LLO+α帰朝報告

PEM meeting 2018/12/11

Takaaki Yokozawa, Takahiro Yamamoto, Keiko Kokeyama

Contents

- 長い間meetingが不定期で、ご迷惑をおかけいたしました。
  - 10/23 - 26 : 台湾
  - 11/5 - 11/22 : USA
  - 11/26 - 11/28 : 京都
  - 12/5-12/7 : NAOJ/柏
- 今年はもう出張がなく、神岡に滞在しておりますのでPEM workを加速していきます。
- 12/13,12/14,(12/21,12/22予備) B4卒論用データ測定
- 今年度中に行いたいhigh priority work
  - Cチェンバーのcharacterization
  - PSL tableのcharacterization
  - 磁場マップの作成
  - 音場マップの作成
  - その他チェンバのcharacterization
  - その他

USA出張

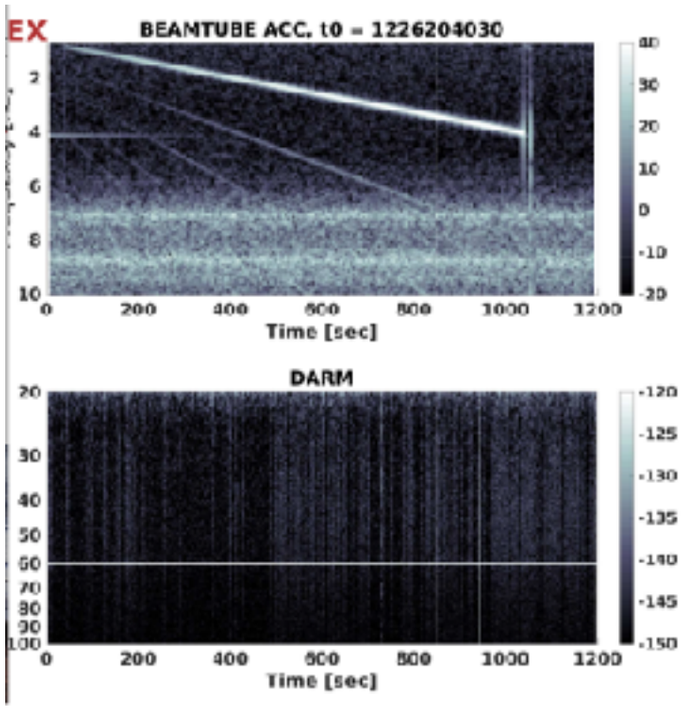
- 11/5 - 11/6 : Caltech
  - Hiro-YamamotoさんRanaと議論
  - http://gwwiki.icrr.u-tokyo.ac.jp/JGWwiki/KAGRA/Subgroups/PEM/Meeting/181105
- 11/7 : Cal. State. Fullerton
  - Jess, Josh,関係者と議論(オフラインDetCharの一大拠点)
  - http://gwwiki.icrr.u-tokyo.ac.jp/JGWwiki/KAGRA/Subgroups/PEM/Meeting/181106
- 11/8 - 11/22 : LLO滞在
  - AlexとDetChar議論
  - East Call DetChar meetingに参加 , LVの方々と議論
- その他、色々な方から、色々な情報を得ることができました。
- 次ページから紹介

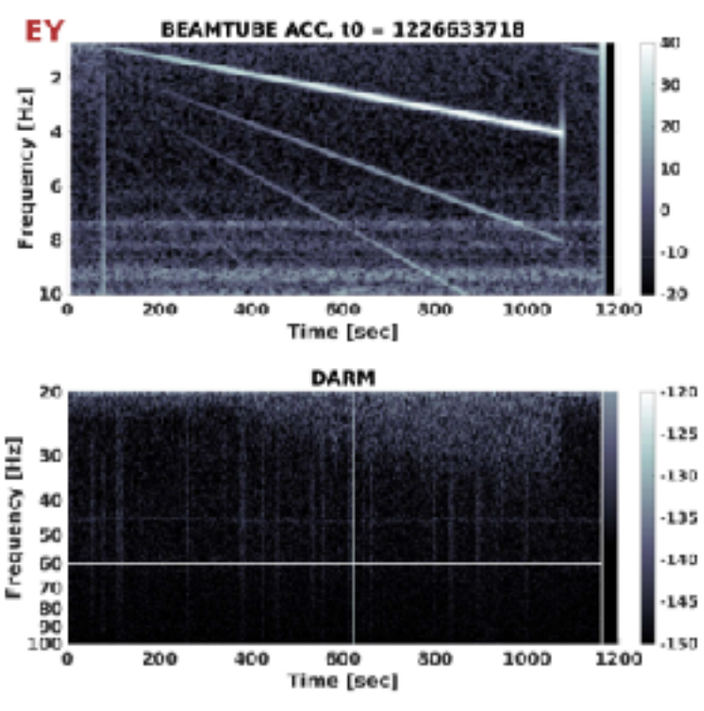
LLO滞在中のcommissioning work

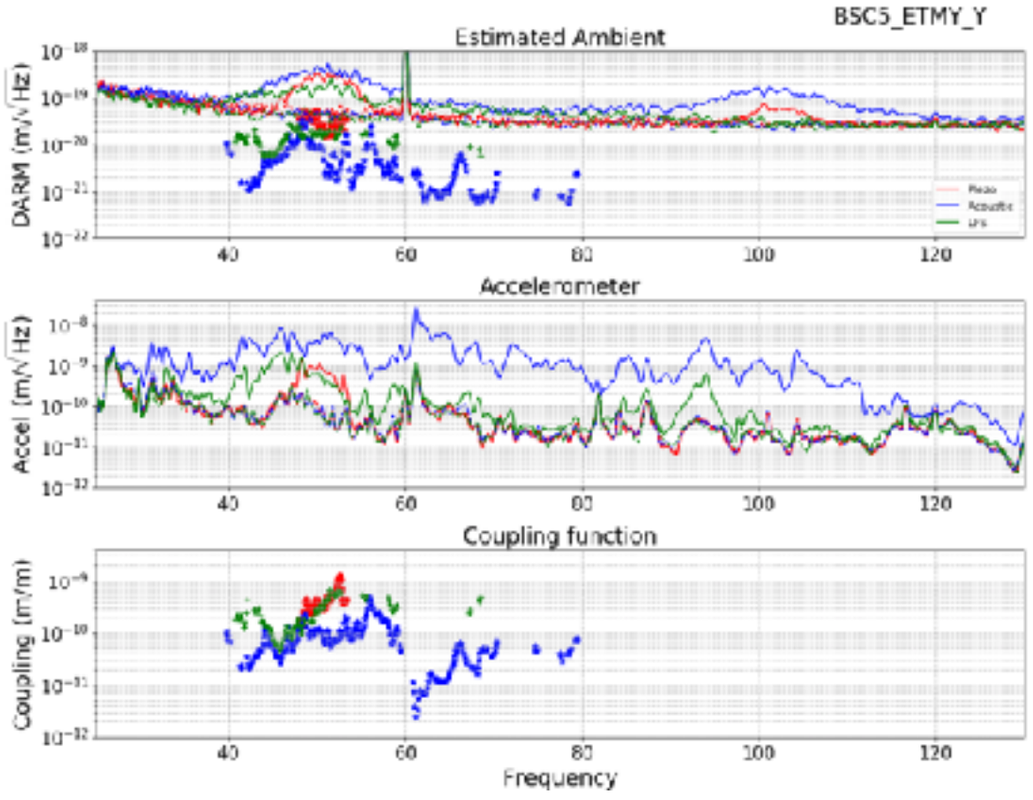
- 僕らがLLO滞在中はまさにコミッショニング作業真っ只中
  - 残念ならが、我々がLLOのデータを触ることはできなかったため、基本的には、作業を横で見ながらどんなことをやっているか教えていただいたり、議論に参加するのがメイン
  - I. High power laser化
    - 到着時は、約25Wでの運用、その後、慎重に(1~2Wずつ)レーザーを強くしていっているよう。最終的に2週間弱で2Wくらい上昇した。
    - laser強化して、initial alignmentの確認、lockできるか、lock後soft&hard motionに対するdarmとcarmの信号をチェック、ALSのoptical filterの形を調整する
- Squeezing試験
- Lock guardianの最適化(OMCロックがまだ少し手動が必要)
- GNDやテストマスの電荷やふらつきの調査など
- Noise hunting
  - ここがメインなので、次ページからもう少し細かく

Up-conversion noise

- 一つ、high-priorityで行われていたNoise huntingは、Yendが電車通過(~3Hz)に伴ってDARMにupconversion noiseが生じるものであった。
- PCalに伴っている何かであろうという推測があった
- 結局、チェンバを開けて、ゴーストビームのdamping失敗に伴うノイズであった。
- そのノイズと向き合う際の経験を少し記述しておきます。





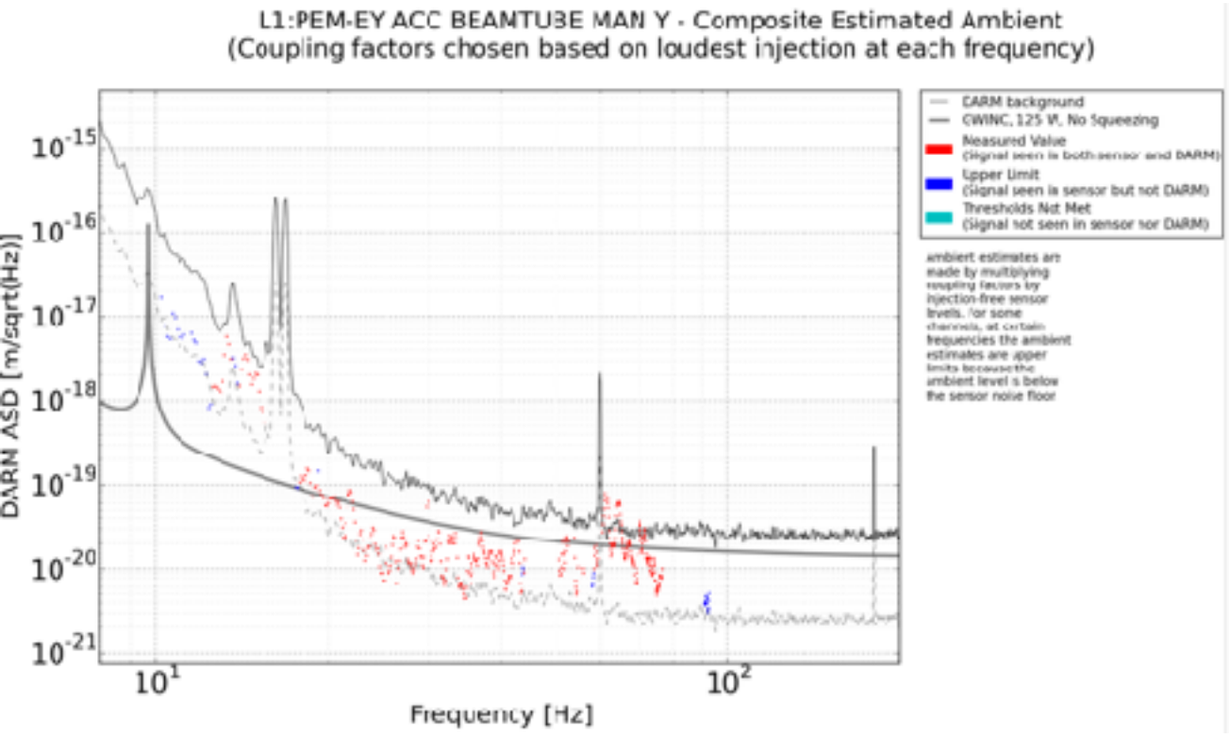


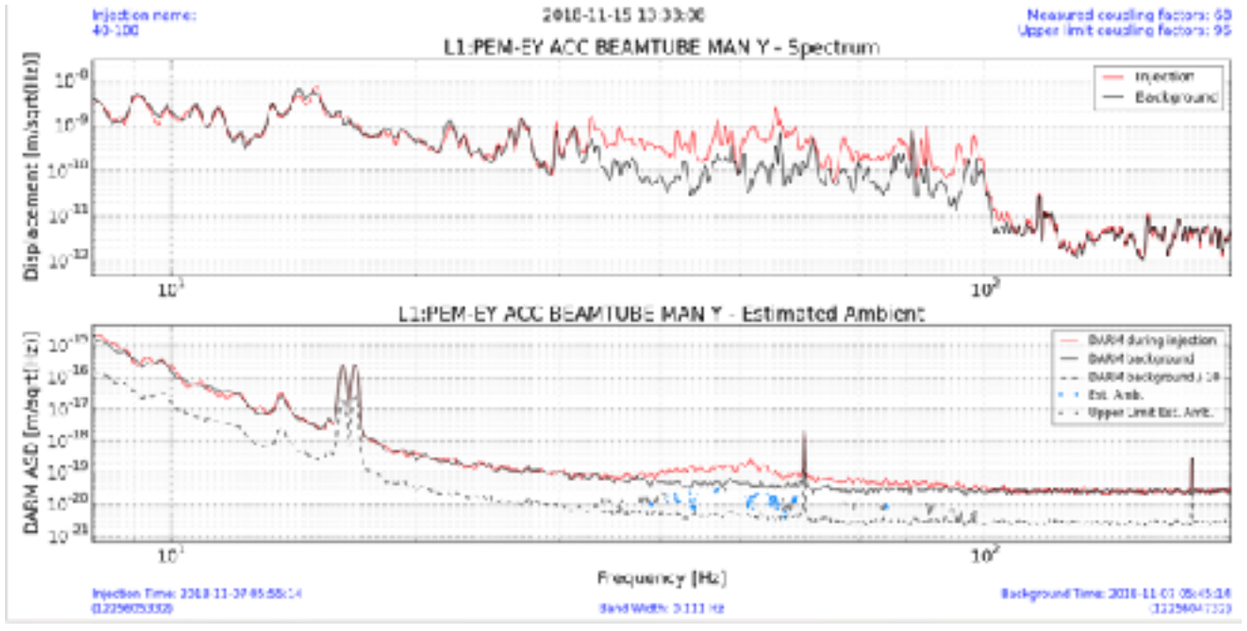
PEM injection

- General
  - End stationに、DAC, ADCを即時使用できるようにBNC portが用意されている
  - 加速度計は、定電流電源とBNC-DSub converter内で10倍加速されている(だけ)、チェンバのcharacterizationには十分なのかどうかなどを今後おこなっていくのがいいかもしれません。他のもの(マイク等)は専用のアンプを使用していた。
- MAG injection
  - 大きなコイルとアンプがすでに用意されていて、場所を移動させながら確認をしていた。すでにLIGOでは精密チェックの時間が終わっているようだが、KAGRAではこれからのはずなので、様々な場所からインジェクションを行わなくてはと思います。

PEM injection

- Shaker injection
  - 高周波用のピエゾshakerと低周波用のshakerが存在、現在、情報をまとめた資料を請求中。結局、振動->散乱の影響をコツコツと潰していくことが改めて重要だということを再認識。shalerおよび、加速度計を駆使して特に散乱光が残っていそうなところを一つ一つ細かく確認していかなくてはいけないでしょう。
- PEM coupling
  - injectionしたら、DAMR信号にその周波数のcouplingがあるのかを調べるのは極めて重要。開発さん、森さん、冨士川さんがすでにacoustic injectionの測定をしてくれて、coherenceがあるのかを確認してくださったが、それがどれくらいの大きさで起こっているのかはまだ解析途中である。これをfinalizeしてくれる強力なツールになると思う。





Report on LLO visit

KAGRA F2F satellite meeting@Kashiwa 2018/12/7

Takaaki Yokozawa, Takahiro Yamamoto, Keiko Kokeyama

ICRR University of Tokyo

Introduction

- Most part of the important information about LLO visit is shown by Yamamoto-san
  - Not only the data characterization tools, but also detector characterization tool is important as easy data check tools
  - DQ flag ideas (online/low latency/offline)
  - LV detchar people are very supportive!
    - Reducing the manpower/efforts of KAGRA detchar
    - Some core people have ICRR machine account -> access to k1sum0 machine
    - Detchar Slack
    - Glitch trigger tools and glitch TF mapping tools, summary pages
    - For using LV useful detchar tools, the communication with LV detchar people is essential
      - Calculation machine, NDS2 server, maintenance, …
  - After the O3, most detchar/CDS tools will be upgraded to the debian9 and python3, …
  - DMT and signal processing
- My main tasks in LLO were joining the commissioning and learning about PEM and noise hunting
  - Such information is for onsite and commissioning. I will skip in this meeting
  - KAGRA PEM activities are reported in the last F2F meeting at NAOJ

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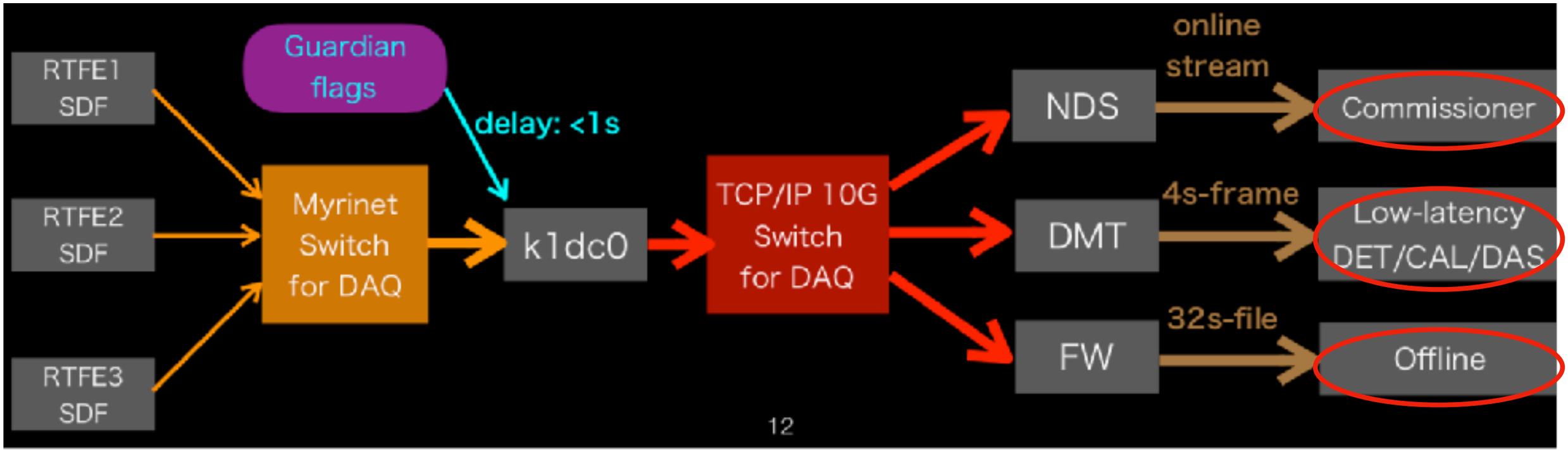
detector/data characterization tool

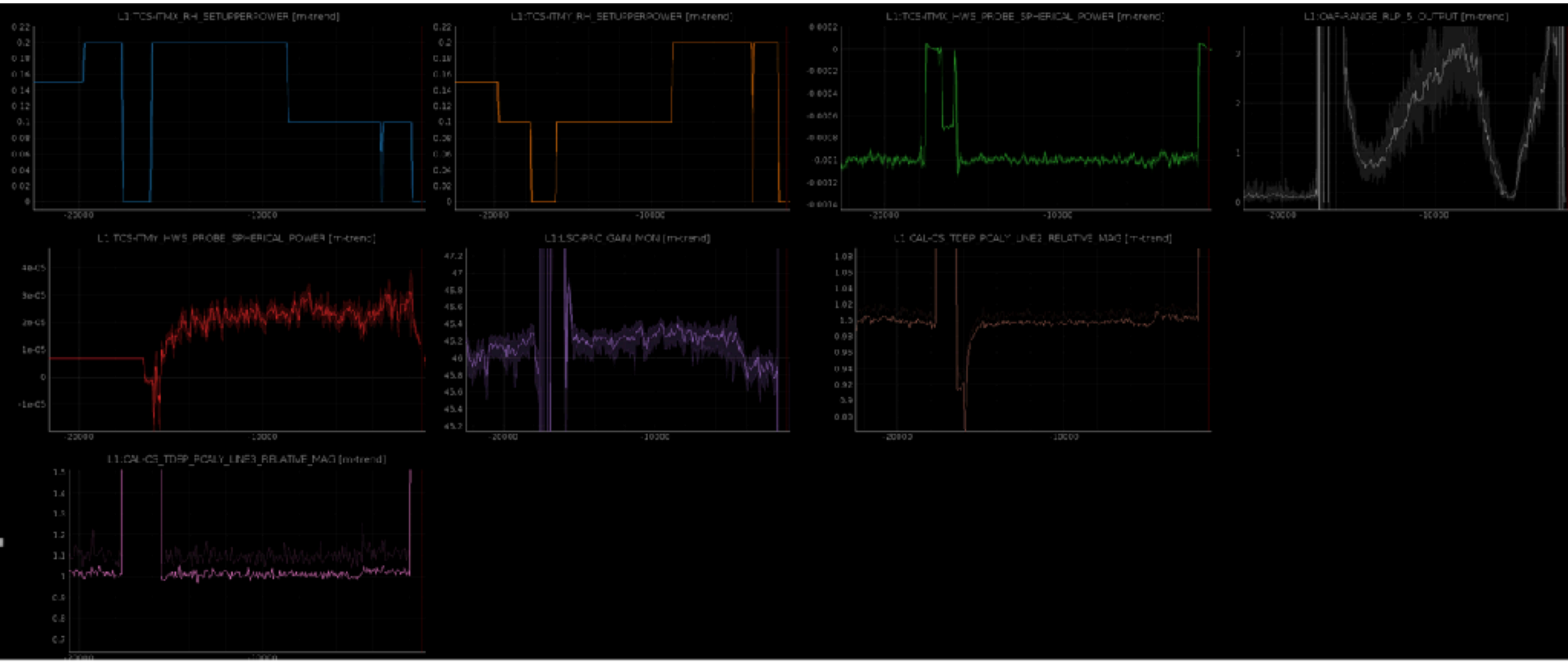
- Picture from Yamamoto-san's slide



- The useful tools are different in each working group
  - Commissioner/onsite people
    - easy detector/data characterization tools
      - Summary page, Bruco, ndscope, glitch characterize(omicron, omega scan, …), LIGO DV web, pem coupling calculation program(pemcoupling),
      - Useful tools are frequently used by commissioner
    - online data(detector?) quality flags
      - Guardian flags(auto interferometer lock/unlock system)
      - Laser, suspension health check
      - Excitation/commissioning/observation stage flag

detector/data characterization tool

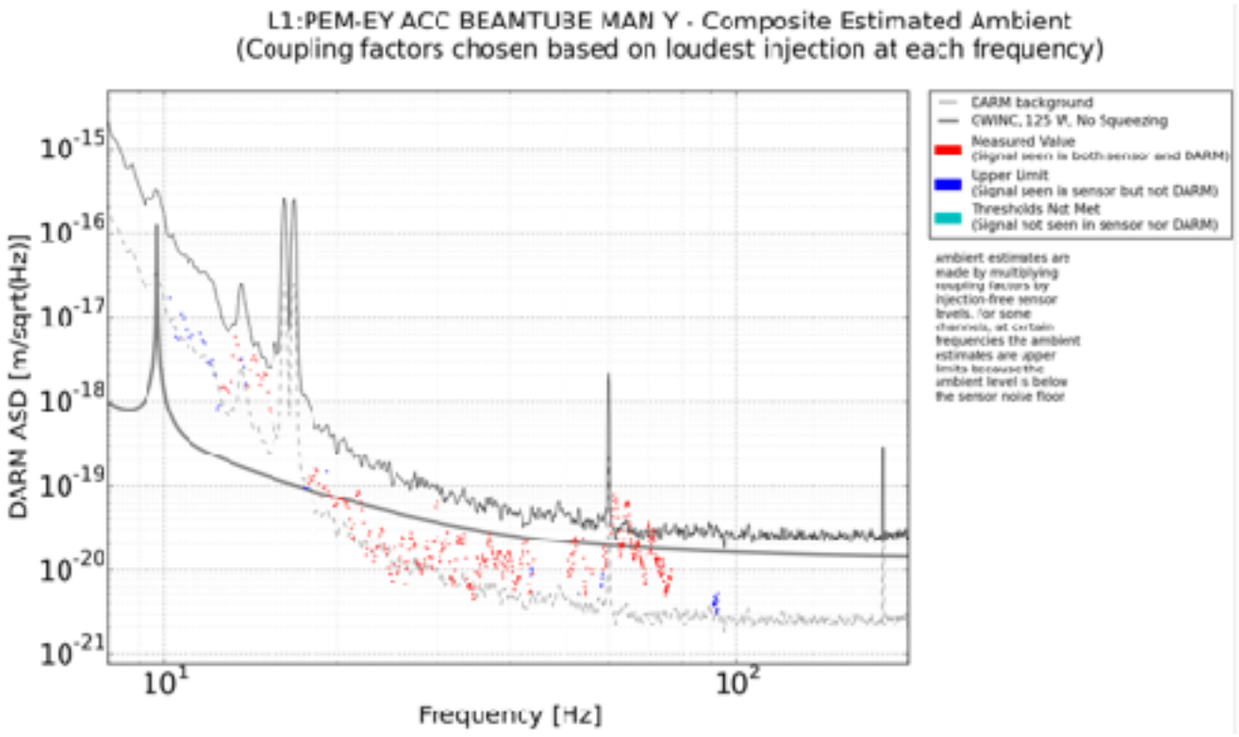
- From aLOG LLO

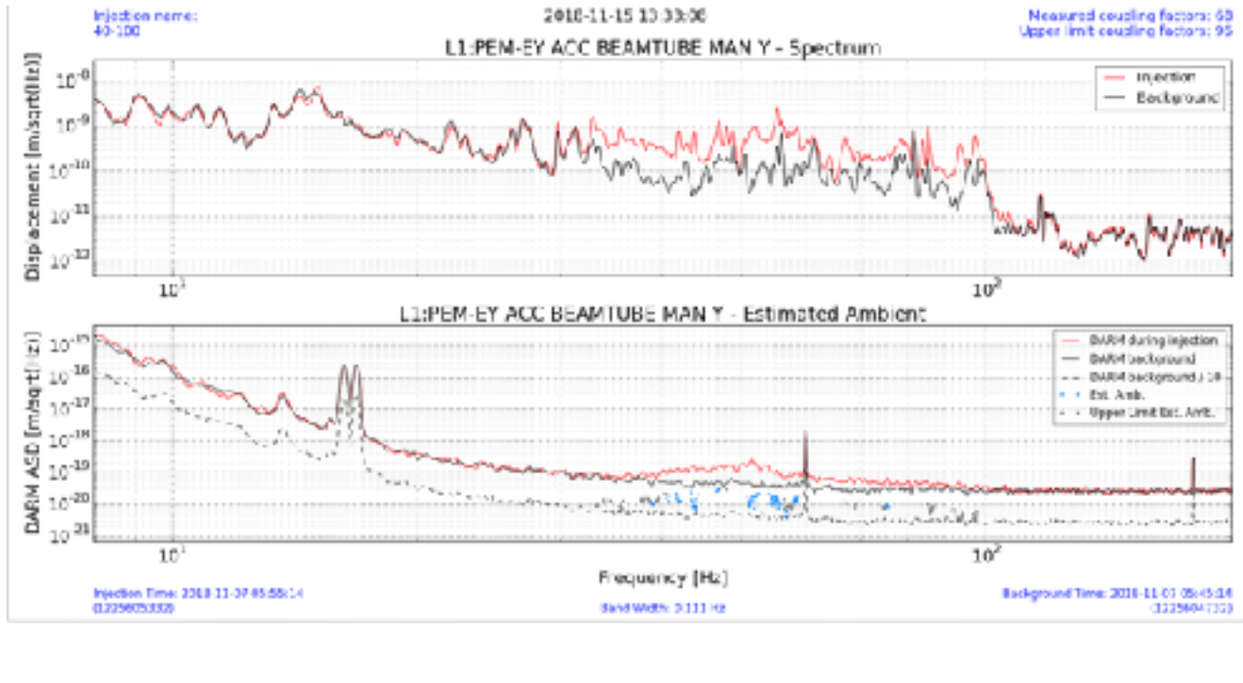


- ndscope
  - Yamamoto-san installed to one client machine
  - Easy to check (1) multi channel time domain signals (2) expand/decrease axes (3) read values
- Semi-automated tool (ex. band limited time domain signal, fast spectrogram, quick plot tools)

detector/data characterization tool

- Results of shaker injection LLO

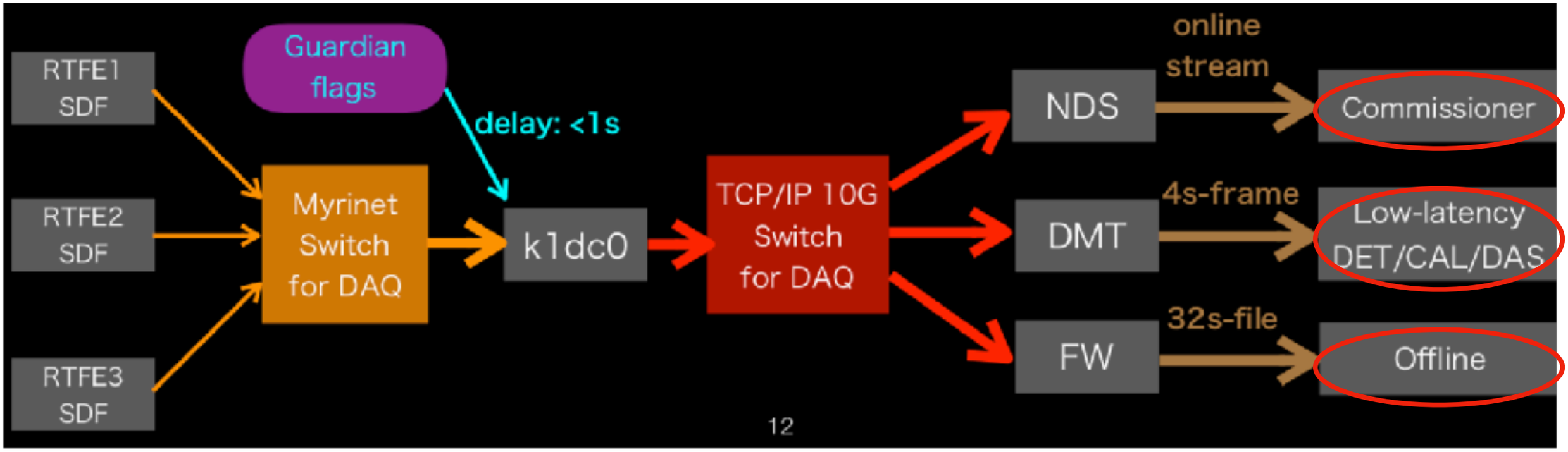




- pemcoupling
  - Yokozawa installed on k1sum0/k1ctr5 (need GWpy)
  - Automated plotting tool with calculating the coupling function for the PEM injections.
  - Users just set the silent GPS time and injection GPS time
  - Following quick check tools with aa small working cost are preferred for the onsite workers.

detector/data characterization tool

- Picture from Yamamoto-san's slide



- The useful tools are different in each working group
  - Low-latency DET/CAL/DAS
    - Need to discuss what type of data quality flag is important, who manage.
    - Using DMT or other possible way? -> Yamamoto-san's slide
    - data management plan (from which machine/where to send)
  - Offline
    - Deep detector/data characterization
    - Search noise sources with advanced methods
    - High quality characterization of glitch and line noise
    - etc. …

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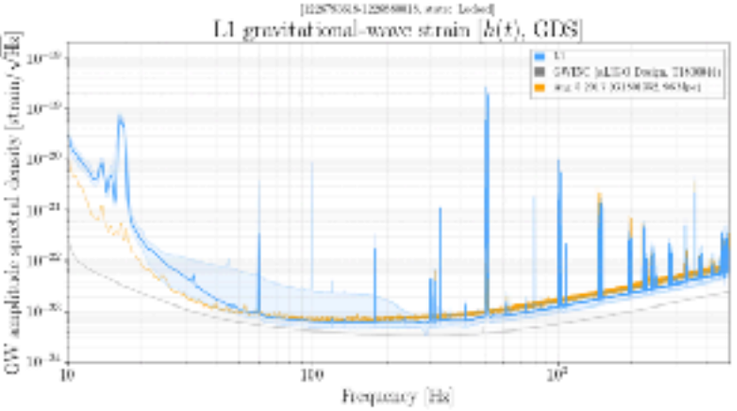
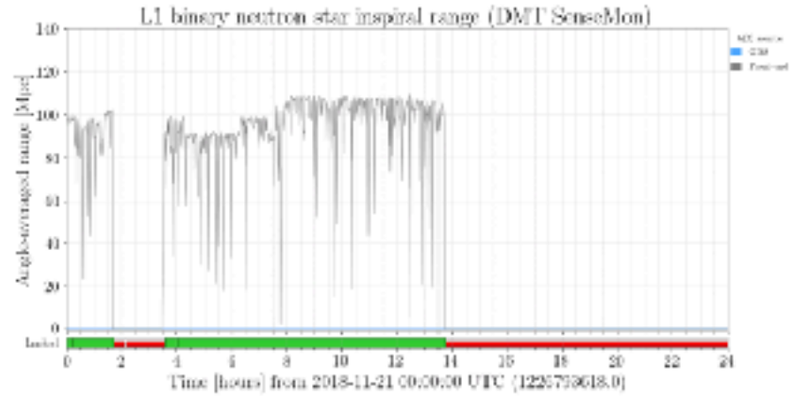
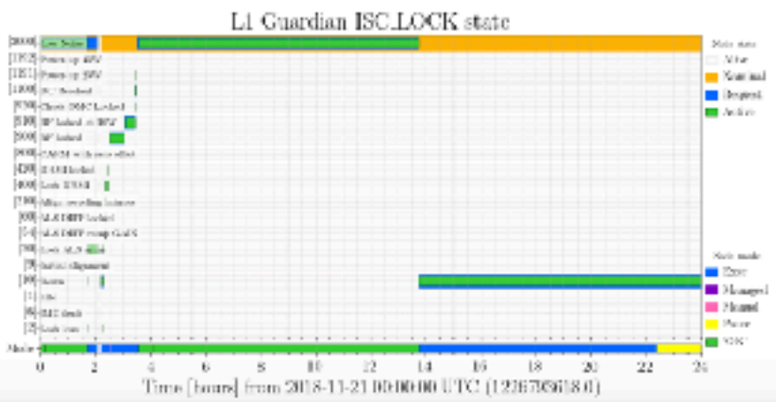
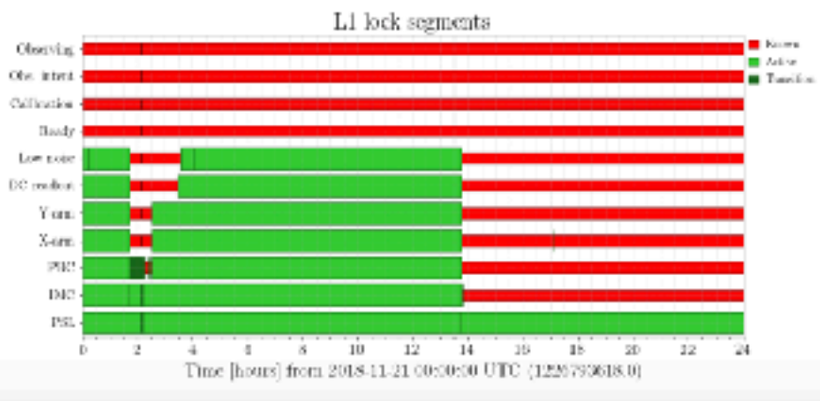
LV detchar group's kind supprt

- Access to summary pages
  - https://ldas-jobs.ligo-la.caltech.edu/~detchar/summary/
  - https://ldas-jobs.ligo-wa.caltech.edu/~detchar/summary/
- k1sum0 upgrade
  - daily summary page, omicron, …
- LVK detchar call
  - https://wiki.ligo.org/DetChar/Nov192018









DetChar Call, Monday Nov 21/Tues Nov 22 2018

When: 2100 Pacific time Monday Nov 21
Where: TeamSpeak | DetChar channel[launch]

Agenda
- Announcements
- One-minute updates
- Agenda
- Minutes

Announcements

- Fill in upcoming SpecialTopics
- Report from sites (LHO, LLO, Virgo, KAGRA)
- Deadline for LIGO DQR contributions: **Wed Nov 28**
- LIGO detchar f2f noise sprint at LLO Jan 14-18 2019

One-minute updates

- ...

Agenda

- Update from KAGRA detchar
  - PEM [slides 16 and 17]
- Gravity Spy Methods Paper Part 2 - Scotty Coughlin (15')
- AOB

Minutes

Audio recording: https://dcc.ligo.org/LIGO-T1700154

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PEM channel information

- Web based DQ channels explanation page
  - Important detector channels saving in the frame files
  - Yuzu summary page
- KAGRA wiki
  - Installation plans, PEM-ADC relationships
  - Summary of the PEM injection plans
- web based tool
  - Learned how to make the PEM webpage (will appear in future)

PEM Channel Info

LHO | LLO | Database | Contact | Sensor Specs | PEM Home Page

Channel Lookup show ▼

L1:PEM-EY_ACC_BSC5_ETMY_Z

Current Status: Check here

Coupling Function: Data Plot

Calibration:

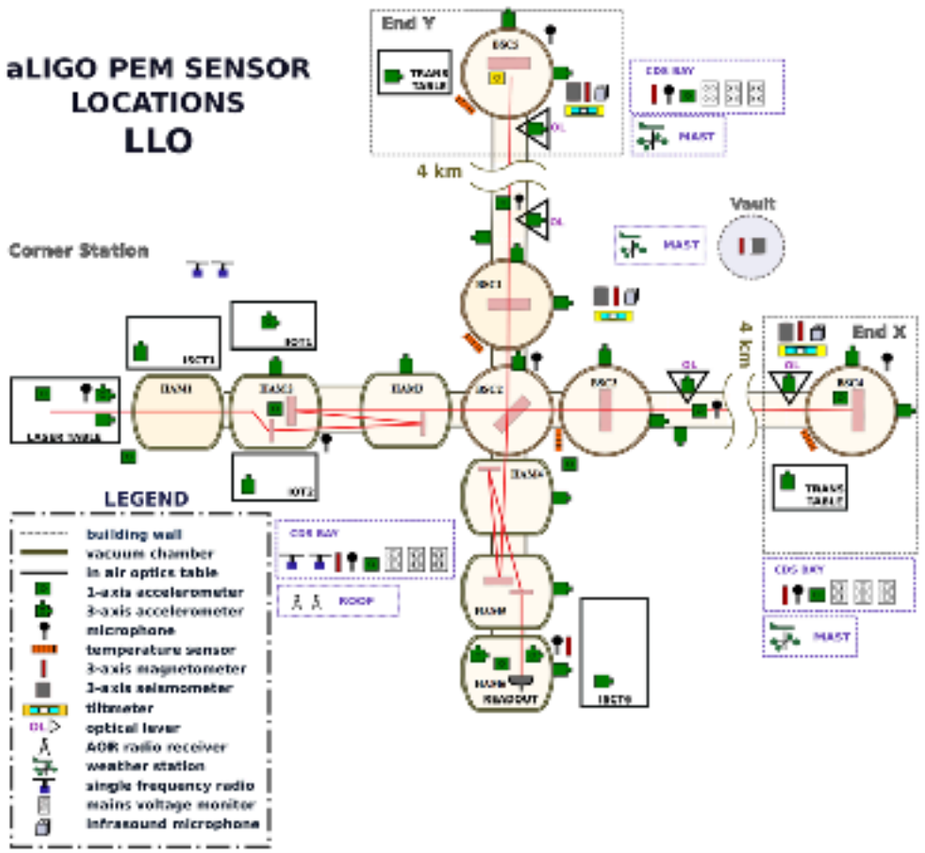
- *Factor:* 6.1 μ/s2 per ADC count
- *Calculation:* ((10 m/s2) / 100 V) * (4 V / 65536 counts)
- *Range:* 1 - 900 Hz
- *Amplitude Error:* 7%
- *Phase Error:* Not reported

Sample rate: 8192

Grid location (X, Y, Z) (mm from vertex on LVEA floor): (0, 0, 0)

Sample spectrum:
Not currently available. (Click here to open the current time series and spectrum in a new tab. NOTE: Ligo credentials required.)

Picture:



Created by Maggie Tse, Vincent Roma, Terra Hardwick Last Updated: Apr 23, 2013 Instructions for editing website

My opinion

- My impression on LV detchar is summarized in white paper 2018
  - https://dcc.ligo.org/public/0150/T1800058/002/WP18.pdf

– Fundamentally necessary services:

  * The summary pages; an invaluable set of webpages containing key plots that describe the state and behavior of the LIGO detectors and their environment
  * The Data Monitoring Tool (DMT), including the low-latency DMT DQ vector infrastructure

* The segment database; which stores state and DQ flag information used by the astrophysical searches
* Omicron triggers, which identify transient noise triggers, including in low-latency, delivered with very high reliability
* Robustly accurate interferometer states, including for configuration changes made between or during lock stretches (i.e., suspension damping state)

My(our) opinion

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– Highest priority software and services
  * Automated data quality checks for candidate events: the Data Quality Report (DQR)
  * iDQ
  * GWpy
  * Stochmon
  * STAMP-PEM
  * Hveto
  * ligoDV web
  * Omegascans
  * Channel Information System
  * VET
  * Offline noise subtraction code
  * Suite of remote access tools (remote MEDM, remote EPICS, remote DataViewer)
  * ODC (or potentially an alternative for key information at low latency)
  * Mapping of overflow channels
  * LigoCAM
  * GravitySpy
  * FScans and dependent programs / scripts
  * NoEMi

My(our) opinion

- My impression on LV detchar is summarized in white paper 2018
  - https://dcc.ligo.org/public/0150/T1800058/002/WP18.pdf
- ODC(Online detector characterization)
  - They existed in LIGO model, but were not used now.
  - Online DQ is summarized in DMT
- Summary page
  - One of the most important detchar tools
  - Now you can see the LLO/LHO summary pages using your LIGO DCC account.
  - Fruitful contents
- Data flow especially for the low latency pipeline
  - calibrated h(t)
  - data quality flags
  - component of proc data
    - -> Detail is Yamamoto-san's slide
- We need tools not only for the data analysis/pipeline but also onsite worker
  - Low-latency characterization, Detail-offline characterization
  - LIGO detchar structure may not fully established, KAGRA member should learn and developing very efficiently!

List of discussion / My suggestion

- Who manage/control the DQ flags?
- What types of DQ flags are necessary?
- Fix the low latency data path (including the proc frame file) and Tear-2
- I want to suggest at least one onsite person join the DAC as a observer.

- How to communicate with LV detchar group?
  - My opinion is “Need deep communication”
  - Learning and importing the useful tools and information, constructing KAGRA one
  - Export the useful tools to LV

PEM: Status of PEM Subsystem

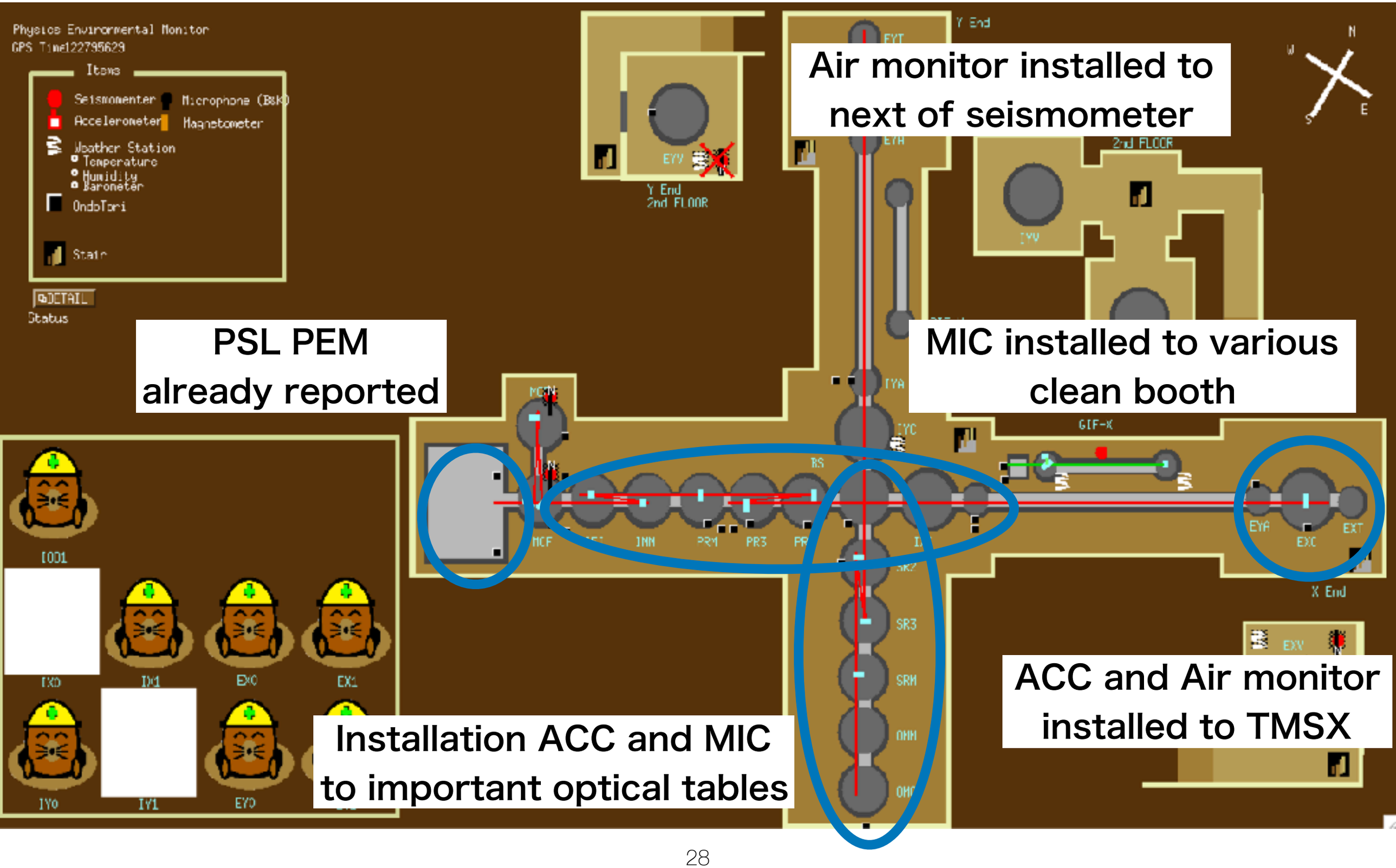
KAGRA F2F meeting@NOAJ 2018/12/5

Takaaki Yokozawa on the behalf of the PEM subsystem

Contents

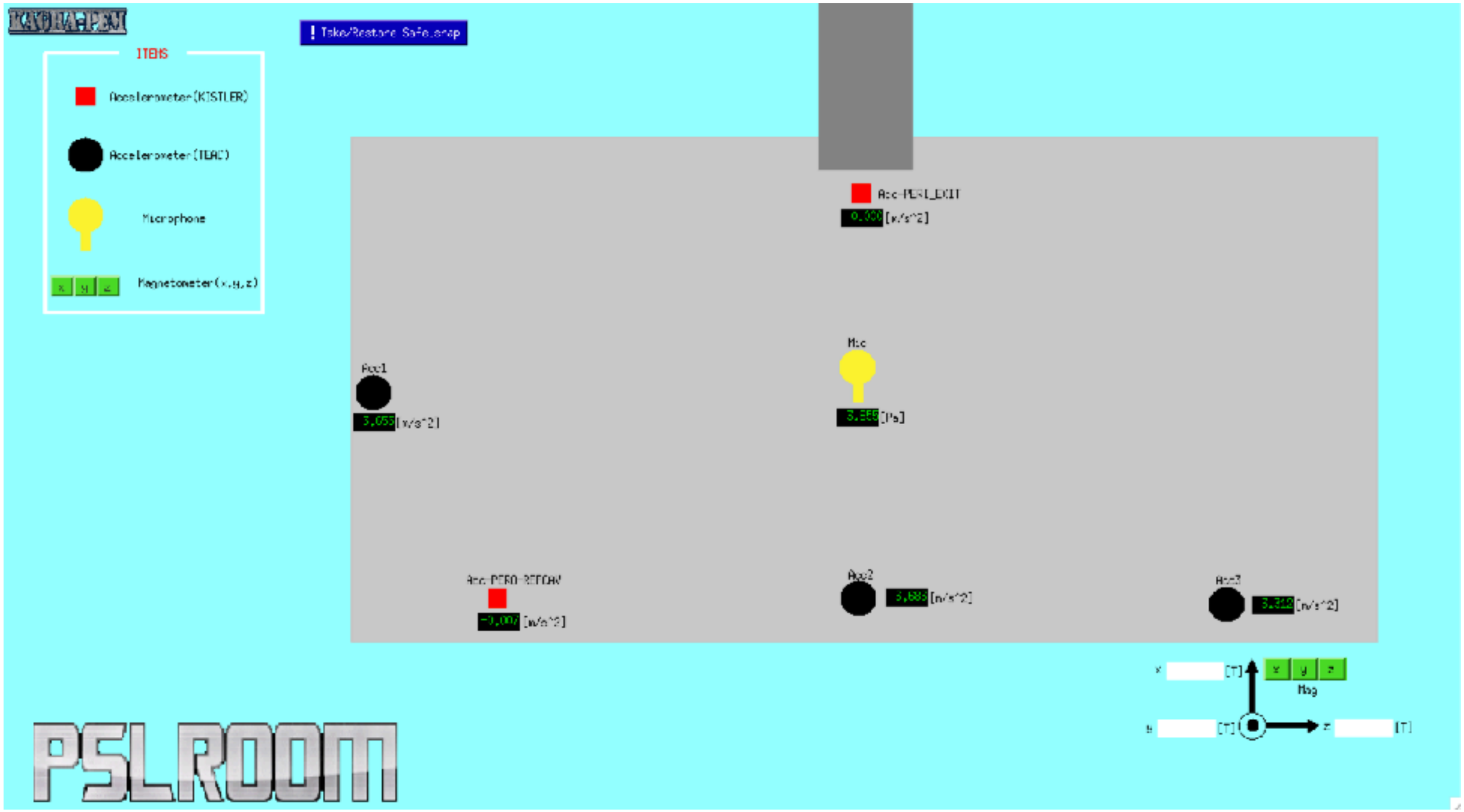
- Additional PEMs from last F2F meeting
- KAGRA environment measurements
- Noise identification
- Useful tools for commissioning
- Summary and future prospects

Additional PEMs



Additional PEMs

PSL room



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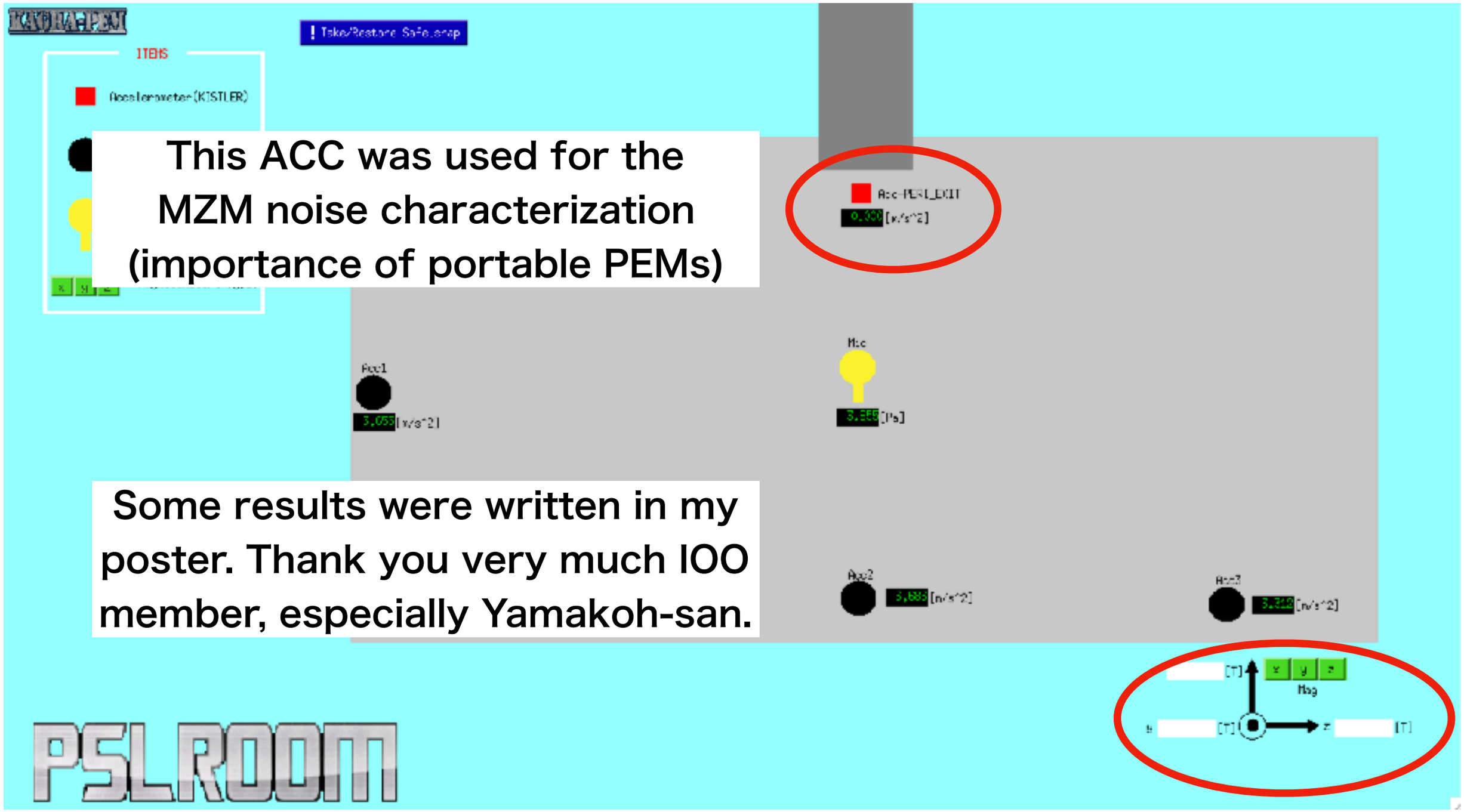
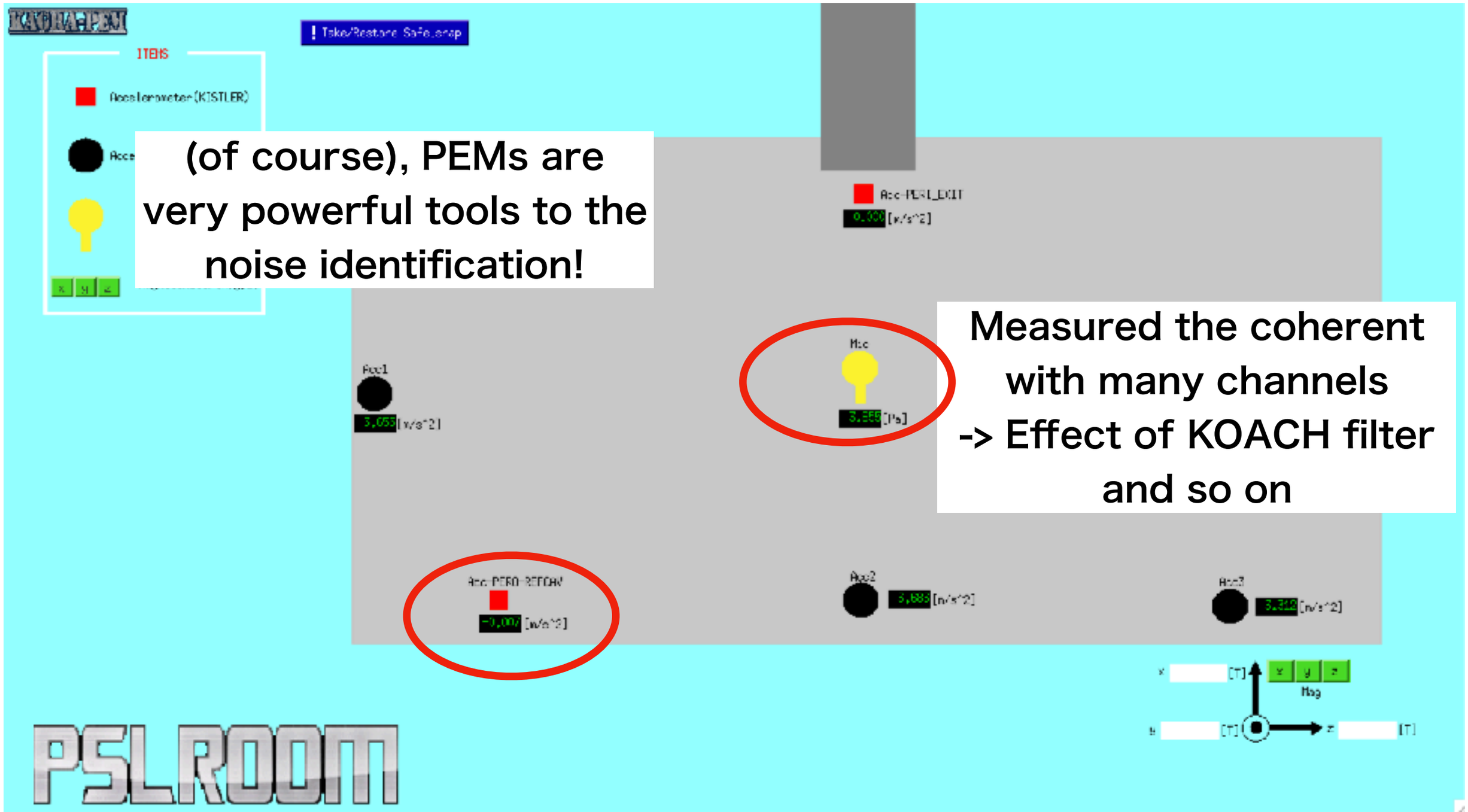


Magnetometer temporary removed

Additional PEMs

PSL room

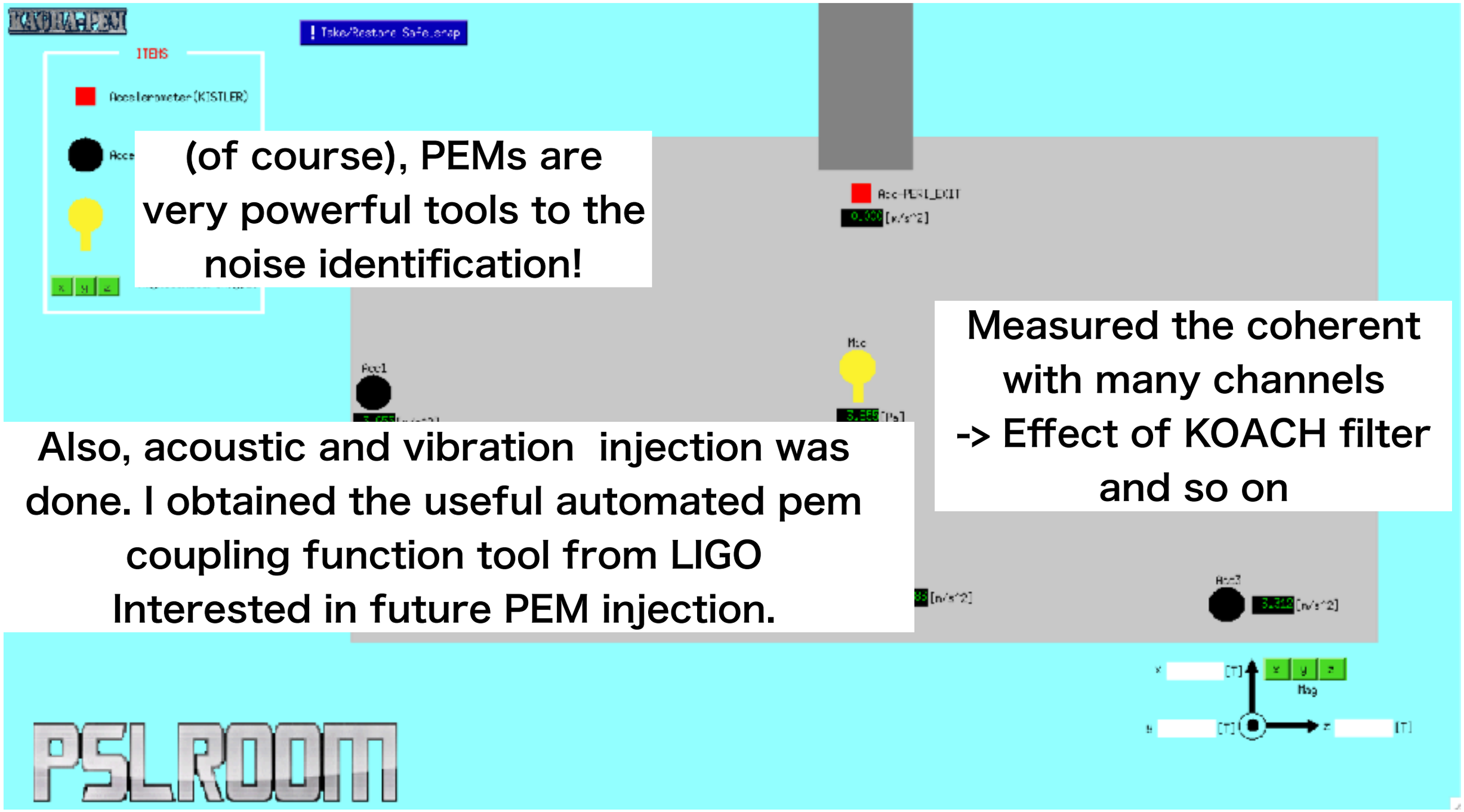


(of course), PEMs are very powerful tools to the noise identification!

Measured the coherent with many channels
-> Effect of KOACH filter and so on

Additional PEMs

PSL room



(of course), PEMs are very powerful tools to the noise identification!

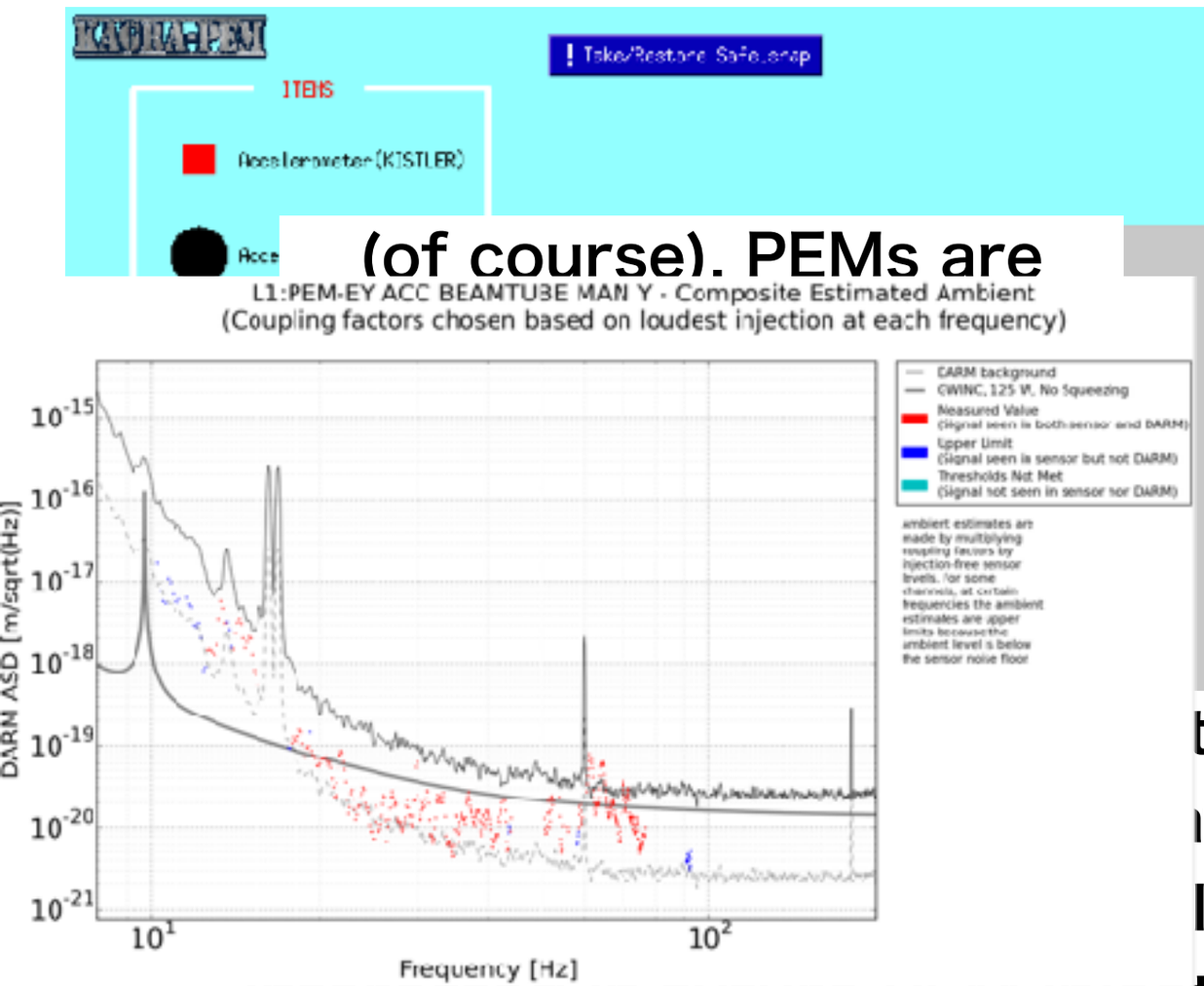
Measured the coherent with many channels
-> Effect of KOACH filter and so on

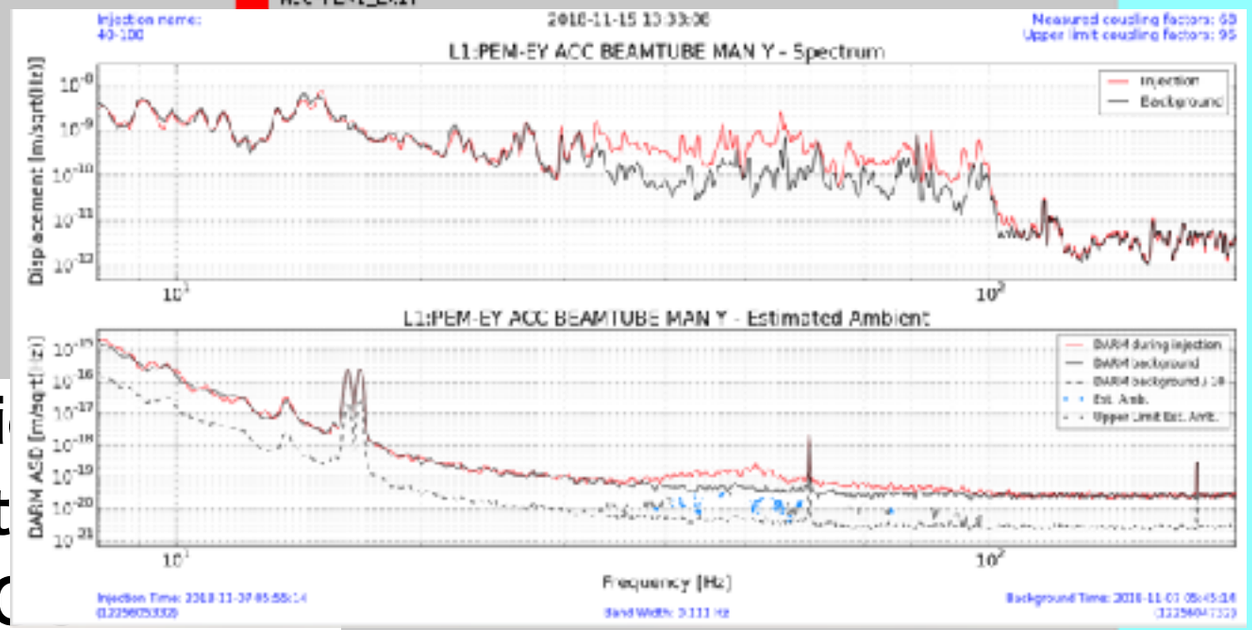
Also, acoustic and vibration injection was done. I obtained the useful automated pem coupling function tool from LIGO
Interested in future PEM injection.

Additional PEMs

PSL room

(of course). PEMs are interested in future PEM injection.

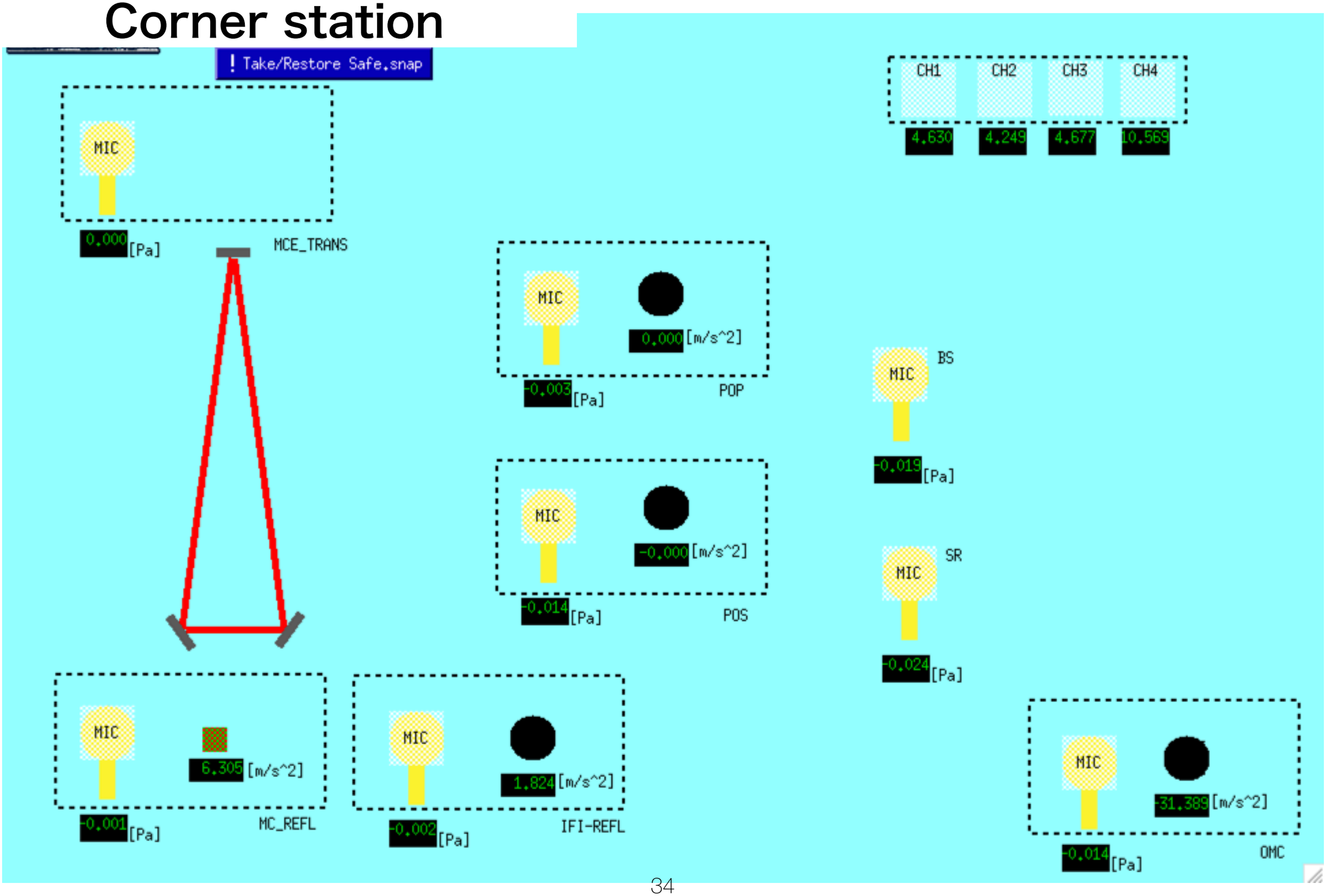




One of the important Future work :
Characterization of optical table using three accelerometers

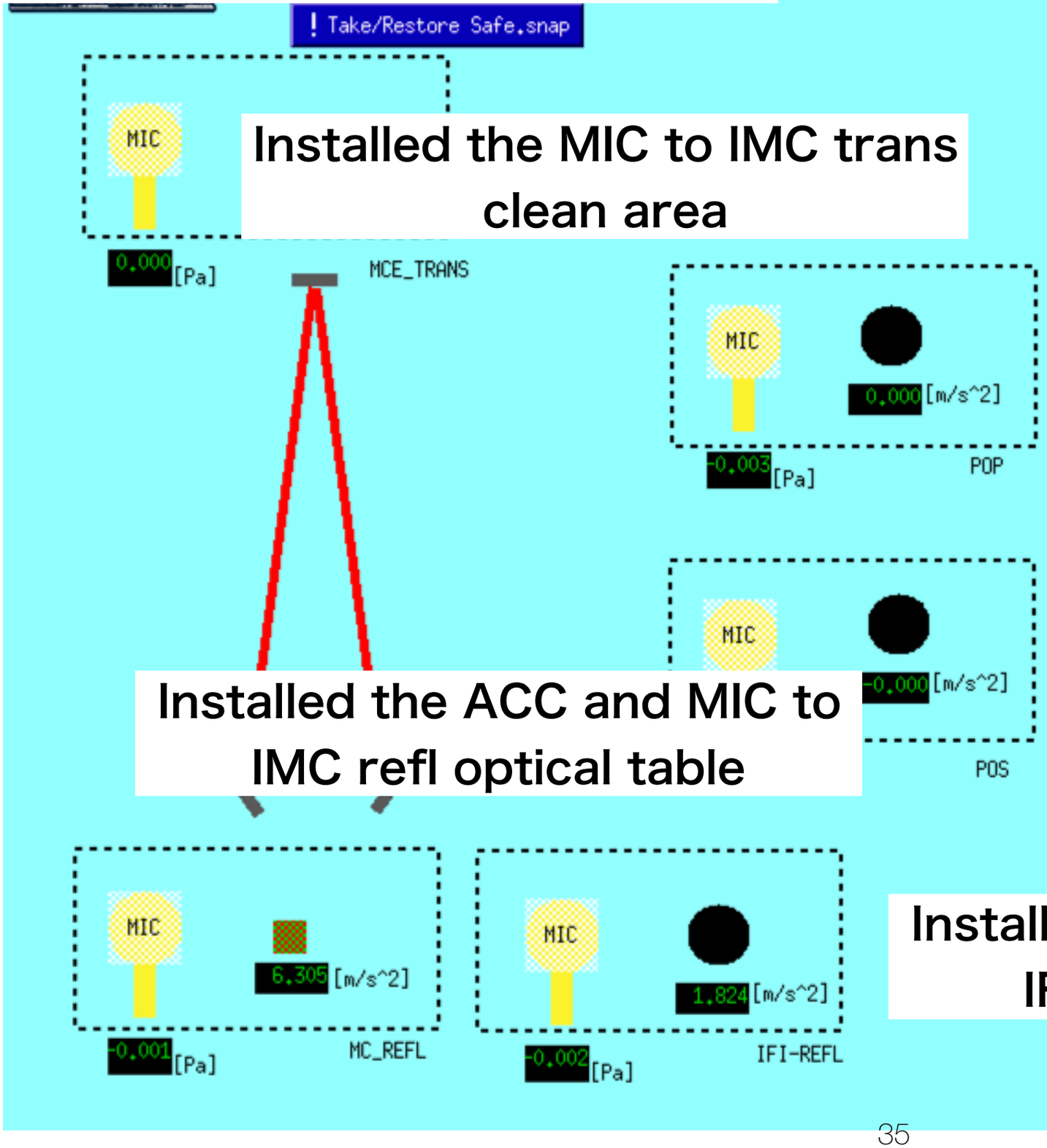
Additional PEMs

Corner station



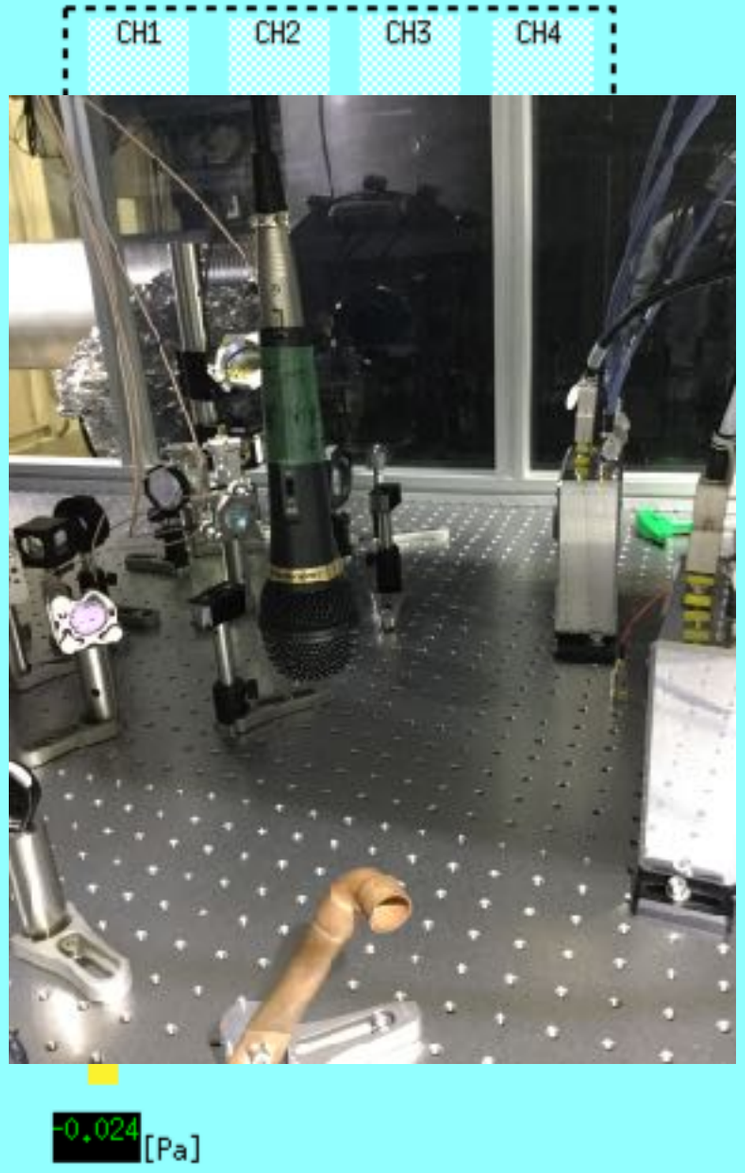
Additional PEMs

Corner station

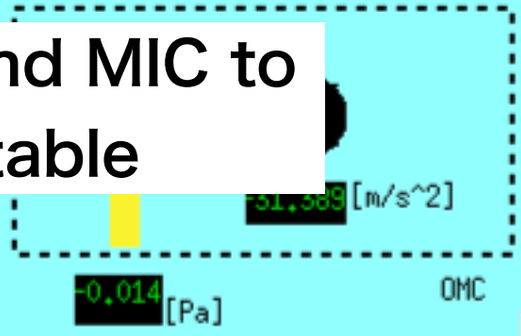


Installed the MIC to IMC trans clean area

Installed the ACC and MIC to IMC refl optical table



Installed the ACC and MIC to IFI refl optical table



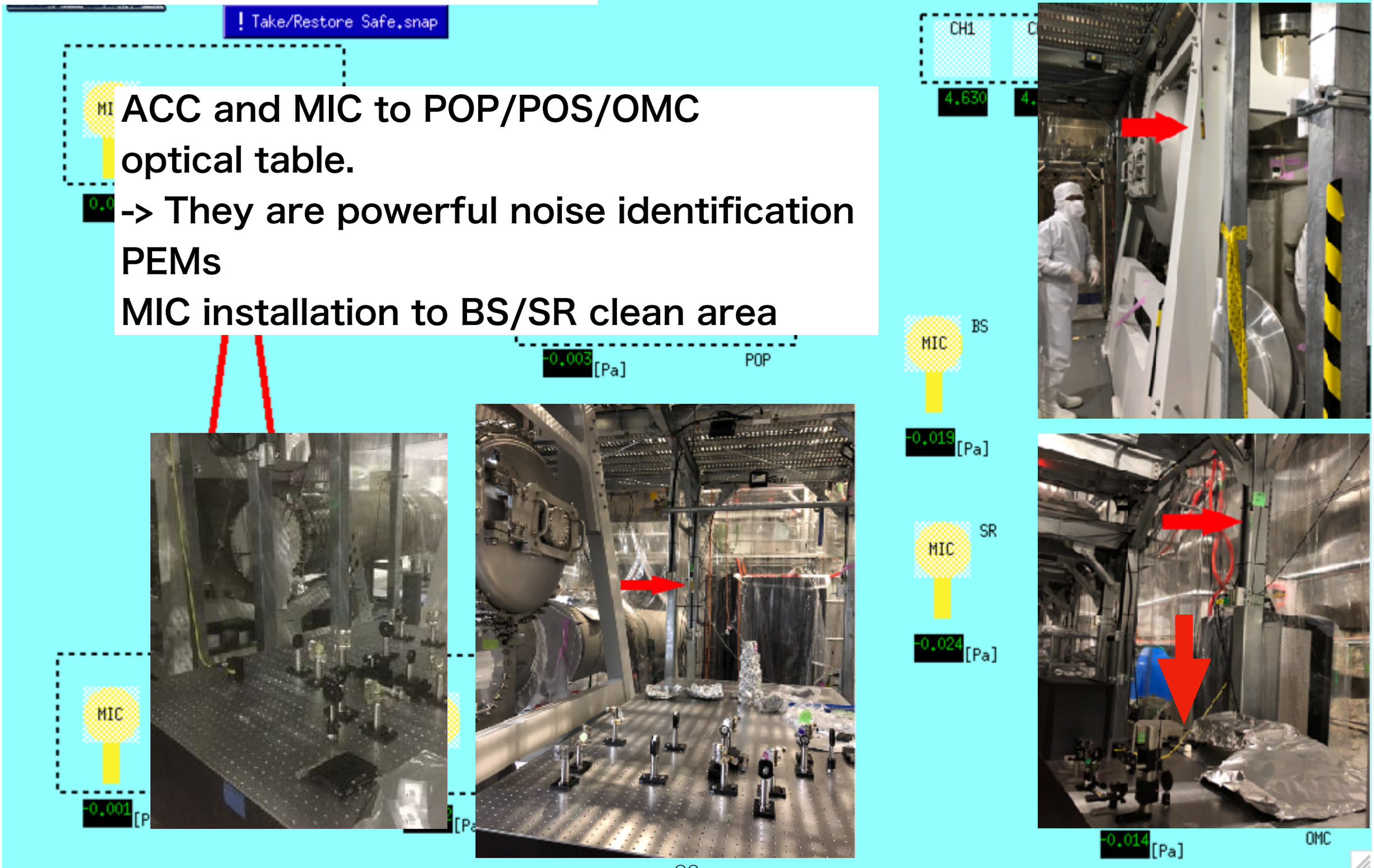
Additional PEMs

Corner station

ACC and MIC to POP/POS/OMC optical table.

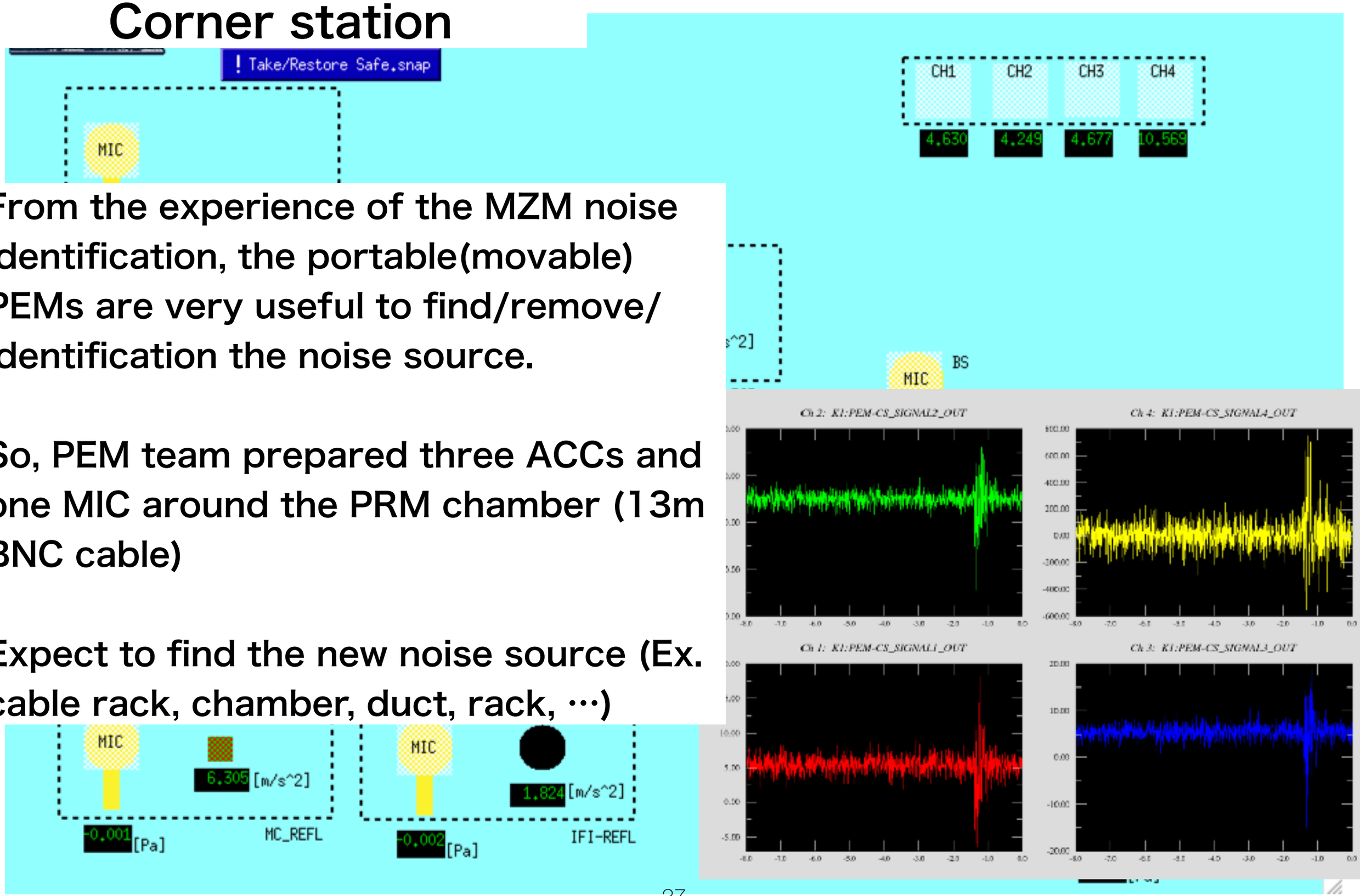
-> They are powerful noise identification PEMs

MIC installation to BS/SR clean area



Additional PEMs

Corner station



From the experience of the MZM noise identification, the portable(movable) PEMs are very useful to find/remove/ identification the noise source.

So, PEM team prepared three ACCs and one MIC around the PRM chamber (13m BNC cable)

Expect to find the new noise source (Ex. cable rack, chamber, duct, rack, …)

Additional PEMs

- We(Mainly Miyo-san) installed the air monitors around the Seismometer and center area for the test

- ACC and temperature monitors for the TMSX monitors

- Two ACC and one MIC (temporary) installed to Xend PCal area.

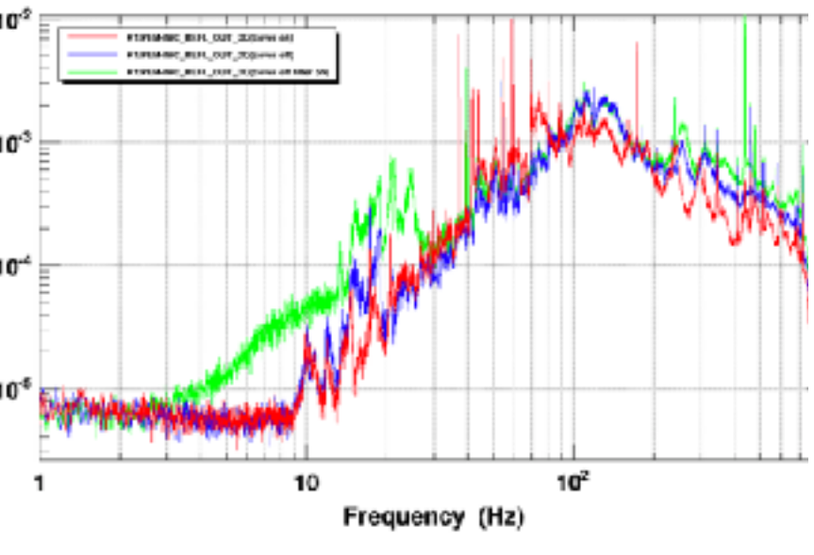
- Next step
  - Set PEMs for the chamber characterization
  - Seismometer(Trillium compact) re-placement
  - Magnetometer installation (back to KAGRA next year)

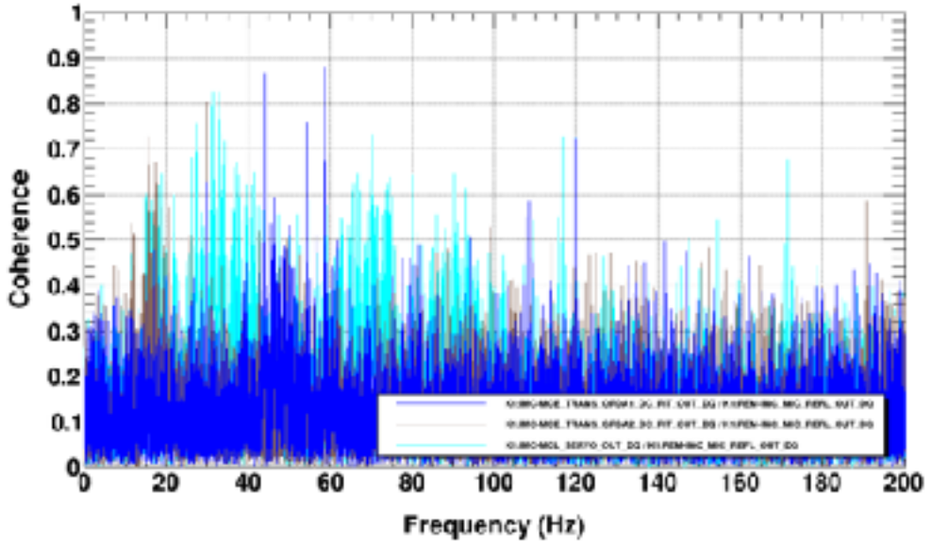
- If you have interested in and/or required to PEMs, please contact to us!

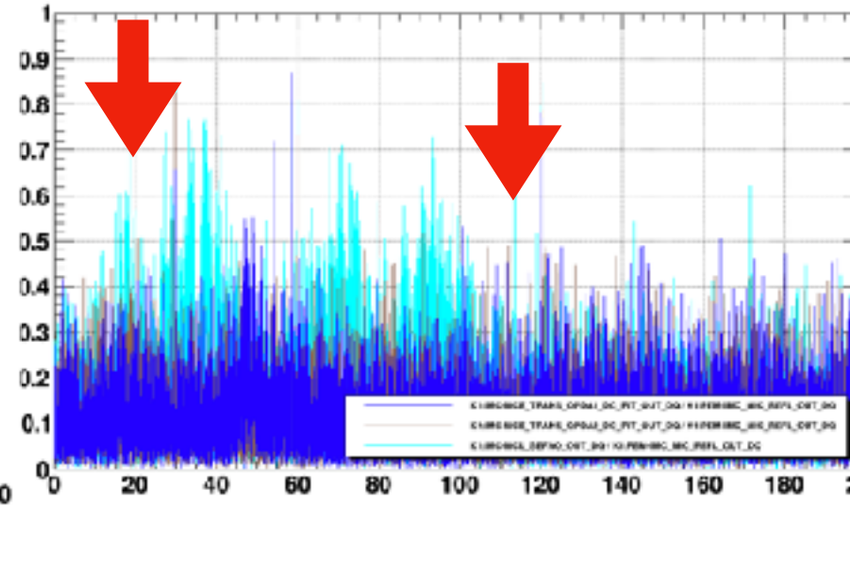
KAGRA environment measurement

IOO member installed the wind shield to the IMC refl optical table.
The wind and acoustic environment will be one of the serious noise.
So, PEM team tried to evaluate the effect of wind shield using MIC.

-attach the cover panels (A)
-detach the cover panels (B)
-detach the cover panels and turn on a FFU filter (C)







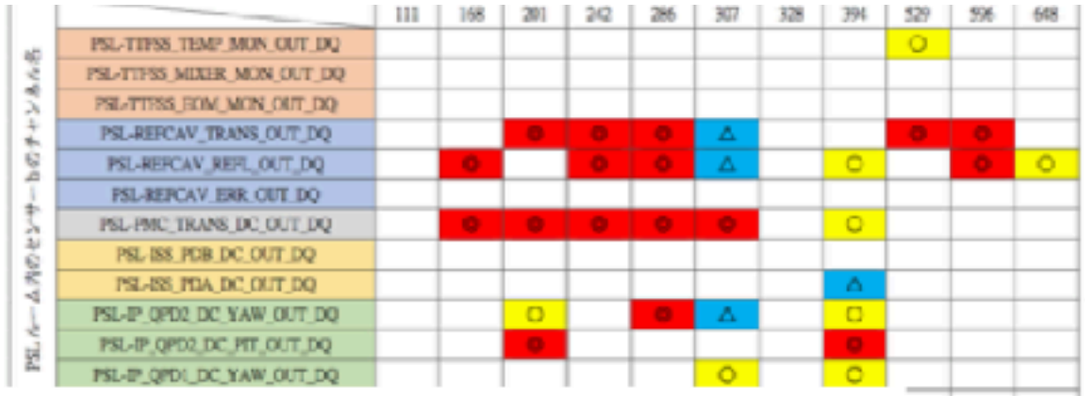
Now under investigation by T.Tanaka

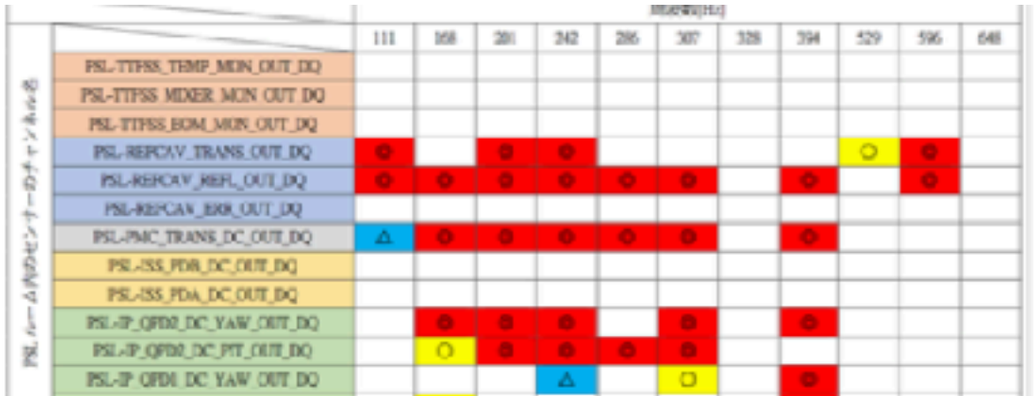
KAGRA environment measurement

PEM member was challenged the acoustic/vibration injection test to the PSL and IMC area

Channel list which have strong coherent with acoustic.

Next, we will evaluate the coupling factor





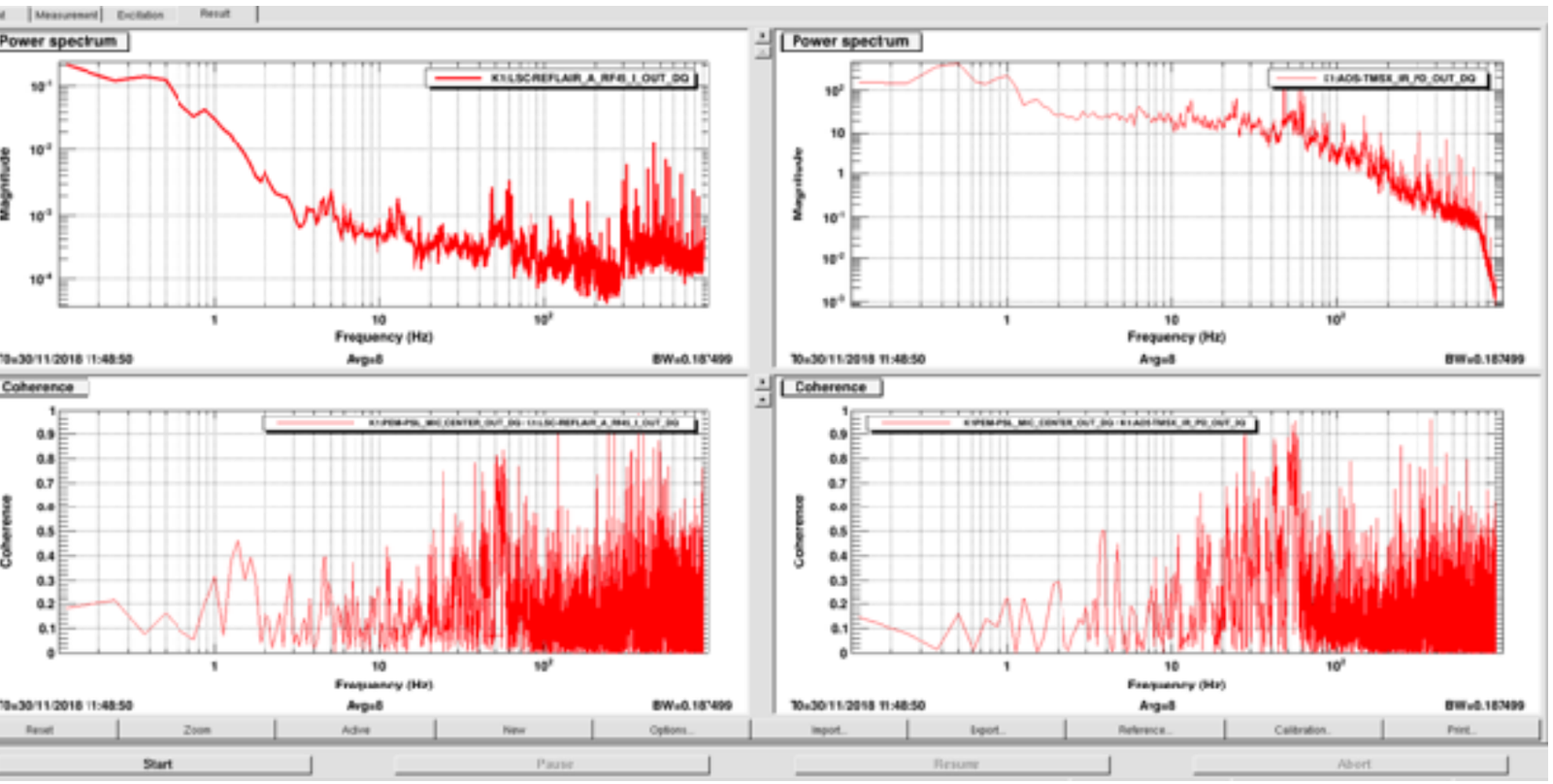
・IMC

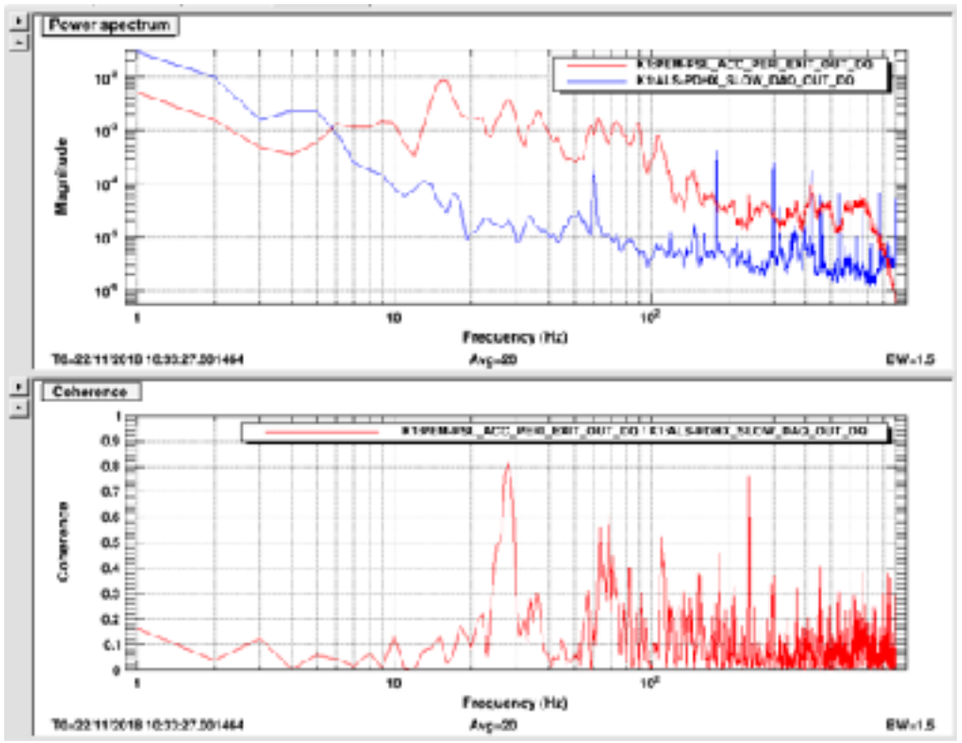
マイク(REFL)との相関

マイク(POP)との相関

Also, we will generate the KAGRA environmental magnetic filed and acoustic map for their thesis

Noise identification





Bruco, coherent finder, search the various coherent channel between IR/green important channels (TMSX PD signal, demodulated signal, IMC signal, …) and PEMs

Ex1. coherence between IR TMSX signal and PSL MIC

Ex2. coherence between ALS controls signal and PSL ACC

The detail will be explained by Kohei Yamamoto-san about the noise characterization of MZM system, he confirm the useful of PSL PEMs

Useful tools installation

We are almost final phase of the PEM installation.
(Due to the limited budget, we are focusing the PSL and optical tables)

Next, we should generate or import the detector characterization tools!
(The detail will be presented by Yamamoto-san.)

Frequency [Hz]	Top channels				
0.00	IMC-MCL_SERVO_IN2_DQ (1.00)	PEM-IMC_SEIS_MCE_NS_SENSINF_OUT_DQ (0.67)	PEM-IMC_SEIS_MCE_NS_SENSINF_IN1_DQ (0.67)	PEM-LVV_SEIS_TEST_NS_BLRMS_HI_OUT_DQ (0.66)	PEM-LVV_SEIS_TEST_NS_BLRMS_LOW_OUT_DQ (0.66)
0.50	IMC-MCL_SERVO_IN2_DQ (1.00)	VIS-ETMY_IP_BLEND_ACCY_IN1_DQ (0.62)	VIS-ETMY_IM_PSINF_H3_IN1_DQ (0.49)	VIS-ETMY_BF_DAMP_GAS_IN1_DQ (0.40)	VIS-ETMY_BF_LVDTINF_GAS_IN1_DQ (0.40)
1.00	IMC-MCL_SERVO_IN2_DQ (1.00)	CAL-CS_PROC_IMC_FREQUENCY_DQ (0.70)	CAL-CS_PROC_IMC_DISPLACEMENT_DQ (0.70)	CAL-PCAL_EX_2_PD_RX_V_DQ (0.41)	PEM-IMC_SEIS_MCI_WE_BLRMS_HI_OUT_DQ (0.38)
1.50	IMC-MCL_SERVO_IN2_DQ (1.00)	CAL-CS_PROC_IMC_DISPLACEMENT_DQ (0.94)	CAL-CS_PROC_IMC_FREQUENCY_DQ (0.94)	VIS-PRM_BF_LVDTINF_GAS_IN1_DQ (0.40)	VIS-PRM_BF_DAMP_GAS_IN1_DQ (0.40)
2.00	IMC-MCL_SERVO_IN2_DQ (1.00)	CAL-CS_PROC_IMC_FREQUENCY_DQ (0.99)	CAL-CS_PROC_IMC_DISPLACEMENT_DQ (0.99)	IMC-REFL_OPDA2_RF14_Q4_IN1_DQ (0.46)	IMC-REFL_OPDA2_RF14_I4_ERR_DQ (0.44)
2.50	IMC-MCL_SERVO_IN2_DQ (1.00)	CAL-CS_PROC_IMC_DISPLACEMENT_DQ (1.00)	CAL-CS_PROC_IMC_FREQUENCY_DQ (1.00)	VIS-ETMY_MN_OPLEV_TILT_PIT_OUT_DQ (0.42)	
	IMC-MCL_SERVO	CAL-CS_PROC_IMC_FREQUENCY	CAL-CS_PROC_IMC_DISPLACEMENT	VIS-PR2_BF_DAMP_V_IN1	

Useful tools installation

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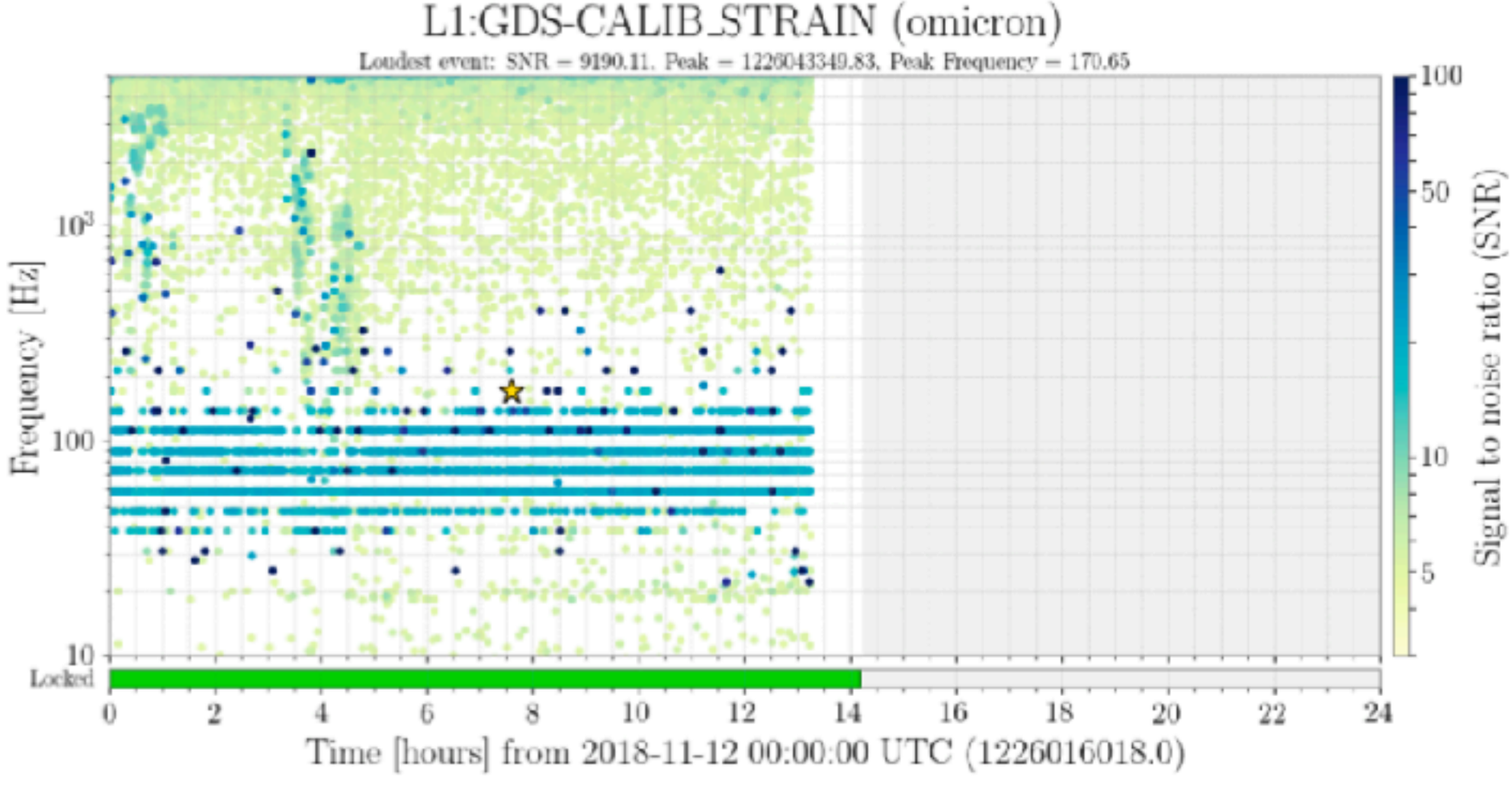
Omicron glitch search



Useful tools installation

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LIGO summary pages

Useful tools installation

We are almost final phase of the PEM installation.
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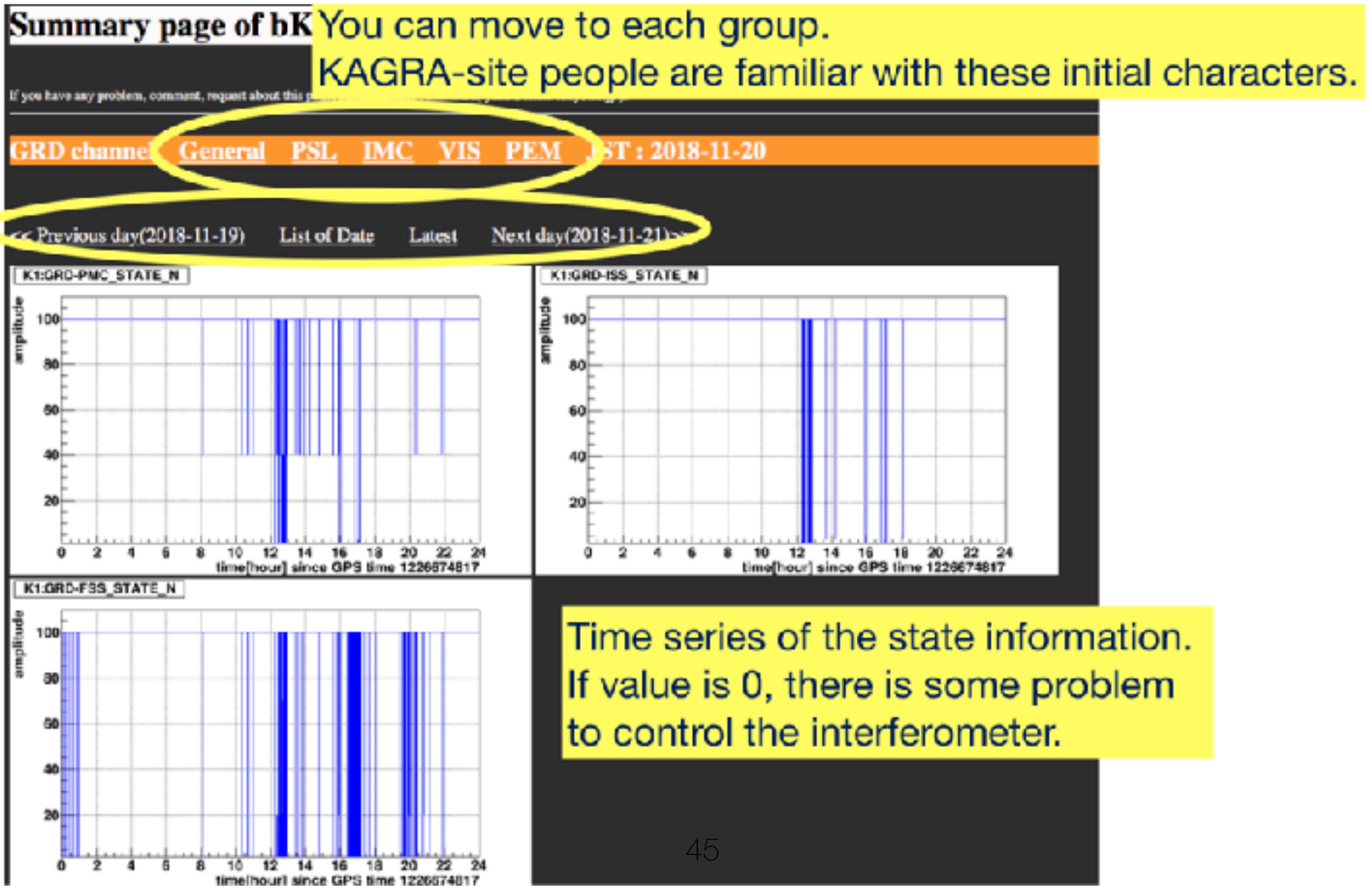

Summary and future prospects

- We installed various physical environmental monitors (PEMs) to KAGRA detector
  - You can find the detail PEM information in the KAGRA wiki
  - Portable PEMs challenging
- We will generate the KAGRA environmental map for magnetic field, acoustic, RF, …
  - Chamber/duct/Rack/… characterization
  - Find unexpected noise
  - Characterization the environmental noise
    - narrow band line
    - higher noise floor level
    - time dependences
- Various noise identification are ongoing
  - Identification -> Reduce -> Remove the origin of noise
- We are welcome to join the noise hunting using PEMs
  - Everyone can be the HERO of KAGRA noise hunter.
  - Development various noise characterization tools.