



LIGO Laboratory / LIGO Scientific Collaboration

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O3 Coincident Observation Strategy

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1 Scope

The third observation run of the advanced detector era (O3) will have three highly sensitive detectors available for observation. A logical question that arises is whether we should maximize doubly coincident or triply coincident observations. We will plan to keep at least one detector in observation mode for the duration. This memo only addresses **planned** downtime. There will be many times when detectors are offline for unplanned reasons.

2 Planned Downtime

Planned downtime takes place for two reasons, weekly maintenance activities and weekly commissioning investigations.

2.1 Weekly Maintenance

Each week a 4-hour period per site is set aside for performing maintenance and upkeep on the detector and the facility. Outside contractors and vendors schedule their activities and deliveries to fit in this window. The maintenance period involves tasks as diverse as Liquid Nitrogen delivery to lawn maintenance. It would take considerable effort, perhaps involving renegotiation of contracts, to change this schedule. We maintain the same maintenance schedule outside of observation runs to avoid disruption and confusion. The weekly maintenance is performed each Tuesday at the following times.

- **LIGO Livingston:** Tuesday 15:00 – 19:00 UTC
- **LIGO Hanford:** Tuesday 16:00 – 20:00 UTC
- **Virgo:** Tuesday 07:00 – 11:00 UTC

This results in 3 hours per week (from 16:00-19:00 UTC every Tuesday), where Virgo is observing alone and 6 hours where two interferometers are observing (Tuesdays from 07:00-11:00 UTC 15:00-16:00 UTC and 19:00-20:00 UTC). We do not consider it feasible, due to the different time zones, to synchronize weekly maintenance between the LIGO and Virgo sites.

2.2 Weekly Commissioning Investigations

Each week we set aside time for investigations of the instrument noise and stability. We plan to allocate 6 hours per detector per week for such activities. Since this chiefly involves on-site staff we have more flexibility in scheduling and planning these interruptions. Our approach in O2 was to synchronize LIGO commissioning activities but not to attempt to overlap with Virgo investigations. Continuing this approach leads to a further 6 hours where Virgo observes alone and 6 hours of doubly coincident observation by the LIGO instruments.

3 Comparison

	V	LV	HV	HL	HLV
O2 (Synchronize HL Maintenance and Commissioning as much as possible, Stagger V and HL)	3+6	1+0	1+0	4+6	147
Stagger Maintenance, Stagger Commissioning	0	4+6	4+6	4+6	138
Synchronize HL Maintenance, Stagger Commissioning	3+0	1+6	1+6	4+6	141

Table 1: Hours per week of planned uptime for LIGO and Virgo detectors under various approaches to maintenance and commissioning time. X+Y means X hours due to planned maintenance, Y due to planned commissioning, of the other detector(s).

The status quo, shown in green above, maximizes triple coincidence (TC) resulting in 9 hours of Virgo observing alone, 12 hours of double coincidence (DC) and 147 hours of TC (91%). None of the LIGO detectors will plan to observe alone.

It is possible to have no planned single detector observation time, shown in black. However, as stated above it is very difficult for us to alter the current maintenance schedules at the LIGO sites.

A middle strategy, shown in red, of keeping the (almost) synchronized LIGO maintenance times, but staggering the commissioning investigations gives 3 hours of Virgo observing alone, 24 hours of DC and 141 hours of TC.

4 Strategy for O3

Going forward for O3, we'll keep the status quo of maximizing TC. If there is a necessity of staggered HL commissioning in a particular week, LIGO run managers will approve on case-by-case basis. We expect that some commissioning investigations will be opportunistic, occurring when other two instruments are offline.

In the event that KAGRA joins O3 we will revisit this strategy.