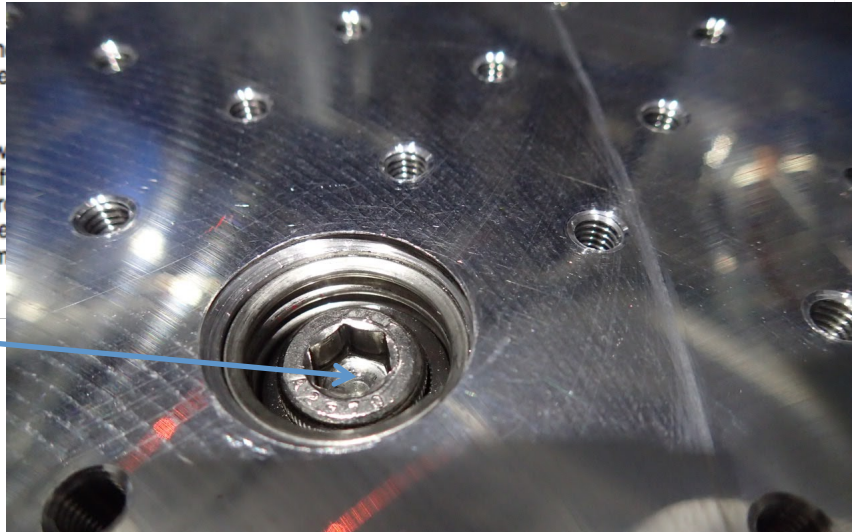
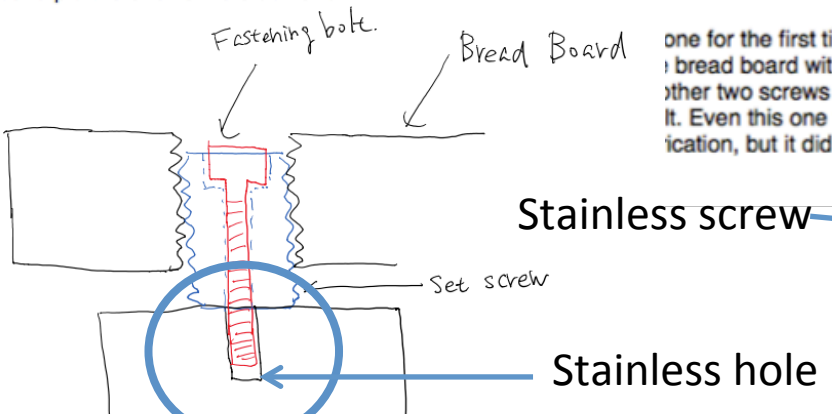
One of the MCF bread board screws is stuck in the middle

Aso, Ohishi on 2015/8/12

After the bread board leveling, when we were fastening the bread board to the stack, one of the three screws got stuck in the middle.

What happened

The structure of the fastening part is shown in the attached PDF. The set screw used to adjust the height of the bread board with the crane. After the leveling, we successfully fastened two screws. However, the third one got stuck at 1 - 2mm before the set screw. The second picture shows the stuck one.



one for the first time, we felt it was difficult to fasten the bread board with the crane. After the leveling, the other two screws were easy to fasten. However, this one was hard. When we tried to fasten it, it did not help. From

Use **silver-plated** bolts on stainless holes and fasten carefully

Position deviation of Breadboard

- **Reference:**

 - Top flange of each vacuum chamber

- **MCE**

 - +2mm in x-direction, +1mm in y-direction

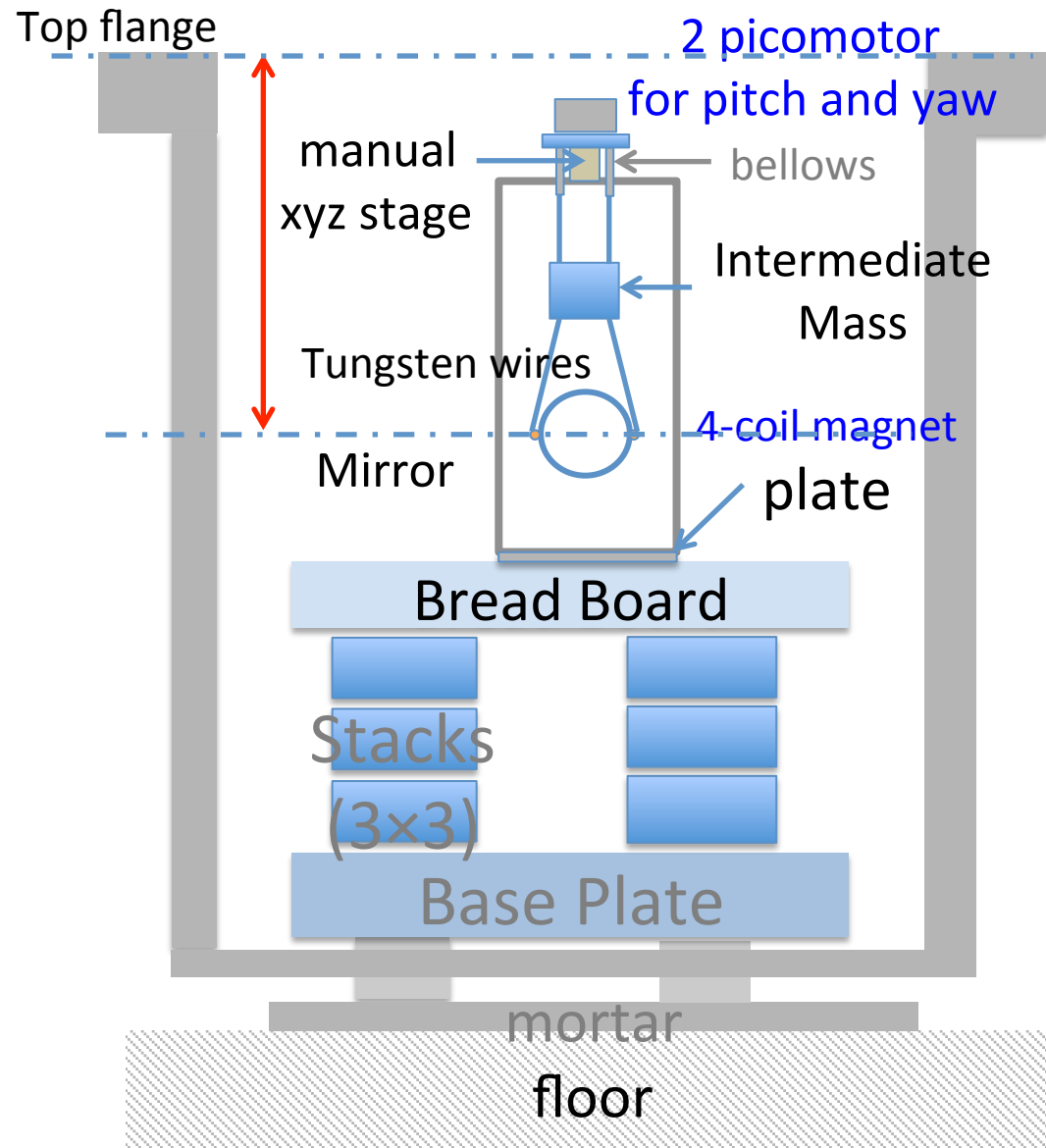
 - Orientation error is less than 0.1 deg

- **MCF**

 - 2mm in x-direction, 4mm in y-direction

 - Orientation error is about 0.5 deg

Position and orientation deviation will be compensated by the plate under suspension



3. Coil driver circuit malfunction

- Transfer function of the suspension was measured by Saito-san at NAOJ
 - Resonant frequencies and Q-values seems OK
 - Absolute value was smaller than expected
- Coil driver performance seems to be strange

TAMA-CD1
COIL DRIVER 3

Gain, Offset調整済み。

OP amp差し替え済み。

NM1

Stability Multiplier
Gain: 0.1/1000

AC MONI
1-3 1+3 2+4 -2+4

DC MONI
2+4 -2+4 TOTAL

INPUT
1 2 3 4

CURRENT OUTPUT
1 2 3 4

TAMA-CD1
COIL DRIVER 6

EM1

Stability Multiplier
Gain: 0.1/1000

OP amp差し替え済み。

ON1
4 -2+4 T +5V L

DC MONI
1+3 2+4 -2+4 TOTAL

INPUT
1 2 3 4

CURRENT OUTPUT
1 2 3 4

TAMA-CD1
COIL DRIVER 1

Gain, Offset調整済み。

OP amp差し替え済み。

EM2

Stability Multiplier
Gain: 0.1/1000

AC MONI
1-3 1+3 2+4 -2+4 T +5V L

DC MONI
1+3 2+4 -2+4 TOTAL

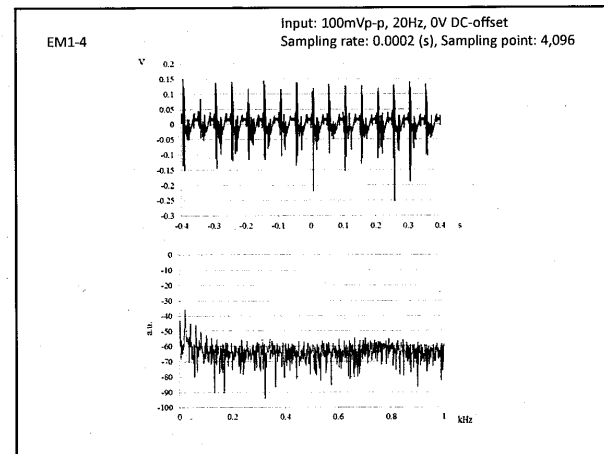
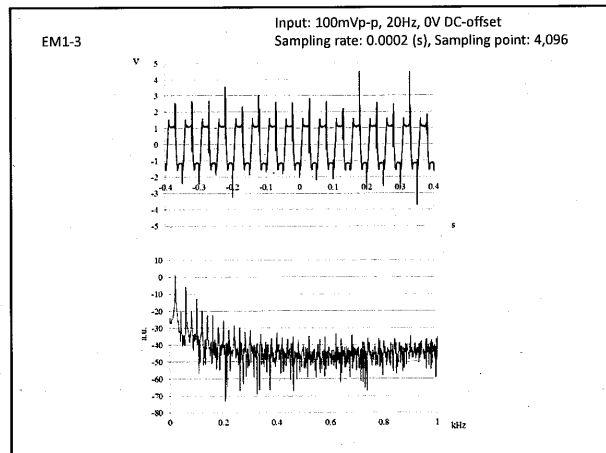
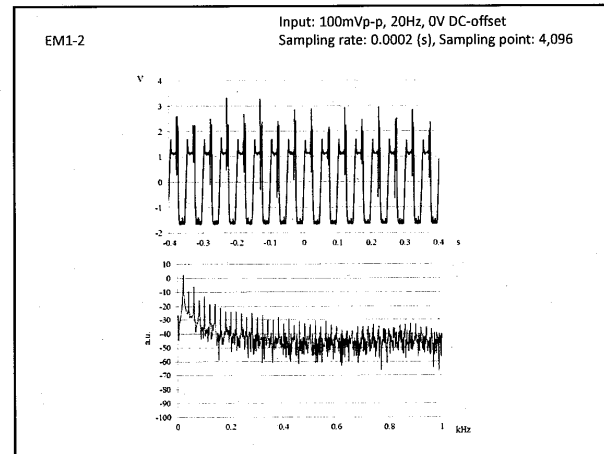
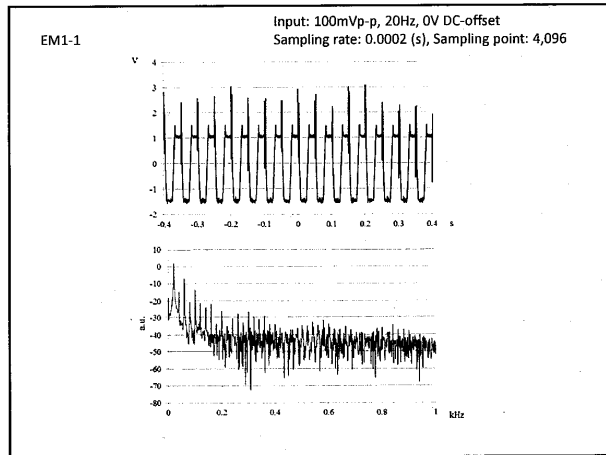
INPUT
1 2 3 4

CURRENT OUTPUT
1 2 3 4

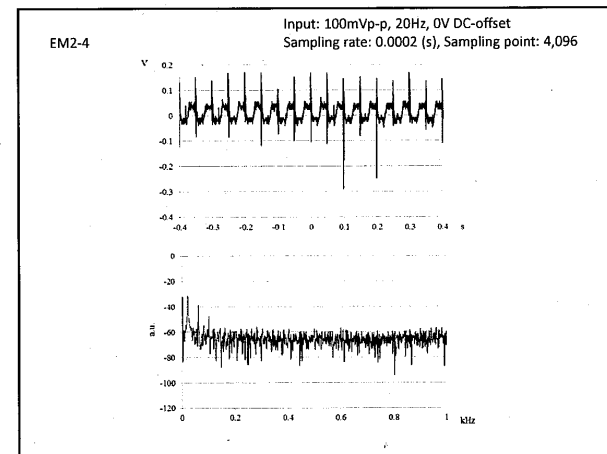
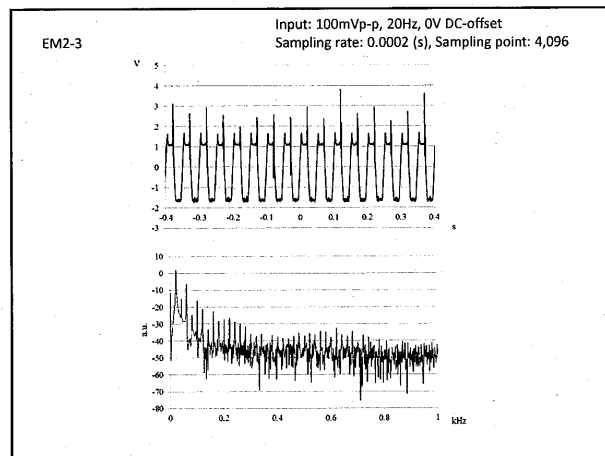
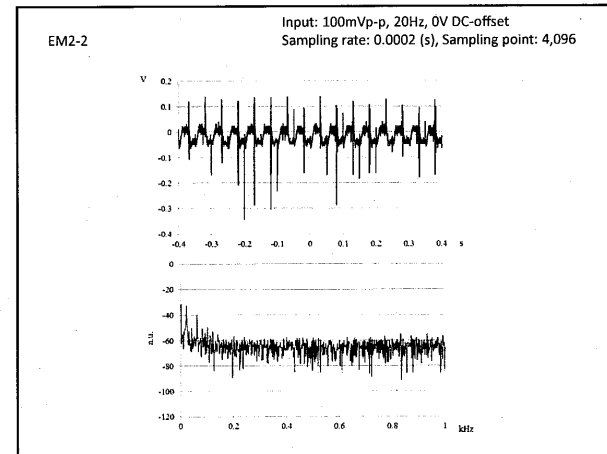
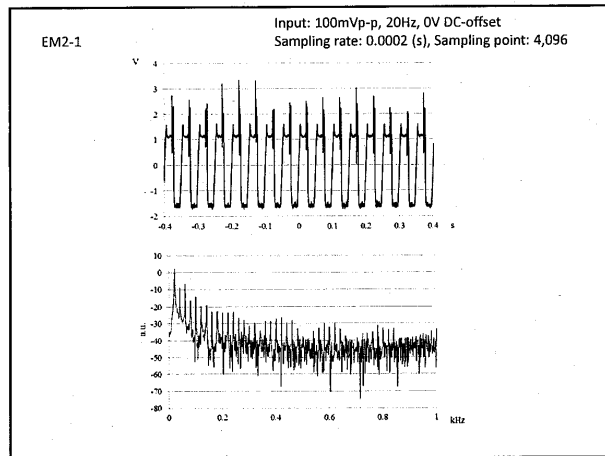
OP amp has been changed

modified version 0.05
TAMA-CD1 Rev. 1.0
Development on 2002.10.10

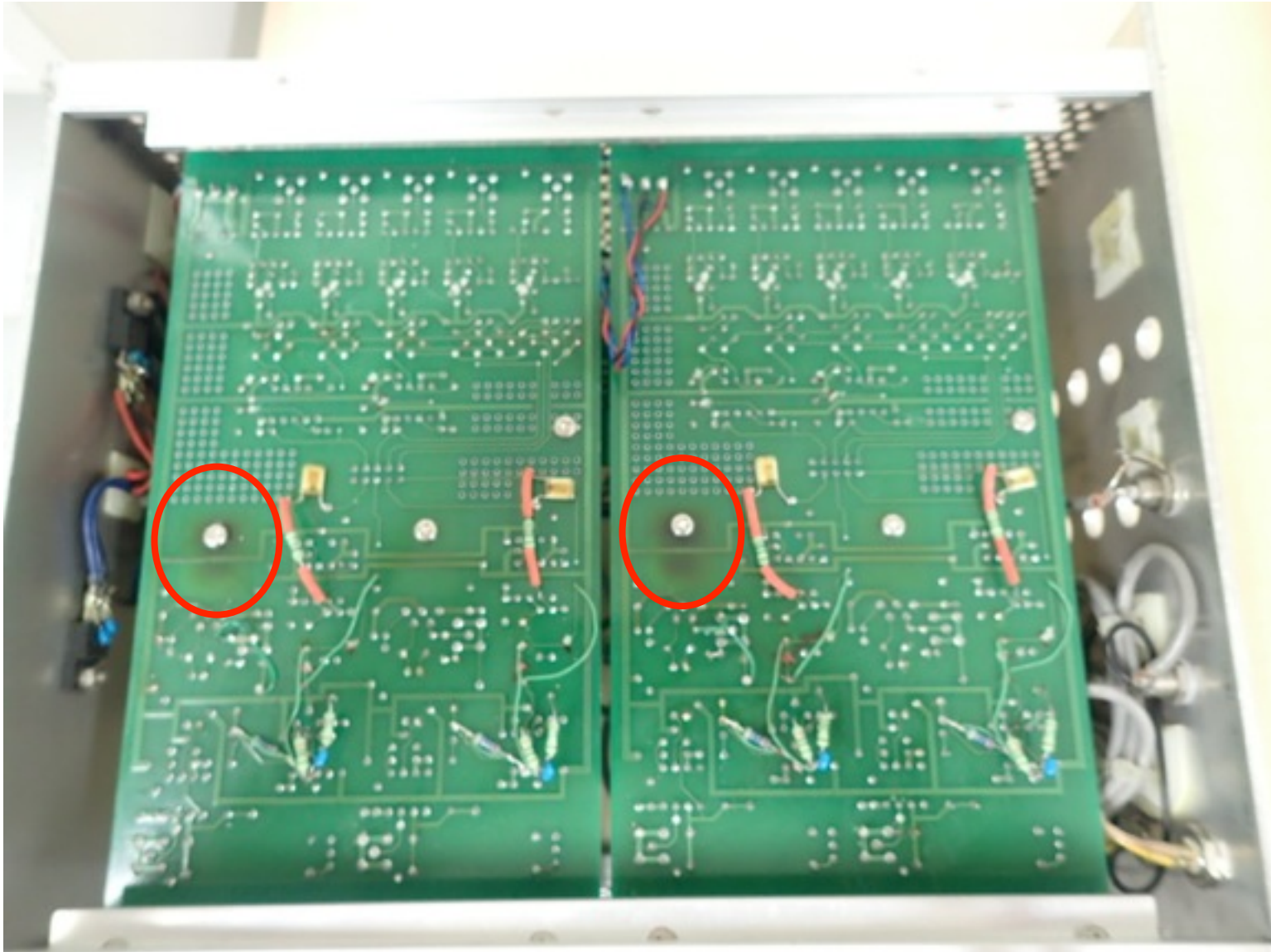
EM1: ch4 is strange

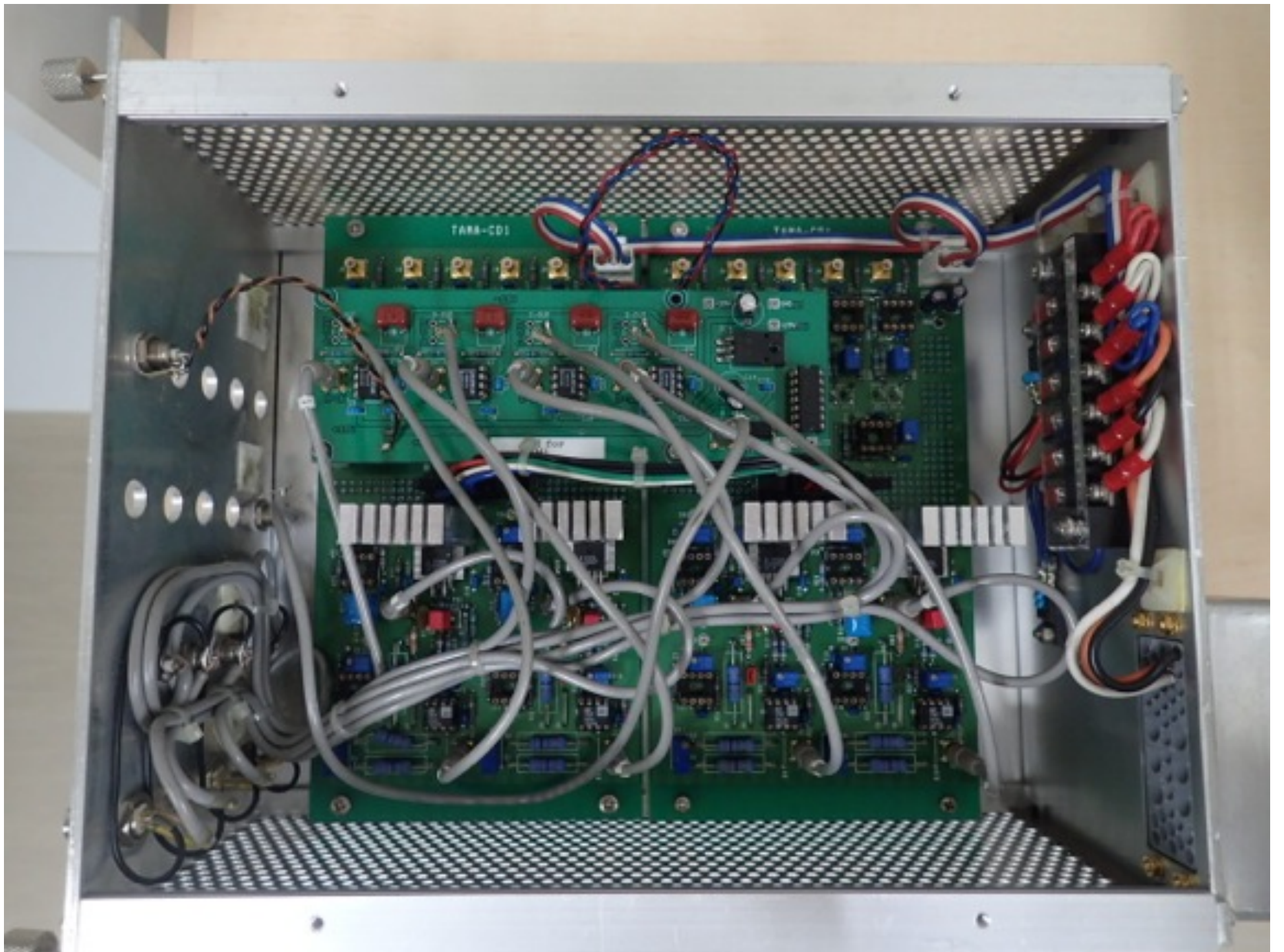


EM2: ch2 and ch4 are bad



NM1: circuit board burned





Measure

- Need to be discussed at the next IOO meeting.
- **Repair TAMA coil driver**
 - Current OP amp is already obsolete
 - OP amp replacement seem to be not enough
- **Use KAGRA coil driver**
 - KAGRA coil driver are already made (under test)
 - A kind of converter is necessary for handling differential signal output of KAGRA coil driver
- In either case, it takes a few weeks, I think.

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Schedule delayed about half a year since the last f2f meeting

Plan

- Installation of M*C*i and M*C*o is intended to start from March.
- Method of alignment for suspension is under consideration.
- It is required to prepare the magnet and standoff gluing tool.

Remaining issues and time needed

- **Coil driver problem**
 - We found TAMA Coil Driver didn't work properly
 - Measures need to be discussed at the next IOO meeting
 - **In either case, it takes a few weeks**
 - Replace of tungsten wires (a few days; 2persons)
- **Wrong direction of a magnet on MCE**
 - To be determined at the next IOO meeting
- **Preparation of plates under suspension**
 - A few days
- **Reassembling of some parts**
 - half a day

Schedule adjustment with MIR

- Install manual is in preparation by Nakano-san

MCE install procedure

Naoko Ohishi, Masayuki Nakano

August 28, 2015

1 General warnings

- 磁石を折らない
- 鏡を wedge の向きを間違えない
- 鏡を間違えない箱に鏡の名前を明記
- 鏡の表面に触らない
- ワイヤを切らない
- 作業員 B は非常に辛い体勢で作業を行うため、きつくなる前にすぐに休憩する。作業員 A、補助員も適宜休憩を取るようにする

2 サスペンションインストール手順

一応書いておいたほうがいいと思います。

3 鏡インストール手順

3.1 必要作業員数

3名。

- 作業員 A:大開口部からの作業

Latest Schedule of MC suspension Installation

- **8/31-**
 - Determine what to do for coil driver and magnet
 - Take measures to malfunction of coil driver
 - Preparation for coarse alignment
- **9/7-**
 - Take measures to malfunction of coil driver
 - Transfer function measurement and replacement of curly tungsten wires if possible
- **9/14-**
 - Suspension installation if possible
- Mirror installation schedule has not been fixed yet

Summary

- There remains some problems need to be fixed in MC suspension installation
 - Coil driver malfunction
 - Wrong direction of a magnet
- However, I expect that MC suspension installation will be done in the next month.