Status of KGWG-KAGRA DetChar Activities

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On behalf of KGWG-Detchar Working Group

2018. 5. 18 - 20
KAGRA F2F Meeting @ Osaka City University

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- Status Report II – Channel Safety Study
- Status Report III – CAGMon (Detchar Tool)
- Future Work

Members

John J. OH (NIMS)
DET / Deep Learning

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DET / Deep Learning

Young-Min KIM (UNIST)
DET / Deep Learning

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DET / Deep Learning

Piljong Jung (GIST)
(Temporary member)
Channel Safety Study

Keun-Young Kim (GIST)
(Supervisor)
Channel Safety Study

Temporary Membership

Will be a regular member
of KAGRA SOON!

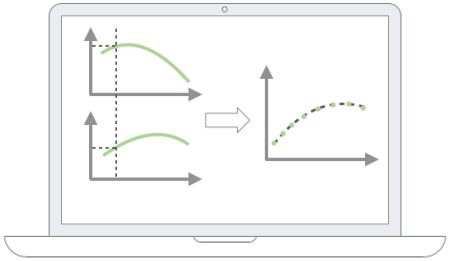
NIMS (4), UNIST (1), GIST (2)

Status Report I – Site Work @ KAGRA

Grad. Student
Piljong Jung (GIST)

Long-term visit KAGRA during 2017. 12. 14 – 2018. 1. 31
as a temporary member of KAGRA (under special permission)

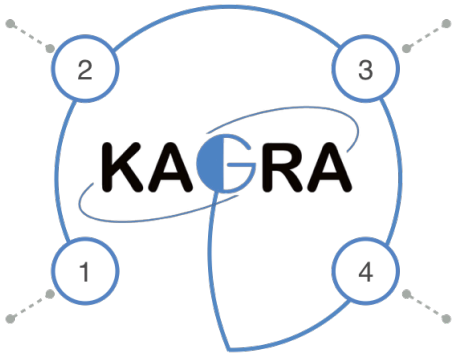
✦ ANALYSIS TOOL DEVELOPMENT



- Coupling function
- Realtime Cache generator in k1det1

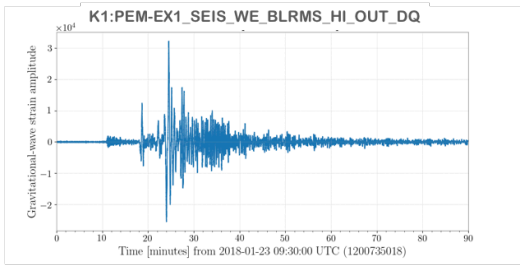
✦ BUILDING ENVIRONMENT

- Build the Python environment at seikai and k1det1
- LALSuite install in seikai and k1det1
- gwpy install in seikai and k1det1

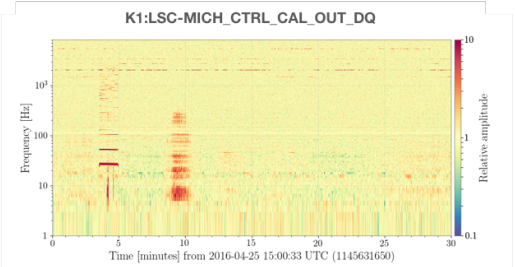


✦ DETECTOR CHARACTERIZATION

- Check for the impact of an earthquake from Jakarta on KAGRA



- glitch signal analysis

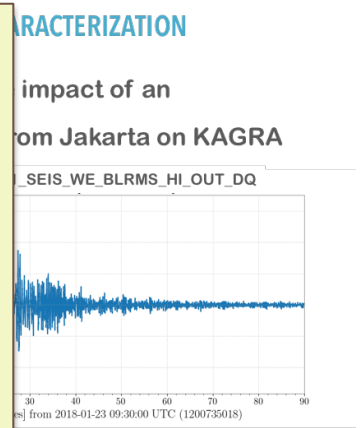


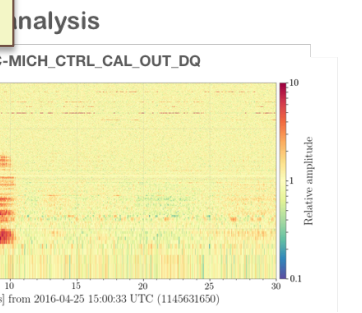
Status Report I – Site Work @ KAGRA

Grad. Student
Piljong Jung (GIST)

Long-term visit KAGRA during 2017. 12. 14 – 2018. 1. 31
as a temporary member of KAGRA (under special permission)

I would like to thank Kajita-san, Kanda-san, Hayama-san and other peoples at KAGRA for the hospitality and the temporary membership during his visit to KAGRA.





- Build the Python environment
  at seikai and k1det1
- LALSuite install in seikai and k1det1
- gwpy install in seikai and k1det1

Purpose of Channel Safety Study

Detector characterization:

- monitor and understand the glitches from environmental disturbances and instrumental anomalies that is very harmful to gravitational-wave detection (e.g. wind, earthquake, light-scattering, thermal vibration etc)
- reduce the rate of such glitches by using various veto methods and detchar tools (enhancing DQ)

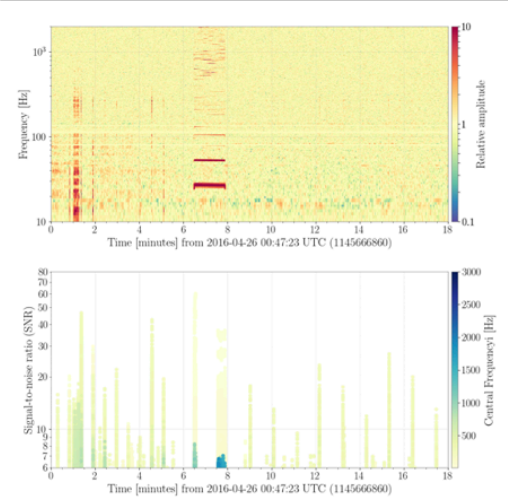
If there are some subsystem channels that behave identically with the gravitational wave channel (we said 'the channel is unsafe'), then all gravitational-wave signals will be removed by glitch veto algorithm. So we must remove those channels from the glitch vetoing channel list (so called 'Detchar Channel List or Safe Channel List').

Channel Safety Study should be done before the signal search and glitch veto analysis. The study is about 'making a decision which channels behave like gravitational-wave channel and generating a safe channel list for detchar purpose'.

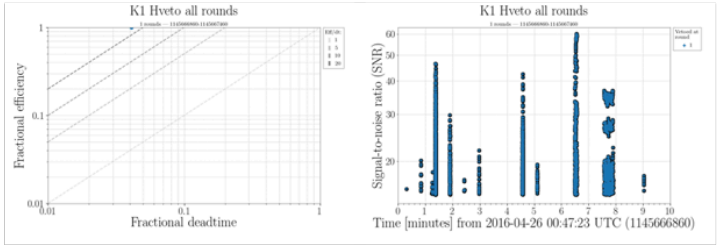
For example: GW150914 (at the very early stage of detection)
- Veto algorithm (Hveto used in LSC) rejected the signal since some unsafe channels are not properly removed from the Detchar Channel List. This fault has been modified soon, then the detection has been made correctly.

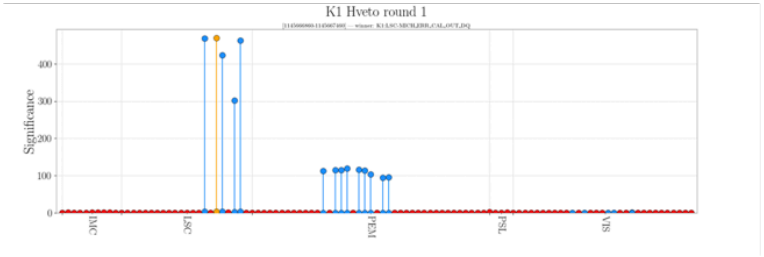
Status Report II – Channel Safety Study (1/2)

DATA PROPERTIES



HVETO RESULT



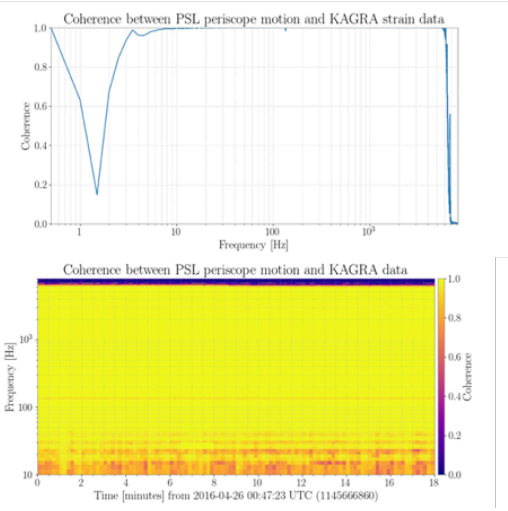


 # Families

K1:LSC-MICH_OUT_DQ
K1:LSC-REFL_PDA1_RF17_I_OUT_DQ
K1:LSC-REFL_PDA1_RF17_Q_OUT_DQ
K1:LSC-MICH_ERR_CAL_OUT_DQ
K1:LSC-MICH_BLND_CAL_OUT_DQ

K1:PEM-EX_SEIS_NS_BLRMS_HI_OUT_DQ
K1:PEM-EX_SEIS_NS_BLRMS_MID_OUT_DQ
K1:PEM-EX_SEIS_NS_SENSINF_OUT_DQ
K1:PEM-EX_SEIS_WE_BLRMS_HI_OUT_DQ
K1:PEM-EX_SEIS_WE_BLRMS_MID_OUT_DQ
K1:PEM-EX_SEIS_WE_SENSINF_OUT_DQ
K1:PEM-EX_SEIS_Z_BLRMS_HI_OUT_DQ
K1:PEM-EX_SEIS_Z_BLRMS_MID_OUT_DQ
K1:PEM-EX_SEIS_Z_SENSINF_OUT_DQ

COHERENCE K1:LSC-MICH_OUT_DQ

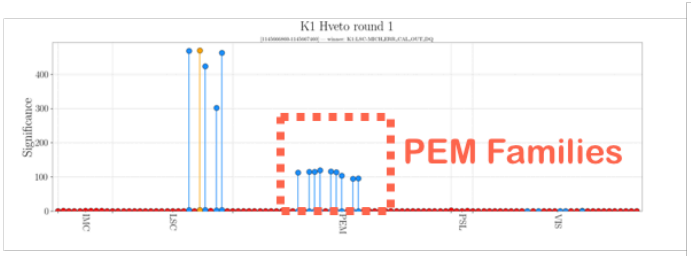


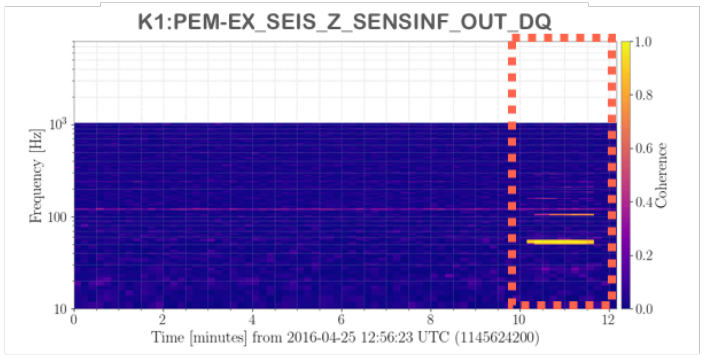
UNSAFE CHANNEL LIST in iKAGRA

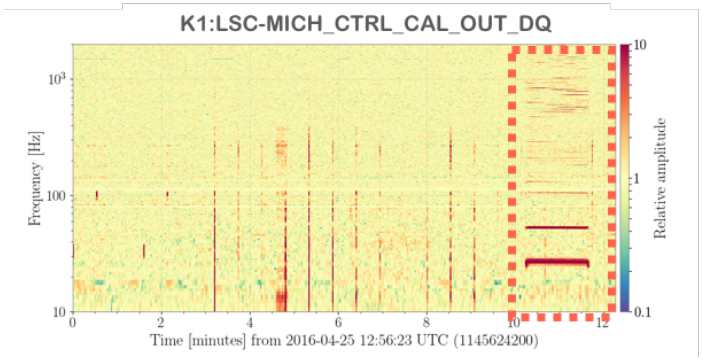
K1:LSC-MICH_OUT_DQ
K1:LSC-REFL_PDA1_RF17_Q_OUT_DQ
K1:LSC-MICH_ERR_CAL_OUT_DQ
K1:LSC-MICH_BLND_CAL_OUT_DQ
K1:LSC-REFL_PDA1_RF17_I_OUT_DQ

Status Report II – Channel Safety Study (2/2)

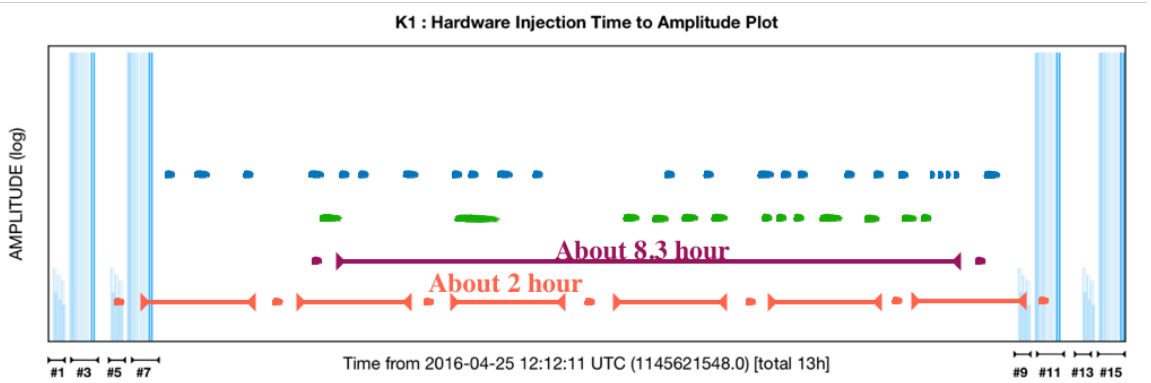
✦ STRANGE PHENOMENON







✦ IDENTIFY GLITCH SIGNAL



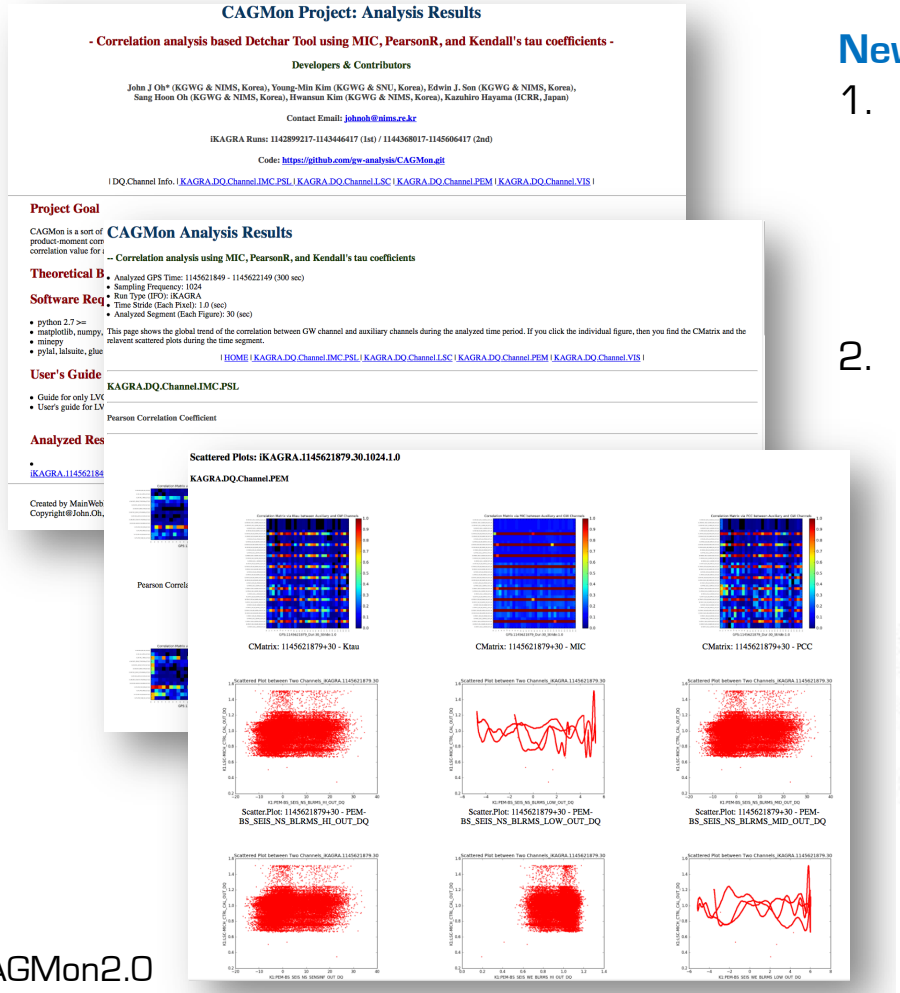
✦ PROPERTY OF GLITCH SIGNALS

- ✓ In the **EX** seismometer and **EX** TestMass-channel, main-channel, harmonics glitch signals of **26Hz and 53Hz** for 80 seconds occurs **every 2 hours**
- ✓ In the **BS** seismometer and **BS** TestMass-channel, main-channel, harmonics glitch signals of **53Hz** for 80 seconds occurs **every 8.3 hours**

✦ HYPOTHESIS

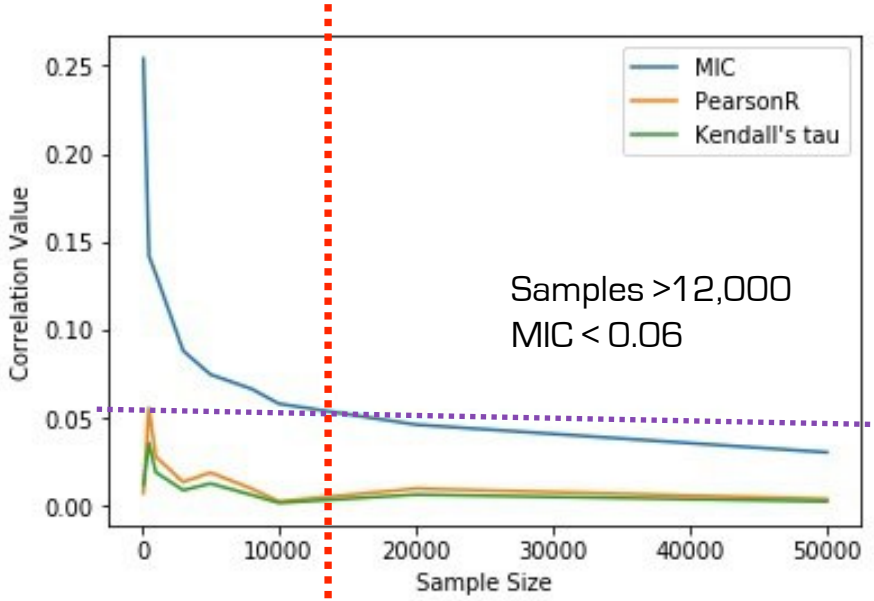
- the pump rotary is operated at the base line
- the vibration is transmitted to the seismograph and OpLev
- Vibration signal entering OpLev adjusts TM position

Status Report III – CAGMon



New Development So Far:

1. Data Sample vs MIC value validation
   - Fixed data samples > 12000 (depends upon computing cost)
   - Code Development: Extract High Rank Channels
   - Write results as HDF5 format
2. CSS Run for iKAGRA Injection data



CAGMon2.0
Summary Page
http://seikai.icrr.u-tokyo.ac.jp/~johnoh/

Status Report III – CAGMon

Injection Test 1:
SG injection: 1145621548_3.0_4096

Kendall's tau coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.993
LSC-MICH_ERR_CAL_OUT_DQ	0.992

Pearson's correlation coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.999
LSC-MICH_ERR_CAL_OUT_DQ	0.999

Maximal information coefficient:

Short-period Propagating channels

LSC-ACT_DEMOD1_I_OUT_DQ	1.000
LSC-ACT_DEMOD1_Q_OUT_DQ	1.000
LSC-ACT_DEMOD2_Q_OUT_DQ	1.000
LSC-ACT_DEMOD3_I_OUT_DQ	1.000
LSC-ACT_DEMOD3_Q_OUT_DQ	1.000
LSC-CAL_A1_REAL_OUT_DQ	0.931
LSC-CAL_A2_IMAG_OUT_DQ	0.999
LSC-CAL_A2_REAL_OUT_DQ	1.000
LSC-CAL_B1_REAL_OUT_DQ	0.952
LSC-CAL_B2_IMAG_OUT_DQ	1.000
LSC-CAL_B2_REAL_OUT_DQ	1.000
LSC-MICH_BLND_CAL_OUT_DQ	1.000
LSC-MICH_ERR_CAL_OUT_DQ	1.000
LSC-UGF_SERVO_OUT_DQ	0.913
PEM-BS_SEIS_WE_BLRMS_LOW_OUT_DQ	0.984
PEM-EX_SEIS_NS_BLRMS_LOW_OUT_DQ	1.000
PEM-EX_SEIS_WE_BLRMS_LOW_OUT_DQ	1.000
PEM-EY_SEIS_NS_BLRMS_LOW_OUT_DQ	1.000
PEM-EY_SEIS_WE_BLRMS_LOW_OUT_DQ	1.000
PEM-EY_SEIS_Z_BLRMS_LOW_OUT_DQ	1.000
VIS-PR3_GAS_DAMP_BF_OUT_DQ	0.999

Status Report III – CAGMon

Injection Test 2:
CBC injection: 1145622508_13.0_1024

Kendall's tau coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.998
LSC-MICH_ERR_CAL_OUT_DQ	0.942

Pearson's correlation coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.999
LSC-MICH_ERR_CAL_OUT_DQ	0.996

Maximal information coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	1.000
LSC-MICH_ERR_CAL_OUT_DQ	0.962
PEM-EY_SEIS_NS_BLRMS_LOW_OUT_DQ	0.945
VIS-PR3_GAS_DAMP_BF_OUT_DQ	0.999

Injection Test 3:
BNS injection: 1145623468_64.0_256

Kendall's tau coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.998
LSC-MICH_ERR_CAL_OUT_DQ	0.681

Pearson's correlation coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	0.999
LSC-MICH_ERR_CAL_OUT_DQ	0.882

Maximal information coefficient:

LSC-MICH_BLND_CAL_OUT_DQ	1.000
LSC-MICH_ERR_CAL_OUT_DQ	0.590

1. Ktau, PCC, MIC can find identical channels to GW channel that are obviously unsafe for ***longer duration data of injections***
2. More injection studies needed to find their families, comparing to the H-veto result.

Future Work

Channel Safety Study: H-veto based study has been done so far

- Documentation for general users
- Rerun for all detchar channel list
- Making unsafe channel list for detchar works
- Interface (web-based) for daily detchar study

CAGMon Detchar Tool:

- Channel Safety Run – Comparing to H-veto Results
- Improving Parallelized MIC algorithm (for Speed-up)
- Interfacing an Interactive Detchar Tool

Visit to KAMIOKA Site:

- Developing and installing Detchar tools
- Analyzing bKAGRA data (Hveto, CSS, CAGMon etc)
- Newtonian noise measurement