

# Status of KAGRA DetChar

July 9th, 2021

KAGRA International Workshop

Takahiro Yamamoto on behalf of KAGRA Collaboration

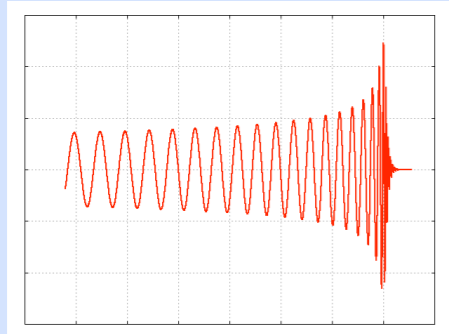
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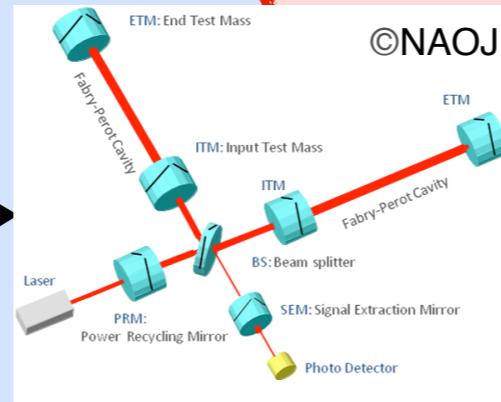
# Role of DetChar

## Observation

metric

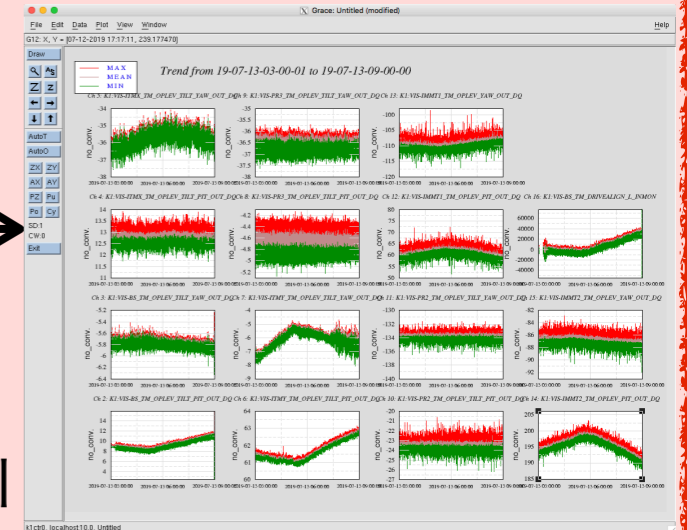


GW propagation

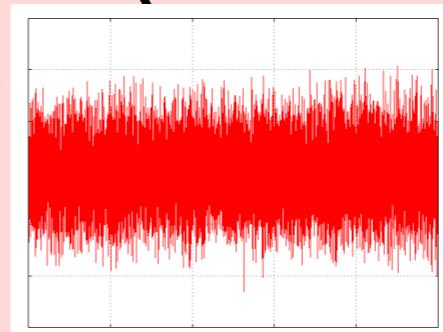


## Interferometer diagnostic

Auxiliary signals



main IFO signal

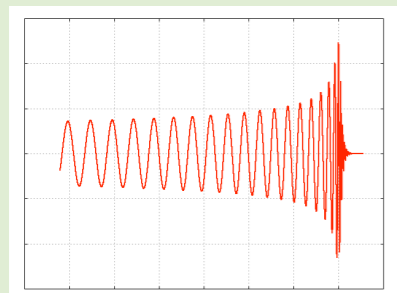


KAGRA O3

- ~20,000 channels are recorded

## GW searches

Theoretical waveform



Search  
Parameter estimation

Noise evaluation  
Noise removal  
Event validation

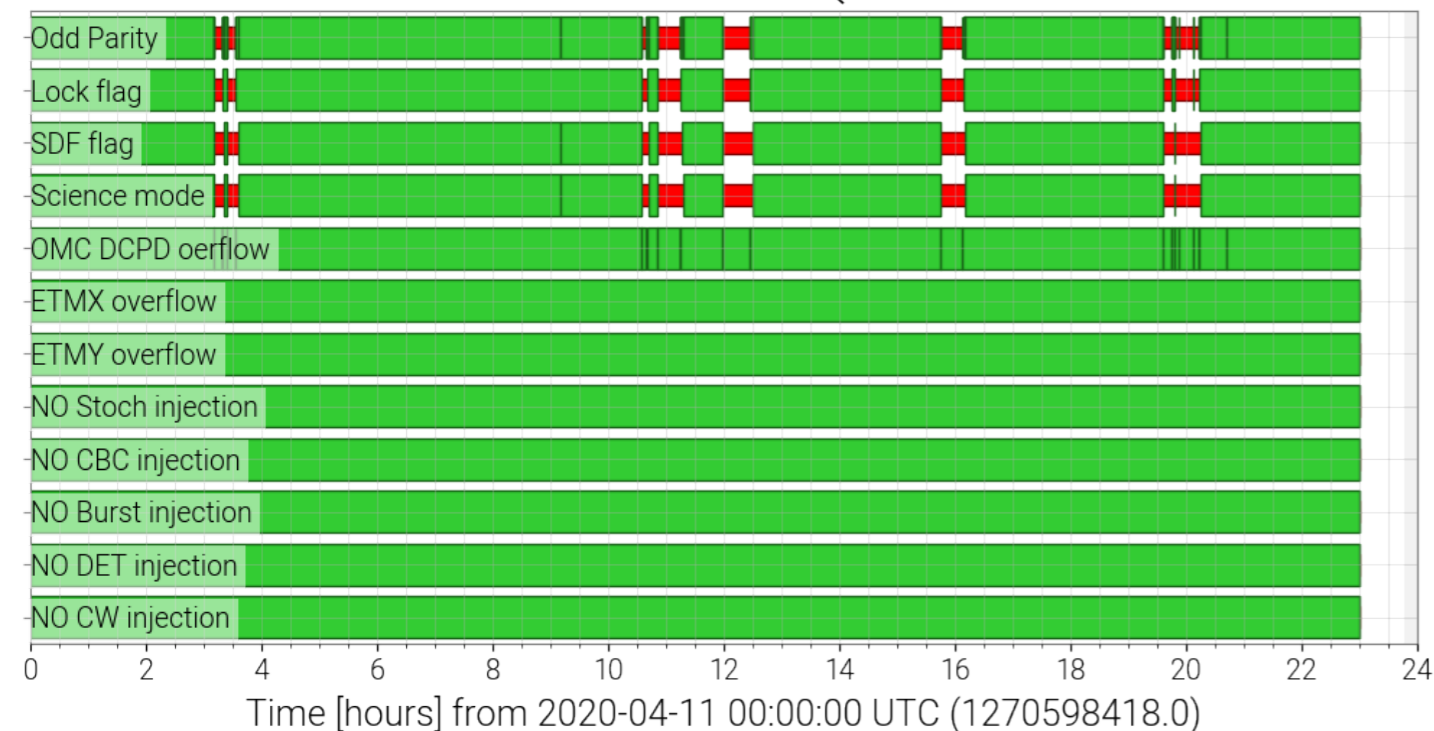


Search groups use only GW channel

# Online Data Quality

- DQ flags were provided as a real-time process (16Hz)
- Online DQ was used for estimating duty factor, BNS ranges, low-latency DQ by CAL etc.
- Online DQ was shared as a part of LL-frames (1-sec) with LIGO and Virgo.

K1 online DQ



	Observation Time [s]	Duty Factor
<b>GEO</b>	940133 (11 days)	80%
<b>KAGRA</b>	628135 (7.3 days)	53%
<b>Coincident</b>	551340 (6.4 days)	47%

JGW-G2011688

# Data Quality Sharing

- DQ flags were shared among LVK within a few minutes cadence.
- Data sharing was performed via low-latency frame files.



## Gravitational Wave Detector Network

Operational Snapshot as of May 26, 21:35 UTC

Detector	Status	Duration
<a href="#">GEO 600</a>	Observing	0:49
<a href="#">LIGO Hanford</a>	Calib issue	>4:52
<a href="#">LIGO Livingston</a>	Down	>4:52
<a href="#">Virgo</a>	Info too old	
<a href="#">KAGRA</a>	Down	>4:42

[Detector status summary pages](#) [LVK links](#)

<https://ldas-jobs.ligo.caltech.edu/~gwistat/gwistat/gwistat.html>

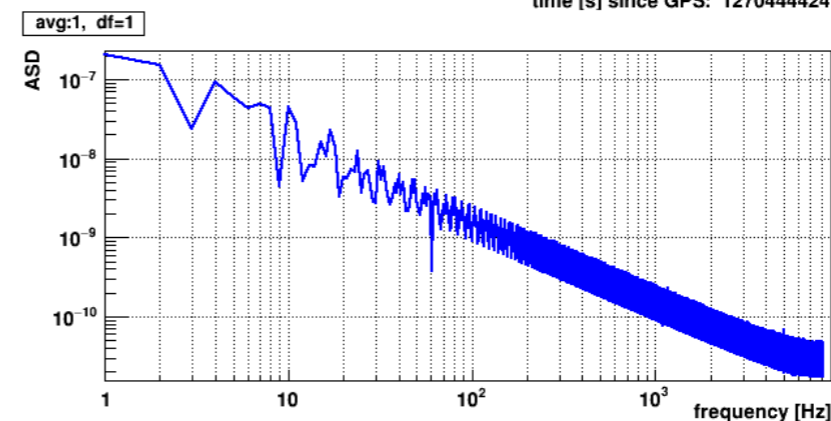
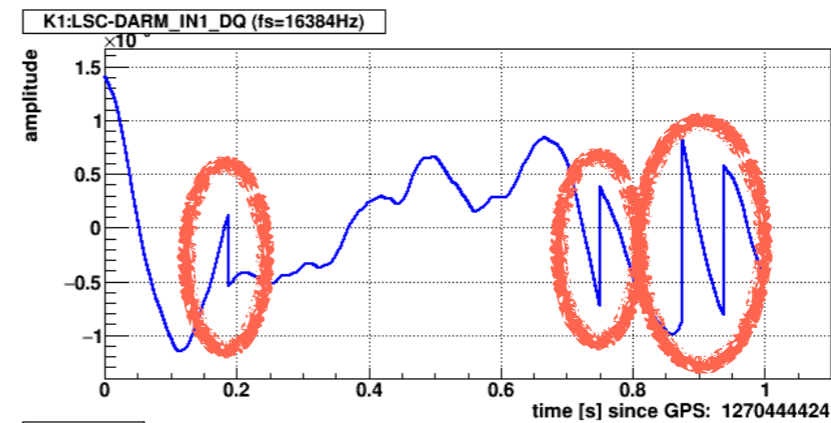
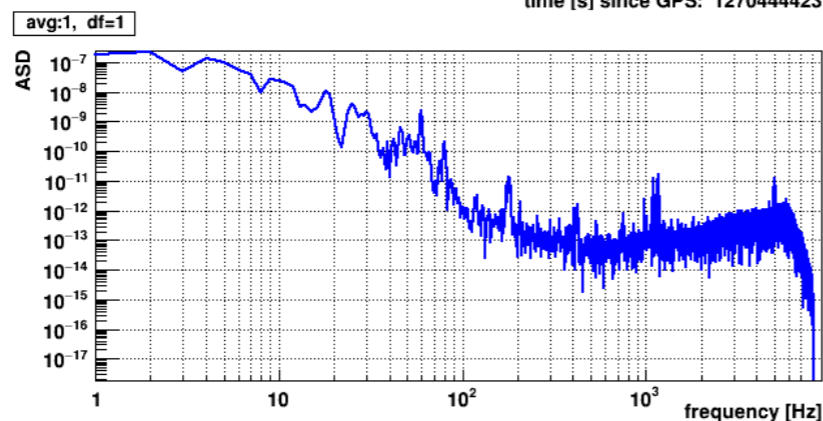
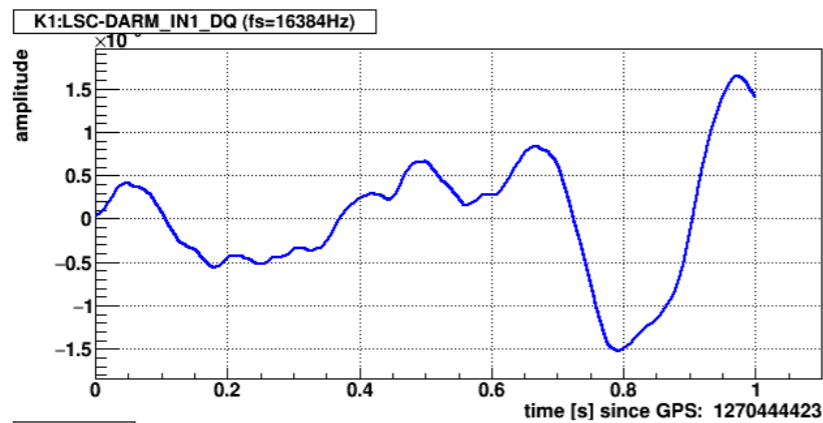
<https://monitor.ligo.org/gwstatus>

The dashboard displays the following information:

- LIGO Hanford:** NOHOFT, Duration: 0d 03:12:00 (prev: unknown), Last updated at 6:35
- LIGO Livingston:** NOHOFT, Duration: 7d 05:49:00 (prev: unknown), Last updated at 6:35
- Virgo:** UNKNOWN, Duration: 21d 07:48:53 (prev: nohoft), Last updated at 2:49
- KAGRA:** NOHOFT, Duration: 19d 06:10:59 (prev: unknown), Last updated at 6:35
- Date:** Wed May 27 2020
- Time:** 6:35:55
- Count:** 1274564173
- DMT:** 1 / 15 UNKNOWN
- Low-latency Data:** 45 OK
- LIGO Data Replicator:** 14 OK
- DetChar Summary:** Call Alex Urban, 1 / 23 CRITICAL, 1 / 12 UNKNOWN
- DetChar Jobs:** 1 / 16 UNKNOWN

# Offline Data Quality

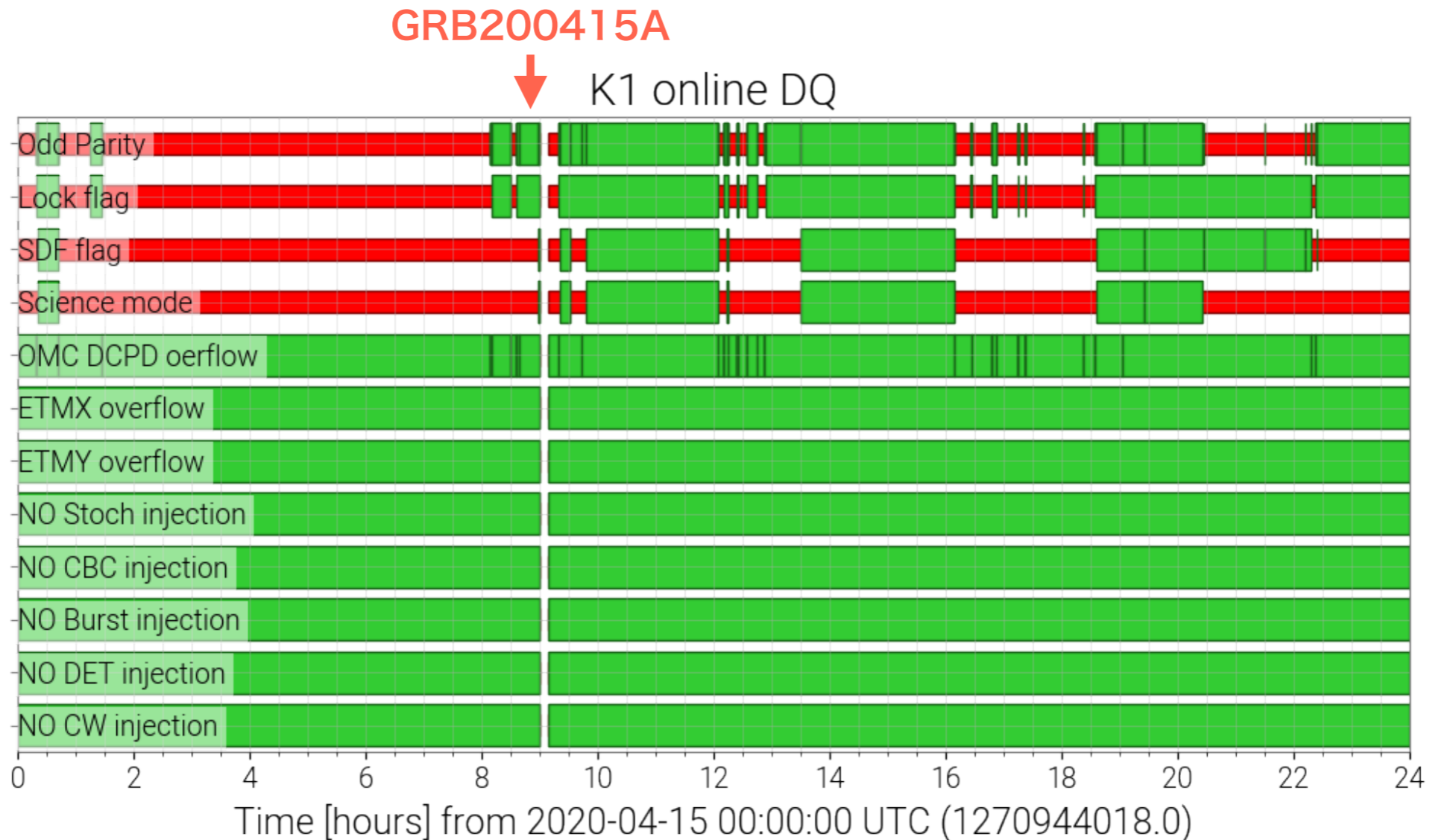
- Glitches due to the DAQ checksum errors were occurred (totally 4 files in science segments)
- These files were removed from science mode as an offline data quality evaluation.
- It haven't been solved and we need to solve this problem until O4 observing run.



# Offline Data Quality

**IFO was locked when GRB occurred.**

At this time, data was not flagged as science mode because of the maintenance of the green laser system. The green laser system doesn't affect the final IFO status with IR lock. **So this data period can be used for the GW searches.**





# Segment information

- Data Quality Segments are provided with the 15min. cadence for the low-latency DetChar analysis such as glitch trigger searches.
- They were shared among LVK with the 1 day cadence for the offline GW searches

## DQ Segment information

- Science segment
- Locked segments
- Unlocked segment
- Overflow segment
- DAQ errors

The screenshot shows a web browser window with the URL `segments-web.ligo.org`. The page title is "DQSEGDB WEB" and it features the LSC VIRGO logo. The navigation menu includes "HOME", "CLIENTS", "MONITORING", and "DOCUMENTATION".

The main content area is titled "QUERY DQSEGDB" and contains a form to query segments. The "IFO" dropdown is set to "K1". Below the form, a list of flags is displayed:

- GRD\_SCIENCE\_MODE
- GRD\_SCIENCE\_MODE\_AND\_DQA\_STATUS\_OK
- GRD\_UNLOCKED
- K1\_test\_flag\_01
- K1\_test\_flag\_02
- OMC\_OVERFLOW\_OK
- OMC\_OVERFLOW\_VETO
- SCIENCE\_MODE

Below the flags list, there is a "Dataset Info" section with a table of "Recent Interface/Integrity Tests":

Start time	Failures
2021-07-03 03:30:01	0
2021-07-02 03:30:01	0
2021-07-01 03:30:01	0
2021-06-30 03:30:01	0
2021-06-29 03:30:01	0



# DQ shift During O3GK

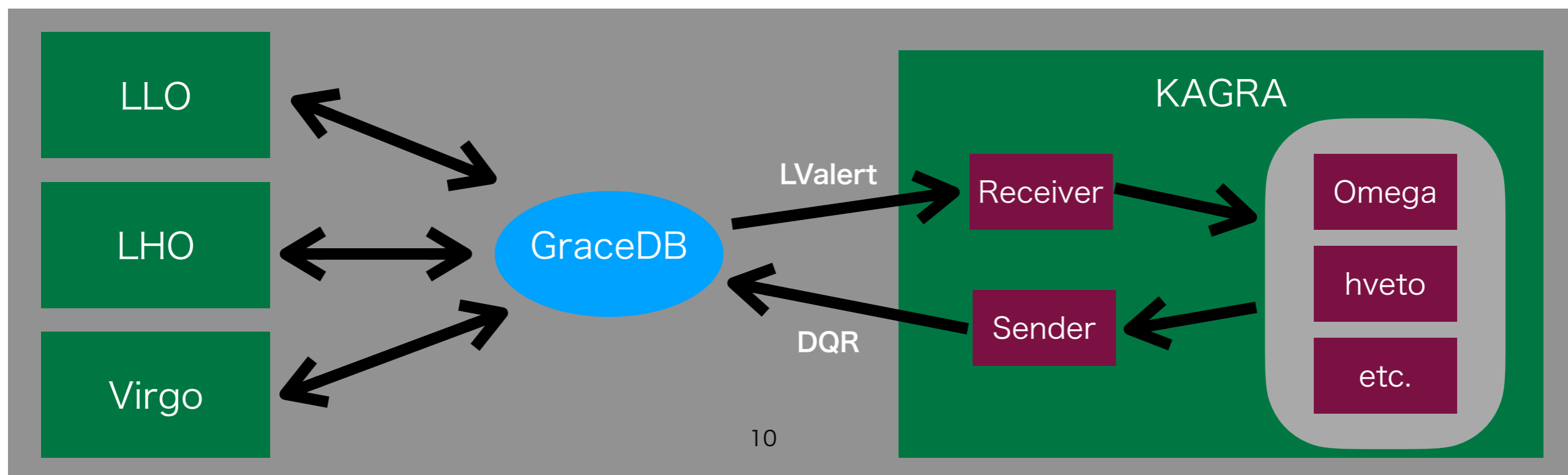
18 people joined the remote shift during O3GK  
mainly by data analysis working group folks

Date	Link to report	Volunteers	Operator's klog
Apr 7 (8:00-24:00 UTC)	<a href="#">klog14325</a>	Irene Fiori, Kyujin Kwak	<a href="#">klog14025</a> , <a href="#">klog14031</a> , <a href="#">klog14036</a>
Apr 8 (0:00-24:00 UTC)	<a href="#">klog14321</a>	Irene Fiori, Zhoujian Cao	<a href="#">klog14046</a> , <a href="#">klog14049</a> , <a href="#">klog14053</a>
Apr 9 (0:00-24:00 UTC)	<a href="#">klog14312</a>	Sharan Banagiri, Shichao Wu	<a href="#">klog14066</a> , <a href="#">klog14072</a> , <a href="#">klog14075</a>
Apr 10 (0:00-24:00 UTC)	<a href="#">klog14295</a>	Chun-yu Lin	<a href="#">klog14094</a> , <a href="#">klog14098</a> , <a href="#">klog14104</a>
Apr 11 (0:00-24:00 UTC)	<a href="#">klog14323</a>	Sumeet Kulkarni, Jishnu Suresh	<a href="#">klog14106</a> , <a href="#">klog14117</a> , <a href="#">klog14118</a>
Apr 12 (0:00-24:00 UTC)	<a href="#">klog14299</a>	Nami Uchikata	<a href="#">klog14119</a> , <a href="#">klog14129</a> , <a href="#">klog14130</a> , <a href="#">klog14132</a>
Apr 13 (0:00-24:00 UTC)	IFO was down	N/A	
Apr 14 (0:00-24:00 UTC)	<a href="#">klog14322</a>	John J Oh	<a href="#">klog14151</a> , <a href="#">klog14159</a> , <a href="#">klog14132</a>
Apr 15 (0:00-24:00 UTC)	<a href="#">klog14356</a>	Kentaro Mogishi, Soichiro Morisaki	<a href="#">klog14180</a> , <a href="#">klog14174</a> , <a href="#">klog14165</a>
Apr 16 (0:00-24:00 UTC)	<a href="#">klog14339</a>	Jaewan Kim	<a href="#">klog14218</a> , <a href="#">klog14210</a> , <a href="#">klog14198</a>
Apr 17 (0:00-24:00 UTC)	<a href="#">klog14306</a>	Kuo-Chuan Pan	<a href="#">klog14232</a> , <a href="#">klog13230</a> , <a href="#">klog14222</a>
Apr 18 (0:00-24:00 UTC)	<a href="#">klog14301</a>	Tatsuya Narikawa	<a href="#">klog14239</a> , <a href="#">klog14237</a> , <a href="#">klog14233</a>
Apr 19 (0:00-24:00 UTC)	<a href="#">klog14293</a>	Gang Wang	<a href="#">klog14249</a> , <a href="#">klog14245</a> , <a href="#">klog14244</a>
Apr 20 (0:00-24:00 UTC)	<a href="#">klog14294</a>	Wenbiao Han	<a href="#">klog14256</a> , <a href="#">klog14254</a> , <a href="#">klog14252</a> , <a href="#">klog14251</a>

<https://dac.icrr.u-tokyo.ac.jp/KAGRA/Observations/O3GK/DQshift>

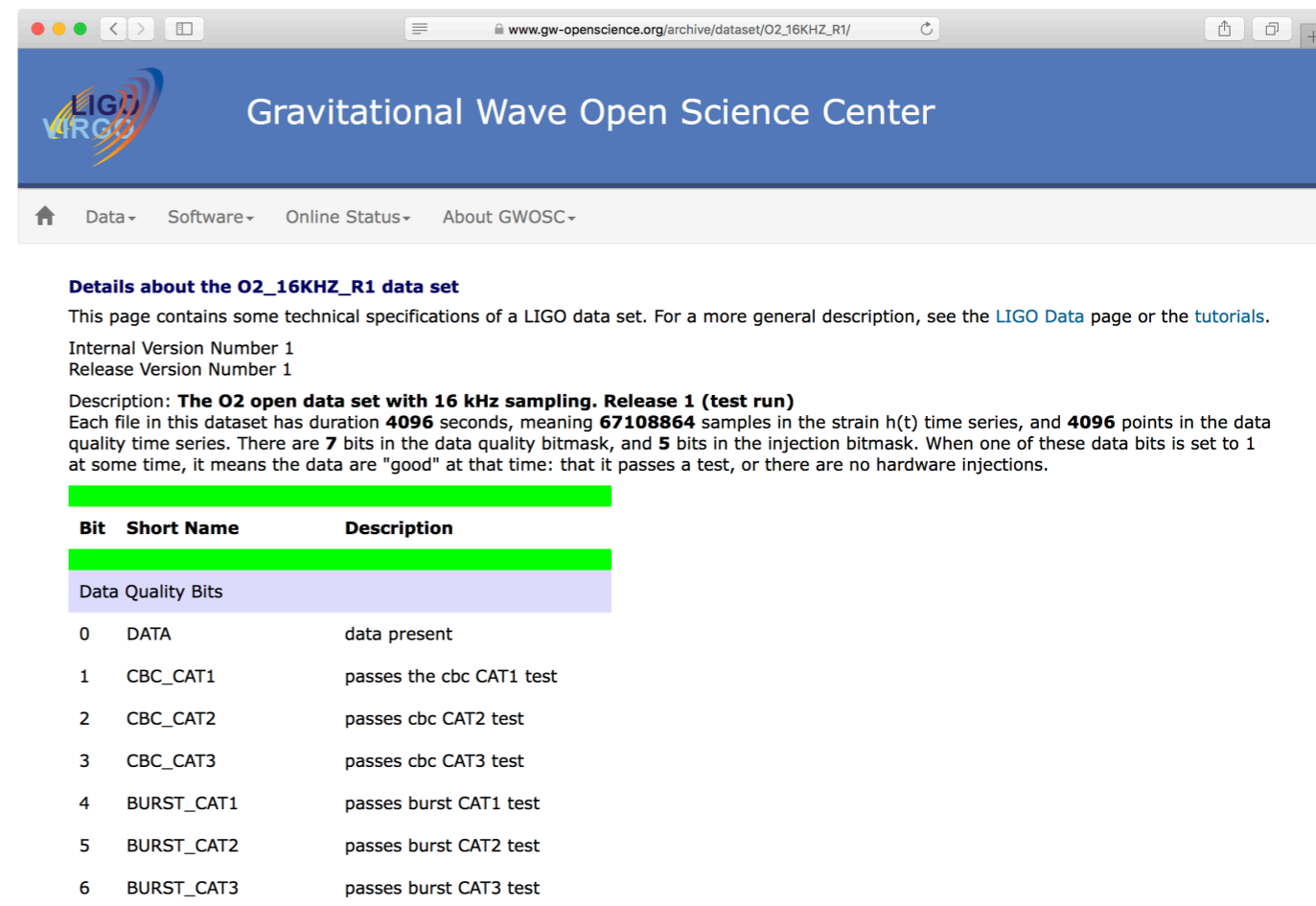
# Update plans toward O4

- Low-latency activities
  - Reducing the cadence of Segment sharing
    - 1 day cadence (O3GK)  $\Rightarrow$   $\sim$ minutes (O4)
  - Event validation mainly for Rapid Response Team (RRT)



# Update plans toward O4 (Cont'd)

- Offline activities
  - Data category (at least CAT1) will be provided for each search group.
  - Data validation for offline searches will be performed.
  - During O3GK, we cannot find efficient auxiliary channels. So we need to (re-)consider to choose the aux. channel list.



The screenshot shows a web browser window with the URL [www.gw-openscience.org/archive/dataset/O2\\_16KHZ\\_R1/](http://www.gw-openscience.org/archive/dataset/O2_16KHZ_R1/). The page header includes the LIGO VIRGO logo and the text "Gravitational Wave Open Science Center". A navigation menu contains "Data", "Software", "Online Status", and "About GWOSC".

**Details about the O2\_16KHZ\_R1 data set**  
This page contains some technical specifications of a LIGO data set. For a more general description, see the [LIGO Data](#) page or the [tutorials](#).

Internal Version Number 1  
Release Version Number 1

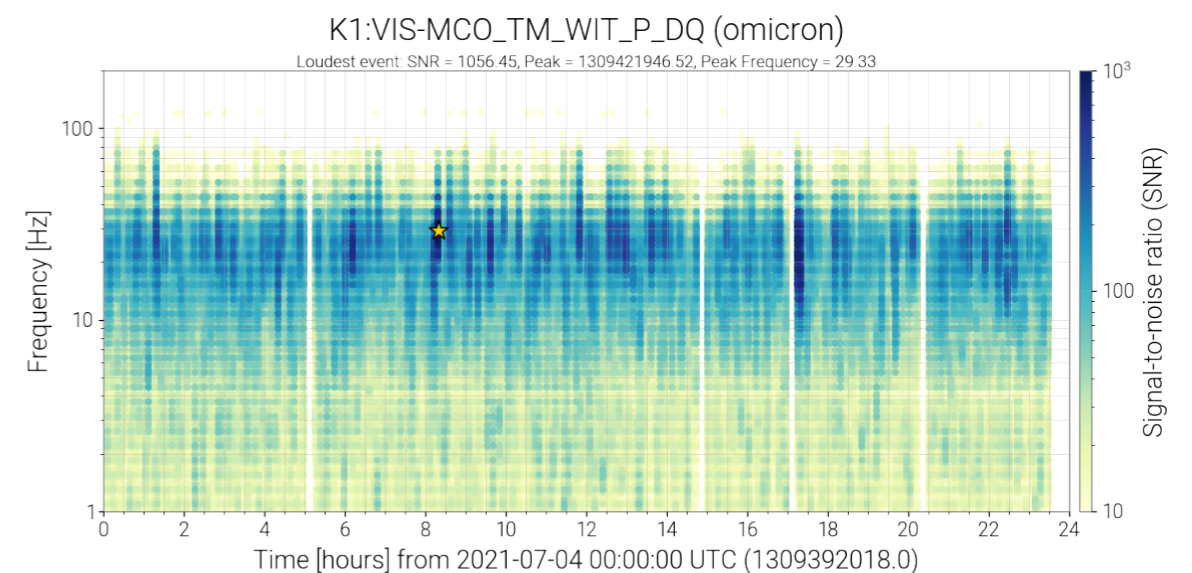
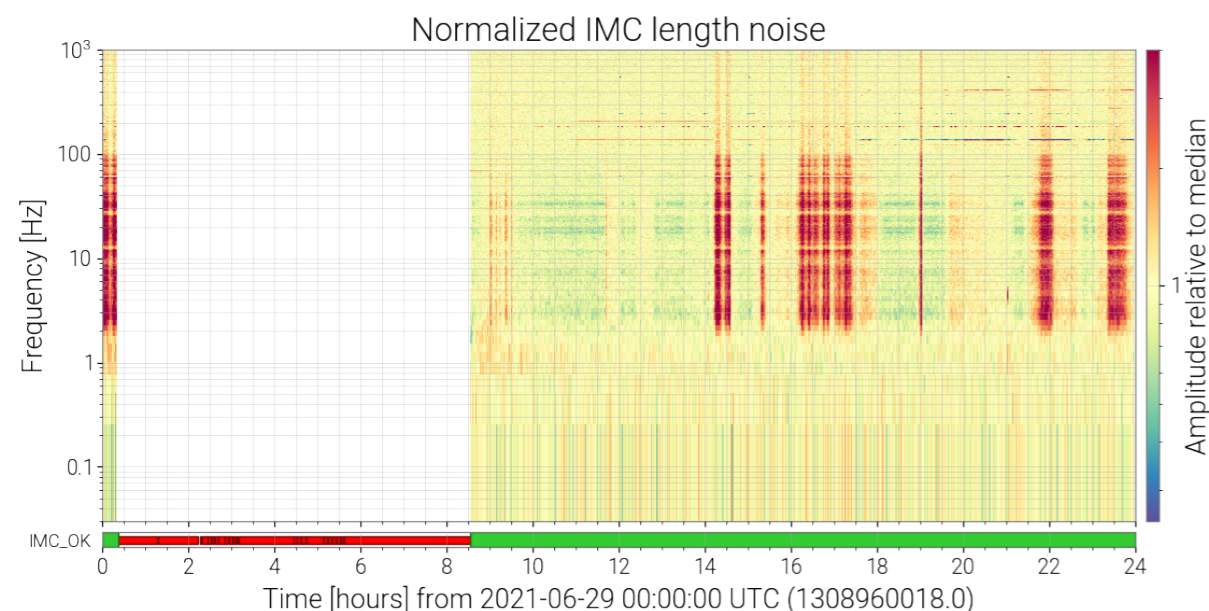
Description: **The O2 open data set with 16 kHz sampling. Release 1 (test run)**  
Each file in this dataset has duration **4096** seconds, meaning **67108864** samples in the strain  $h(t)$  time series, and **4096** points in the data quality time series. There are **7** bits in the data quality bitmask, and **5** bits in the injection bitmask. When one of these data bits is set to 1 at some time, it means the data are "good" at that time: that it passes a test, or there are no hardware injections.

Bit	Short Name	Description
Data Quality Bits		
0	DATA	data present
1	CBC_CAT1	passes the cbc CAT1 test
2	CBC_CAT2	passes cbc CAT2 test
3	CBC_CAT3	passes cbc CAT3 test
4	BURST_CAT1	passes burst CAT1 test
5	BURST_CAT2	passes burst CAT2 test
6	BURST_CAT3	passes burst CAT3 test

# O4 commissioning

- Commissioning test with IMC is now ongoing.
  - Non stationary coherence between frequency noise of IMC/PMC/PLL and sound noise.
  - Too many glitches on OpLevs for MC suspensions.

Detailed will be discussed in Hirotaka's talk



# Summary

- Online DQ flags and Offline segments were shared among LVK during O3GK observation.
- KAGRA's science mode is available as K1-SCIENCE\_MODE
- Segment production with shorter cadence will be required for the low-latency activities during O4
- Data Category information also required by GW searches using the KAGRA strain signal.
- KAGRA is in the commissioning test with a part of IFO and noise hunting is now ongoing.