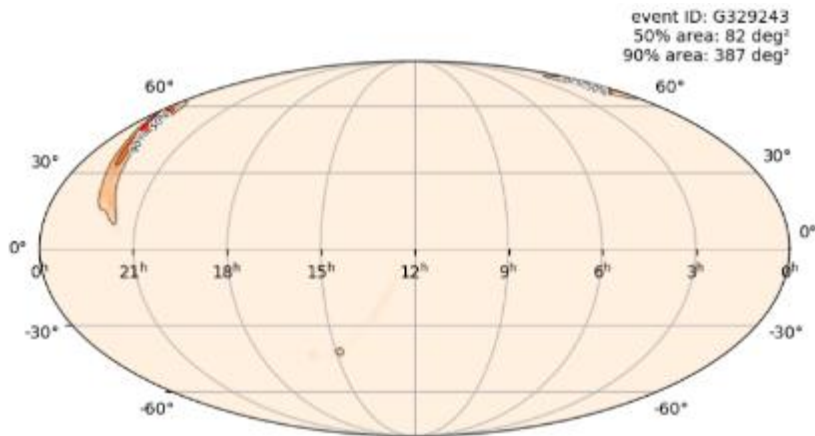


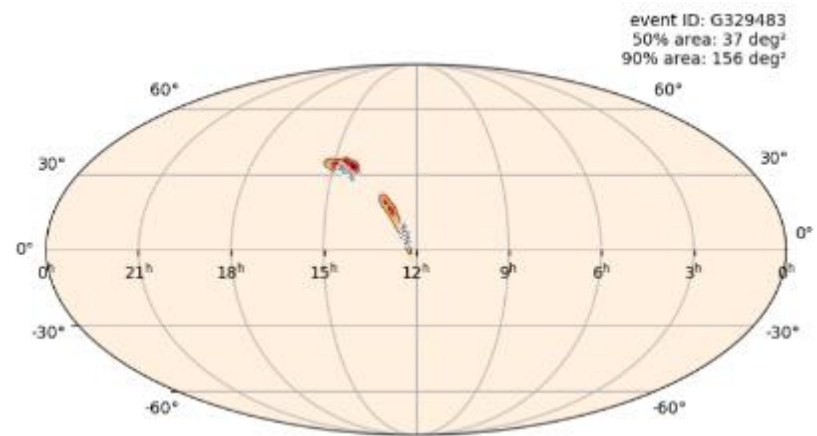
Detectors and observations in O3

Lisa Barsotti, Nicolas Leroy,
Keita Kawabe, Shinji Miyoki, Brian O'Reilly, Alessio Rocchi
for the LIGO-VIRGO Joint Run Planning Committee

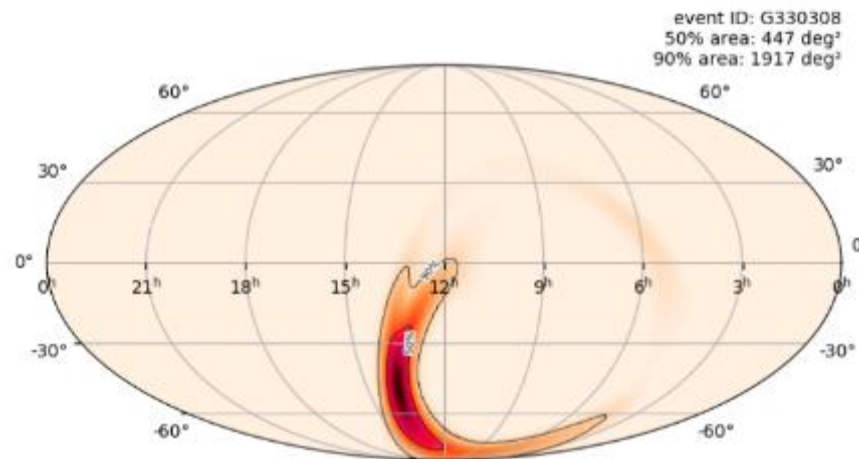
24 days, 3 public alerts.



S190408an



S190412m

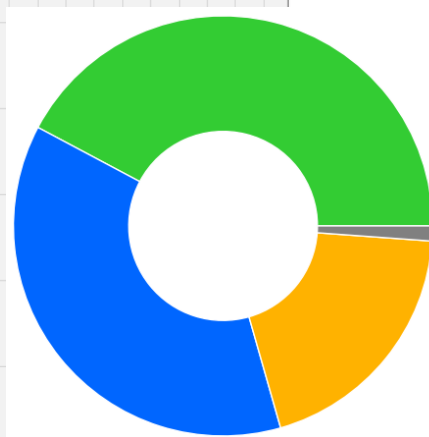
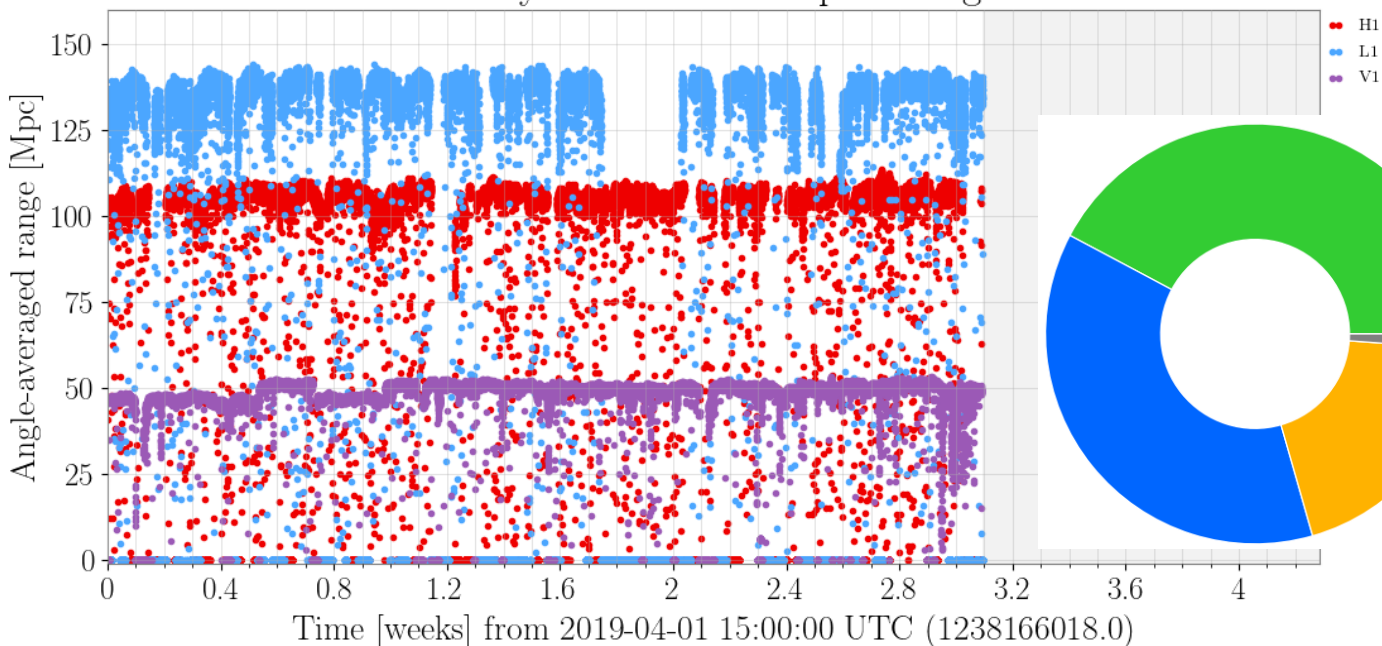


S190421ar

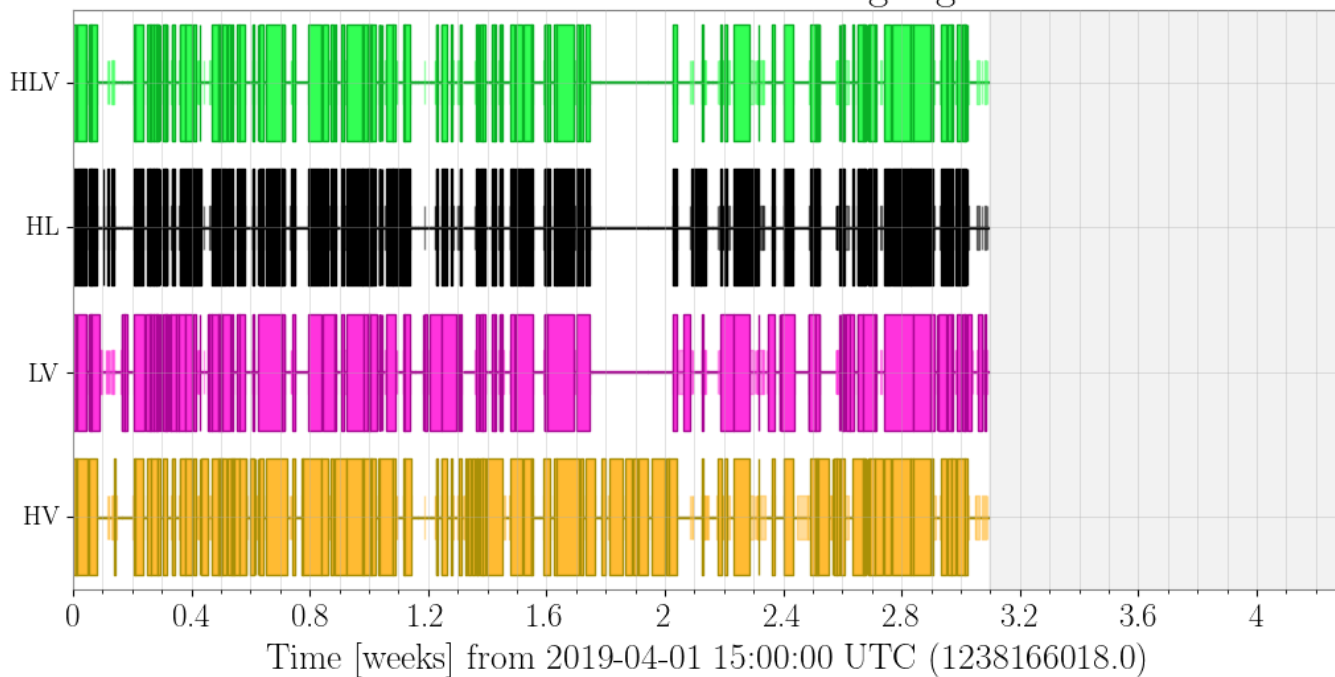
<https://gracedb.ligo.org/>

O3 and Instruments Status

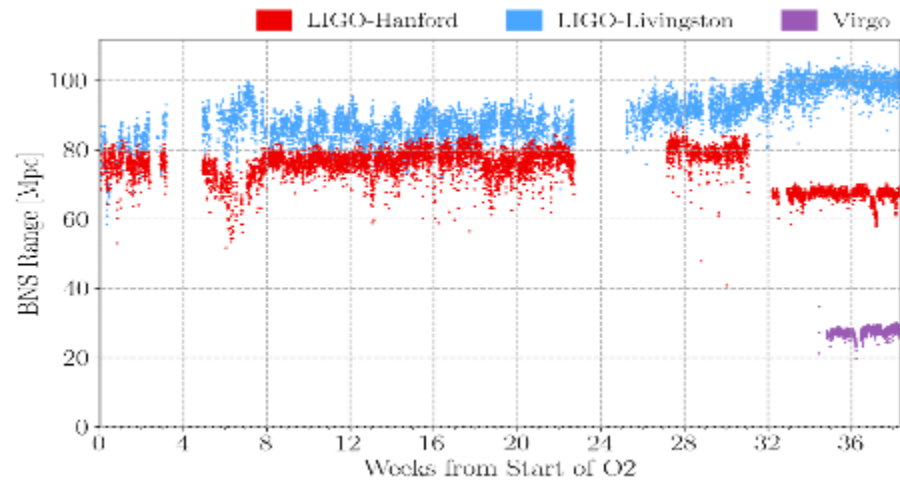
- O3 started in time on Mon Apr. 1st 2019
 - Better sensitivity than O2 for all 3 instruments.
 - As planned, shorter than usual commissioning time at all three sites for the first week.
 - Coordination between the sites to maximize 3-IFO operation.
 - Planned down time for:
 - Tuesday maintenance: 6-10 UTC for V1, 14-18 UTC for L1 and 15-19 UTC for H1 (with seasonal changes due to summer time);
 - Calibration on Wednesday: 15-19 UTC @ V1 and 20-23 UTC @ LIGO
 - At least one instrument tries to remain online at any given time.
 - Very good triple coincidence **OBSERVING** so far, about 40%.
 - Only 1.1% with no interferometer in observation mode.
 - At least two interferometers 80% of the time.
 - We **WILL** spend time on problems that need immediate attention, or if we think we can make significant improvement in short period.



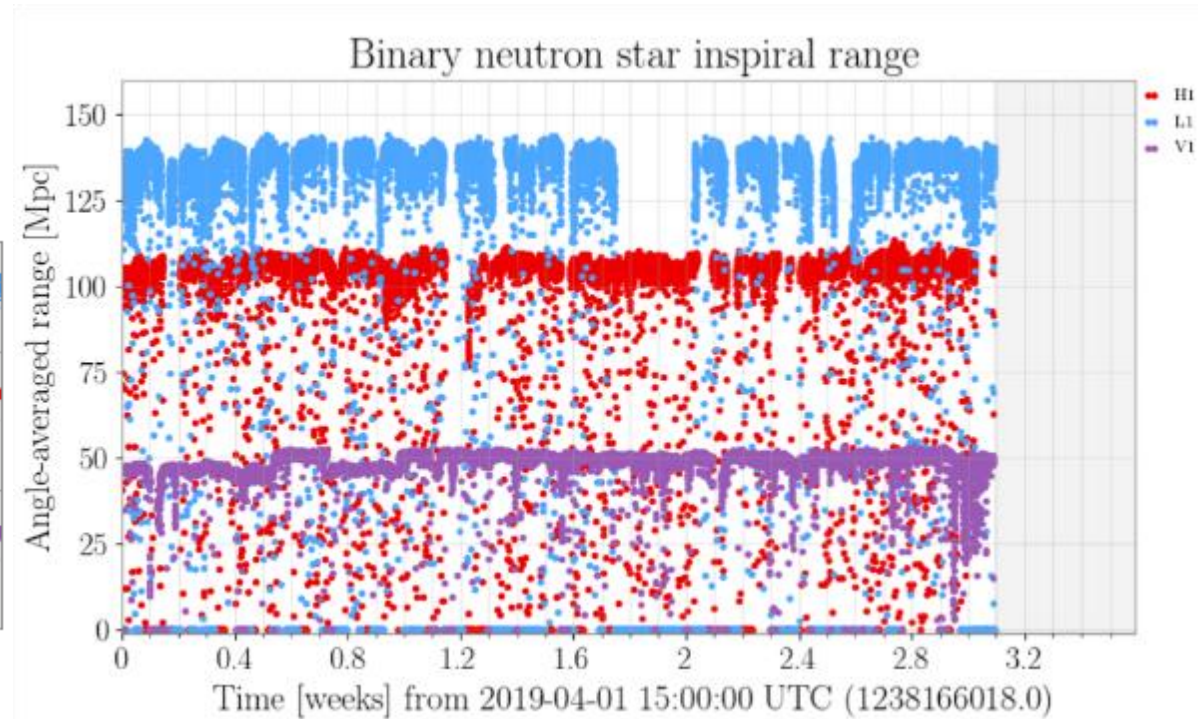
Multi-interferometer observing segments



Improved Noise Performance



O2

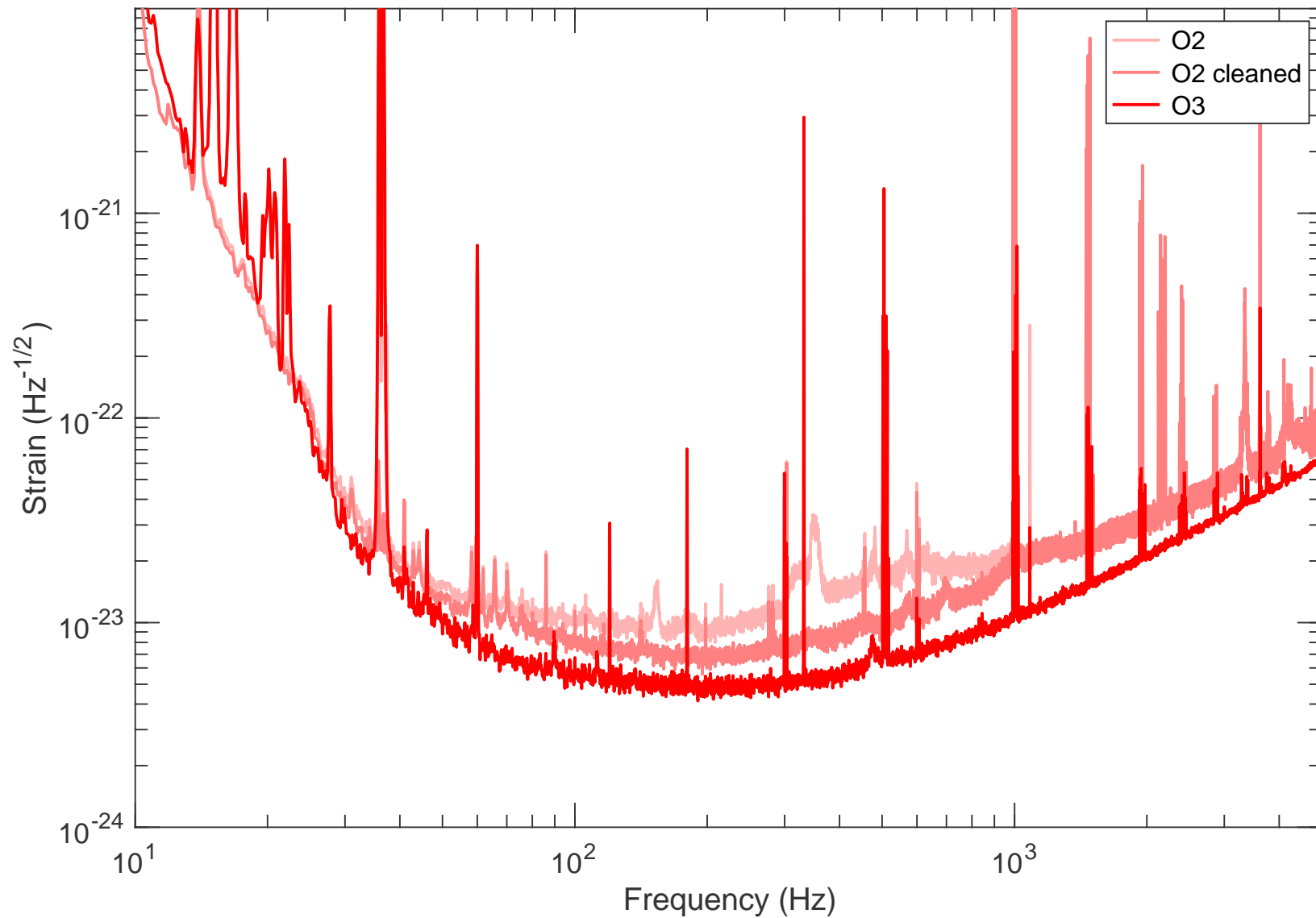


First three weeks of O3

Reminder: LIGO improvements for O3

- Higher laser power
- Replaced 5 of 8 test masses (better optical quality)
- Added squeezed light injection systems
- New baffles to mitigate scattered light
- Improvements to various controls systems (seismic, alignment, etc)

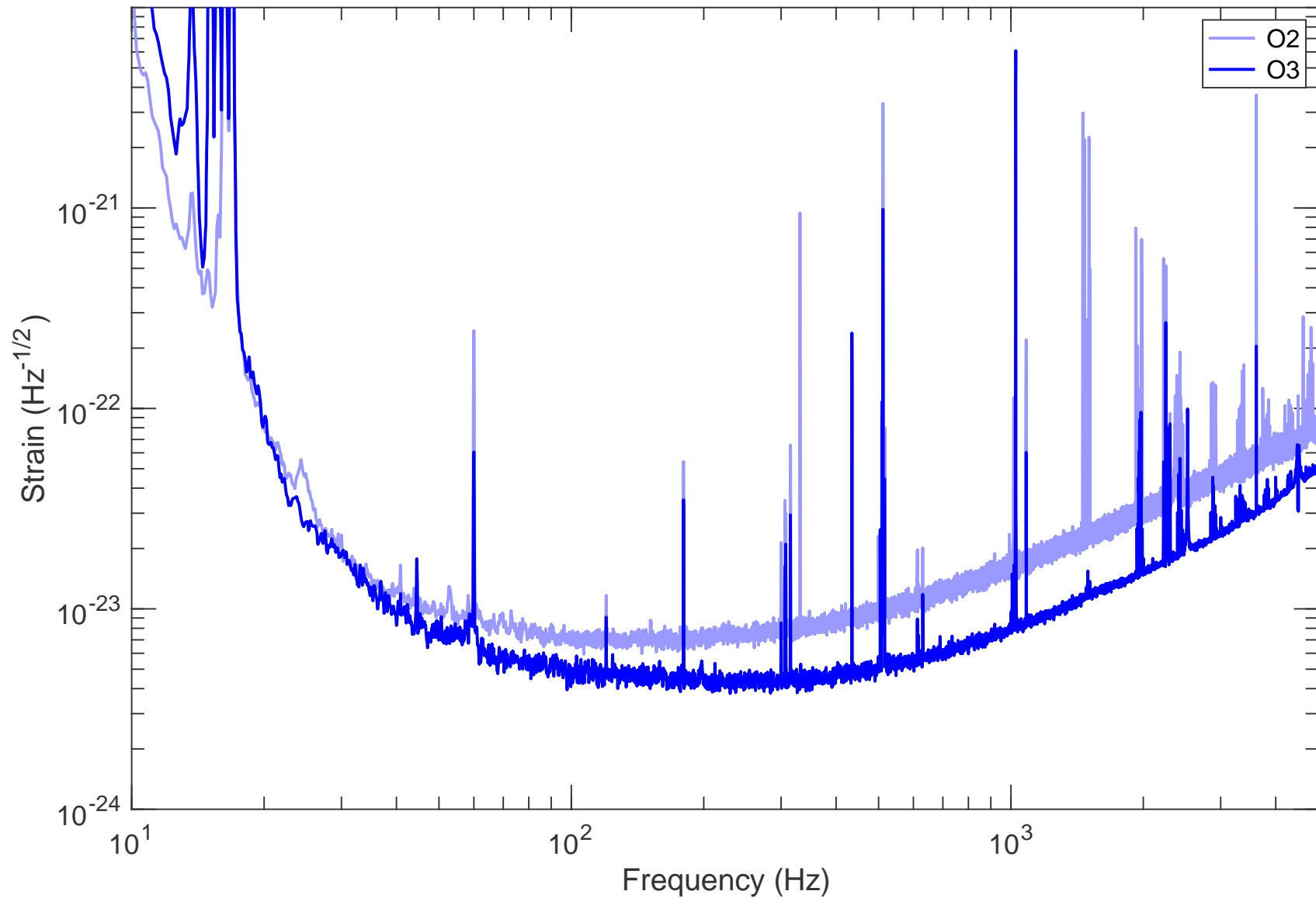
H1: O2 vs O3



Current detector performance: H1

- 2.2dB of squeezing + 35W
- Higher recycling gain (~45 as opposed to ~35).
Mirror replacement paid off.
- No major bumps/peaks from the laser (unlike O2).
- Longer planned downtime for the first month or so to perform various investigations. Will be back to normal schedule in a couple weeks.
 - Calibration, environment noise, glitches, lock losses, upconversion from wind and EQ, stability, larger low frequency noise than L1.
- Good duty factor (68%) despite this. Very good considering that this is the start of the run.

L1: O2 vs O3



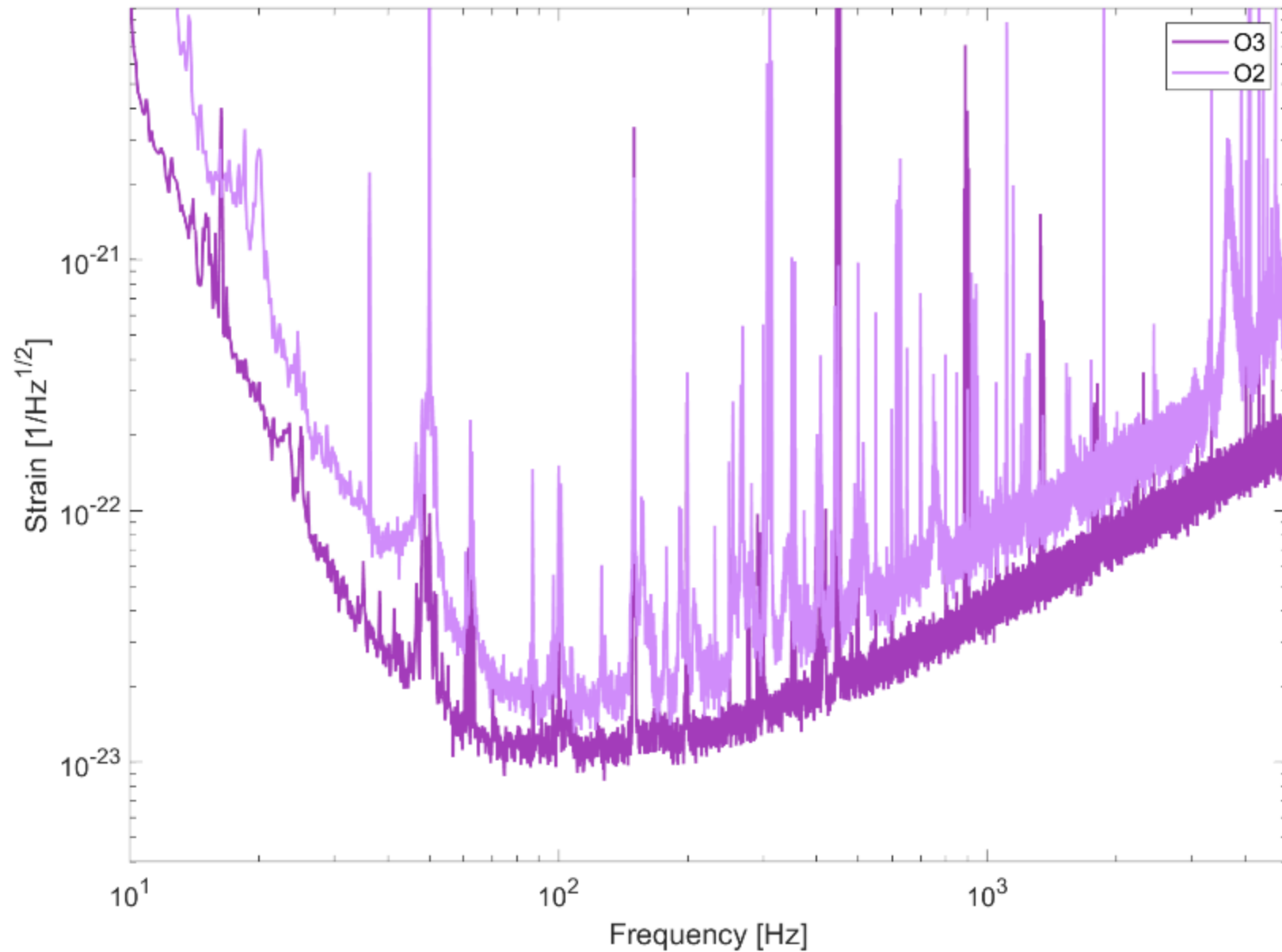
Current detector performance: L1

- Sensitivity impacted by seismic noise: microseism, wind, human-induced daytime activity.
- Work continues on increasing robustness to improve duty cycle. Budgeting 4-6 hours a week for tests and investigations.
- Calibration systematics at the 2% level. Weekly measurements to improve statistical accuracy (currently around 5%).

Reminder: Virgo improvements for O3

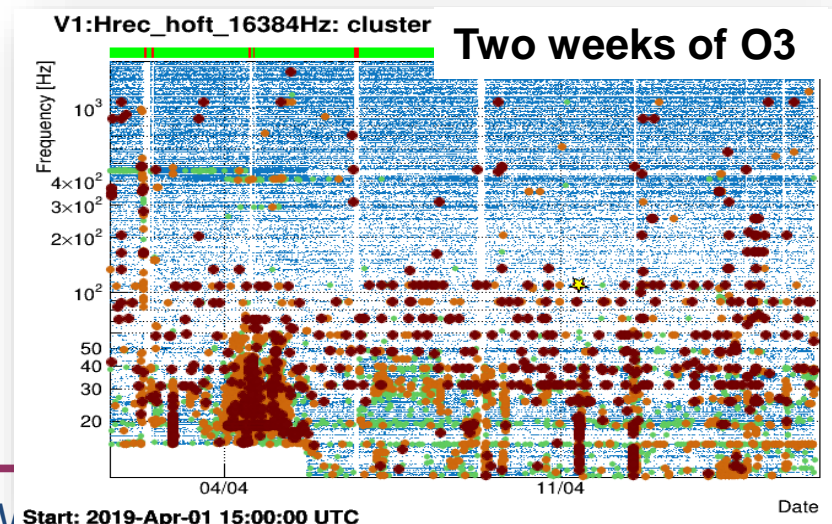
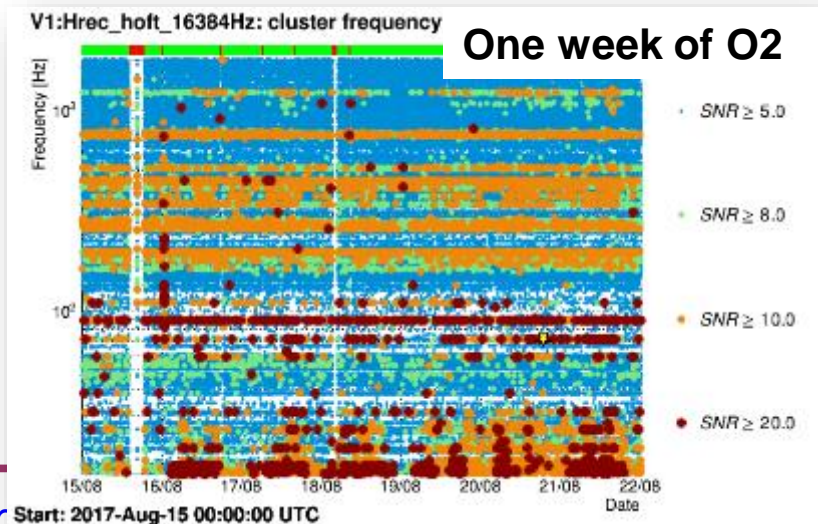
- Higher laser power
- All test masses suspended with fused silica fibers
- Intracavity power improved with adaptive optics
- Injection bench suspension activated
- Added squeezed light injection systems
- Scattered light mitigation on output optics
- New high quantum efficiency PDs with optimized electronics
- Improvements to various controls systems (seismic, alignment, etc)

V1: O2 vs O3



Current detector performance: V1

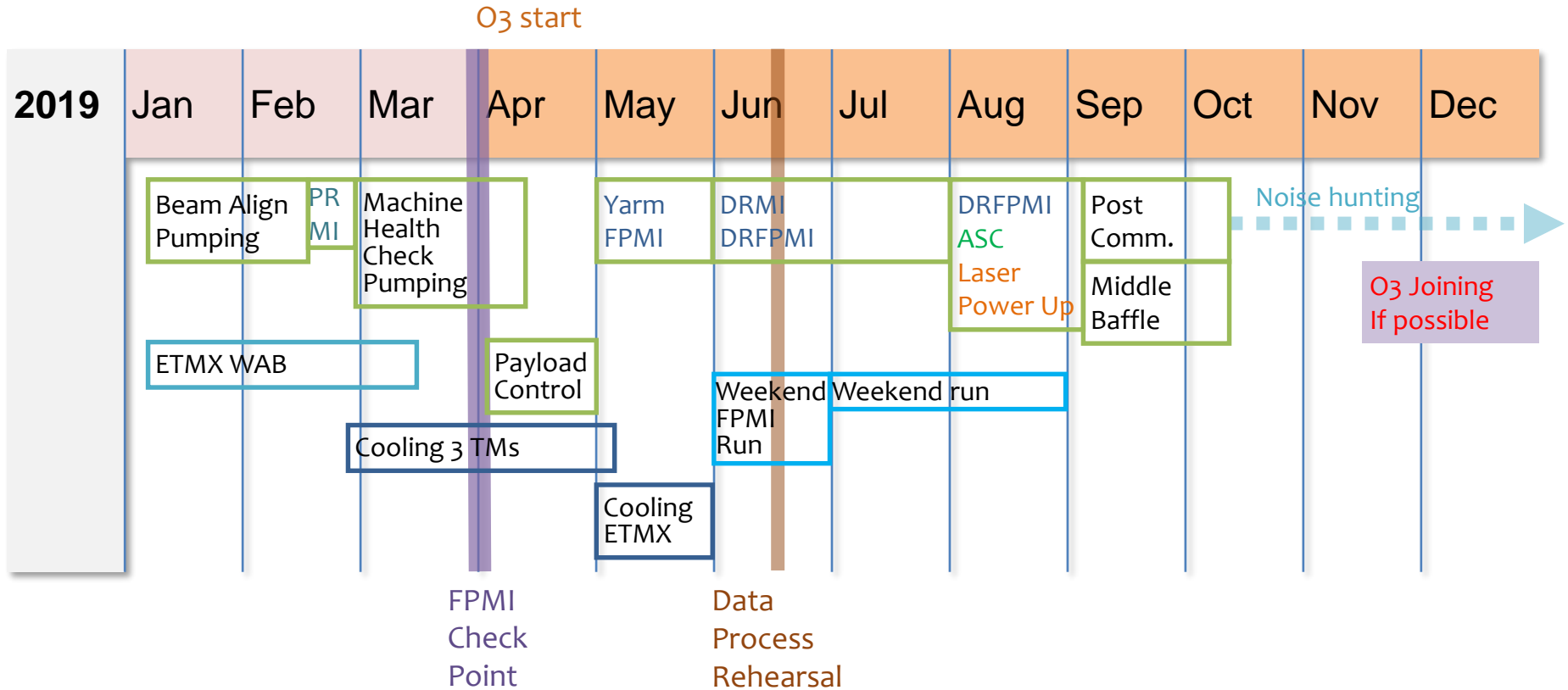
- Good (>90%) duty cycle in science mode
- Rather stable sensitivity:
 - about 50 Mpc for BNS;
 - around 600 Mpc for 30 Msol BBH
- Glitch rate greatly reduced wrt O2;
- Highest science mode state comprises injection of squeezing (up to 3 dB), but science mode state without squeezing is also possible;
- Short commissioning breaks (order of few hours) planned on a weekly basis to improve both sensitivity and robustness;



KAGRA, the Japanese cryogenic detector, is expected to join late 2019

- Oct/Nov 2018: 3km X-arm “locked” using IR and green.
 - EXC mirror trouble after that, chamber was opened, now pumping down. IXC mirror is being cooled down.
- Apr 2019: 3km Y-arm “locked” using green at cryogenic temperature.
 - IYC is already fully cooled down. Still cooling EYC.
- Control optimizations undergoing for cryogenic suspensions.
- 40W fiber laser, 10W after input mode cleaner. Long term stability under investigation.
- Will start combining two arms using Michelson ~mid May 2019, will transition to the final configuration later.
- Detailed study of the impact of adding KAGRA to LV network is ongoing.

Current KAGRA schedule for O3



Summary

- First 24 days excellent with 3 public alerts.
 - Good noise performance, extremely good V1 duty factor, good LIGO duty factor.
- KAGRA is planning to join later this year.
- Projected observation period of O3: 1 Calendar year (nominally ends at the end of March).
 - Nothing is concrete yet, but if we ever decide to make a break of ~weeks and if we shift the end date, how much advance notice do you need? Please respond to our email inquiry.