

Summary of iKAGRA Test Run Apr 11-25, 2016

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Quick Facts

- 3 km Michelson, **dark fringe lock**
- input power to BS ~ 220 mW
- power at detection port (REFL) ~ 4 mW
- duration: Apr 11 9:00 JST - Apr 25 17:00 JST
(from 1144368017 to 1145606417 in GPS time)
- duty cycle (lock): 90.4 % (IMC was 98.5 %)
- total locked time: 257.7 hours (from Apr 13)
- longest lock: **21.3 hours** (typically ~ 2 hours)
- strain sensitivity: $\sim 6e-16$ /rtHz @ 100 Hz
(**~ 4.2 pc** for 1.4Msun-1.4Msun NS-NS inspiral range)

Thanks to inputs from K. Kokeyama, Y. Aso, A. Shoda, M. Nakano, Y. Enomoto, T. Shimoda, K. Hayama, S. Mano, Y. Shikano, etc

Update from March Run

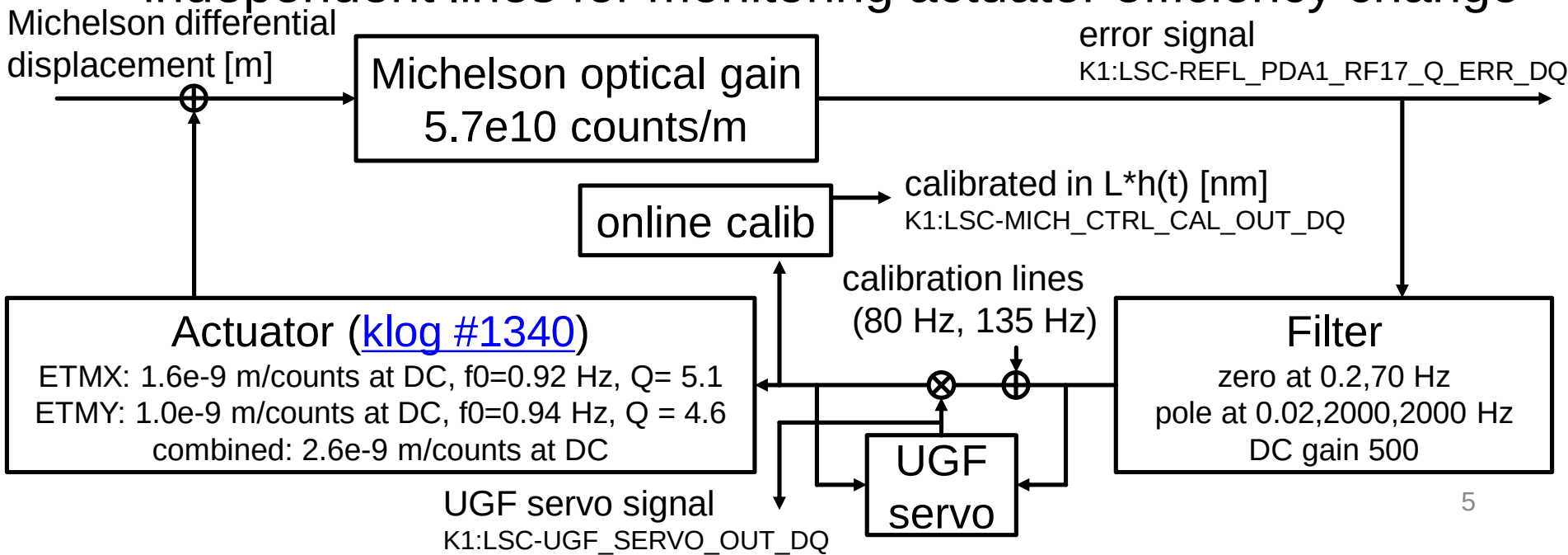
- RF dark fringe lock instead of DC mid fringe ([klog #1388](#)), UGF servo at 94 Hz.
- Folded oplev for ETMs to reduce length to angle coupling ([klog #1355](#), [#1406](#))
- IMC servo topology changed; crossover frequency 30 Hz to 10 Hz, oplev DC servo turned off, dither alignment installed ([klog #1386](#), [#1449](#), [#1484](#), [#1507](#), [#1508](#))
- PR2-BS duct was connected
- GVs close to IXA/IYA were opened ([klog #1338](#))
- See [JGW-T1605101](#) for basic configurations
- See [ChannelList wiki](#) for the channel list and summary of some detailed settings ([Suspensions wiki](#) for suspension configuration summary, [OplevCalibration wiki](#) for oplev summary)

Apr 12 Commissioning Break

- Test run was stopped during Apr 12 13:00 to Apr 12 16:10 for commissioning works
- **Actuator gain monitor was added** ([klog #1506](#))
- MCi feedback was added for IMC length loop, and filter setting was modified ([klog #1507](#), [#1508](#))
- PZT loop was modified for IMC length loop
- ETMX/Y coil balance modified ([klog #1500](#))
- Also, guardian bug was fixed on Apr 13 ([klog #1506](#))
MICH_LOCK OPERATION state is valid only from the run starting at Apr 13 10:54:30 (JST)
- Any others???
- These changes are summarized in [ChannelList wiki](#)

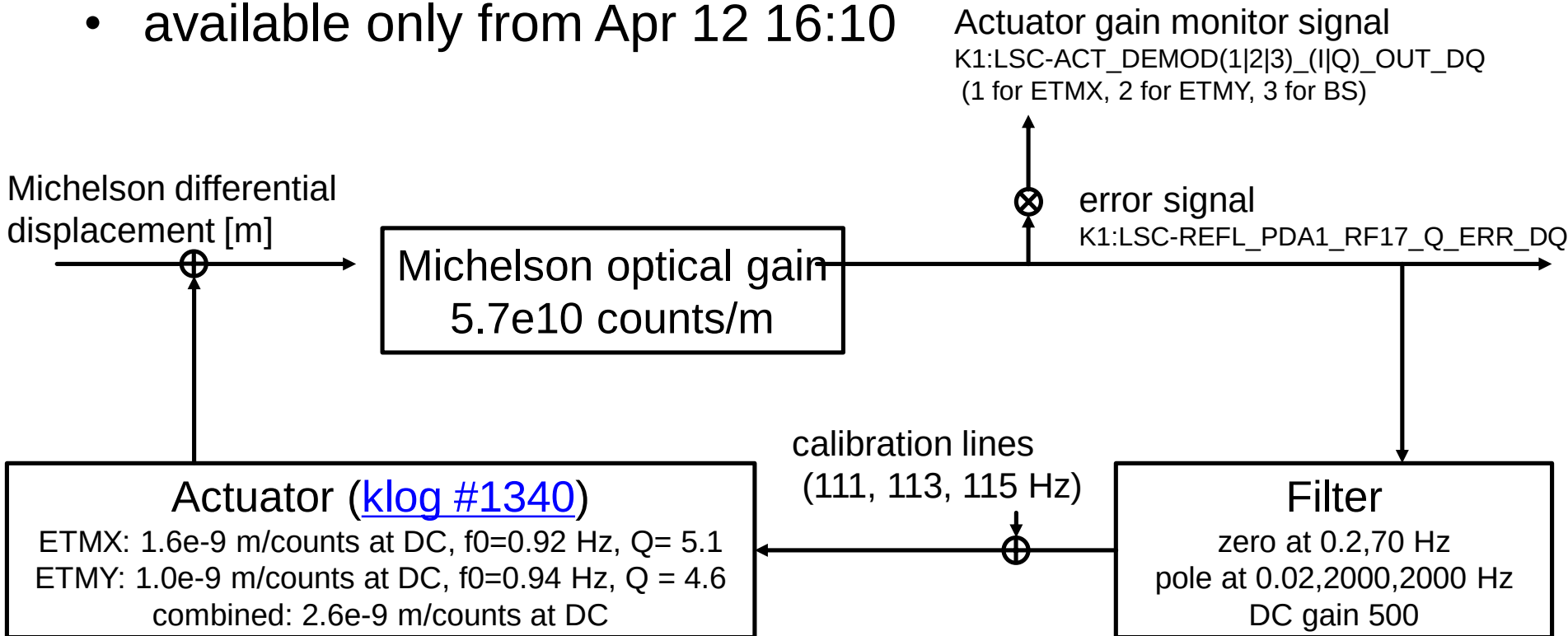
Calibration

- calibration of error signal (optical gain)
5.7(1)e10 counts/m ([klog #1610](#); [IPython NB](#))
- calibration of feedback signal (actuator efficiency)
2.6(1)e-9 m/counts @ DC ([klog #1340](#); [IPython NB](#))
- calibration lines at 80 Hz for UGF servo (UGF controlled at 94 Hz) and at 135 Hz for loop gain monitor, other independent lines for monitoring actuator efficiency change



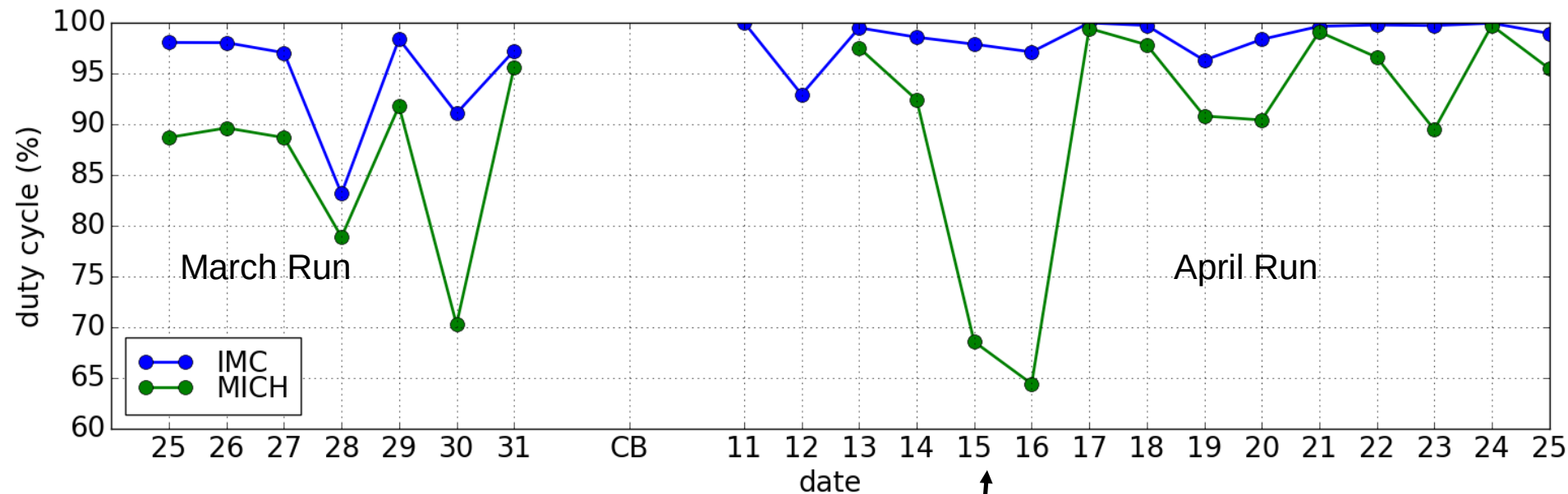
Actuator Gain Monitor

- independent lines; 111 Hz for ETMX, 113 Hz for ETMY, 115 Hz for BS ([klog #1506](#))
- actuator gain monitor signal is effected by Michelson optical gain change
- available only from Apr 12 16:10



Duty Cycle

- duty cycle: 90.4 % (98.5 % for IMC)
was 85.2 (94.4 % for IMC) during March Run



Plot generated using K1:GRD-IMC_LOCK_STATE_N
and K1:GRD-MICH_LOCK_STATE_N.

Duty cycle for MICH on Apr 11 and 12
is not plotted because there was a bug
in guardian state.

Kumamoto Earthquake,
BS went wrong ([klog #1550](#), [#1553](#))

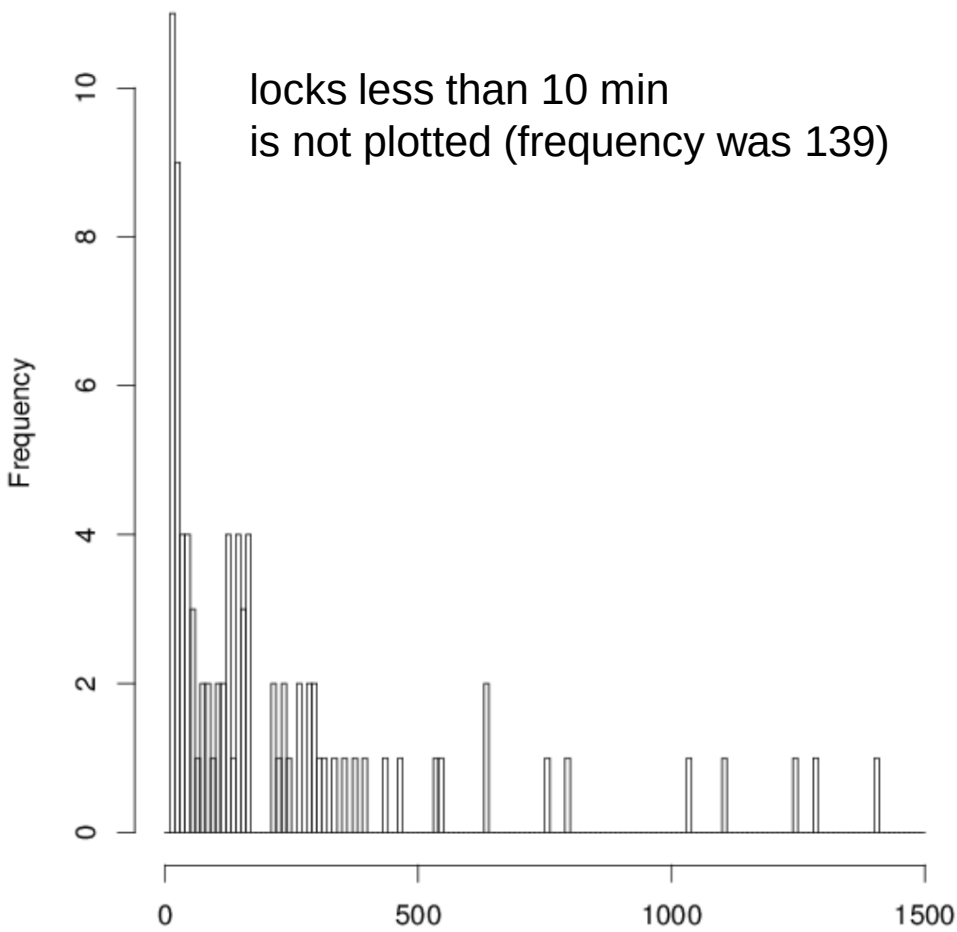
data processing by S. Mano
plot by Y. Michimura

Lock Duration

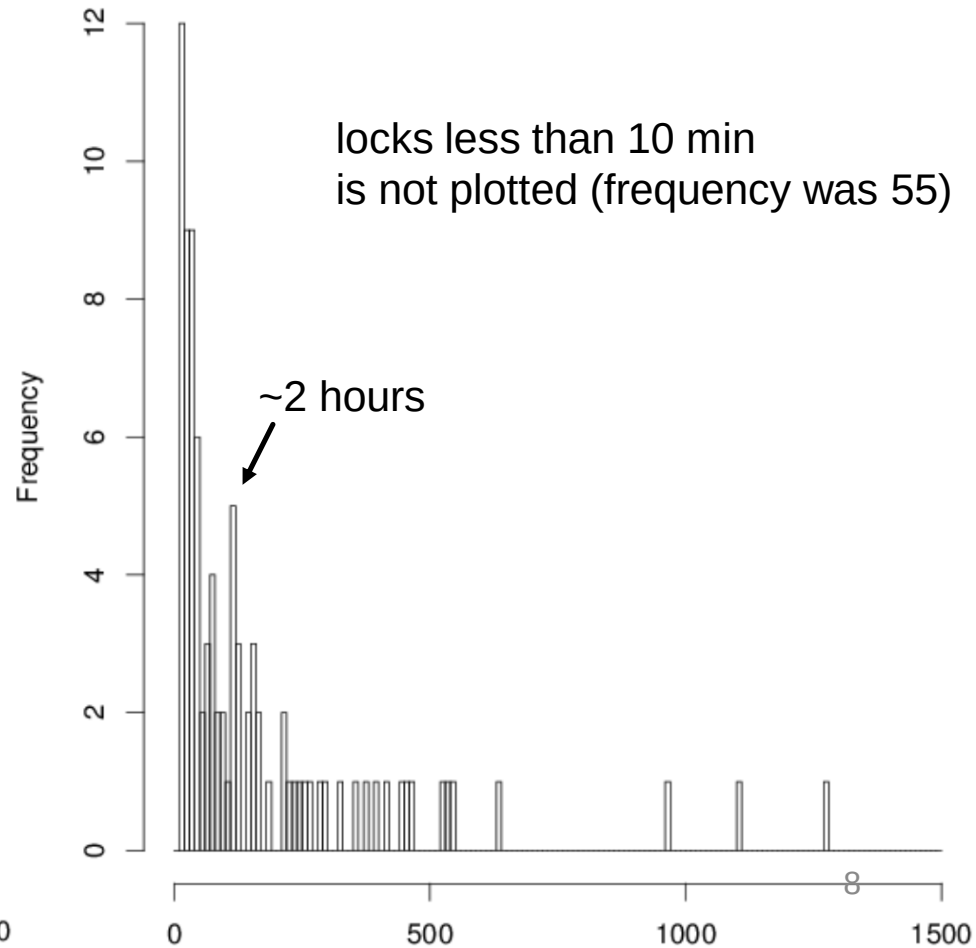
- longest lock: 21.3 hours (23.5 hours for IMC)

data processing and plot by S. Mano

histogram of imc lock (minute)

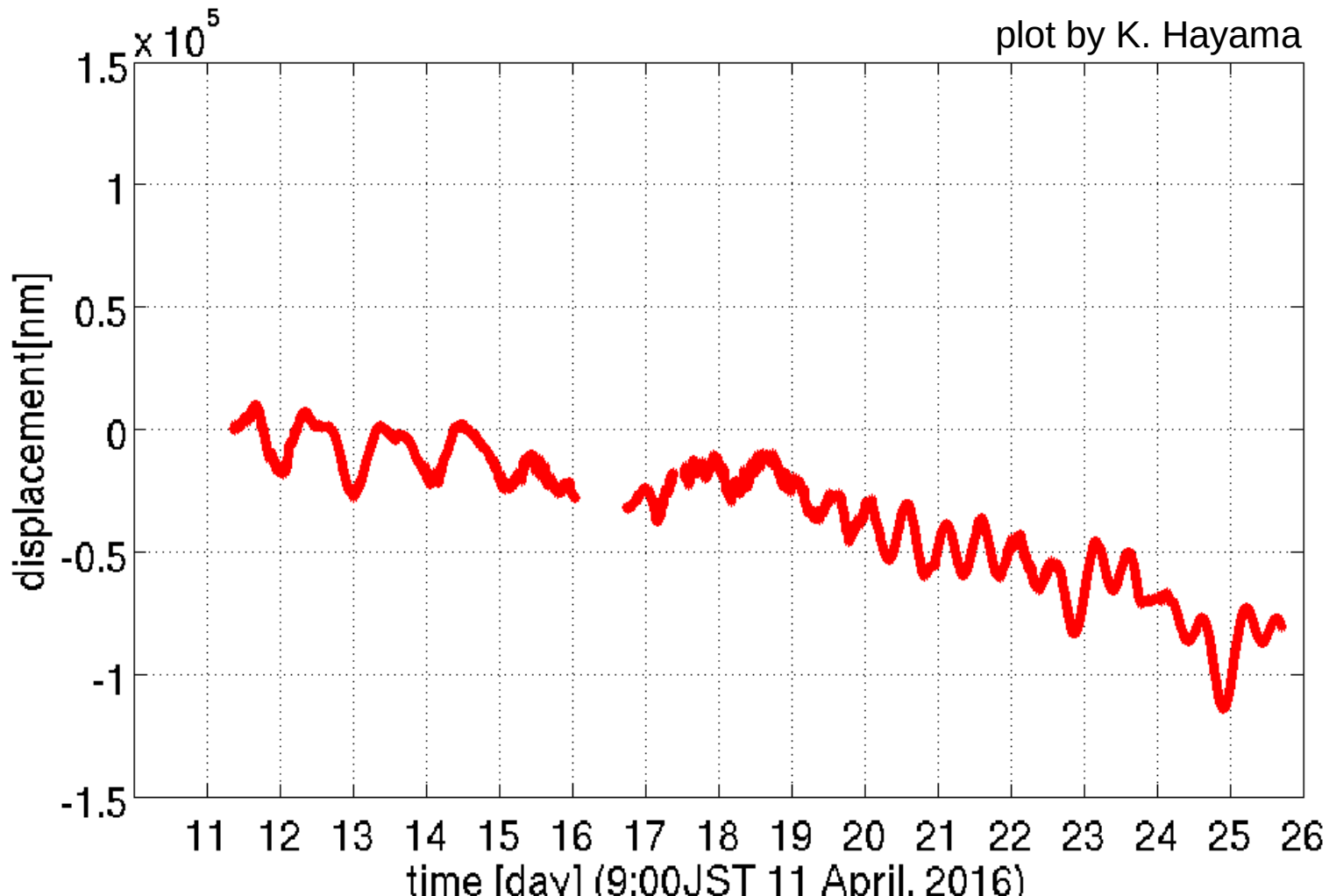


histogram of mich lock (minute)



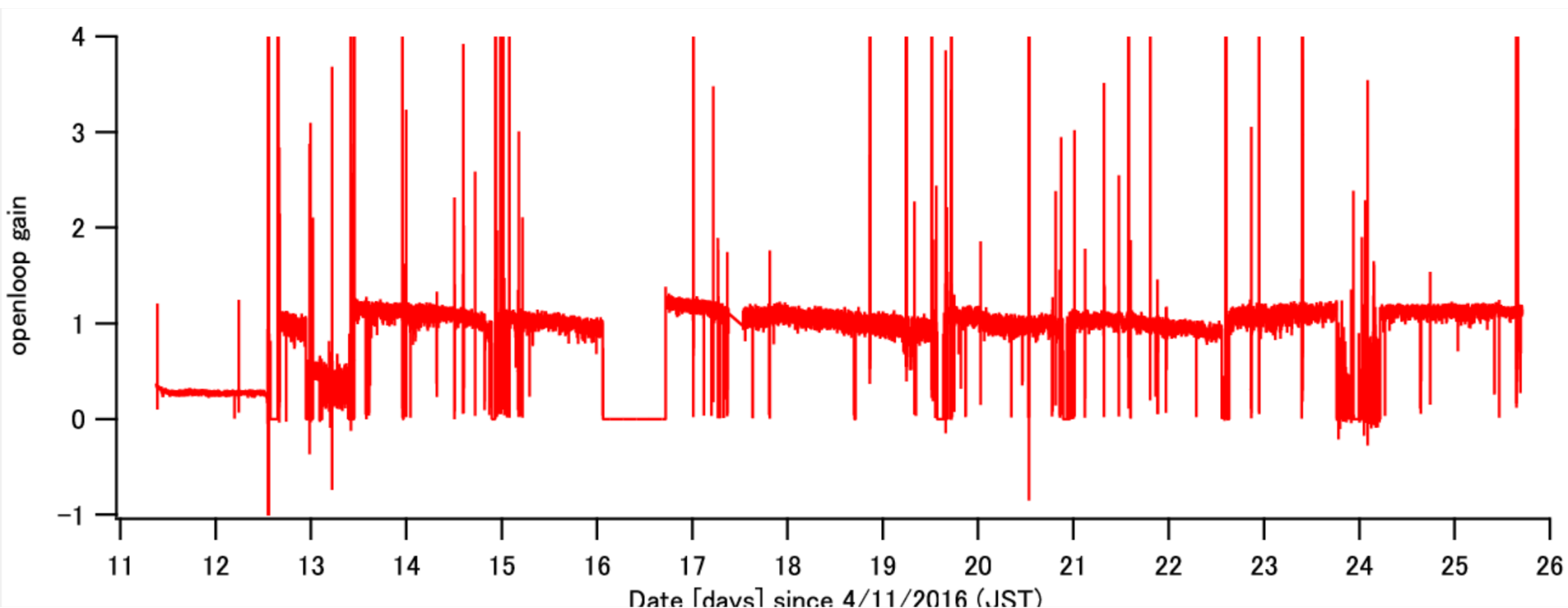
Tidal Drift

- X arm length and Y arm length drifted by ~ 30 $\mu\text{m}/\text{day}$, ~ 100 μm for whole period



Openloop Gain Drift

- MICH openloop gain drifted by $\sim 20\%$ (likely by alignment drift)
drift was $\sim 80\%$ during March Run

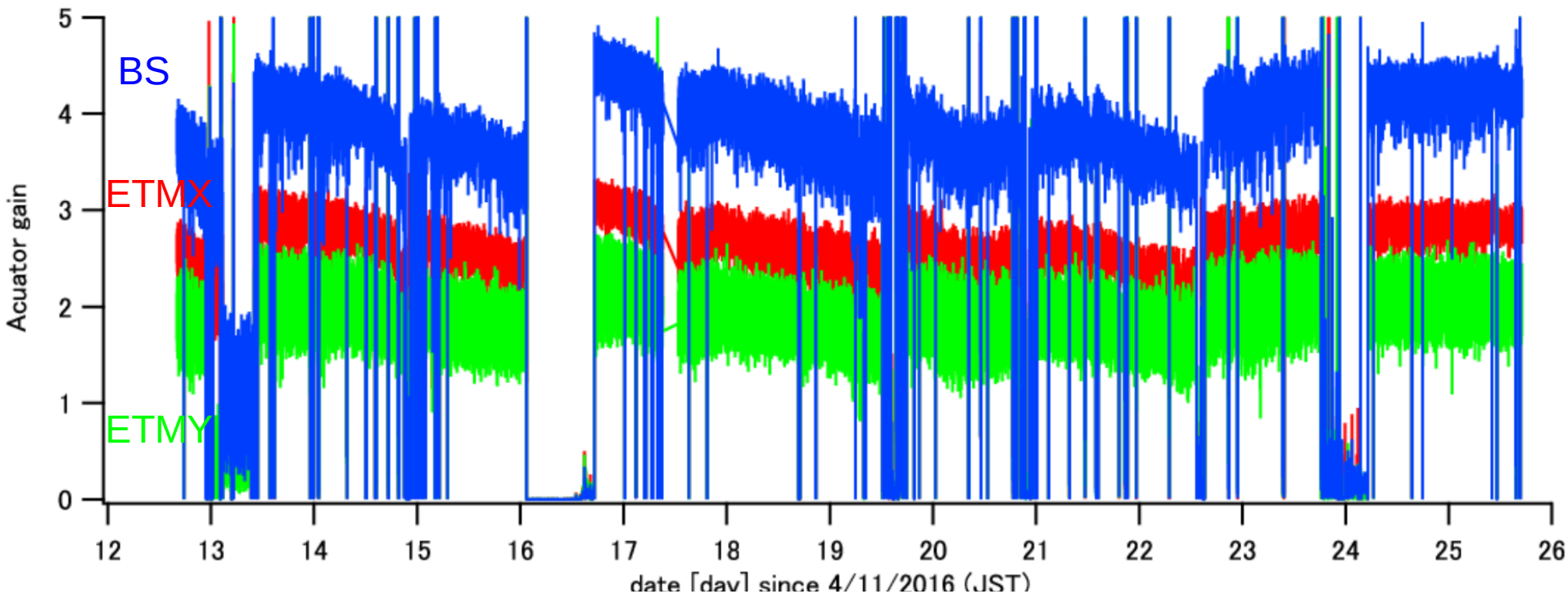


time series plot of K1:LSC-UGF_SERVO_OUT16 (openloop gain at 80 Hz)

by Y. Shikano

Actuator Gain Monitor

- drift is mostly in common to all the suspensions
→ likely to be MICH optical gain drift (actuator drift was less)
- more investigation, calibration needed



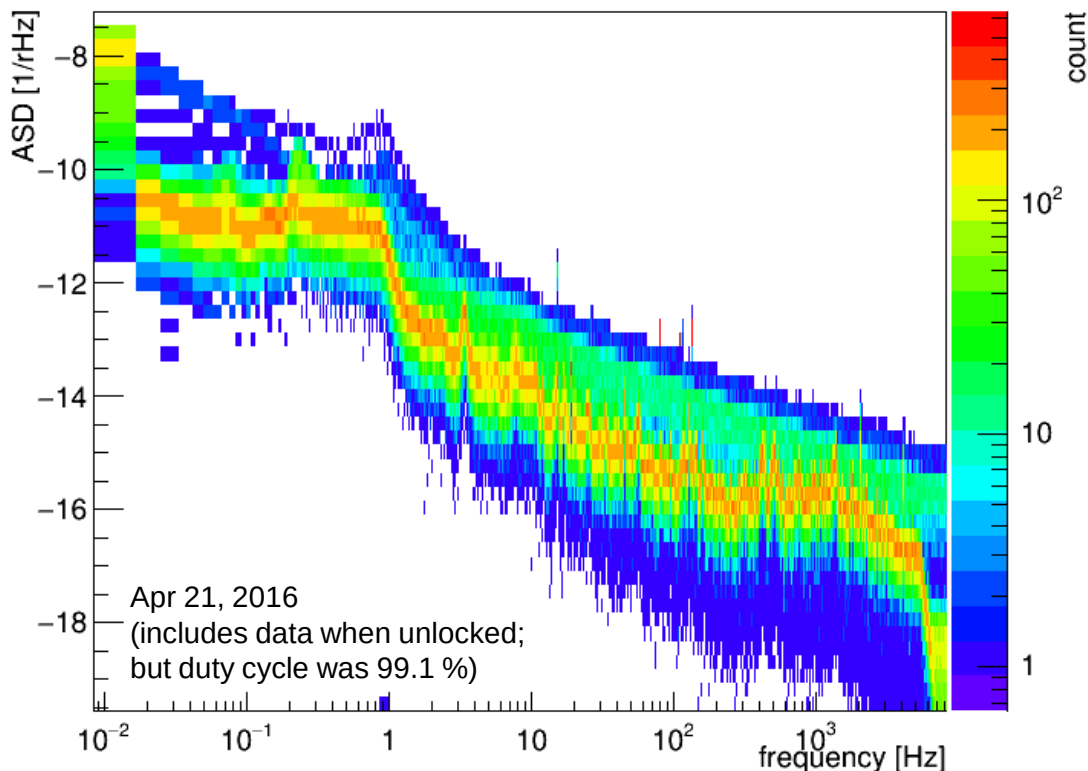
calculation done using K1:LSC-ACT_DEMOD(1|2|3)_(I|Q)_OUT_DQ

by Y. Shikano

Inspiral Range

- ~ 4.2 pc for 1.4Msun-1.4Msun NS-NS
(average value on Apr 21)
was 0.77 ± 0.39 pc during March Run
- strain sensitivity fluctuated by roughly 1 order of magnitude

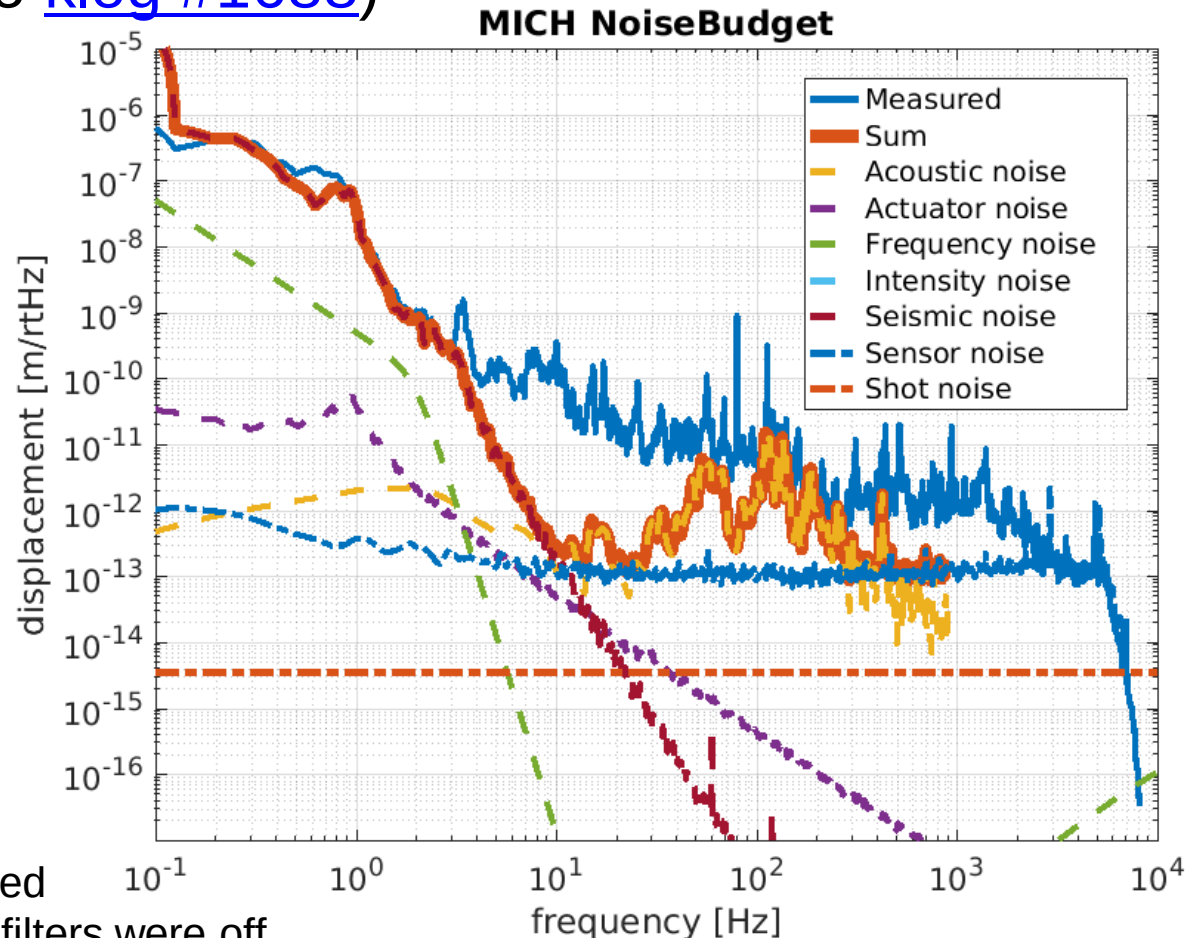
SensMon: K1:LSC-MICH_CTRL_CAL_OUT_DQ



plot by K. Hayama

Noise Budget

- limited by **seismic noise** below ~4 Hz, **acoustic/fan noise** at around 100 Hz (see also [klog #1715](#)), **ADC noise** above ~3 kHz (see also [klog #1688](#))
- unknown noise at around 10 Hz



above NoiseBudget is generated
when fans were on, whitening filters were off

plot generated with Simulink NoiseBudget by T. Shimoda, M. Nakano ([klog #1568](#), [#1705](#))

Some Issues to Remember

- **Unknown 550 Hz LPF in MICH loop** ([klog #1645](#))
also, DGS delay in 3km arm is not measured yet (?)
so, phase delay in OLTF is not fully understood
- Unknown sensitivity improvement over 2 kHz after Apr 12 commissioning break ([klog #1531](#))
- Oplev calibration for IMC mirrors might be wrong and need to be checked ([OplevCalibration wiki](#))
- Why there are no 60 Hz line noise?