



LIGO Virgo KAGRA

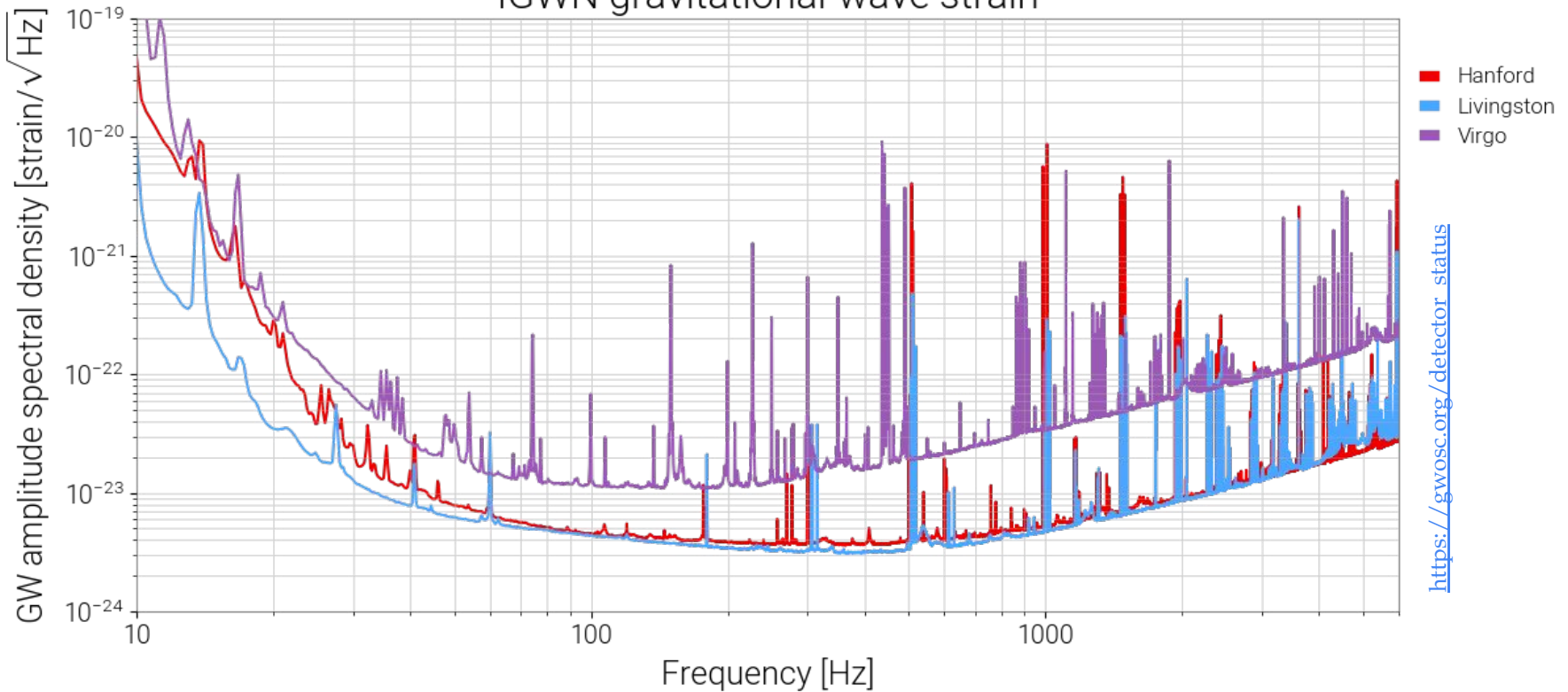
Observatory Status and O4 Update

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Chair, LSC Operations Division

OpenMMA Meeting
29 August 2024

[1408752018-1408838418, state: Observing]

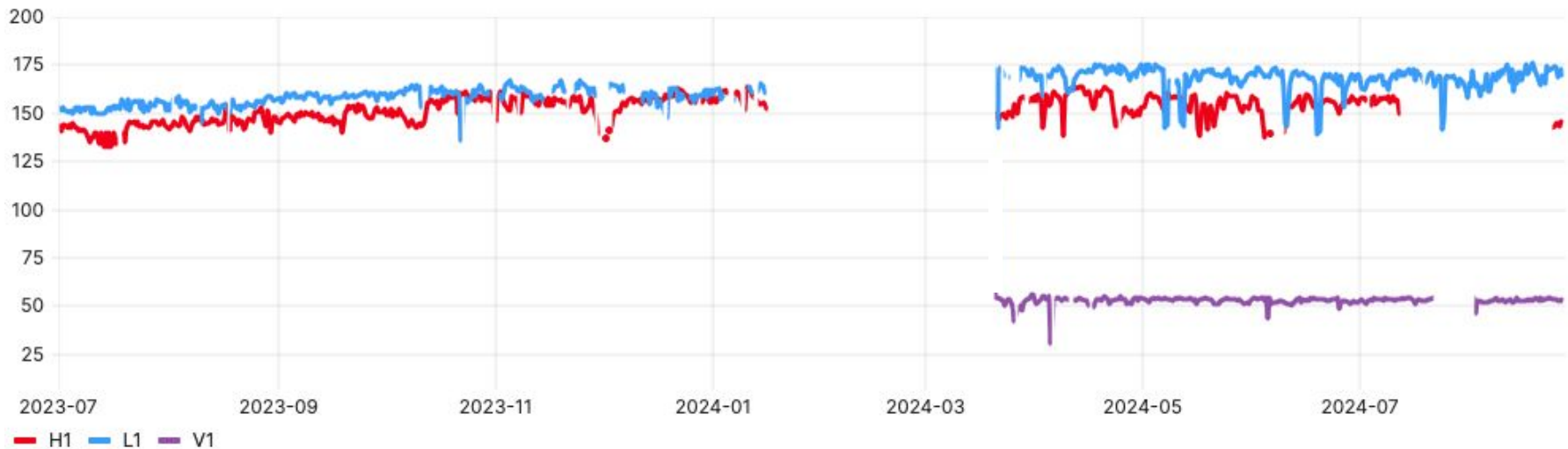
IGWN gravitational-wave strain



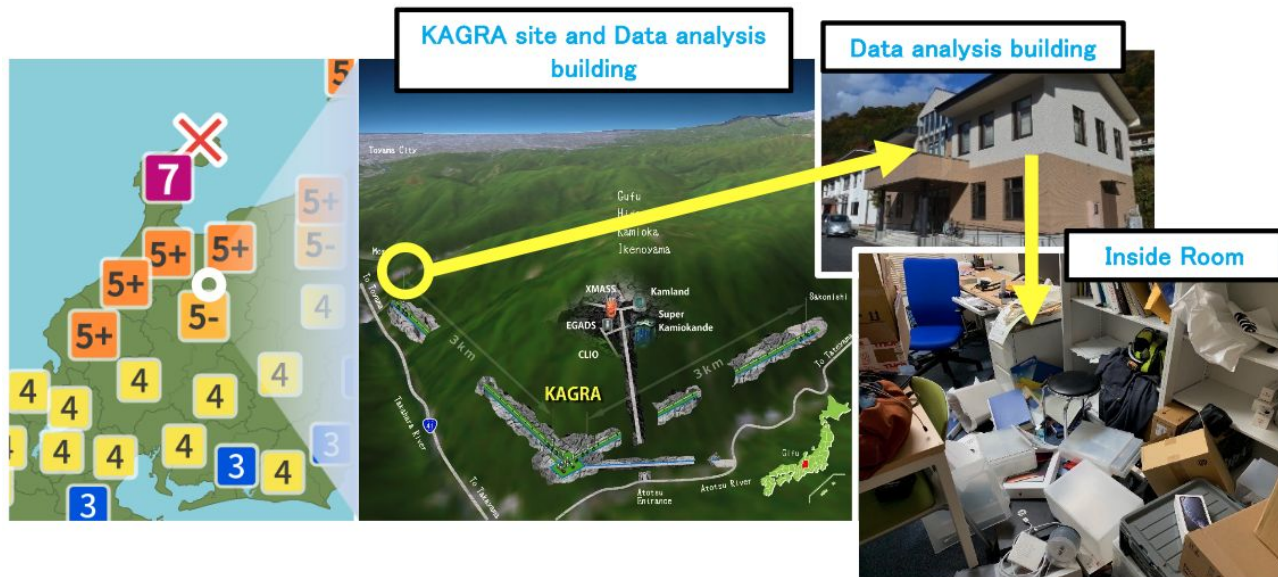
- Status of Observatories
- Status of Low Latency Alerts
- O4 Planning

- O4a: May 2023 - Jan 2024
 - KAGRA Observing first 4 weeks
 - LIGO Hanford-Livingston 2 detector time: 53%
 - At least one detector: 70%
- O4b: April 2024 - current
 - Virgo Observing, KAGRA planning to re-join later in run
 - Pause for some interferometers July - August to address in-vacuum components
 - At least one detector: 88% (non-Observing times overlapped to maximize multi-interferometer detections, which limits the “at least one” time to about 90%)
 - 3 detector time: 31% (was 45% until mid-July pause)

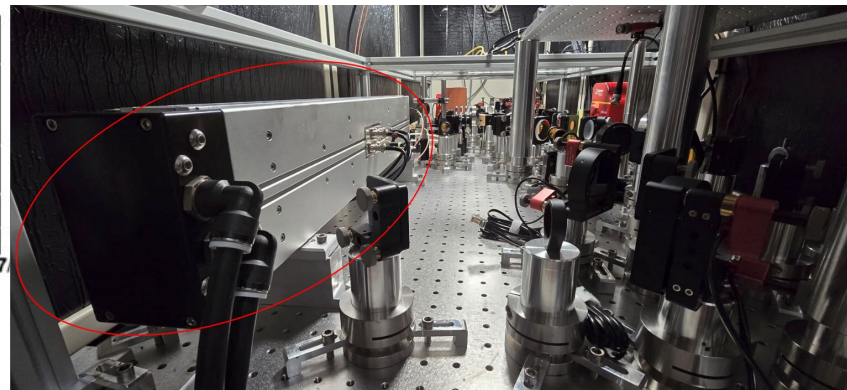
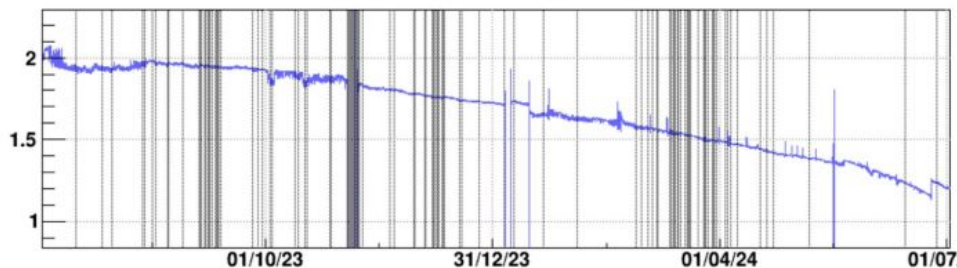
GstLAL Inspirational Detector Range History (Mpc)



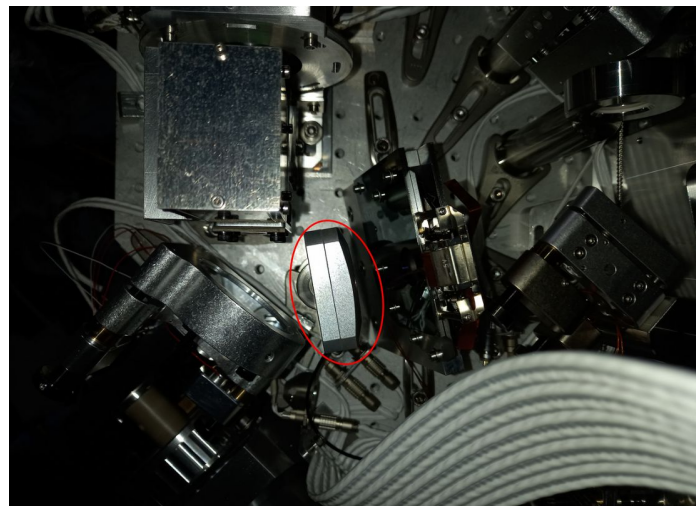
- Sensitivity during O4a Observation is well-understood, with paths toward improvement in all areas
- Noto Peninsula Earthquake (January 2024) caused significant setbacks, however **all repairs are now complete** and commissioning work is again ongoing
 - Required significant in-vacuum work
- Goal remains to rejoin O4 with sensitivity of about 10 Mpc or higher
 - A primary target of investigation is acoustic noise coupling that is limiting sensitivity



TCS_WI_CO2_PWRLAS_mean_TIME

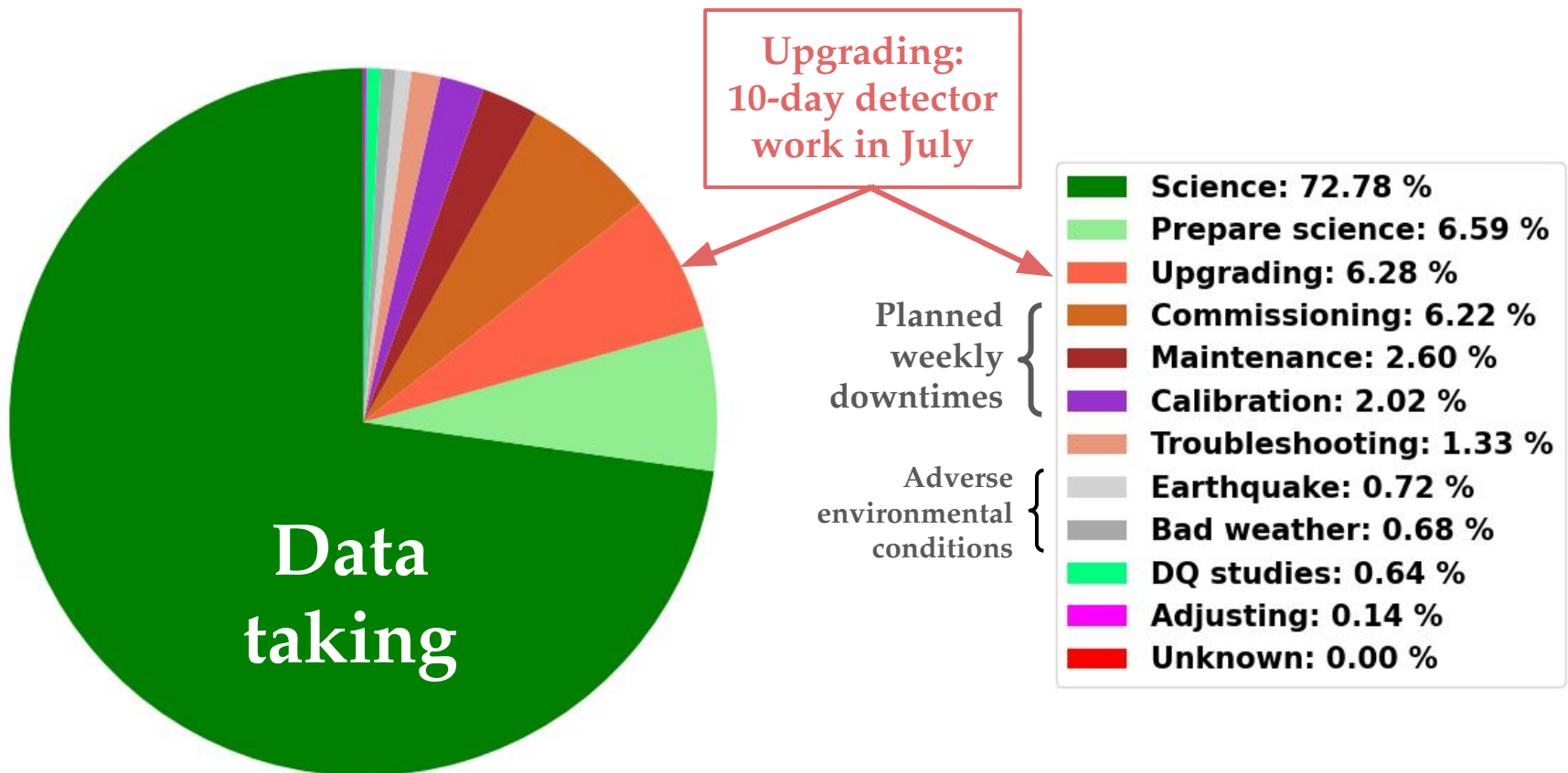


- Replaced ageing thermal compensation CO2 laser that was losing power
- Would have insufficient power in 4 months

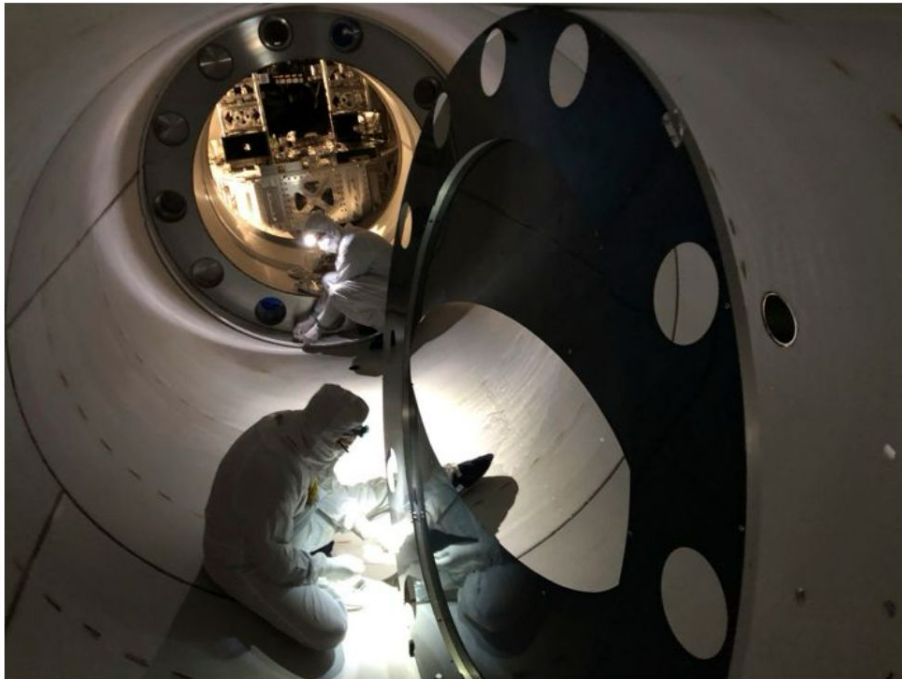


- Added half-wave-plate at output port
- Study dependence of detector noise on light polarization
- Excluded orthogonal polarization as a source of additional noise

- Virgo full O4b duty cycle
 - Close to 80% excluding the 10-day stop
 - Limited to ~90% by weekly downtimes



Coupling of HVACs and other vibrations tracked to input arm baffles and beam tube: angle of baffles too small

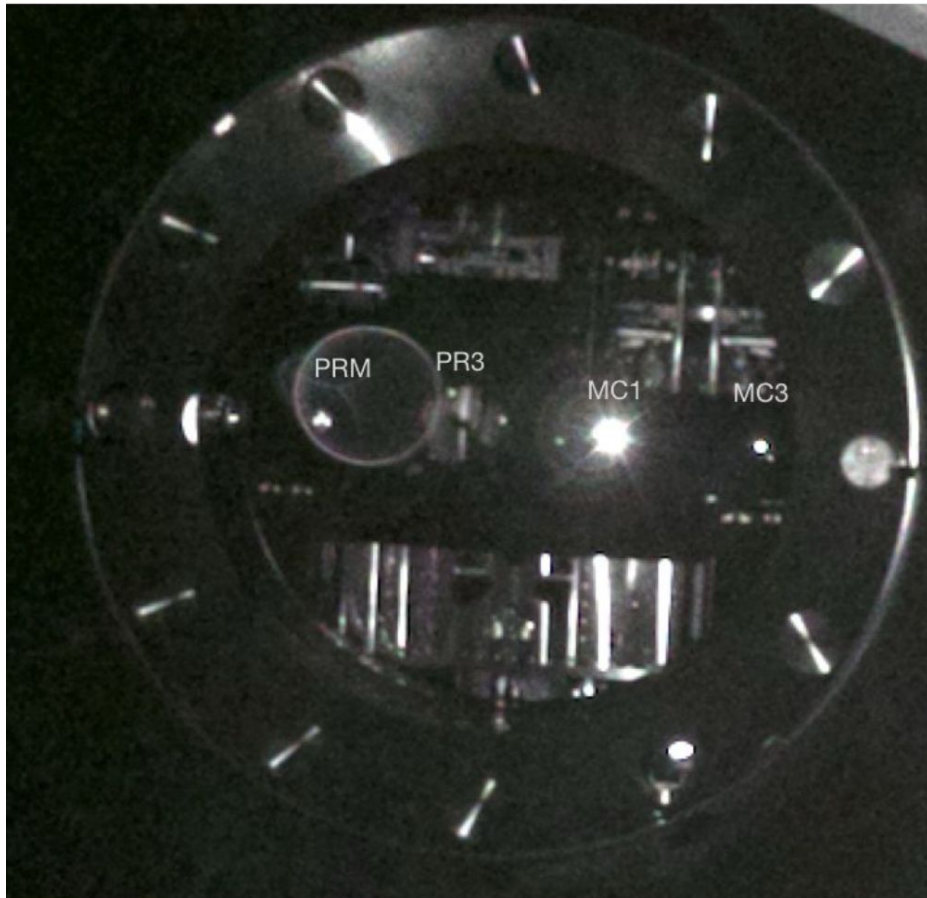


Modifying baffle to increase angle

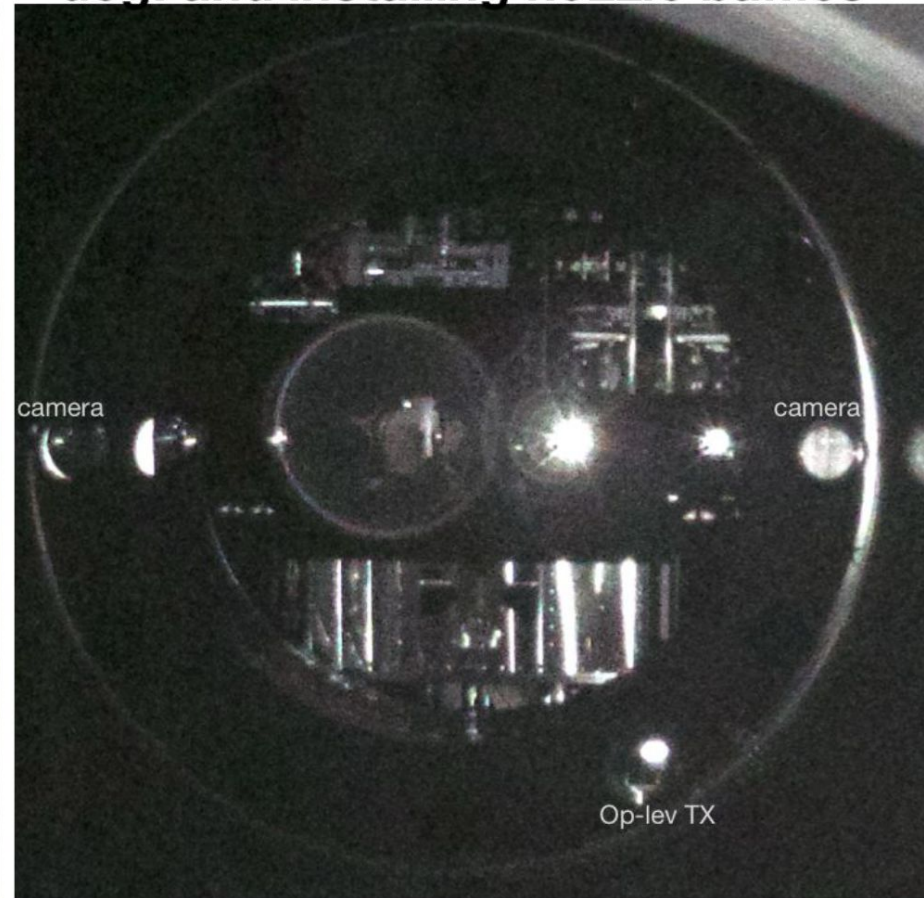


Installing baffles to hide small flanges

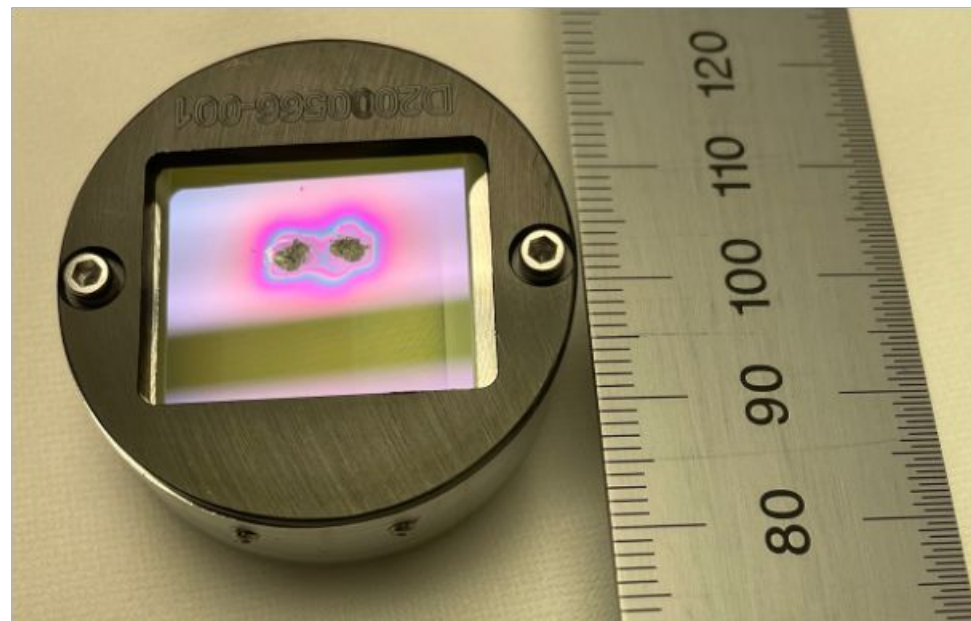
Before: view from MC2



After increasing baffle angle to 10 deg. and installing nozzle baffles

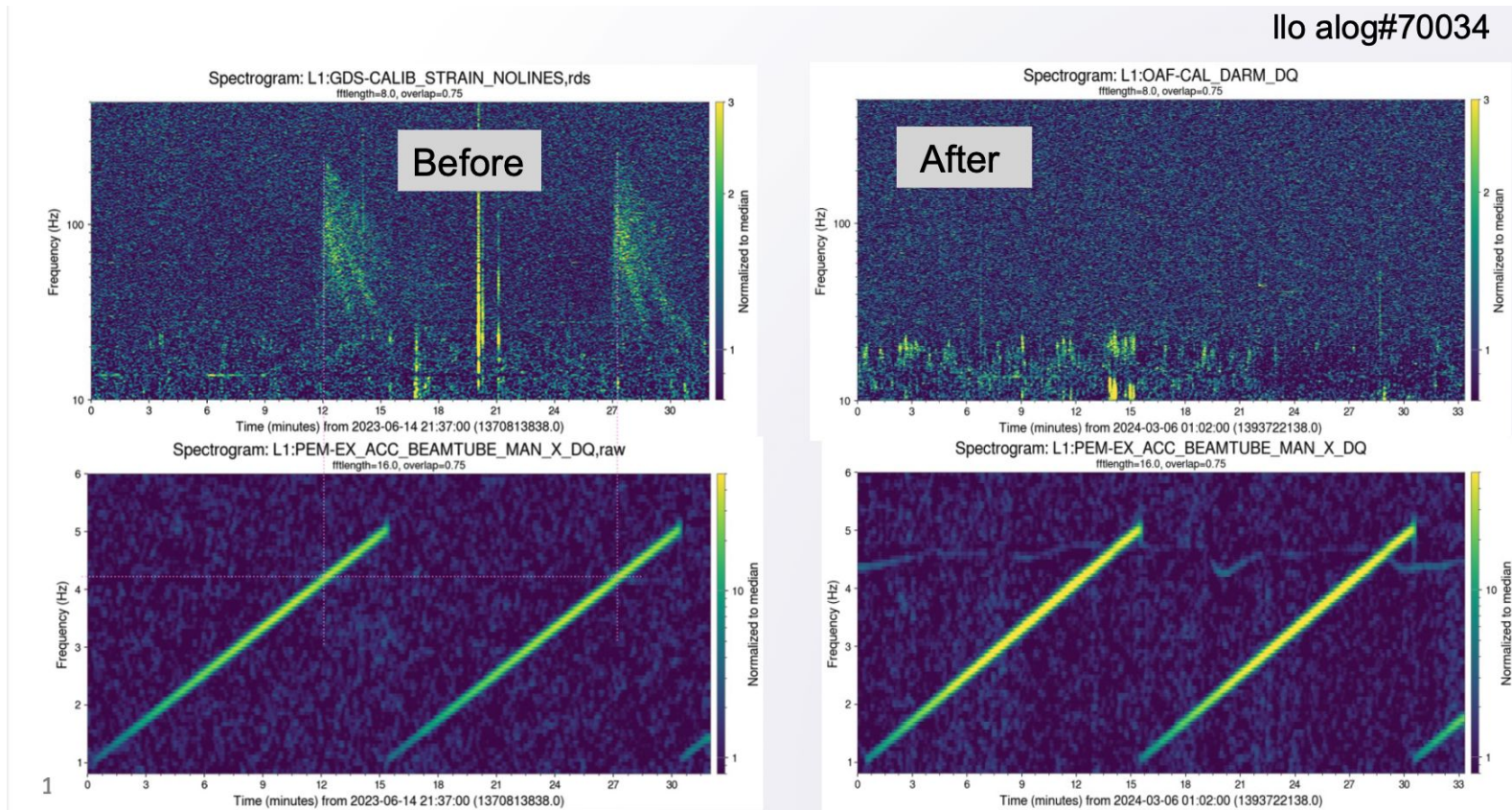


- Significant loss in output portion of detector
 - 1 occurrence in late April 2024
 - Happened again early July 2024
 - Urgent need to understand and mitigate failure mechanism
- Optics replaced in-vacuum
 - Fastest to-date pumpdown back to ultra high vacuum
 - Back to Observing 4 days after vacuum available



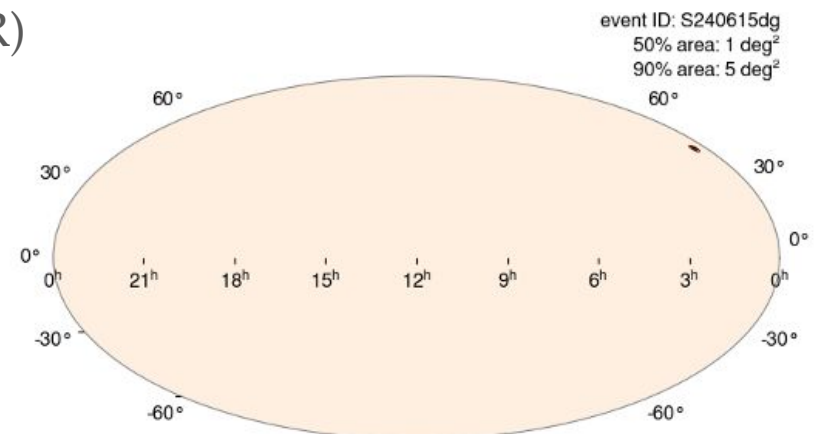
[LHO alog 79331](#)

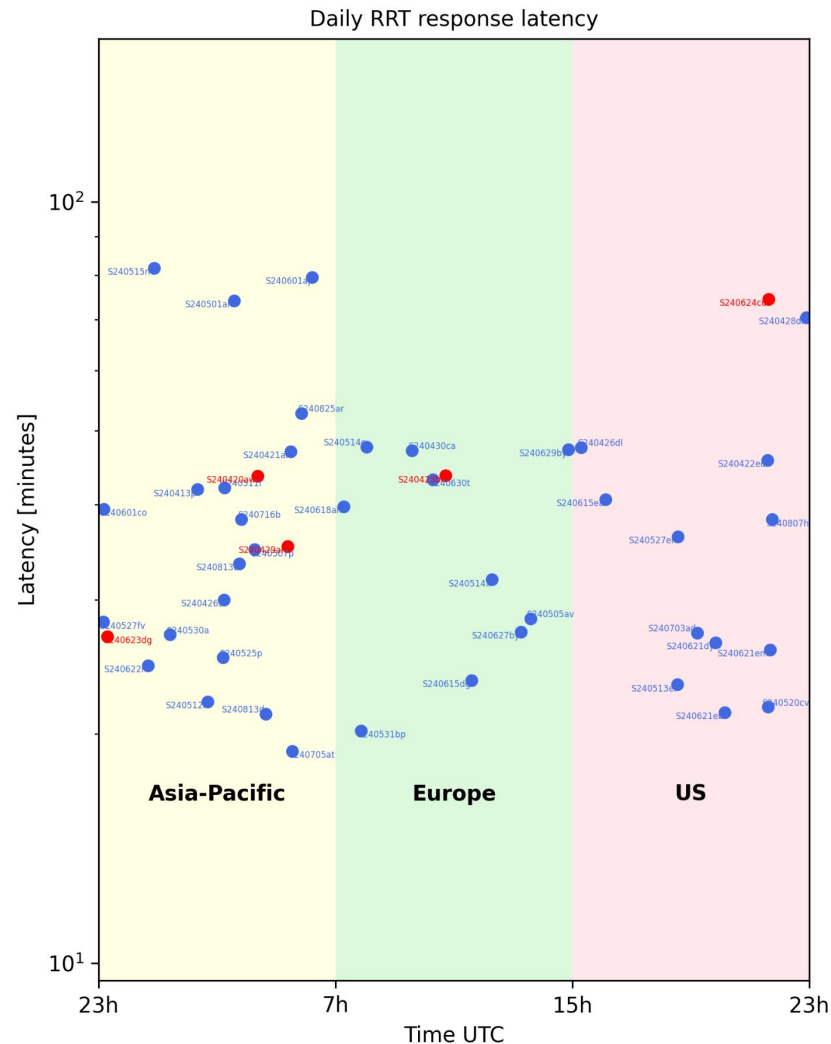
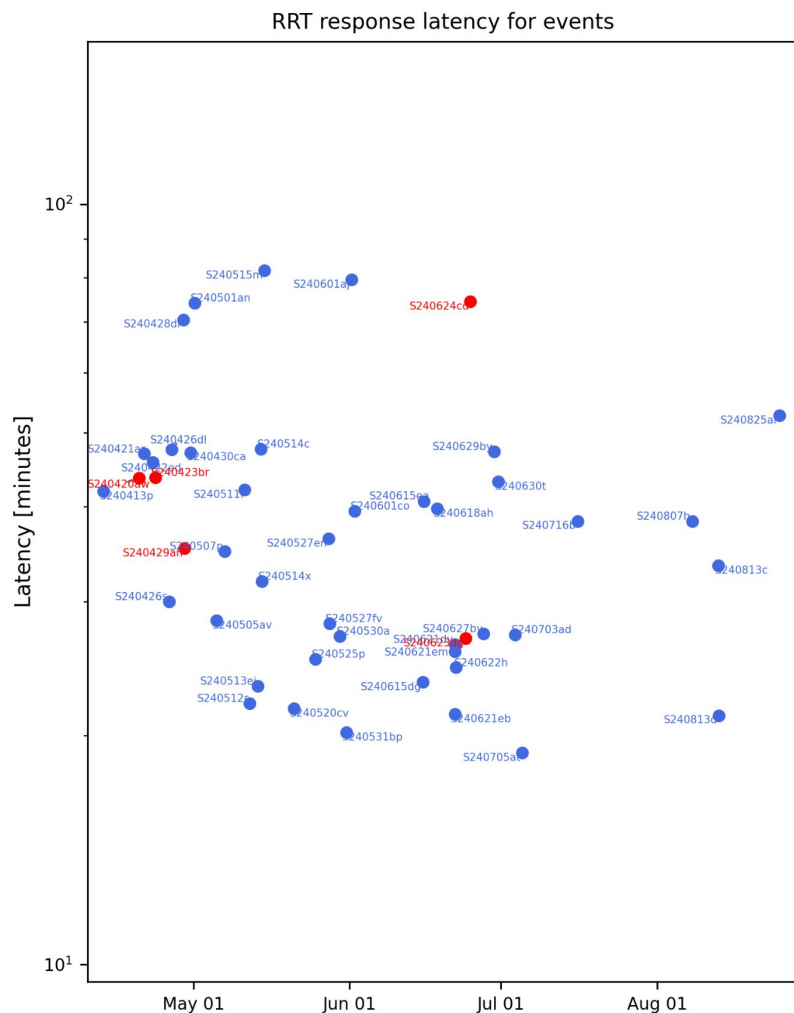
- Cleaning of End Mirrors
- Increased laser power buildup in long arm cavities
- Damping of in-vacuum components to reduce transient noise from scattered light

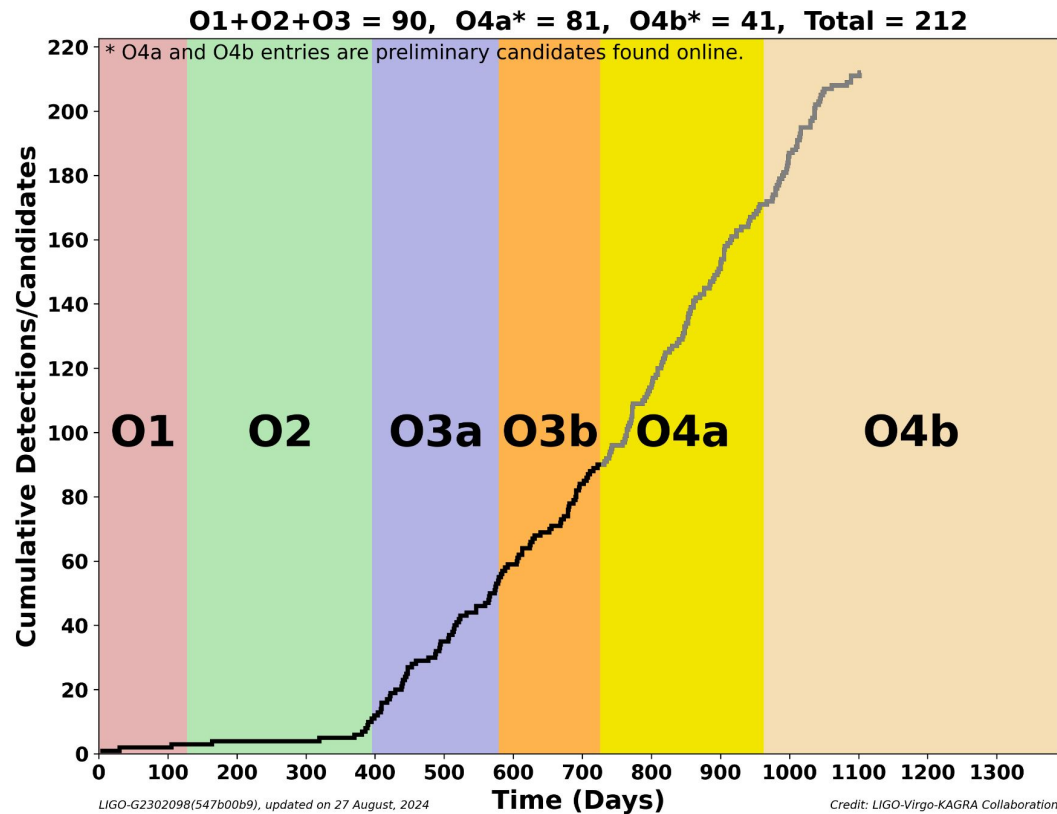


- At the start of September we will resume operation of the SPIIR CBC pipeline and we will operate a new burst pipeline (MLy).
- The ‘trials factor’ applied to alerts will be updated to account for these searches, such that the false alarm rate after accounting for trials factors remains
 - Once per month for CBC searches
 - Once per year for Burst searches
 - See <https://emfollow.docs.ligo.org/userguide/analysis/index.html> for details
- Virgo data is used for sky localization, parameter estimation, and downstream analyses and is used to select candidate triggers in low-latency by the GstLAL pipeline (and soon SPIIR)

One BBH (S240615dg) with 90% localization ~ 5 sq. deg. at ~ 1.4 Gpc

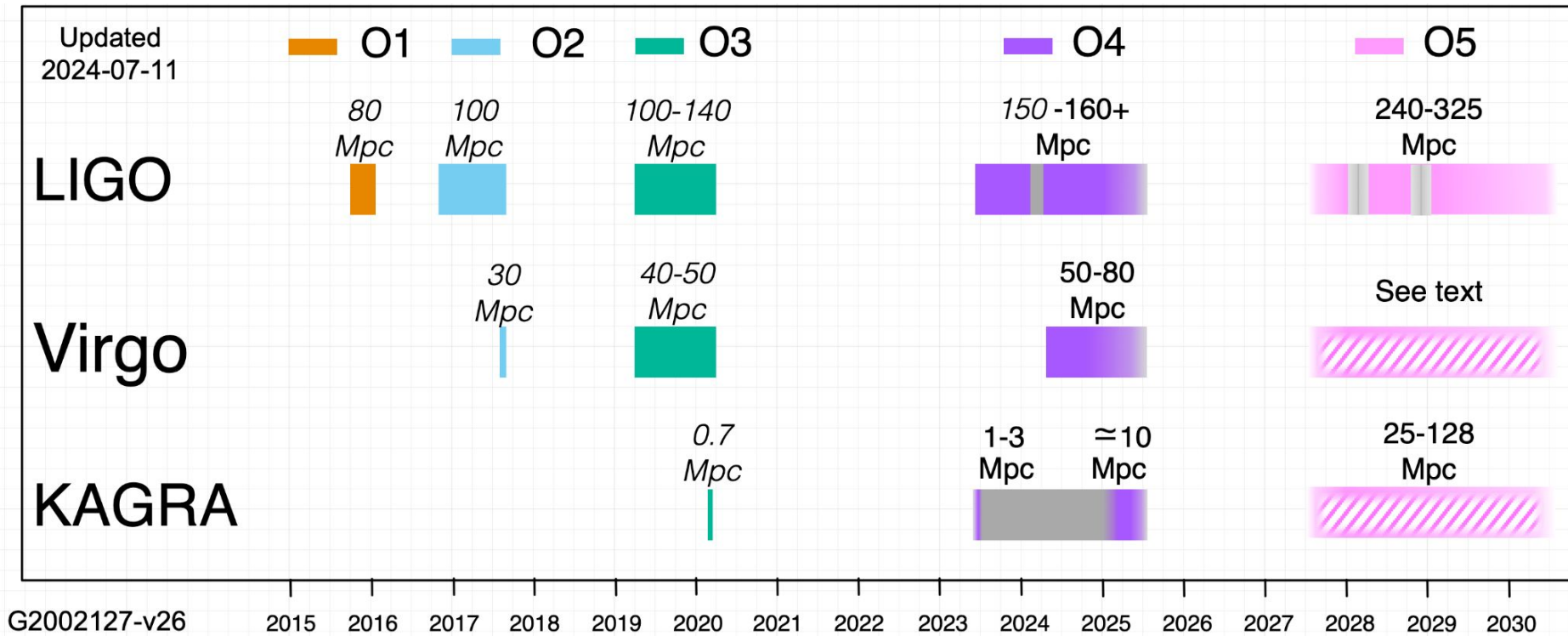






O4b Significant Detection Candidates: **41** (46 Total - 5 Retracted)

O4b Low Significance Detection Candidates: **615** (Total)



<https://observing.docs.ligo.org/plan/>

- No further breaks in Observing are planned for O4.
- O4 will continue through June 2025