Status of Advanced LIGO detectors

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For the LIGO Scientific Collaboration and the Virgo Collaboration

A reminder: Observing Scenario

- Prospects for Localization of Gravitational Wave Transients by the Advanced LIGO and Advanced Virgo Observatories, The LIGO Scientific Collaboration and The Virgo Collaboration, [arXiv:1304.0670]

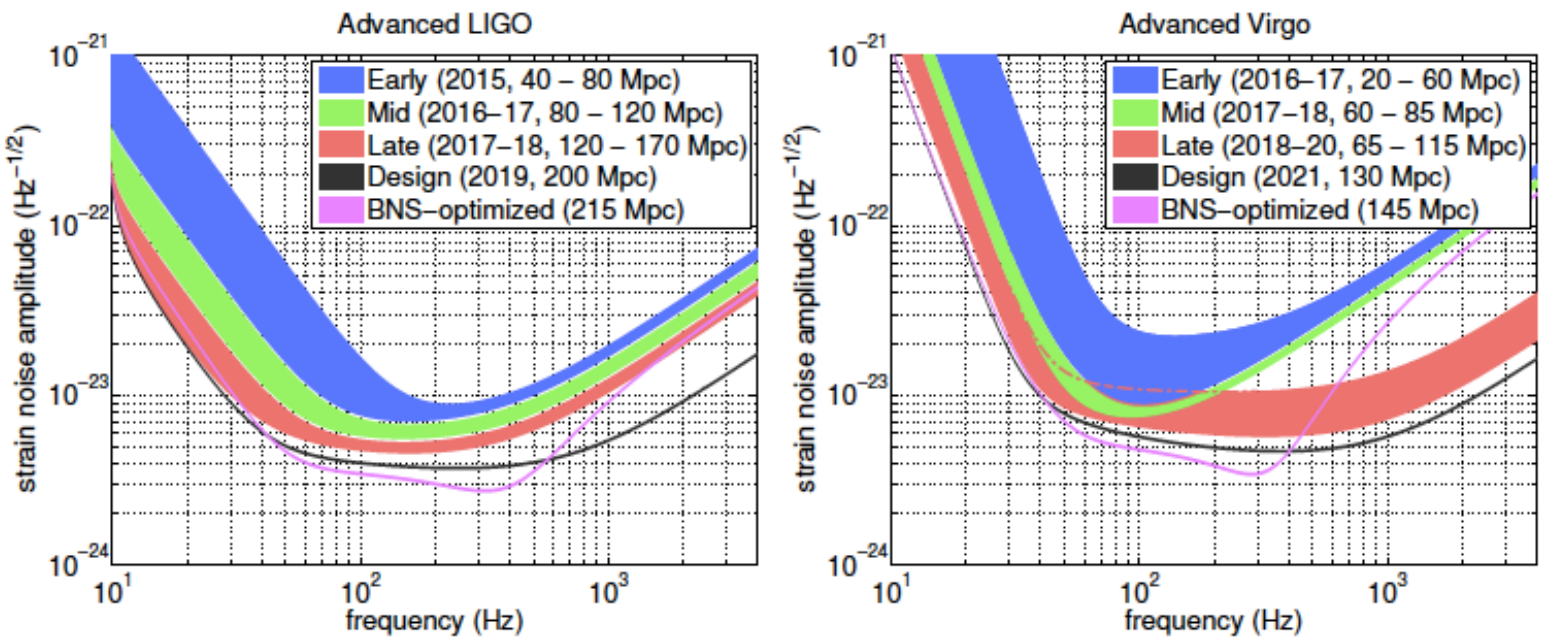


Figure 1: aLIGO (left) and AdV (right) target strain sensitivity as a function of frequency. The average distance to which binary neutron star (BNS) signals could be seen is given in Mpc. Current notions of the progression of sensitivity are given for early, middle, and late commissioning phases, as well as the final design sensitivity target and the BNS-optimized sensitivity. While both dates and sensitivity curves are subject to change, the overall progression represents our best current estimates.

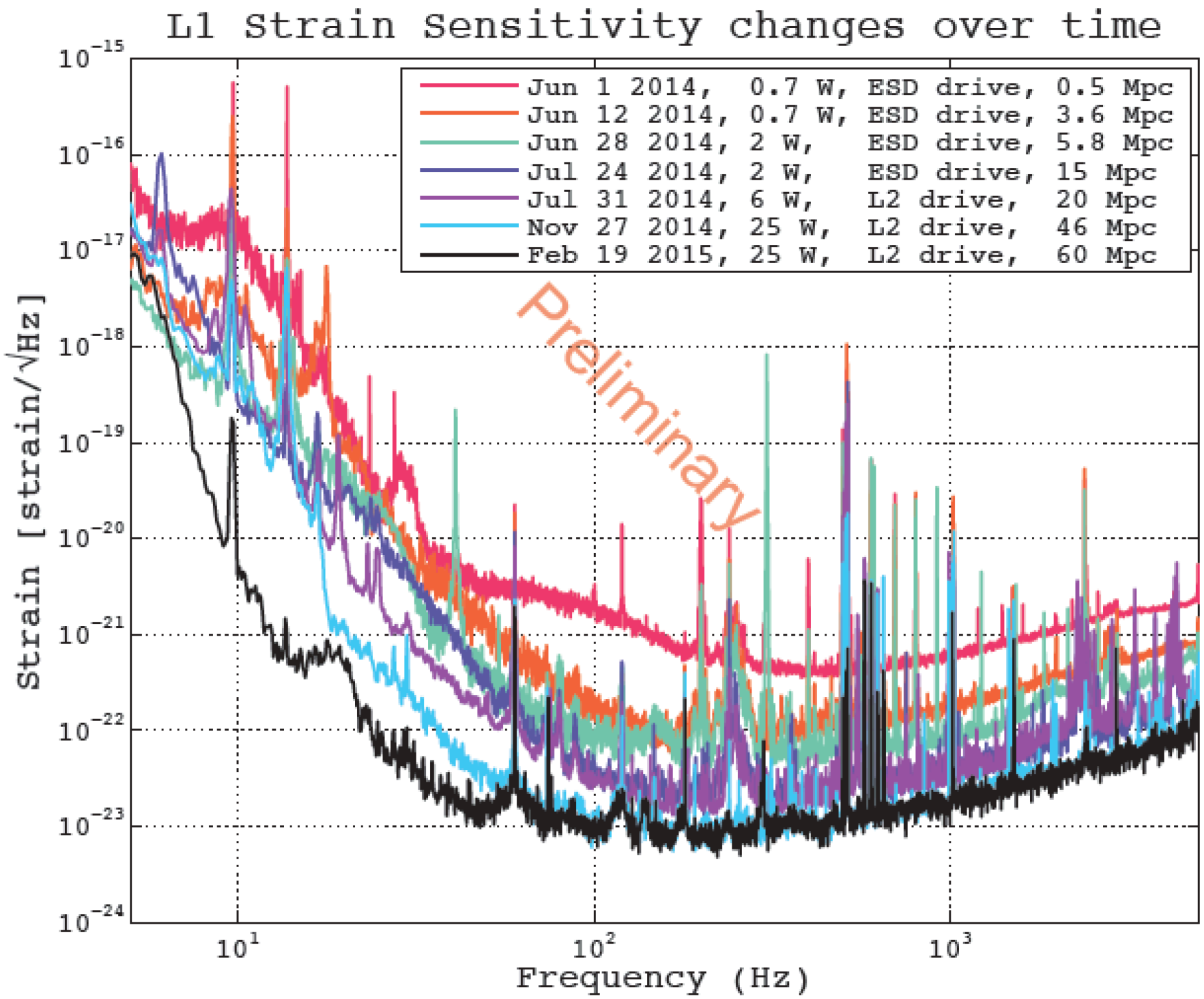
A reminder: Observing Scenario

Epoch	Estimated Run Duration	$E_{GW} = 10^{-2} M_{\odot} c^2$ Burst Range (Mpc) LIGO	Virgo	BNS Range (Mpc) LIGO	Virgo	Number of BNS Detections	% BNS Localized within 5 deg^2	20 deg^2
2015	3 months	40 – 60	–	40 – 80	–	0.0004 – 3	–	–
2016–17	6 months	60 – 75	20 – 40	80 – 120	20 – 60	0.006 – 20	2	5 – 12
2017–18	9 months	75 – 90	40 – 50	120 – 170	60 – 85	0.04 – 100	1 – 2	10 – 12
2019+	(per year)	105	40 – 80	200	65 – 130	0.2 – 200	3 – 8	8 – 28
2022+ (India)	(per year)	105	80	200	130	0.4 – 400	17	48

Table 1: Summary of a plausible observing schedule, expected sensitivities, and source localization with the advanced LIGO and Virgo detectors, which will be strongly dependent on the detectors' commissioning progress. The burst ranges assume standard-candle emission of $10^{-2} M_{\odot} c^2$ in GWs at 150 Hz and scale as $E_{GW}^{1/2}$. The burst and binary neutron star (BNS) ranges and the BNS localizations reflect the uncertainty in the detector noise spectra shown in Fig. 1. The BNS detection numbers also account for the uncertainty in the BNS source rate density [28], and are computed assuming a false alarm rate of $10^{-2}\,yr^{-1}$. Burst localizations are expected to be broadly similar to those for BNS systems, but will vary depending on the signal bandwidth. Localization and detection numbers assume an 80% duty cycle for each instrument.

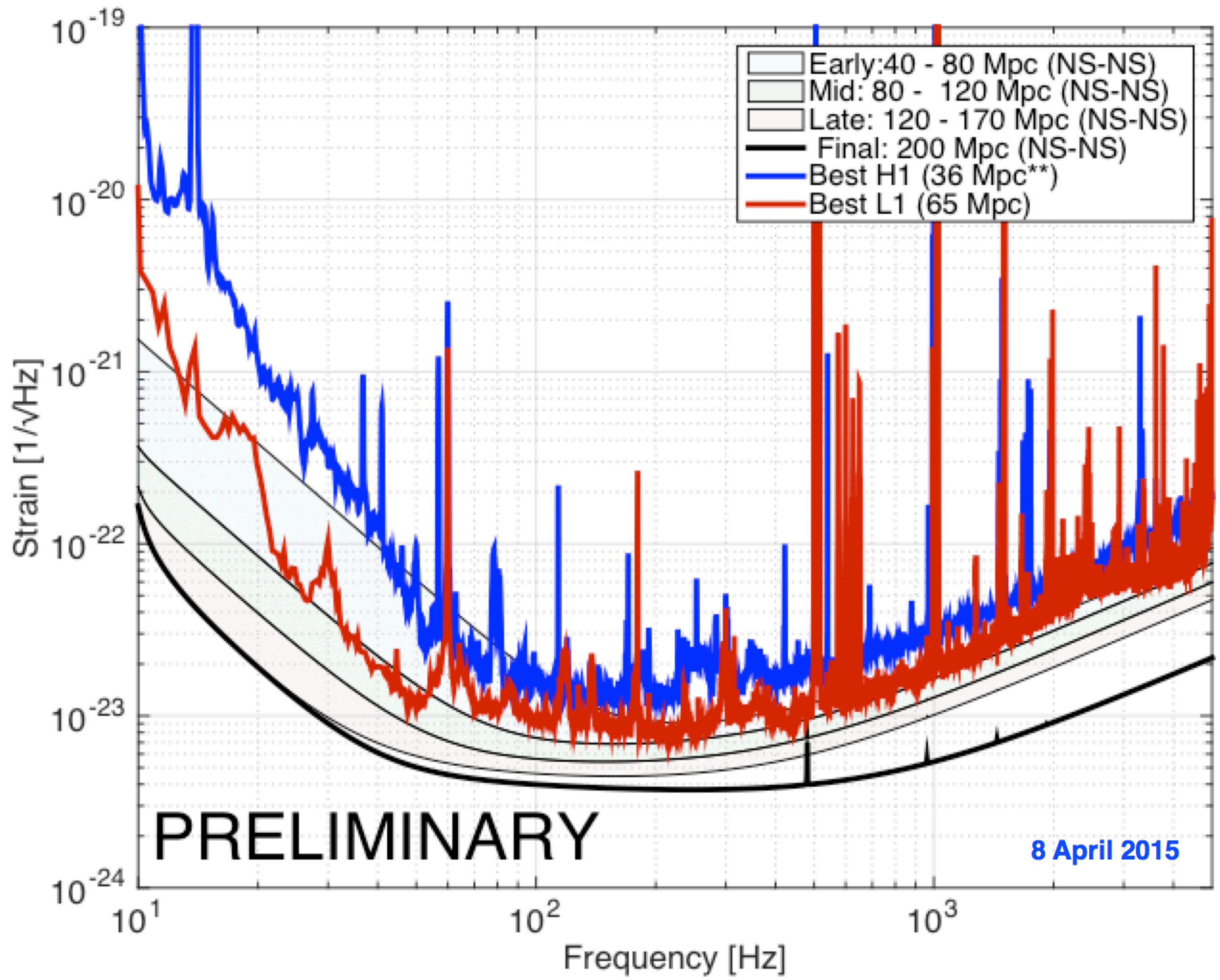
Updated news on localization for O1 – talk by F. Marion

Very rapid commissioning progress



Latest calibrated spectra in https://dcc.ligo.org/LIGO-G1401390/public

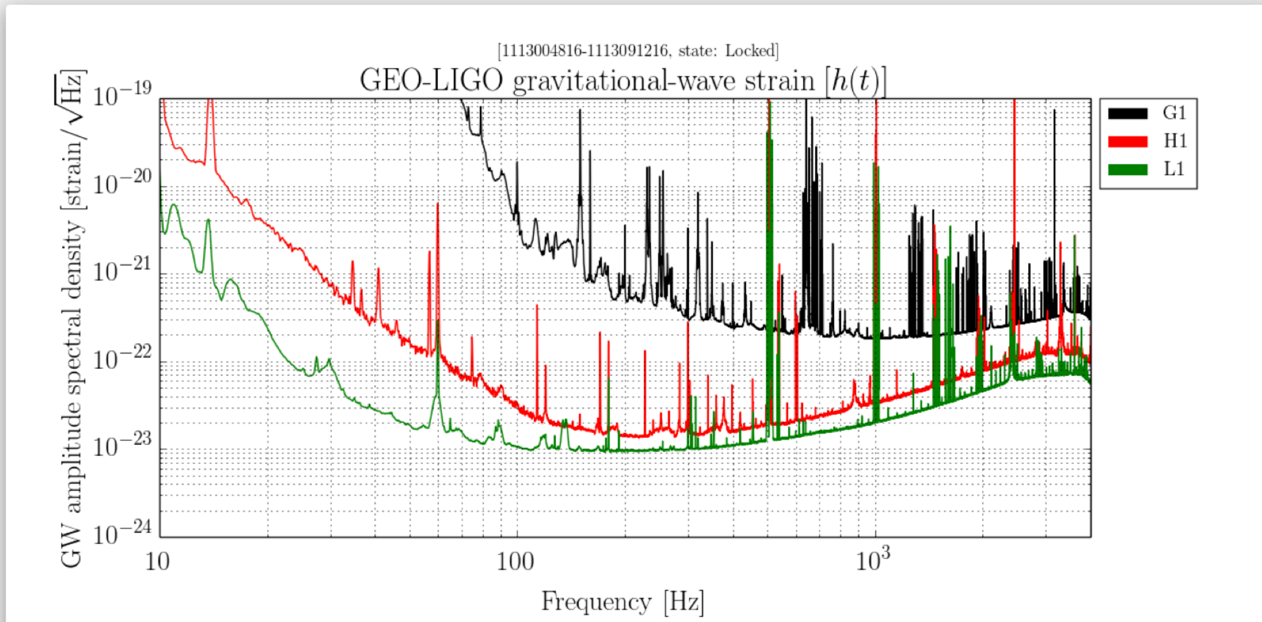
Current sensitivity acceptable for O1

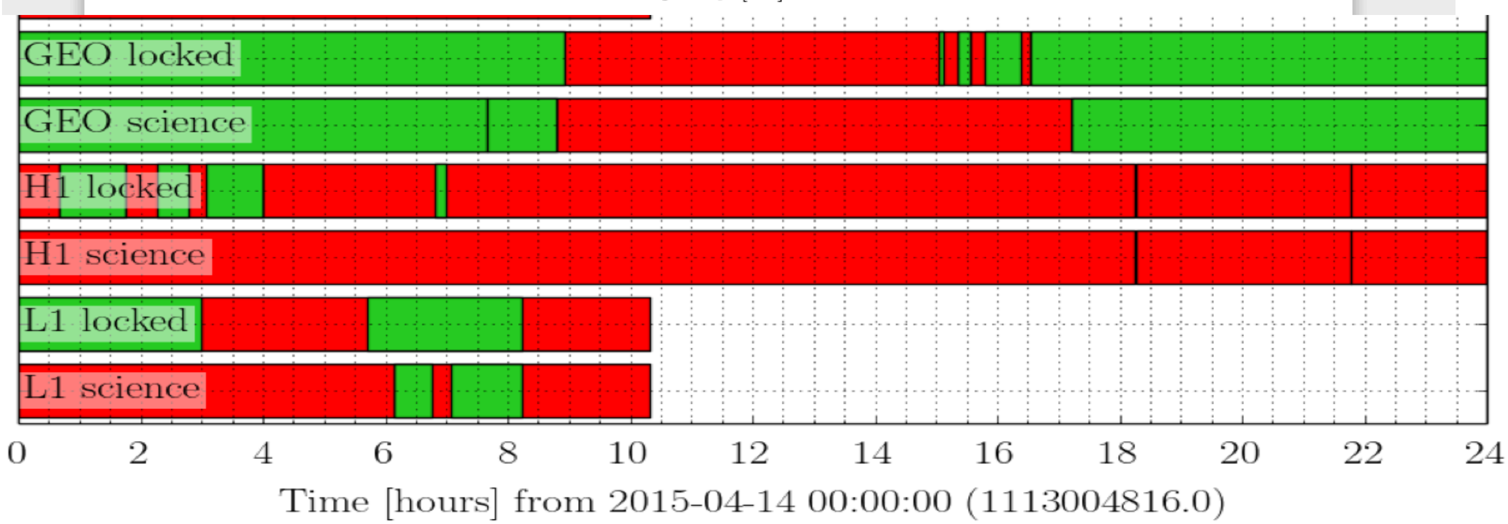


LIGO-G1500518

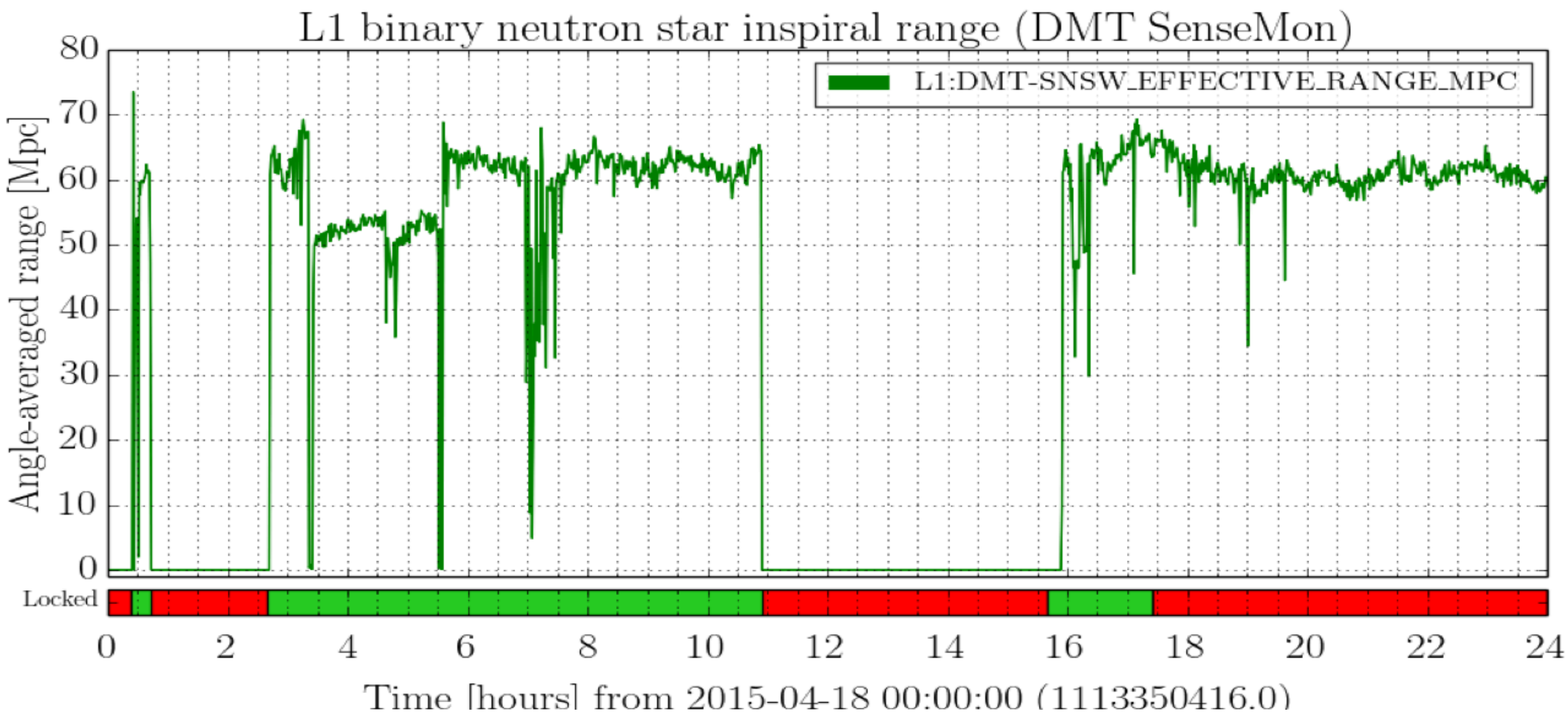
Detectors in operation

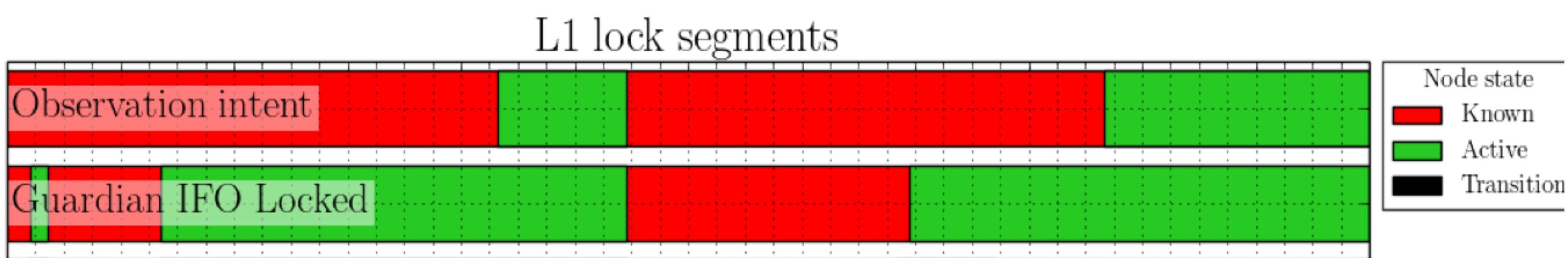
Summary





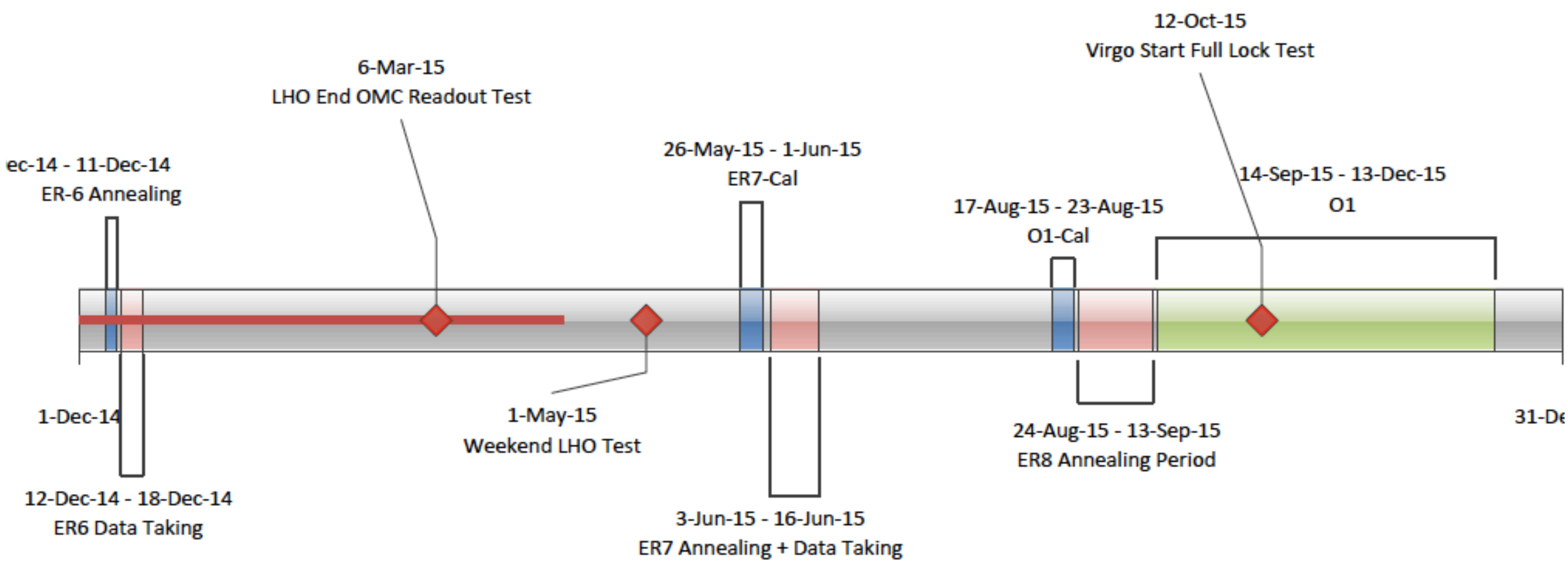
… and stable


L1 binary neutron star inspiral range (DMT SenseMon)
L1:DMT-SNSW_EFFECTIVE_RANGE_MPC
Angle-averaged range [Mpc]
80
70
60
50
40
30
20
10
0
Locked
0
2
4
6
8
10
12
14
16
18
20
22
24
Time [hours] from 2015-04-18 00:00:00 (1113350416.0)


L1 lock segments
Observation intent
Guardian IFO Locked
Node state
Known
Active
Transition

Timeline for Engineering Runs and O1

Working Timeline to First Observing Run
(G1301309; Revised 9-Apr-15)



Precise dates will depend on status of detectors, operations and analysis.

Future runs' dates (with Virgo)

Epoch	Estimated Run Duration	$E_{GW} = 10^{-2} M_{\odot} c^2$ Burst Range (Mpc) LIGO	$E_{GW} = 10^{-2} M_{\odot} c^2$ Burst Range (Mpc) Virgo	BNS Range (Mpc) LIGO	BNS Range (Mpc) Virgo	Number of BNS Detections
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Again - will depend on progress on detectors' sensitivities.
There will likely be short engineering runs in between observing runs.